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VOL. IV.—PART I.

S—TODA.

(TESTIMONIALS AT THE END OF LAST VOLUME.)

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A Word in Conclusion.

The task proposed to themselves by the undersigned in entering, four years ago, upon the preparation of the work which reaches its completion with the present volume, is at length accomplished. The task has been somewhat more protracted and greatly more laborious than was originally anticipated; but both time and labor have been cheerfully spent in the belief that the value of the work has been thereby more than proportionately increased.

In taking leave of the public, the occasion seems to the undersigned to be a fit one for making certain statements in regard to the history of the work which have not hitherto been presented.

The circumstances in which this formidable enterprise had its origin are succinctly narrated in the *Publisher's Announcement* prefixed to the First Volume. The idea entertained by its eminent originator (the late Horace Greeley), as to the form which the work should practically take, is there also given. The plan as he conceived it appears to have been that of a compendium of facts and results of research stripped of all comment and set forth with the smallest possible amount of connecting narrative—a plan by which, for example, history should be substantially reduced to a chronological record; science, to the enunciation of laws and numerical results; and philosophy, to a synopsis of opinions and dogmas. In the execution of such a plan, compilation from standard works already existing was the process which it would be necessary, mainly if not exclusively, to employ; the task not being one likely to interest original investigators or other eminent living authorities so far as to attract and secure their co-operation. It was upon this plan, however, that the work was commenced, and under which it was prosecuted nearly to the close of the First Volume, the editorial superintendence having been in the mean time committed to a gentleman of acknowledged ability, especially qualified for the task by a large previous experience in analogous forms of literary labor. A few of the members of the present Editorial Staff, including the present directing Editor-in-Chief, were at the same time engaged to examine the proofs of the plates as they were successively prepared for publication; so that when, on the retirement of the original Editor, in March, 1873, these incidental collaborators were invited to assume the principal charge, they were fully acquainted with the condition of the work in the form which it had then reached. As this was not such as they would have made it had it been under their control from the beginning, they could not respond to the invitation by consenting to take up the work at this point, and to carry it forward to completion, without an essential modification of the plan pursued in its prosecution, and a thorough revision and reconstruction of the portion which had already been finished. To their judgment it appeared that, in order to secure to the work the high character for fulness and freshness of information, and for logical method and lucidity of statement in the treatment of important subjects, which could only justify its publication, writers specially qualified by past study and experience, and known by reputation to the public to be so, should be engaged to treat each such subject; the plan of compilation being limited to the preparation of those articles of secondary importance which do not require the hand of a master.

The value of eminent names had, it is true, been to a certain extent recognized during the previous management, and some contributions from writers of distinction had been embraced within the pages so far completed; but these were exceptions, the general rule having been the usual one of compilation, and the compilations not having been always made by persons well conversant with the subjects as to which they attempted to summarize the statements which they found in books.

It was a necessary condition, therefore, of the acceptance by the present Editors-in-Chief of the responsibility proposed to them, that the part of the work already prepared should be wholly remodelled and reconstructed; and after a careful consideration of the best means of securing this end, the conclusion was reached that the shortest and simplest, though by no means the cheapest, method of accomplishing the object would be to commence the work *anew* from the beginning. There had been already completed 1106 electrotype plates ready for the press, at a cost of \$20,864.67, and at an expense of more than two years of valuable time. It was a large amount, whether estimated in money or in time, to be fruitlessly wasted; but the publisher has never allowed a question of expense to stand in the way of the object which in all his literary adventures he has ever kept steadily in view, and which has been to secure the highest attainable excellence at whatever cost; and he no sooner became satisfied that this sacrifice was necessary than he promptly cancelled all these plates and consigned them to the melting-pot.

In regard to the future conduct of the work, another condition imposed by the new management, and conceded to them, was that the Editorial Staff should be so increased and organized that each important department of the field of human knowledge might be placed in charge of an Associate Editor specially assigned to that department; these several Associates being charged with the duty, first, of exercising a strict censorship over all contributions relating to subjects within their departments; secondly, of taking care, also within their departments, that no subject which ought to receive attention should be neglected; thirdly, of aiding the Editors-in-Chief to secure, in those departments severally, well-qualified special contributors; and finally, of themselves furnishing contributions on such important topics within their proper provinces as should be peculiarly their own. How completely this plan was carried out may be seen in the title-page of the work, in the scheme of the Organization of the Staff, and also in The Departments and Index to Special Articles. About one-half of the titles of the Special Articles which have passed under the personal revision of the several Associate Editors are enumerated in this Index, but not a complete list of those which they have personally contributed; and a glance at the Index is sufficient to show how largely the work has been benefited by the labors of its numerous Associate Editors in their special fields. The departments to which the names of the Editors-in-Chief are attached have been more especially taken in charge by them, because not otherwise provided for. Their supervision, nevertheless, has extended to the whole work.

The reconstruction of Volume I. began with the close of March, 1873. The volume was at that time so far advanced that its publication had been looked for as early as July 1st of the same year; but the great labor involved in the change of plan, and the determination of the Editors to be thorough, conspired to delay its appearance for fully fifteen months, so that the earliest copies were not placed in the hands of subscribers until September, 1874. In the reconstruction, much of the material employed in the work in its original form was of course retained; and thus some of the biographical sketches—which, though entirely accurate, might perhaps without impropriety have been more extended—have been for their brevity subjects of criticism; but these sketches were originally prepared in strict accordance with Mr. Greeley's principle to tell simply and without comment what a man had done, refraining alike from censure and from praise.

The views of Mr. Greeley have in fact been allowed to govern the more recent editorial management, in that part of his scheme at least which exacts the severest brevity of statement consistent with clearness; but in the treatment of all subjects of importance there have been presented, instead of summaries of disjointed facts—which in its literal execution that scheme would have required—memoirs logically and systematically arranged, forming complete and comprehensive monographs. It is accordingly true that the articles in this work are in general at least equal, and in many instances much superior, in respect both to their length and to the fulness of the information they contain, to those on the same topics in other cyclopædias, if we except only those very voluminous publications which are not only very expensive and can have no place on the study-table, but fill whole shelves of libraries.

It may be proper, before concluding, to add one word in regard to the Appendix which will be found at the close of the present volume. This, to some extent, is occupied with articles intended to supplement those of the work itself as to which the progress of time has brought additions to knowledge; but it is designed also to make amends for the omission in the regular order of some articles not furnished in season to appear in their proper places; and it includes a number of biographical and geographical titles previously omitted through inadvertence or because they could not be earlier obtained. Many, furthermore, relate to the department of Natural History, which have been added by the accomplished Associate Editor in that department in order to give to this work a completeness as to those subjects not usually aimed at in works of this class.

It remains only for the undersigned to tender to that generous public whose steady encouragement has sustained and cheered them to the close of their labors, their most heartfelt acknowledgments of the unexampled favor with which the previously-issued volumes of this work have been received, and which has been manifested in subscriptions for more than 20,000 copies already received, with a demand daily increasing. The very numerous and warm expressions of approbation, moreover, which have reached them, as well from critics by profession as from intelligent readers in every walk of life, in regard to the manner in which their task has been performed, have been too flattering to permit them to withhold this public expression of their thanks. The thing which is chiefly gratifying, however, about these expressions is not so much the assurances they convey that the undersigned have succeeded in making a good book, as the concurrent testimony they bear to the fact that the book which the undersigned have made is the book they set out to make; and that is, a book of ready reference adapted to the uses of the busy multitude, a treasury of knowledge in which questions upon every subject of interest to man may find a prompt and satisfactory solution.

New York, April, 1877.

F. A. P. BARNARD,
ARNOLD GUYOT, } *Editors-in-Chief.*

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Drawn, and Engraved on Copper-Plate
EXPRESSLY
FOR
JOHNSON'S UNIVERSAL CYCLOPÆDIA

Fig. 1. *Type* II. *The Sun, Pollux, &c.*

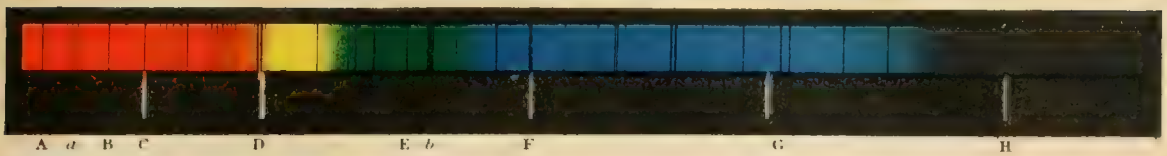


Fig. 2. *Type* I; *Sirius, α Lyrae, &c.*

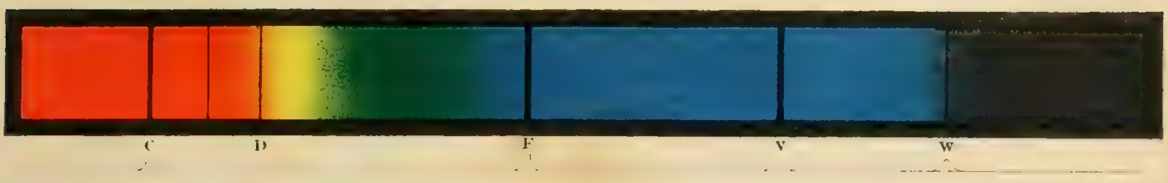


Fig. 3. *Type* III, *α Herculis, β Pegasi, &c.*

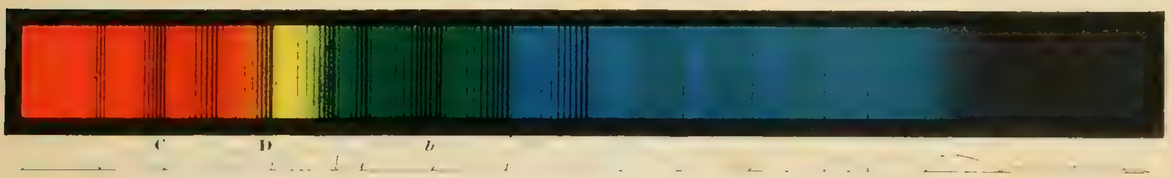


Fig. 4. *Type* III; *α Orionis, Antares, &c.*

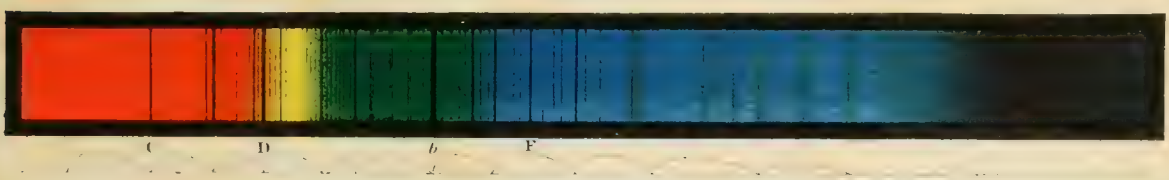
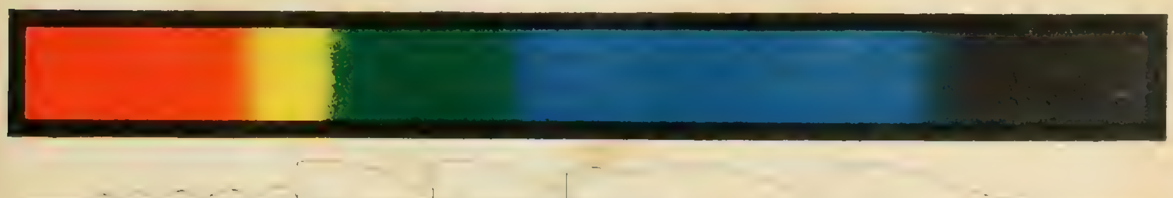


Fig. 5. *Type* IV; *152 Schjellerup.*

Fig. 6 *Type* IV. *78 Schjellerup*

Fig. 7 *Carbon — the Voltaic Arch.*



Note.—*The curves beneath the spectra show the relative intensity of the light at different points, which is approximately as the ordinates. Perpendiculars extending beyond the curves indicate sharply defined lines of superior brilliancy.*

Johnson's New Universal Cyclopædia:

THE DEPARTMENTS, AND INDEX TO LESS THAN HALF THE SPECIAL ARTICLES.

It had been the intention to present here a complete list of the special articles contained in all the Four Volumes, alphabetically arranged under the several departments to which they belong, with their writers' names annexed; but after preparing the list it has been found to be too voluminous for insertion in the space which remains at our command. There are given, therefore, but about one hundred titles under each department, which is considerably less than one-half the average. The total number of articles in the entire work bearing their writers' signatures is 8121; of articles by editors of newspapers, relating to local geography and statistics, 1694; and of writers selected for their special knowledge of the subjects treated, 6427. The Editors-in-Chief, besides exercising a general supervision over the whole work, and an immediate supervision over the particular departments to which their names are attached, have personally contributed over 160 special articles. The personal contributions of several of the Associate Editors have been even more numerous.

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S.

S, a consonant of the sibilant class, frequently interchanged with *z*, and also with the mute sound of *th*—the latter more especially in the lisping speech of children. *S* in English often has the sound of *z*, as in *closes*. S. is the abbreviation for south and saint; SS. for saints; *SS.* for Essex (which see); *Ss.* for *scilicet*, "to wit;" *ss.* for *semis*, "half" (in medical prescriptions). S. in chemistry designates sulphur; S. on medical prescriptions stands for *signa* or *scribe*, "write."

Saadi. See Persian Literature, by E. H. Palmer.

Sa'adia Ben Jo'seph, b. at Pithom in Egypt in 892; was appointed director of the Jewish academy at Sura, Babylonia, in 928. D. there in 942. He wrote in Arabic a work on the dogmatics and morals of Judaism, which was translated into Hebrew by Judah Ben Tibbon under the title of *Emunoth vedebth*, and into German by Fürst in 1845. He also translated many, if not all, of the books of the Old Testament into Arabic, and wrote commentaries on the Canticle, Daniel, and Job.

Saa'le, a river of Germany, rises in the Fichtelgebirge, flows in a northern direction through the Prussian province of Saxony, where it becomes navigable, and falls into the Elbe after a course of about 200 miles.

Saal'feld, an old town of Germany, in the duchy of Saxe-Meiningen, on the Saal, has a fine ducal palace with a magnificent church, several good educational institutions, and manufactures of chemicals, vinegar, etc. P. about 5000. On Oct. 10, 1806, the Prussians were defeated here by the French.

Saar'brücken, town of Rhenish Prussia, on the left bank of the Saar, connected by a floating bridge with the suburb of St. Johann on the right bank, has about 14,000 inhabitants, and was the theatre of the opening of the Franco-German war of 1870–71. On Aug. 2, 1870, Napoleon III., at the head of a whole army corps and accompanied by his son, attacked the town, which was feebly garrisoned by the Germans, compelled the garrison to retreat, and marched into the town. Next day, however, the French evacuated the place, and on Aug. 6 a violent encounter took place in the vicinity, the 1st German army attacking the French position on the hills of Speichern to the S. W. of the town. In front of the French corps, under Frossard, which held the hills occupied, the 14th German infantry division and the 5th cavalry division crossed the bridge and pushed onward to attack the superior force, though no such order had been given from head-quarters. The crossing took place between 12 and 1 o'clock, and the German troops, commanded by Gen. von Kameke, began immediately to deploy their columns for attack. Kameke made his dispositions for an attack on both flanks of the French position, and reported to the commander-in-chief of the corps, Gen. von Zastrow. On the German right wing the 28th brigade gained possession of the woods between Drathzug and Stiring after three hours' fighting, and kept the terraine with effect. On the left the 27th brigade achieved an extraordinary exploit by climbing the steep slope of the hills under the terrible fire of the enemy; among their dead was their general, Von François. In the centre six batteries maintained a stubborn and only slowly-advancing fight. Meanwhile, new German troops came on, attracted by the din of the battle, and the 14th division, whose position at one time was rather exposed, was reinforced first by the 40th regiment, and next by six battalions under Von Alvensleben, commander-in-chief of the 3d army corps. Nevertheless, the French could not be wholly dislodged, and the fight continued from 5½ to 8½ o'clock. But at that moment the left French wing began to feel the approach of the 13th German division, which had crossed the Saar at Wehrden and directed their advance toward Forbach. When the vanguard began to attack from this dangerous position, the French immediately retreated across Eslingen to Blittersdorf, leaving behind them many prisoners, their camp equipage, pontoons, and provisions. The loss of the Germans in dead and wounded amounted to 223 officers and 4648 men; that of the French was somewhat less. August Niemann.

Saardam. See Zaandam.

Saar-Lou'is, town of Rhenish Prussia, on the Saar, was founded by Louis XIV. and its fortifications constructed by Vauban. It was the birthplace of Marshal Ney. It has now more importance as a manufacturing town than as a fortress. P. 7247.

Saavedra, de (Angel). See Rivas.

Saaz, town of Bohemia, on the Eger, has 7674 inhabitants, who are mostly engaged in the cultivation of hops.

Sabadell', town of Spain, province of Barcelona, on the Ripoll, is a prosperous and rapidly increasing manufacturing town, with 80 woollen and 20 cotton spinning and weaving factories. P. 13,945.

Sabadilla, or **Cebadilla.** See Asagræa.

Sabæans. See Sabaism.

Sa'baism, or **Zabism**, the religion of the Sabæans, originally a people of Arabia Felix, supposed to be the Sheba of the Old Testament. Their religion was a system of sun, moon, and star worship, widely prevalent, not only in Arabia, but in Chaldæa, Syria, and Ethiopia. It is probable that it was quite distinct from Magianism. The name Zabism especially designates the Syrian development of the system, which powerfully impressed itself upon ancient philosophy, and upon Judaism and Christianity as well. Neo-Platonism, the Cabbala, and Gnosticism were among its fruits. The Mendaïtes, or Christians of St. John (so-called), are descendants of the old Zabians, and it is probable that other fragments of the old sect remain. In Arabia the Mohammedan, and in Ethiopia the Christian, religion overthrew Sabaism. The derivation of the term is extremely doubtful. The doctrines, especially in Syria, were complicated, obscure, and absurdly fantastical.

Saba'ra, town of Brazil, province of Minas Geraes, on the river Velhas, an affluent of the São Francisco, is well built and has some trade and manufactures of leather, saddlery, and cotton fabrics. In the vicinity are rich gold-mines, and rice, maize, sugar, and grapes are produced. P. about 5000.

Sab'bath [Heb. שַׁבָּת, "rest," "cessation from labor"], the weekly day of religious rest. The observance of a weekly rest-day is now very widely held to have a natural basis in the constitution of man. The persistency with which such an institution has been maintained for many ages among Jews, Christians, Mohammedans, and even some pagan nations, supports this view. Inquiries instituted by a commission of the English Parliament in 1832, the testimony of 641 medical men of London in a petition to Parliament in 1853, and of a great number of medical societies, physicians, physiologists, political economists, and managers of industrial establishments, go to prove that in the case of men engaged in ordinary bodily or mental labor the rest of the night does not fully restore the waste of energies during the day, and that to maintain a condition of vigor a supplementary rest of about one day in seven is needed. This view is confirmed by the experience of France during the Revolution, when the decade was substituted for the week, and each tenth day devoted to rest—a proportion of time which was found to be insufficient. The need of a weekly respite from daily toil appears also in the social nature and relations of man as a member of the family and of the state. This point has been ably illustrated by Pierre Proudhon, the French radical philosopher, in his essay *La Célébration du Dimanche*. The natural law of a weekly rest-day is conceded by most of the theological writers who deny what is called the Sabbatarian doctrine, and is held by them to underlie the Jewish Sabbath, the Christian Lord's Day, and other forms of weekly religious rest.

The first mention in the Bible of such an institution is in Gen. ii. 2, 3—a passage which forms the close of the earliest of the records of which the Mosaic history, according to the theory of many biblical scholars, is composed. The seventh day is consecrated by the Creator, who, having finished the creative work of six days, blessed and hallowed the seventh day, because he rested therein. The natural meaning of the passage is the establishment of a holy rest-day after every six days of labor for the race just created. The natural law of periodic rest was thus lifted out of the sphere of mere physical necessities into that of intellectual and spiritual privilege and enjoyment, as befitting a creature made in the image of the Creator and capable of holding fellowship with him. Its connection with the Creation shows that, with the family constitution, it was intended to lie at the basis of the development of all human life, inclusive of all human conditions, and not merely for any sect or age. The view is held by some writers that, while

[illegible] Creation, its pro- [illegible] take place till the [illegible], though also resting [illegible] without explicit [illegible] [illegible]. Paley and others [illegible] seventh day was not [illegible] [illegible] Creation, but is mentioned in [illegible] and by way of [illegible] [illegible] the Sabbath in the [illegible] [illegible] narrative, which is very brief [illegible] knowledge save what may be in- [illegible] intimations of the division of [illegible] (Gen. [illegible]; viii. 10, 12; ix. 10, etc.). The [illegible] use among the Semitic nations, and [illegible] cuneiform tablets, which give the [illegible] traditions of the Creation, as translated by [illegible], record the institution of a seventh day of holy rest.

The first mention of the Sabbath by name occurs in Ex. xvi. 23 seq., where its observance is not introduced with the formalities with which an institution of such importance would be inaugurated for the first time, but in language which seems to imply that it was not wholly unknown to the people. It next appears among the Ten Commandments, which were distinguished from the rest of the Jewish law by the circumstances of peculiar solemnity under which they were spoken on Mount Sinai and given to Moses engraved on stone tablets by the hand of God (Ex. xx. 8). Its observance was enforced by gratitude for deliverance from bondage (Deut. v. 15), and was constituted a sign of covenant between God and the Jews. Like other of these great commands, the law of the Sabbath reappears in the Jewish municipal and ceremonial code with special prescriptions and penalties, all of which show the importance attached to its observance and the great care taken—as by the prohibition of servile work, gathering of sticks, kindling fires, etc.—that all alike, servants as well as masters, strangers as well as members of the congregation, should enjoy its benefits. A single instance is recorded of the punishment of death being inflicted upon a presumptuous transgressor (Num. xv. 30 *seq.*). Connected with the weekly Sabbath there was ordained in the Jewish municipal and ceremonial law a system of sabbatical years of local and national significance and use (Lev. xxv.). The Sabbath also, in its leisure and opportunity for social intercourse and holy convocation (Lev. xxiii. 3), sustained an important relation to the free republican institutions of the Jews. In later periods of the Jewish history, Isaiah (lviii. 13) and Jeremiah (xvii. 21 *seq.*) enforced its observance with threatenings and promises; Ezekiel (xx. 12 *seq.*) puts its violation foremost among the national sins; Nehemiah (x. 31; xiii. 15) narrates the public efforts at reformation after the return from the Babylonish captivity. Henceforward, the Sabbath was kept with scrupulous care, and gradually to the time of Christ became burdened with self-enforced severities and ridiculous prohibitions.

Christ, while observing the Sabbath, sought by his example and teachings to rescue it from the puerile superstitions by which it had come to be degraded. He performed miracles of healing, and, with his disciples, gathered ears of grain for food as he passed through the fields, on the Sabbath, and justified his conduct by showing that such works of [illegible] and mercy were not violations of its true law. He also taught that the Sabbath was made for man, for his benefit, and not man for the Sabbath, and that He, the Son of man, [illegible] in whom all humanity is represented in its [illegible], was [illegible] the Lord of the Sabbath as rightfully to define and [illegible] its true obligation and use (Mark ii. 27, 28).

The resurrection of Christ and his subsequent appearances to his [illegible] his ascension, and the miraculous descent of the Holy Spirit on the first day of the week, led to that day being set apart [illegible] the special religious assemblies of the Christians and to the [illegible] services of their faith. For a time the Jewish converts [illegible] both the seventh day, to which the name Sabbath [illegible] to be given exclusively, and the first day, which came to be called the Lord's Day. Later, the apostle Paul sought to relieve their [illegible] from the obligation of keeping the Jewish Sabbath (Rom. xiv. [illegible]; Col. ii. 16). The [illegible] in Gal. iv. 10, 11 [illegible] evidently to the superstition of lucky and unlucky days into which these converts from [illegible] were in danger of relapsing. Within a century after the death of the last of the apostles we find the observance of the first day of the week, under the name of the Lord's Day, [illegible] custom of the Church, according to the [illegible] of Barnabas, Ignatius, [illegible], Justin Martyr, and Tertullian. It was regarded not as a continuation of the Jewish Sabbath (which was denounced, together with circumcision and other Jewish and anti-Christian practices), but rather as a substitute for it; and naturally its observance was based on the resurrection of Christ rather than on the Creation rest-day or the Sabbath of the Decalogue. Tertullian (about 200), in saying that Sunday was given to joy, and enjoining on it abstinence from secular care and labor, makes it evident that the Lord's Day was regarded as taking the true place of the original seventh day Sabbath. But the position of the early Church, struggling into existence, exposed to persecution, and with many of its members slaves of heathen masters, would prevent unbroken regularity of worship and a general cessation of labor, until in the time of Constantine (321) the observance of Sunday as the weekly rest-day was protected by law. Later in the history of the Church the connection between the Lord's Day and the original Sabbath became explicitly recognized. The second Council of Macon (585), in forbidding secular work on that day, and enjoining that it be occupied with the hymns and praise of God, says, "For this is the day of perpetual rest; this is shadowed out to us by the seventh day in the Law and the Prophets." At the Reformation, Luther, Zwingle, Calvin, and Bucer at first favored the abolition of all holy days but the Lord's Day. But their antagonism to what they considered the Judaizing legalism of Rome, and their zeal for evangelical freedom, led them at times to deny the scriptural obligation of a weekly rest-day. They were not, however, always consistent with themselves. Luther says of the Sabbath, "Keep it holy for its use's sake both to body and soul, but if anywhere the day is made holy for the mere day's sake, if anywhere any one sets up its observance upon a Jewish foundation, then I order you to work on it, to ride on it, to dance on it, to feast on it, to do anything that shall reprove this encroachment on the Christian spirit and liberty." Elsewhere he represents the observance of Sunday as "good and necessary," and defends the Ten Commandments as still binding on Christians. Upon the Continent, since the Reformation, both among Roman Catholics and Protestants, the observance of Sunday has been based chiefly upon ecclesiastical authority. A different view early obtained in Great Britain, and there and in this country the prevalent doctrine recognizes the weekly rest-day as founded in the nature of man, consecrated by the example of God at the Creation, authoritatively promulgated in the Fourth Commandment, confirmed by Christ, and, while transferred from the seventh to the first day of the week and invested with new significance, perpetuated in the Lord's Day of the Christian Church. (Robt. Cox, *Literature of the Sabbath Question* (1865); Hessey, *Bampton Lectures* (1860); Gilfillan, *The Sabbath, etc.*; Oehler, *Theol. of Old Test.*; Hodge, *Syst. Theol.*, vol. iii.; P. J. Proudhon, *La Célébration du Dimanche*; Philip Schaff, *Hist. of the Apostolic Age* and *Ch. Hist.*, 2d per.; Tayler Lewis, Excursus in his trans. of Lange's *Com. on Genesis*, ch. i.; N. Y. Sabb. Com., *Doc. 26*. See LORD'S DAY, SUNDAY.)

W. W. ATTERBURY.

Sabbathai Lewi. See JEWS, by PROF. FÉLIX ADLER, PH. D.

Sabbat'ical Fes'tivals. The laws of Moses enjoined the observance of four. These were: (1) the Sabbath day, noticed above. (2) The Sabbath month, which was Tisri, the seventh in the Hebrew year, corresponding with our October. It opened with the Feast of Trumpets, contained the Day of Atonement (10th), and the Feast of Tabernacles (15th to 22d). (3) The Sabbath year, which in *Exodus* (xxiii. 10, 11) has an agricultural aspect (the land is to rest from culture); in *Deuteronomy* (xv. 1, 2) has a commercial aspect (debts were either to be relinquished or held in abeyance); and in *Leviticus* (xxv. 3–7) a religious aspect ("for the Lord"). Every seventh year was thus interdicted to secular and selfish uses. But before the Babylonian captivity the ordinance appears not to have been well observed, as may be gathered from Jer. xxv. 11, 12, compared with 2 Chron. xxxvi. 21. After the Captivity it was different. Alexander, who conquered Syria 332 B. C., remitted the tribute of the Jews every seventh year, "that they might enjoy the laws of their forefathers" (Josephus, *Ant.*, xi. 8, 5). Julius Cæsar afterward did the same (*Ant.*, xiv. 10, 6). According to Jewish reckoning, the last sabbatical year was from Oct., 1874, to Oct., 1875. (4) The Year of Jubilee, which was not, as some say, every forty-ninth, but every fiftieth year, so that there were then two successive years of rest. In that year every Hebrew servant was to regain his freedom, and landed property revert to the representatives of its original proprietors. It has been a question whether this jubilee year was ever observed. Michaelis doubts, Hupfeld denies, but Ewald asserts its observance. (See also FEAST.)

R. D. HITCHCOCK.

Sabbione'ta, town of Italy, province of Mantua, about 5 miles S. W. of the city of Mantua, in a district made unhealthy in summer by exhalations from the adjacent

marshes. It is an old walled town, and was placed by Charlemagne under the government of a monastery of Benedictines, but it afterward became for centuries a favorite possession of the great family Gonzaga. In 1806, Bonaparte formed it, together with Guastalla, into a principality for his sister Pauline. The ex-ducal palace is still imposing, though stripped of most of its artistic treasures. The Jews have a remarkably fine synagogue in Sabbioneta, and in 1541 they established a printing-press here which issued several Hebrew works with such neatness and elegance that they are now much sought for by bibliophiles. The industry and trade of Sabbioneta (the latter being chiefly carried on by Jews) have recently revived very much. Silk-reeling occupies a large portion of the population from September till May; very tasteful household furniture is also manufactured here. Besides silk and wine, hemp and rice are abundantly produced in the vicinity. P. 7000.

Sabellians. See Sabellius.

Sabel'lius, a presbyter of the church of Ptolemais in Egypt, excommunicated by Bishop Dionysius of Alexandria in 261 for a heresy which is called after his name. It refers to the doctrine of the Trinity, and is the direct opposite of tritheism. He taught that the Trinity of the Godhead is not a trinity of persons, but of manifestations and periods in the history of revelation. God is strictly one in person, but reveals himself in a threefold aspect as Father, Son, and Holy Spirit in the works of creation, redemption, and sanctification. The same view has been recently revived by Schleiermacher and Bushnell. (See Schaff, *Church History*, vol. ii. p. 292.)

Sab'etha, p.-v., Rock Creek tp., Nemaha co., Kan., on St. Joseph and Denver City R. R.

Sa'bin (Joseph), b. at Braunston, Yorkshire, in 1821; was for some years a bookseller at Oxford, where he published *The XXXIX. Articles of the Church of England, with Scriptural Proofs and References* (1844); came to the U. S. 1848 and settled in New York, where he has become well known as a bibliographer, antiquarian bookseller, and publisher. He has prepared the catalogues of most of the valuable libraries sold at auction in New York since 1850, among which may be mentioned those of Samuel Farmer Jarvis (1851), E. B. Corwin (1856), G. R. Hazewell (1856), W. E. Burton (1861), Edwin Forrest (1863), John Allan (1864), and T. W. Field (1875). He has republished in limited editions on large paper a large number of curious old works on American history; has edited for several years the *American Bibliopolist* (1869 *seq.*), and undertook in 1867 the publication, in parts, of a *Dictionary of Books relating to America, from its Discovery to the Present Time*, still incomplete (1876), but which promises to be a lasting monument of bibliographical industry and enterprise.

Sabine', parish of W. Louisiana, on Sabine River and watered by its tributaries, has a level surface and a fertile soil. Staples, Indian corn, cotton, sweet potatoes, cattle, and swine. Cap. Manny. Area, 1300 sq. m. P. 6456.

Sabine, county of E. Texas, adjoining Louisiana, from which it is separated by Sabine River, has a broken surface and a fertile soil, and is largely covered with timber. Staples, Indian corn, cotton, sweet potatoes, sorghum-molasses, and wool. Cap. Hemphill. Area, 525 sq. m. P. 3256.

Sabine (Sir Edward), D. C. L., F. R. S., b. in Dublin, Ireland, in Oct., 1788; educated at the military schools of Marlow and Woolwich; entered the British army as second lieutenant of artillery 1803; became captain 1813; took part in the campaign on the Niagara frontier, commanding the batteries at the siege of Fort Erie, 1814; accompanied the Arctic expedition of Ross and Parry 1818, and that of Parry 1819–20, when he made important researches in terrestrial magnetism, which were communicated to the Royal Society; edited during the latter voyage the *North Georgia Gazette and Winter Chronicle*, a periodical written by the officers on board the Hecla (republished at London 1822); aided in the preparation of the *Natural History* of Parry's first expedition (1824); made a series of voyages, ranging from the equator to the Arctic circle (1821–25), in quest of data concerning the variations of the magnetic needle, the figure of the earth, and other problems in meteorology and terrestrial physics; published *An Account of Experiments to determine the Figure of the Earth* (1825); was secretary of the Royal Society 1827–30; passed several years on garrison duty in Ireland; made valuable reports on magnetic forces to the British Association 1836–38, which led to the establishment of a system of magnetic observatories; published *The Variability of the Intensity of Magnetism upon Many Parts of the Globe* (1838); edited the records of magnetic observations made at Cape Town, Toronto, St. Helena, Hobarton, and other colonial observatories in several large volumes (1843–60), and translations by his wife of Admiral Wrangell's *Narrative* (1840), Humboldt's *Cosmos* (4 vols., 1846–58), *Aspects of Nature* (2 vols., 1849), and Arago's *Meteorological Essays* (1855); contributed numerous memoirs to the British Association, and more than 40 to the Royal Society; was an officer of those corporations for many years, having been president of the former in 1853, and of the latter 1861–71; made a knight of the Bath 1869, and full general 1870, and was chosen corresponding member of the French Academy of Sciences in the section of geography and navigation Apr., 1875.

Sabine (Lorenzo), b. at Lisbon, N. H., Feb. 28, 1803; was self-educated; became a merchant, and subsequently a bank officer; collector of the board of trade and confidential agent of the treasury department at Boston; resided some years at Eastport, Me., which town he three times represented in the Maine legislature; was collector of the port of Passamaquoddy, and was led by his proximity to New Brunswick to undertake inquiries into the personal histories of the American Tories, who were the chief element in the population of that province and of Nova Scotia. He was a member of Congress from Massachusetts 1851–53, and fishery commissioner on the part of the U. S. for several years. Author of a valuable work, *The American Loyalists, or Biographical Sketches of Adherents to the British Crown in the War of the Revolution* (1847; revised ed., 2 vols., 1864), *Report on the Principal Fisheries of the American Seas* (1853), *Notes on Duels and Duelling* (1855), *An Address before the N. E. Historico-Genealogical Society, etc., Sept. 13, 1859, the Hundredth Anniversary of the Death of Major-General James Wolfe* (1859), *The Life of Preble* in Sparks's *American Biography*, vol. xxii., of four *Annual Reports* of the Boston board of trade, of eleven articles in the *N. A. Review* 1843–59, and of various essays in the *Christian Examiner* and other periodicals. He was an honorary A. M. both of Bowdoin and of Harvard, and a member of the Massachusetts Historical Society. D. April 14, 1877.

Sabine City, v. (Sabine Pass P. O.), Jefferson co., Tex., on Sabine Bay and Pass. P. 457.

Sabine Pass, the mouth of Sabine River and Lake, has a muddy bar, with 6 or 8 feet of water, and a narrow channel. There is a brick lighthouse on Brant Point, the E. side, lat. 29° 43′ 55″ N., lon. 93° 50′ 19″ W., with a flashing dioptric light of the third order.

Sabine River, a stream which rises in Hunt co., Tex., flows S. E. to the W. boundary of Louisiana, and then turns southward, forming throughout the rest of its course the boundary beween Texas and Louisiana for 250 miles. It is 500 miles long, is navigable in its lower course, and after traversing Sabine Lake enters the Gulf of Mexico through Sabine Pass, its mouth, which has a maximum depth of 8 feet on the bar. Much timber is shipped from its valley.

Sabines [Lat. *Sabini*], a valiant people of ancient Italy, inhabiting the mountain-region N. E. of Rome. The original population of Rome, it would appear, was largely Sabine; and a Sabine king, Numa, was the most eminent of the royal line of old Rome. They were doubtless kindred with the Latins and the Oscans, as is rendered probable by the study of the few Sabine words which have been preserved to us. The Sabine religion, modified by other Italian and Etruscan elements, became in substance that of the Roman state. The Tities, one of the original patrician tribes, were Sabine, as in later times was the Claudia gens. There were numerous wars between the Romans and the later Sabines, who were finally overthrown in 290 B. C. by Manius Curius Dentatus, after the third Samnite war. In 268 B. C. they became full citizens of Rome, and were assigned to the Sergian tribe. The Samnites were of Sabine stock. The Sabines were renowned not only for valor, but for gravity, dignity, and austere virtue.

Sabi'nus (Aulus), a contemporary and friend of Ovid, by whom he and his poems are mentioned several times. He was previously considered the author of the *A. Sabini Epistolæ Tres*, found in the first editions of Ovid's *Epistolæ Heroidum*, but it has since been proved that these belong to a certain Angelus Sabinus of the fifteenth century, while the poems of Aulus Sabinus have been lost.

Sa'ble [Fr. *zibeline*], a name given to species of the family Mustelidæ and genus *Mustela*. The species in external appearance resemble the familiar little weasel, but their bodies are not so elongated. In summer the color is reddish or brownish yellow, clouded with black, and becoming lighter toward the head; in winter it is dark. The length of the body in well-grown animals does not vary much from seventeen inches from the snout to the tail, while the tail is about seven to ten inches. The Old-World form (*Mustela zibellina*, Linn.) inhabits Northern Europe and Asia. The sable furs are chiefly obtained in Siberia. This Siberian form in winter often has the whole body covered with lustrous blackish-brown or sometimes quite black

hairs, but with [illegible] intermingled white ones. The [illegible] upper jaw is oblong, and [illegible] as on the outer side. The [illegible] is most abundant in [illegible] in the markets are chiefly [illegible] Company. It is distinguished [illegible] by the posterior tuber[illegible] being quadrate, and rather [illegible] the outer side. The furs of [illegible] high esteem. THEODORE GILL.

Sablé, [illegible] France, department of Sarthe, on the [illegible] crossed by a bridge of black marble, [illegible] serges, beetroot sugar, and leather, [illegible] works and an active trade in corn, cattle, and [illegible] from the rich quarries in the vicinity. P. 5675.

Sable, tp., [illegible] co., Mich. P. 842.

Sable Island [Fr. *sable*, "sand"], an island 90 miles S. E. of Cape Canso, in Nova Scotia. It is a dependency of the above province, and is 25 miles long from E. to W., and from 1½ to 5 miles in breadth. It is composed of sand-hills enclosing a lake 11 miles long with a maximum depth of 12 feet. Grass and wild beach pea vines grow, and many ponies are bred there. Some of the sandhills reach the height of 80 feet. Lat. of E. point, 43° 59′ N., lon. 59° 47′ W.; lat. of W. point, 43° 57′ N., lon. 60° 14′ W. The island contains a life-saving station, it being surrounded by extensive and very dangerous shoals. It was colonized in 1598 by 40 French convicts, landed there by the marquis de la Roche, but five years later only twelve wretched men survived, and the colony was broken up. The island should not be confounded with Cape Sable Island. (See CAPE SABLE.)

Sables′, or **Les Sables d'Olonne,** town of France, department of Vendée, on the Bay of Biscay, was founded by Louis XI., who built its harbor and constructed its fortifications. It is much frequented as a watering-place, and carries on extensive fisheries and a large export-trade in corn, wine, wood, salt, and fish. P. 7000.

Sa′bre [Fr., a word of Eastern origin], a long, heavy curved or straight cavalry sword, used for cutting and thrusting, and usually one-edged.

Sabretache′ [Ger. *Säbeltasche*, "sword-pocket"], a square pocket or pouch attached to the sword-belt of certain mounted officers in some armies. Originally designed for the carrying of despatches, it is now a mere ornament, and is often finely wrought with embroidery in rich ornamental designs.

Sabrevois, p.-v., Iberville co., Quebec, Canada, 5 miles S. of St. John's, is the seat of Sabrevois College (Anglican French), and of a Protestant girls' mission school. P. about 175.

Sabu′la, p.-v., Jackson co., Ia., on Sabula Ackley and Dakota R. R. and Mississippi River, equidistant from St. Louis and St. Paul, has 2 churches, 2 banks, 1 newspaper, 1 private and 4 public schools, a sash, door, and blind factory, and 2 planing, 1 steam saw, and a grist mill. P. 920. DR. J. F. FAIRBANK, ED. "GAZETTE."

Sac, county of W. Iowa, on Indian and Cedar creeks and Boyer River, has a broken surface and a fertile soil. Staples, wheat, Indian corn, oats, and butter. Cap. Sac City. Area, 526 sq. m. P. 1411.

Sac, tp., Sac co., Ia. P. 584.

Sac and Fox Indians, two associated Algonkin tribes, first known to the French as dwellers in Canada. They were early driven to the Saginaw region, thence to Green Bay, and from that point to Fox River. They afterward occupied a large tract of land on both sides of the Mississippi, including great tracts in Illinois, Wisconsin, Missouri, and Iowa. They were often involved in wars with their neighbors, French, Indian, and English. Their great chief Keokuk was of the Sac (Sauk) tribe. Black Hawk, a later chief of the tribes, was a Pottawattomie by birth. Between 1830 and 1849 they were gradually removed south-westward. In 1872 there were, on a reservation of 483,340 acres in the Indian Territory, 463 Sacs and Foxes, one-half Sacs. They entirely reject civilization, schools, and churches. There are also 88—called Sacs and Foxes of the Missouri—on a reservation in Kansas and Nebraska. They have 16,000 acres of land, and are progressing favorably. They are shortly to be removed to the Indian Territory. There are also 275 Sacs and Foxes in Tama co., Ia., where in 1857 a party of 317 settled and bought lands. Their agency is at Toledo, Ia. They have proved somewhat industrious, but are much given to roving and hunting. They seldom cultivate their own lands, and are mostly employed as hired farm-laborers. (See FOX INDIANS.)

Sac′apa, or **Zacapa,** town of Central America, in Guatemala, on a river of the same name, is well built and is in a fertile and well-cultivated district. Its cigars are celebrated. P. about 8000.

Saccarap′pa, p.-v., Westbrook tp., Cumberland co., Me., on Portland and Rochester R. R., 6 miles N. W. of Portland. P. about 900.

Saccas. See AMMONIUS.

Saccatoo′, or **Sokoto,** capital of a kingdom of the same name in the Soodan, Africa, W. of Lake Tchad, from which it is separated by Bornoo. The area of the country is about 117,000 sq. m., and it is well peopled. The inhabitants belong to the Fulbe tribe, and are Mohammedans; a large military force, consisting of 20,000 cavalry, is maintained. The city of Saccatoo is on the Ziermian affluent of the Quorra, in lat. 13° N. and lon. 6° E. It has a weekly market, at which large transactions are made in cloth, raw silk, horses, cattle, glassware, and perfumery. P. about 20,000.

Saccharim′eter [Lat. *saccharum*, "sugar," and Gr. μετρον, "measure"], an instrument for determining the percentage of sugar in solutions by the aid of polarized light. (See SUGAR.)

Sacchi′ni (ANTONIO MARIA GASPARO), b. at Pozzuoli, near Naples, July 23, 1734; was educated in the conservatory of San Onofrio at Naples, and received instruction in counterpoint from Durante; achieved a great success at Rome in 1762 by his grand opera *Semiramide*, and at Venice in 1768 by his *Alessandro nell' Indie;* went, after composing about 50 operas for various Italian theatres, to Germany in 1771; repaired next year to London, where he was very successful with his operas, but whence he at last was compelled to flee in 1782 on account of debt: found employment in Paris, but only one of his operas, *Œdipe à Colone*, performed after his death, made any great impression. D. at Paris Oct. 7, 1786.

Sac City, p.-v., cap. of Sac co., Ia., on Iowa Pacific R. R., 45 miles W. of Fort Dodge, has good schools, 1 newspaper, and the usual county-seat buildings. P. 156. JAMES N. MILLER, ED. "SAC SUN."

Saccobran′chia, or **Saccobranchiata** [Gr. σάκκος, "bag," and βράγχια, "gills"], an order of tunicates established by Prof. Owen for species whose mantle is united to the tunic at the two orifices, while elsewhere it is generally more or less detached, and whose branchiæ form a dilated solid vascular sac, with, commonly, a tentaculigerous orifice. It includes the larger number of the members of the class, some of which are solitary—*i. e.* each animal complete in itself, such as the Asciididæ, etc.—while others are social—*i. e.* with individuals more or less confluent, such as the Botryllidæ, Polyclinidæ, Didemnidæ, Sigillinidæ, Clavellinidæ, and Perophoridæ. THEODORE GILL.

Saccomy′idæ [from *Saccomys;* Gr. σάκκος, "sack," and μῦς, "mouse"], a family of mouse-like rodents peculiar to North America, and distinguished by the hind limbs being much longer than the fore, and hence adapted for leaping; the presence of large external cheek-pouches not connected with the mouth, and lined with fur within; and the development of a long tail. The skull is quite thin, with the interorbital space rather broad; the tympanics inflated and vestibular; the petrosals approximated; the squamosals more or less restricted to the orbit; the mastoids roofing over in part the cerebral cavity; the nasals are produced forward beyond the line of the incisors; the zygomatic arches are very slender; and no special anteorbital foramen is developed. In the dental series the molars are $\frac{4}{4}(\times 2)$. The forms exhibiting these characters in other respects exhibit variations especially in dentition, some (Saccomyinæ) having molars rooted and the upper incisors broad and smooth; others (Perognathinæ) also having rooted molars, but the upper incisor compressed and sulcate; while still others (Dipodomyinæ) have rootless molars, but agree with the second in having compressed and sulcate upper incisors. The species are confined to the western and southern portions of the U. S. and Middle America. They vary in size, some being smaller than the ordinary house-mouse, while others are nearly as large as a rat. They progress chiefly by long leaps, in the fashion of the kangaroo or ordinary jumping mice. In the U. S. there are, according to Dr. Coues (in *Proc. Acad. Nat. Sci.*, Philad., for 1875, pp. 272–327), six species—viz. three *Perognathus*, two *Cricetodipus*, and one *Dipodomys*. THEODORE GILL.

Saccopharyng′idæ [Gr. σάκκος, "small bag or pouch," and φάρυγξ, "pharynx"], a family of fishes of the order Apodes, supposed to be related to the eels, and distinguished by the enormous head and mouth and the whip-like tail. The body is very long, but cannot be called eel-like; the abdominal portion is of moderate length; the caudal portion extremely elongated, band-like, and tapering into an attenuated thread-like extremity; the skin is lax and destitute of scales; the head is very large; the snout

short, pointed, flexible, and like an appendage overlapping the gape; the eye situated far forward; the opercular apparatus apparently imperfect; the nostrils single (?) and in front of the eyes; the mouth is fissured far backward, and the gape consequently is very extensive; the upper and lower jawbones very thin, slender, and arched; the teeth slender, curved, with points directed inward, and in one or two rows; palate unarmed; branchial apertures wide, at some distance from the head, and at the lower part of the sides; "dorsal and anal fins rudimentary, the former more so than the latter, and indicated by a groove bordered by a whitish line on each side, and commencing at a short distance behind the head. Now and then a short ray is visible toward the end of the trunk; anal rays distantly placed, commence behind the vent, and are visible for some distance;" pectoral fins small. The skeleton has thin soft bones, deficient in inorganic matter, and connected by a lax, easily-torn fibrous tissue; the gills are very narrow, free, and exposed; the stomach is distensible in an extraordinary degree, and when full has a bag-like form, which is alluded to in the name. The family has been instituted for the reception of a single species of fish (*Saccopharynx flagellum*) inhabiting the deep portions of the Atlantic Ocean. The only known specimens have been found far off the American coast and off the island of Madeira. The color is black. The last specimen obtained measured nearly three feet in total length, the head to the mandibular joint being two and a half inches, the trunk six inches, and the tail twenty-five inches in length. The affinities of the family are very doubtful, but Günther is probably more correct than his predecessors in referring it to the same great group as the Murænidæ and Anguillidæ. He has also redescribed the species, and to him we are indebted for our better knowledge of it. THEODORE GILL.

Sachev'erell (HENRY), D. D., b. at Marlborough, Wiltshire, England, about 1672; educated at and fellow of Magdalen College, Oxford, where he was room-mate with Addison; took orders in the Church of England; was given the living of Cannock, Staffordshire; appointed preacher at St. Saviour's, Southwark, 1705; preached a sermon at Derby assizes Aug. 15, and another before the lord mayor of London at St. Paul's Nov. 5, 1709, in both of which he denounced toleration of dissenters, attacked Low Churchmen, inculcated passive obedience, and declared that the Church was in danger; was impeached for these discourses by the House of Commons Feb. 27, 1710, found guilty of a misdemeanor Mar. 23, and sentenced to three years' suspension from preaching, the offending sermons being burnt by the common hangman. Great excitement prevailed throughout England during this trial, and large numbers of pamphlets were printed on both sides, the Tories favoring the publicity of Sacheverell's sermons, of which at least 40,000 copies were sold, while 30,000 copies of the record of the trial (1710) were circulated. Sacheverell profited by this easy martyrdom; he was invited by the new (Tory) House of Commons to preach before them on the day his sentence expired, and was presented by Queen Anne to the rectory of St. Andrew's, Holborn. D. at London June 5, 1724. The defence he pronounced at the bar of the Lords was an eloquent production, written for him by Atterbury.

Sachs (HANS), b. at Nuremberg Nov. 5, 1494; was apprenticed to a shoemaker, his father being a tailor; undertook, after finishing his apprenticeship, the professional wanderings (1510–15) which at that time formed a part of the education of a thorough mechanic; visited many German cities, studying in the guilds his trade and the art of the meistersingers; settled in 1515 in his native city as a shoemaker and a poet. D. there Jan. 20, 1576. He was a man of some knowledge, of good judgment, of wide sympathies, and powerful humor, and he possessed to perfection the skill and taste of his time in the sphere of poetry. Immensely prolific, he became the representative poet of his age, and produced several thousand strophic poems which he published on fly-leaves, and several hundred dramas, dialogues, *Schwänke*, which were performed in the guild-halls or on festive occasions in private houses. The æsthetical merit of these productions, especially of the meistersongs, is very small. A naive, pious sympathy, a dry but rather coarse-grained humor, a fluent dialogue, and now and then a well-turned verse—that is all. But it must be remembered that the principal aim of this whole literary activity was didactic, a moral and intellectual influence, and in this respect Hans Sachs and his pen were a power in the camp of the Reformers, and his writings contain much precious material for the true understanding of German life and character during the time of the Reformation. Selections of his works are numerous; one of the richest was given in 11 vols. by Götz (Nuremberg, 1821–30). His *Life* has been written by Salomon Ranisch (1764) and by Hofmann (1847). CLEMENS PETERSEN.

Saci'le, town of Italy, province of Udine, on the Livenza, 35 miles N. N. E. of Venice. This city—for it has enjoyed that distinction from a remote period—was once very strong, being defended by the Livenza on one side and by a castle and extensive fortifications on the other. It is a well-built town, and some of its churches are of great antiquity, and otherwise of no small interest. In one of the many private palaces, the Palazzo Carli, are good portraits of Dante, Petrarch, and Laura by an old but unknown artist. The immediate neighborhood of Sacile has been the theatre of many important military conflicts, both in mediæval and modern times. P. 5300.

Sack [Fr. *sec*, "dry"], a name formerly applied to wines of the class now called "dry"—*i. e.* not saccharine—but especially given to "sherris sack," represented now by the amontillado sherry wines.

Sack'but, a wind instrument somewhat resembling the trumpet, having a slide like the modern trombone. It is mentioned in the book of Daniel, but the translation is probably wrong, the English sackbut being a very different instrument, derived from a model excavated at Pompeii.

Sack'cloth, coarse hempen or hair cloth, such as was used for making sacks or bags, was worn by the ancients as an emblem of grief, and in later times was much employed as a means of penitential maceration of the body among ascetics.

Sack'et (DELOS B.), b. in New York May, 1822; graduated at the U. S. Military Academy, and promoted brevet second lieutenant of dragoons July 1, 1845, when he was ordered to Texas with the army of occupation, and in the war with Mexico was engaged in the battles of Palo Alto, Resaca de la Palma, and Monterey; brevetted first lieutenant. From 1847 to 1861 he served mainly on frontier duty, engaged in numerous expeditions; was assistant instructor of cavalry tactics at West Point 1850–55. In May, 1861, he had risen through successive grades to be lieutenant-colonel of the 2d Cavalry; transferred to the staff in Oct., 1861, as inspector-general, with the rank of colonel, and served in that capacity with the Army of the Potomac throughout the Virginia Peninsular campaign, at the battles of South Mountain, Antietam, and Fredericksburg. Brevet brigadier and major general U. S. A. Mar. 13, 1865, for "gallant and meritorious" and "faithful and meritorious services."

Sackett, tp., Sangamon co., Ill. P. 698.

Sackett's Harbor, p.-v., Hounsfield tp., Jefferson co., N. Y., on the S. shore of Black River Bay, an inlet of Lake Ontario; lat. 43° 55′ N., lon. 75° 57′ W. A crescent-shaped tongue of land running out from the village forms an admirable inner harbor, with sufficient depth of water for the largest vessels. In the war of 1812–15 it was largely used as a naval station, and it was here that the Oneida was launched in 1809, the first American war vessel ever launched on Lake Ontario. In 1819, Madison Barracks were completed by the U. S. government at this place, since which time it has been occupied as a military post. Although possessing a valuable water-power and adjoining a rich agricultural country, the commerce and population of Sackett's Harbor have steadily diminished. P. in 1870, 713.

Sack'ville, p.-v. of Westmoreland co., N. B., at the head of the Bay of Fundy and on Intercolonial Railway, 129 miles N. E. of St. John. It has a good harbor, a brisk trade, 8 churches, 2 weekly newspapers, a large foundry, a steam-tannery, and several mills. It is the seat of Mount Allison College (Wesleyan) and of Wesleyan male and female seminaries. P. about 1500.

Sackville (GEORGE **Germain**), VISCOUNT, better known as LORD GEORGE GERMAIN, third son of the first duke of Dorset; b. in England Jan. 26, 1716; educated at Westminster School and at Trinity College, Dublin, his father being lord lieutenant of Ireland; entered the army as LORD GEORGE SACKVILLE; served with credit at the battles of Dettingen (1743) and Fontenoy (1745), and under the duke of Cumberland against the Pretender in Scotland; became a privy councillor; was secretary for Ireland 1751; made lieutenant-general 1758; commanded the allied cavalry at the battle of Minden, Aug. 1, 1759, when he failed to execute the orders of the commander-in-chief, Prince Ferdinand of Brunswick, to charge upon the French infantry; was tried by court-martial and cashiered early in 1760, but was restored to favor at the accession of George III. (Oct., 1760); entered Parliament 1761; was restored to the privy council 1766; fell heir to the estate of Lady Betty Germain, and assumed her surname 1769; fought a duel with Gov. Johnstone of West Florida 1771; entered the cabinet of Lord North as secretary of state for the colonies Oct., 1775; retained that post throughout the war of the American Revolution, distinguishing himself by

[illegible] and resigned Feb., [illegible] Viscount Sack[illegible] the latter pos[illegible] *Junius Letters* [illegible], but the theory [illegible] works which [illegible] 1825, [illegible], by Rev. Dr. William [illegible], 2 vols., 1822–27, [illegible] Charles [illegible] *Junius* [illegible] 1848, [illegible] later writers considering Sir [illegible] amanuensis.

Sackville, [illegible]. See Dorset, Earl of.

Saco, [illegible] York co., Me., situated on Boston [illegible] Portsmouth R. Rs., [illegible] River, 9 miles from [illegible] open about nine months in the [illegible]. The various [illegible] represented, York Manufac[illegible] the manufacture of cotton [illegible]. Other articles of [illegible], brushes, and [illegible] to some extent, and [illegible] trade. Agriculture [illegible] well represented. It has 1 weekly [illegible], 4 banks, a city building, 4 large [illegible], a common, 2 steam [illegible]. The contiguity of the [illegible], and its not very great distance from [illegible] Mountains, make the health-standard remark[illegible] from all points the wind comes laden [illegible], and the generally hot and suffocating land[illegible] come cool and refresh[illegible] from the tempering influences of the snow-capped and [illegible] of the White Mountain range. Old Or[illegible] is a popular and growing watering place. The [illegible] camp-meeting grounds are at [illegible].

Wm. S. Noyes, Ed. "York Co. Independent."

Saco, a river of Maine, rises in the White Mountains, N. H., and flows S. E. 160 miles to the Atlantic; has several [illegible] falls, one of which, Great Falls, is 72 feet in height, and furnishes water-power, which is utilized at many places for manufactories.

Sacrament [Lat. *sacramentum*, "an oath," especially a military oath, and also a gage in money laid down in court by two contending parties], used in the Church since Tertullian, in a loose sense, of sacred doctrines and ceremonies (like the Gr. μυστήριον), and then, more particularly, of Baptism and the Eucharist, and a few other solemn rites connected with Christian worship. St. Augustine defines sacrament in the narrower sense to be the visible sign of an invisible grace (*signum visibile gratiæ invisibilis*). To this was afterward added by Protestants, as a third mark, that it must be instituted by Christ and enjoined upon his followers. Sacraments are also called signs, seals, and means of grace. Their number is by Protestants confined to two—viz. Baptism and the Lord's Supper—because these alone are instituted by Christ and commanded to be observed to the end of time. The Roman Catholic and the Greek churches add to them five others—viz. confirmation, penance, extreme unction, ordination, and matrimony. The Council of Trent anathematizes those who deny that there are seven sacraments (*esse plura vel pauciora quam septem sacramenta*). In the Greek Church they are called "mysteries." As to the efficacy of the sacraments, Protestants require faith as a subjective condition, while the Roman Catholic Church teaches that the sacraments work *ex opere operato*—i. e. by the inherent power of the institution or by the performance of the act, independently of the moral character of the priest and the state of the recipient. There has been much controversy about the sacraments, especially the Lord's Supper, which is sometimes emphatically called *the* sacrament, between Protestants and Roman Catholics, and also between Luther, Zwingli, and Calvin. The Quakers reject the sacraments as external ceremonies, and hold only to internal baptism or regeneration of the Spirit, and internal communion with Christ. (See articles on the several sacraments, especially Eucharist.)

Philip Schaff.

Sacramentarians. See Tetrapolitan Confession.

Sacramen'to, county of Central California, on Sacramento, American, Calaveras, San Joaquin, Mokelumne, and Cosumne rivers, is mountainous in its eastern parts, is traversed by Central Pacific, California Pacific, and Sacramento Valley and Placerville R. Rs., and is one of the principal seats of gold-mining. The staples are barley, sweet potatoes, hops, hay, wine, butter, cheese, and wool; has very numerous cattle, sheep, swine, and horses, and important manufactories. Cap. Sacramento, which is also the State capital. Area, 1026 sq. m. P. 26,830, of whom 3596 are Chinese.

Sacramento, city, cap. of California, and county-seat of Sacramento co., on the left bank of Sacramento River, at its junction with American River, and at the head of navigation for large steamboats; lat. 38° 31′ N., lon. 121° 20′

State Capitol, Sacramento, Cal.

W. [illegible] San Francisco and [illegible] of the State. P. [illegible] The [illegible], $2,[illegible] cash in the treasury for municipal purposes Mar., 1876, $[illegible],573, and for redemption of bonds $20,594; estimated value of all property in the city, $20,000,000; assessed value of all property for taxable purposes (including prop-

erty of the city, estimated at $500,000), $12,174,526. It has an extensive trade with the mining-districts and with large wheat-raising and agricultural regions, of which it is the centre. Its manufactures are extensive and rapidly increasing, among which are a woollen-mill, with 1440 spindles; carriage manufactories, one of which employs a capital of $100,000; a furniture company, turning out annually goods of the value of $35,000; plough-factories, the largest of which employs a capital of $80,000; a tub, pail, and barrel factory; 2 glue-factories; 2 potteries, each with a capital of $25,000; smelting and refining works for the reduction of silver ores; 4 marble-works, 6 breweries, 4 flouring-mills, ironworks, etc. The city is the railroad centre for the northern part of the State; the Central Pacific R. R. shops and manufactories at this point are very extensive, employing constantly from 1000 to 1500 mechanics. The banks are the National Gold, Sacramento Savings, Capital Savings, Odd Fellows, and Dime Savings, with united capital and deposits of $7,000,000. The city was formerly the western terminus of the overland railroad, which has since been extended to San Francisco. It is also connected with San Francisco by the California Pacific R. R. It has communication with Marysville and the northern part of the State by California and Oregon R. R., with the mining towns of El Dorado and Amador cos. by Sacramento Valley R. R., and with San Joaquin Valley and the southern portion of the State by the connections of Central Pacific with San Joaquin Valley and Southern Pacific R. Rs. A line of steamers and numerous sailing vessels ply on the river between this place and San Francisco. The river is navigable for small steamers for more than 100 miles above the city. The principal buildings are the State capitol, built by the State, in a park of 50 acres, at a cost of $2,500,000; a fine structure erected as a mansion for the governor, but occupied as a State printing-office and armory; Odd Fellows temple, Masonic temple, agricultural hall, C. P. R. R. Co.'s hospital, Turner hall, the stands at Union Park, and many expensive private residences. The principal hotels are the Golden Eagle, Grand, Orleans, and Arcade. There are 14 public-school buildings, 7 of brick, the remainder of wood. The grammar school, a handsome structure of brick erected in 1873, cost $74,000. The total cost to the city for school buildings and lots is $190,500. The school census for 1875 shows 6878 children under 17 years; of these, 150 are Chinese, 100 of whom attend private schools, and 50 who attend no school. The average annual expenses of the public schools is $70,000. The libraries are the City, the Odd Fellows', and the State. The latter contains 25,303 vols. in the general department, and 11,701 in the law department. There are 2 daily papers; also 1 semi-weekly, published in German. Sacramento is well supplied with water from the river by the improved Holly pumps, which were purchased and erected by the city at a cost of $189,993. The streets, which are wide, are laid out at right angles, lighted with gas, and named, those running E. and W. by the letters of the alphabet, and those running N. and S. by numbers. It has a paid fire department, with steam fire-engines, hose carriages, etc. The churches are—1 Roman Catholic, 3 Methodist Episcopal, 3 Baptist, 1 Congregational, 1 Episcopalian, 1 Presbyterian, 1 Methodist Episcopal, South, 1 synagogue, besides other smaller congregations worshipping in halls. Among the charitable institutions are—the Howard Benevolent, which originated at an early day in the history of the city, and relieves distress without regard to Church or party; the Protestant and Roman Catholic orphan asylums, 10 lodges of F. and A. Masons, 13 lodges of Odd Fellows, 1 grove of Druids, 5 tribes I. O. of Red Men, 1 division Sons of Temperance, 1 lodge Knights of Pythias, 5 lodges Good Templars, 1 division Ancient Order of Hibernians, 1 Father Mathew temperance and benevolent association. There are also several Scottish and Jewish benevolent societies. Among other associations are the Sacramento Pioneers, Exempt Firemen's, Turn Verein, Music Union, Turner Harmonie, 2 building and loan associations. Several of these societies own fine halls. The city, built on a plain whose elevation is not more than 30 feet above the level of the ocean, was at one period subject to overflow from floods in Sacramento and American rivers. A flood in the winter of 1861–62 destroyed a large amount of property. During the year 1862 substantial levees surrounding the city were constructed at a cost of $200,000, the principal streets and buildings were raised 8 feet, and since that date it has been exempt from danger from this source. The soil on which the city is built is rich alluvium, and as the climate is semi-tropical, it is noted for its shade trees, beautiful gardens, and pleasantly situated houses. The mean temperature, from three daily observations kept during seventeen years, is 60.25° F.; mean of heat, 78°; mean of cold, 43°; average yearly fall of rain, 20 inches. It is the boast of its inhabitants that "Sacramento has more pleasant days in the year than any other place yet known." Notwithstanding the rich soil, warm days, and luxuriant vegetation, the nights are always cool, as a breeze from the ocean reaches the city about four o'clock of each day during the summer. The record of mortality kept during eighteen years by the late Dr. T. M. Logan shows but 13 deaths annually in each 1000 inhabitants.

The land on which the city is built was originally a part of the New Helvetia grant, given by the Mexican government to Gen. John A. Sutter, the remains of whose fort are still standing within the corporate limits. It was from this fort Marshall was sent to build a saw-mill on American River, where he made the discovery of gold which caused an immigration to California within one year of more than 100,000 persons. A settlement commenced in the vicinity of Sutter's Fort immediately after this discovery, as it was an important point for the supply of the mines. The population on Apr. 1, 1849, was estimated at 150 persons, keeping stores in tents and canvas houses. In 1853 it had an estimated population of 12,000, living in brick and wooden houses, and was then the great centre of the principal stage lines of the State, as it is now of the railroad lines. The destruction of property by the flood of 1862 and the decline of placer-mining did much to retard its progress, but the people are noted for their energy and enterprise, and soon recovered their losses and accommodated their business to the changes wrought by the wonderful development of California as an agricultural, wool-growing, and wheat-raising State. Many of the most important enterprises of the Pacific coast had their origin among the people of Sacramento. The overland railroad was the scheme of a few of its merchants, who carried it to successful completion, who are still its officers, and who still retain homes among the pleasant shade-trees of Sacramento. B. B. Redding.

Sacramento, p.-v., McLean co., Ky. P. 195.

Sacramento River rises in Lassen co., Cal., and flows first in a westward and then in a southern course. Its upper portion is called Pitt River, the name Sacramento being often given to a comparatively small branch which rises S. of Mount Shasta. The principal branches are Feather, American, and Mokelumne rivers. Its broad and fertile valley is a northward continuation of that of the San Joaquin. The stream is navigable from its embouchure in Suisun Bay, some 50 miles, and by small vessels to Red Bluffs, 320 miles, in good stages of water. Its length is 500 miles.

Sacred Heart, tp., Renville co., Minn. P. 316.

Sacred Heart, Ladies of the, an order of nuns founded 1800 in France by J. D. Varin, a Jesuit, and Magdalen Sophie Louise Barat; approved by the pope in 1826; first came to the U. S. in 1819, and have now many houses here. There is also a congregation of Sisters of the Sacred Agonizing Heart of Jesus, with a few houses in the U. S.

Sacred Heart of Jesus, Festival of, on the Friday after the octave of Corpus Christi. It was first observed by the Blessed Marguerite Marie Alacoque at Paray-le-Monial, Burgundy, about 1670, and was first approved by Pope Clement XII. in 1732.

Sacred Heart, Regular Clerks of the, or **Paccanarists,** an association of Roman Catholic priests, founded by Nicolo Paccanari, and recognized in 1800 by the pope, sometimes called **Regular Clerks of the Faith in Jesus,** designed to replace the Jesuits, then forbidden in most countries; in 1814 the order was united with the Jesuits.

Sacred Hearts of Jesus and Mary, Brothers of, a Roman Catholic community founded at Le Puy en Velay, France, by M. Coindre, a priest, in 1822. They were first established in the U. S. in 1847. Their work is educational.

Sacred Music. See Mass and Oratorio.

Sac'rifices [Lat. *sacrificium*]. The origin of sacrifices has been much debated, but is lost in the dimness of antiquity. The earliest records of our race, whether sacred or profane, show sacrifice as an existing institution, and in the former as receiving the Divine approbation. Their object was everywhere alike—to provide a means whereby man, conscious of his own sinfulness, might approach a holy God. The theory of their efficacy seems, however, to have been very different among the heathen and among the Israelites. In the former sacrifices were looked upon as in some sort a compensation to the gods, and their efficacy, therefore, depended somewhat upon their value, so that in extreme cases even human sacrifices were offered, as among rude nations in modern times; among the chosen people different views prevailed, or at least were distinctly embodied in their law and taught by their prophets. Here the fact was recognized that the

[illegible] could only be restored on the [illegible] promise that in the [illegible] "seed of the woman" should [illegible] was always the central point of [illegible]. Meantime, sacrifices in great [illegible] those especially appointed as [illegible] of the same character and [illegible] sacrifice was indeed required as [illegible] priest or of the collective con- [illegible] slightly more valuable from a [illegible] persons; but there was no gradation [illegible] victim in proportion to the aggravation [illegible]. Their efficacy was thus made to depend [illegible] the Divine appointment.

[illegible] kinds of Hebrew sacrifices were—the whole burnt-offering, which was wholly consumed upon the altar, and with which an oblation of fine flour and oil, with incense, and a drink-offering of wine, were offered; the sin-offering, of which only the fat and kidneys were burned upon the altar, the flesh being either "burned without the camp" in case the blood had been sprinkled within the sanctuary, or eaten by the priests alone in case the blood had been only sprinkled upon the brazen altar; and the trespass-offering, which is distinguished clearly from the last, although the ground of the distinction is not entirely clear. These were all propitiatory offerings, and with them the priest was required "to make atonement" for the people. Besides these were the peace offerings, perhaps the most common of all, which might be offered in any number and of any sacrificial animal. Of these, the same parts were burned on the altar, a portion given to the priests to be eaten by them and their families, and the rest of the flesh eaten by the offerer and his friends in a holy feast before the Lord. There were other important sacrifices required. The Passover was a lamb offered in memory of the deliverance from Egypt and as a special type of Christ by each head of a family on the fourteenth of the month Nisan in each year, and eaten in their homes on the following night; the two goats on the great day of atonement in each year, of which one was sacrificed at the altar, the other sent as a "scape goat" into the wilderness; the red heifer, burned without the camp and its ashes used in purifications; and a great variety of sacrifices for individuals on special occasions. The original comprehensive offering, from which all the others were specialized, appears to have been the burnt-offering.

Under the Levitical law the essential point of the sacrifice was the blood, the treatment of which always formed the culminating point in the sacrificial ritual. A burnt-offering of a lamb for the whole people was regularly offered every morning and evening, with its accompanying oblation or "meat offering." In regard to the sin-offering, in order to bring it within the reach of all it was provided that for the required animal might be substituted by the poor a pair of doves, or even in case of extreme poverty an offering of flour.

The symbolical character and significance of the sacrifices is set forth at some length in the Epistle to the Hebrews.

Literature.—Outram, *De Sacrificiis* (translated by Allen, London, 1817); Spencer, *De Legibus Hebr.*; Maimonides, *De Sacrificiis* and *De Vacca Rufa*; Kalisch, Lev., pt. i.; Faber, *On the Origin of Sacrifice*; Davidson, *Enquiry into the Origin of Sacrifice*; Tholuck, *Diss. II. in Ep. to the Heb.* The authors cited by Keil: *Handbuch der biblischen [illegible]*, p. 47; Bähr, *Symbolik des mosaischen Cultus*; [illegible], *Der alttest. Gottesdienst* (Gütersloh, 1864); Hengstenberg, *Die Opfer der heil. Schrift*; Keil, *Die Opfer des alten Bundes* (Guericke's *Zeitschrift*, 1836–37); Kliefoth, *Die [illegible] Gottesdienstordnung der deutschen Kirche*; Kurtz, *Der altt. st. Opfercultus*; Neumann, *Die Opfer des alten Bundes*; Oehler, *Der Opfercultus*, in Herzog's *Realencyklopädie*; Sartorius, *Ueber den alt- und neutest. Kultus*; Tholuck, *Das alte Test. im neuen Test.*; Liske, *Der Ceremonialgesetz des alten Test., seine Erfüllung im neuen Test.*; Wangemann, *Die Opfer der heiligen Schrift nach der Lehre des alten Test.*; Lange, *Com. on Levit.* FREDERIC GARDINER.

Sacrobos′co, de (JOANNES), the Latinized name of JOHN HOLYWOOD, a celebrated English mathematician of the thirteenth century, of whom little is known except that he entered the University of Paris 1221, became professor there, and d. 1256. Author of a treatise *De Sphæra Mundi*, which is little more than a paraphrase of Ptolemy's *Almagest*, which he had employed in Arabic, and having been printed in 1472, passed through more than 20 eds., with commentaries. He also left treatises, *De Computo Ecclesiastico* and *De Algorithmo*.

Sa′crum (Lat. *os sacrum*, the "sacred bone;" the rabbins called it *luz*, and said that it never decays, but forms the germ of the new body at the resurrection; the Arabs say that the judgment angel sits upon it and judges the soul of the departed), in the vertebrate skeleton, is situated below or behind the lumbar and above or before the coccygeal vertebræ. In man it is formed of five (rarely four or six) united vertebræ. It is large, roughly triangular, and is penetrated by foramina for the passage of nerves. It is developed from thirty-five centres of ossification.

Sacs and Foxes. See SAC AND FOX INDIANS.

Sacy′, de (ANTOINE ISAAC SILVESTRE), BARON, b. at Paris Sept. 21, 1758; studied jurisprudence and Oriental languages; was appointed professor in 1795 at the newly-founded École des Langues orientales, and in 1808 at the Collége de France; succeeded Rémusat in 1831 as keeper of the manuscripts of the Royal Library. D. at Paris Feb. 21, 1838. His principal works are—*Mémoires sur Diverses Antiquités de la Perse* (1793), *Principes de Grammaire universelle* (1799; translated by David Fosdick, Andover, Mass.), *Crestomathie arabe* (3 vols., 1806), *Grammaire arabe* (2 vols., 1810), *Mémoires sur l'État actuel des Samaritains* (1812), *Exposé de la Religion des Druses* (2 vols., 1838), besides a great number of minor essays in scientific periodicals, critical editions, translations, etc. But he exercised as great an influence by his teaching as by his authorship. He educated a large number of pupils, not only of France, but also from Germany and the Scandinavian countries, and he supported scientific studies and scientific undertakings of any description with rare enthusiasm and disinterestedness.—His son, SAMUEL USTAZADE SILVESTRE DE SACY, b. at Paris Oct. 17, 1801; studied law; practised as an advocate; became in 1828 a contributor to the *Journal des Débats*, and held for more than twenty-five years a most prominent position in French journalism; was elected a member of the Academy in 1854, though he had published no work besides his articles; was appointed keeper of the Mazarin Library in 1836, its administrator in 1848; member of the council of public education in 1864. He edited *Lettres de Madame de Sévigné* (11 vols., 1861–64), and gave a selection of his literary articles in *Variétés littéraires, morales et historiques* (2 vols., 1858). D. Feb. 14, 1879.

Sad′dle Riv′er, p.-v. and tp., Bergen co., N. J. P. 1168.

Sad′dlery, in its widest sense, includes the draught-harness of horses, mules, etc. In 1870 the U. S. census reported 7607 harness establishments, employing 12 steam-engines of 172 horse-power, and 3 water-wheels of 43 horse-power, giving employment to 23,557 persons, mostly adult males. The capital invested was $13,935,961; wages paid, $7,046,207; materials used, $16,068,310; and the goods produced, $32,709,981. England exports much saddlery, chiefly made at Walsall, Staffordshire.

Sadducees. See JEWISH SECTS, by PROF. FÉLIX ADLER, PH. D., and KARAITES, by REV. SAMUEL ADLER, PH. D.

Sad′ler (MICHAEL THOMAS), F. R. S., b. at Snelston, Derbyshire, England, Jan., 1780; was for some time a merchant at Leeds; became an accomplished popular orator; took a philanthropic interest in behalf of the agricultural poor and the children in factories, on which subjects he wrote and spoke much; and sat in Parliament from 1829 to his death, which occurred in Ireland July, 1835. Author of *Ireland, its Evils and their Remedies* (1828), and *The Law of Population* (2 vols., 1830), a treatise directed against the Malthusian doctrine, which was severely condemned by Macaulay, to whom Sadler published a rejoinder. In Parliament he was a strong opponent of the Reform bill and of Roman Catholic emancipation.

Sadler, or **Sadlier** (Sir RALPH), b. at Hackney, England, in 1507; was in early life a protégé of Thomas Cromwell; was employed by Henry VIII. in effecting the dissolution of the religious houses, and shared in their spoil 1535–37; was ambassador to Scotland in 1537, and again in 1540 and 1541–43; negotiated a treaty for a marriage between Prince Edward and Mary, the infant queen of Scots, July 1, which was, however, declared null by the Scots Dec. 11, 1543; distinguished himself in the ensuing war with Scotland, being made knight-banneret upon the battle-field of Pinkie, Sept. 10, 1547; was made privy councillor by the will of Henry VIII., and master of the wardrobe soon afterward; bore a prominent part in the administration under Edward VI.; lived in retirement during the reign of Mary; was recalled to the privy council on the accession of Elizabeth, and again sent on a mission to Scotland 1558; was one of the commissioners in the conferences at York respecting the charges made against Mary, queen of Scots, Oct. 4, 1568; was her keeper when imprisoned at Tutbury Castle 1562, and was again envoy to Scotland about 1586. D. at Standon Mar. 30, 1587. His interesting *Letters and Negotiations*, first printed in 1720, were edited by Arthur Clifford, with a memoir and notes

by Sir Walter Scott, under the title *State Papers and Letters of Sir R. Sadler* (2 vols., 1809).

Sadlier′ (Mary Anne **Madden**), b. at Cootehill, Cavan co., Ireland, Dec. 31, 1820: wrote at an early age for London periodicals; settled in Montreal, Canada, where she published *Tales of the Olden Time;* married in 1846 James Sadlier of the publishing house of D. & J. Sadlier & Co., and subsequently removed to New York, where she has translated religious and other works from the French, and written novels for Roman Catholic readers.

Sa′do, island of Japan, in lat. 38° 20′ N., lon. 138° 30′ E., a few miles W. of the main island. Area, estimated at 720 sq. m. P. 130,000. It is noted for its rich gold, silver, copper, and lead mines. The chief harbor is Ebisuminato.

Sadole′to (Jacopo), b. at Modena July 14, 1477; was ordained priest in Rome in 1502; appointed secretary to Leo X. in 1513; made bishop of Carpentras, in France, in 1517, and cardinal in 1536. D. in Rome Oct. 18, 1547. He made a favorable impression even on the most zealous Reformers by his conciliatory spirit, and he was often employed, and not without success, in the diplomatic negotiations between Charles V., Francis I., and the popes. His writings, *Philosophiæ Consolationes* (1502), *De Liberis recte instituendis* (1533), *Phædrus sive de Laudibus Philosophiæ* (1538), etc., and his *Letters* were published in a collected edition at Verona (4 vols., 1737) and at Rome (5 vols., 1759). (See Joly, *Étude sur Sadolet* (Caen, 1857).)

Sadow′a, v. of Bohemia, on the Bistritz, near Königgrätz. The battle fought between the Prussians and Austrians (July 3, 1866) in this vicinity is familiarly known by the names of both these places. The strength of the Prussian army advancing into Austria was but little short of 300,000 men, with about 800 guns, and divided into three armies—the 1st under Prince Frederick Charles, the 2d under the crown prince of Prussia, and the army of the Elbe under Herwath von Bittenfeld. On the 16th of June the Prussians entered Saxony; on the 23d, Bohemia. The boundary-line which divides Austria from Prussia and Saxony is marked by ranges of mountains, which, starting from the neighborhood of Zittau, run in a S. W. direction toward Bavaria and S. E. toward Troppau. These ranges are traversed by four groups of roads fit for the passage of an army. The two lines chosen by the Prussian generals for their advance were—that which comprises the roads of Rumberg, Zittau, and Friedland, and that comprising those of Landshut, Braunau, and Glatz. By the 28th of June the whole army had successfully crossed the mountains, and secured as trophies 15,000 prisoners and 24 guns. The Austrian army, under Feldzeugmeister Benedek, opposed to Prussia had a nominal strength about equal in numbers, the number of effectives of each army being, for the Prussians, about 230,000, with 800 guns, for the Austrians 185,000, including 30,000 Saxons, with 700 or 800 guns—a total number greater than has been brought together in modern times on any battle-field except that of Leipsic, where the forces of three empires and three kingdoms were assembled. On the 29th, the Prussians advancing, the 1st army met the Austrians and defeated them at Lochow, taking 7000 prisoners, and at midnight entered Jicin, thus threatening the right flank of the Austrian army, and compelling Benedek (July 1) to take up a new position behind the Bistritz on a range of hills running parallel to that stream. On the 3d of July the Austrian left rested on Problus and Upper Prim, the centre in front of Lipa and Chlum, the right resting on Horenowes. A cavalry corps was stationed near Trotinka. At 7 a. m. of this day the Prussian 1st army and the army of the Elbe attacked the Austrians. At this hour the Prussians were inferior in numbers, the 2d army under the crown prince being 12 or 15 miles away; but moving forward as rapidly as the roads would permit, his advance reached the field about noon, and became at once engaged, and by 3 p. m. had gained the right and rear of the Austrian army, compelling the Austrian commander to retreat as best he could. Considering the number of men engaged and the duration of fighting, the loss in killed and wounded (about 28,000 on both sides) was remarkably small. The Austrians, however, lost largely in prisoners and guns. On the 5th the Prussians advanced on Vienna, but peace was concluded Aug. 23. Probably there has been no instance in the last two centuries in any campaign, except Jena, where success so rapid was followed by results so important. Within a week of crossing the frontier the Prussians utterly routed the combined forces of their enemy in a pitched battle; within a month they dictated peace to him in sight of his capital, the result being the long-desired supremacy of Northern Germany. The operations of the campaign are said to have been directed by Von Moltke.

Sads′bury, tp., Chester co., Pa. P. 2100.

Sadsbury, tp., Crawford co., Pa. P. 894.

Sadsbury, tp., Lancaster co., Pa. P. 1617.

Sae′gerstown, p.-b., Woodcock tp., Crawford co., Pa., on French Creek and Atlantic and Great Western R. R., has good water-power and some manufactures. P. 441.

Safe-Conduct and **Safe-Guard** are not essentially different from Passport (which see).

Safed′ [Heb. *Zephath*], town of Palestine, ancient province of Galilee, at an elevation of nearly 2700 feet, thought by some to be the "city set on a hill" of Matt. v. 14, was almost entirely destroyed by an earthquake in 1837, which killed more than half of its inhabitants. The Jews consider it a sacred city, expecting that the Messiah will make it his capital; its college is one of the principal seats of Hebrew learning. It has some dyeworks and manufactures of cloth. P. about 5000.

Safes, Fireproof. See Fireproof Safes.

Safe′ty Cage, an apparatus worked by steam-power at the mouth of deep mines to facilitate the descent and ascent, as the simple use of ladders is connected with much loss of time and causes great fatigue. The apparatus consists generally of a square cage or open box in which the miners place themselves, and which travels in guides fixed vertically down the sides of the shaft or pit. The term, however, is more especially given to a contrivance for arresting the cage in case of accident, consisting of a catch which, if the rope or chain should snap, takes fast hold of a toothed guide and prevents the cage from being precipitated to the bottom.

Safe′ty Lamp, an illuminating apparatus for mines, so constructed as to obviate the dangers of explosion when artificial light is needed in places where fire-damp exists. In deep coal-mines accumulations of carburetted hydrogen take place; this gas, when mixed with air, is highly explosive, and fearful accidents have resulted from the use of ordinary lamps in such places. The earlier contrivances to effect illumination without danger were clumsy and imperfect. One of these, the steel-mill, produced a succession of sparks by the revolution of steel wheels which struck against bits of flint. In 1813, Dr. W. R. Clanny, and in 1815 George Stephenson and Sir Humphry Davy, each invented, independently, true safety lamps. Of these, Davy's has been most used. All those now most generally in use depend upon two principles for safety—the obstructive action of wire gauze and the protection afforded by a glass cylinder. Davy made a number of experiments upon the nature of the gas escaping from coal-strata, and on the conditions of its union with atmospheric air. Ventilation, perfect enough to sweep away the exhalations, was found to be impracticable, and the problem to be solved was reduced to this: Since flame is incandescent gas, some contrivance was to be devised to prevent the fire-damp becoming heated to the luminous point. Flame, he found, cannot pass through wire gauze of a certain fineness; it loses so much heat as to be incapable of igniting the inflammable gas outside. This is the case even when the gauze is red-hot. One of the greatest dangers in mines arises from the recklessness of the miners, and in the construction of safety lamps precautions have to be taken against this as against more obvious perils. Davy's lamp consists of a closed cylinder of gauze made of wire from $\frac{1}{40}$th to $\frac{1}{60}$th of an inch in diameter, with 28 wires to the inch; over the closed top is fitted a lid like a pill-box cover, fitting closely around, but not closely down over it, and so leaving between the two gauze tops a sort of air-chamber, which protects the upper lid from excessive heat. The cylinder should not exceed $1\frac{1}{2}$ or 2 inches in diameter, or the volume of gas within will be sufficient to induce explosion. Three strong vertical wires extend up the outside of the cylinder and unite above the lid, where a handle is attached; beneath is secured a common lamp. The objections to this lamp are that the light is feeble, and that it is perfectly safe only in still air and when cautiously moved about. Stephenson's lamp has a glass cylinder inside the wire one, and within the upper portion of the glass is a metal chimney perforated with small holes; this forms the double lid. The light is brighter than Davy's, and steadier; the glass, while it intercepts no light, prevents flaring from air-currents; if the glass breaks, it still leaves a wire-gauze lamp, though of rather too large diameter. The Clanny lamp has suspended above its flame an extinguisher; when the flame burns up too high from an excess of fire-damp, the wire which sustains the extinguisher melts; it falls and puts out the dangerous gas-flame, leaving a small and safe oil-flame sufficient to light the miner away from the dangerous spot. The Muessler lamp is much used in continental Europe. The Whitehead lamp is a cylinder of iron with bull's eye and surrounding reflectors and a wire-gauze top. The Mackworth is an improvement upon and modification of Davy's lamp. There are some forms of safety lamp which are considered by

[illegible] mentioned [illegible] do not find [illegible] invented [illegible] proper [illegible] an ex- [illegible] generally, [illegible] by one of [illegible] texture, and the glass [illegible] create a [illegible] and steady [illegible]. S. B. HERRICK.

Safety-Valve. See STEAM ENGINE.

Saffi, or **Azafli,** an old and strongly fortified town [illegible] in Morocco, on the Atlantic, in lat. [illegible] on a naked and barren coast, surrounded by [illegible] good [illegible] and its exports were for- [illegible]. Since the rise of **Mogador, how-** [illegible], it has greatly declined. P. 12,000, of whom 3000 [illegible].

Safflower [from [illegible]], or **Carthamus** [illegible], the flower of *Carthamus* [illegible], indigenous to Egypt and [illegible] France, Spain, Germany, [illegible] Asiatic provinces of Russia, [illegible] South America. It was formerly used [illegible] producing pinks, reds, scarlets, and [illegible] flax, and silk, especially for dyeing "red [illegible]" and for preparing "pink saucers." It is still ex- [illegible] for certain shades of pink for [illegible] market, though aniline colors have displaced [illegible]. Safflower contains two coloring mat- [illegible], yellow, is an acid, latter, soluble in water, and [illegible]; the other, *carthamin* or *carthamic acid*, red, in- soluble in water, but soluble in alcohol and in alkalies, and [illegible] as a dye. To prepare carthamic acid the safflower is placed in bags and washed to remove the yellow color-

The Safflower.

ing matter. It is then macerated in water with 15 per cent. of its weight of crystallized carbonate of soda. Into the [illegible] solution cotton yarn is dipped. On acidulating with [illegible] the cotton takes up the carthamic acid. The [illegible] washed and digested with a solution of car- bonate [illegible], which dissolves the carthamic acid, but [illegible] fixed on the cotton. By acidulating [illegible] carthamic acid is precipitated as [illegible]. This may be further purified by [illegible] with water. Its for- [illegible] of purification with [illegible] in preparing safflower [illegible] in carbonate of [illegible] introduced and [illegible]. The [illegible], the goods are [illegible] solution must be [illegible] any length of [illegible] fleeting; [illegible] dyed with it [illegible] as [illegible] carthamic acid [illegible] dyed [illegible] car- thamic acid [illegible] in water. The [illegible] the [illegible] carthamic acid with [illegible] [illegible] are coated with [illegible] acid. (See SAFRANINE.) See [illegible] Muspratt's *Chem.*; Schütz- berger, *Die Farbstoffe*. C. F. CHANDLER.

Safford (JAMES MERRILL), A. M., PH. D., M. D., b. Aug. 13, 1822, in Zanesville, O.; graduated in the Ohio University, and afterward entered Yale College, Conn., from which institution he received the degree of doctor of philosophy; before leaving Yale was elected to two pro- fessorships—one of mathematics in the Ohio University, the other of chemistry, natural history, and geology in Cum- berland University at Lebanon, Tenn.; accepting the lat- ter, he located in Lebanon in 1848; in 1853 resigned from Cumberland University and moved to Nashville; in 1854 was made State geologist of Tennessee, which office he held for many years and still holds. His report on the geology of Tennessee, published in 1869, is one of the best of the State reports. In 1872 received the degree of doctor of medicine from the University of Nashville; in 1873 was elected to the chair of chemistry in the medical department of the University of Nashville, and the following year to the same position in Vanderbilt University; in May of this year (1875) was elected professor of mineralogy, bot- any, and economic geology in Vanderbilt University, which chair, together with that of chemistry in the medical schools, he now holds. PAUL F. EVE.

Safford (TRUMAN HENRY), b. at Royalton, Vt., Jan. 6, 1836; obtained in early boyhood great celebrity for his wonderful mathematical powers; prepared an almanac at the age of nine years; calculated the elliptic elements of the first comet of 1849; devised an original labor-saving method of calculating the moon's risings and eclipses; graduated at Harvard 1854; was some years engaged in astronomical studies; became in 1863 adjunct observer in the Cambridge Observatory, acting director Feb., 1865, and director of the Chicago Observatory Dec. 28, 1865, a post he still (1876) holds. He determined at Cambridge the right ascension of 1700 stars, the declination of 450, ob- served 6000 transits, and completed Prof. Bond's report of discoveries in the constellation Orion.

Safford (WILLIAM H.), b. at Parkersburg, Va., in 1821; removed to Chillicothe, O., 1848, and was a member of the Ohio senate 1858–60. Author of a *Life of Harman Blennerhassett* (Philadelphia, 1850; 5th ed. Cincinnati, 1859) and editor of *Blennerhassett Papers* (1864), contain- ing important materials for the history of the Ohio Valley.

Saf'fron [Ger. *Saffran*], a yellow substance, consisting of the stigmas, with part of the styles, of the saffron crocus (*Crocus sativus*), a plant indigenous in Greece and Asia Minor, and extensively cultivated in Austria, France, and Spain, and formerly in England. Saffron was formerly imported in two forms—*hay saffron*, consisting of the stig- mas of the flowers, and *cake saffron*, an artificial compound of safflower, gum, etc.; the former only occurs in commerce at present. Spanish saffron is the best. It is said 100,000 flowers are necessary to produce one pound of saffron. This dye is often adulterated with safflower, marigold, pome- granate, and other flowers. The stigmas of the true saffron are from 1 inch to 1½ inches long, narrow and roundish where they are attached to the style, but spreading and club-shaped near the extremity, which is truncated. They have an orange or brownish-red color, yellow in the nar- rower part, an agreeable aromatic, almost intoxicating, odor, and an aromatic bitter taste, and impart a yellow color to the saliva and to water, alcohol, and oils. Strong sulphuric acid colors them blue, then red, and finally brown. Saffron was formerly a favorite dye, but is now rarely used as such. It is employed in medicine for coloring tinctures and for liqueurs, varnishes, confectionery, and especially cakes in the W. of England. The coloring-matter of saf- fron is a glucoside, to which the names safranine, saffron- yellow, polychroite, and crocine have been given. By treat- ment with dilute sulphuric acid it is decomposed, yielding crocetine ($C_{34}H_{46}O_{9}$), glucose ($C_6H_{12}O_6$), and a peculiar vol- atile oil. C. F. CHANDLER.

Saffron, Meadow. See MEADOW SAFFRON.

Saffron of Mars. See IRON, MEDICINAL USES OF.

Saf'fron Wal'den, town of England, county of Essex, trades in malt and cattle, and has 5715 inhabitants.

Saf'ranine [from *saffron*]. **Saffranine, Aniline Pink,** or **New Rose.** This dye, which has to a large extent superseded safflower for dyeing silk and cotton, is obtained by treating heavy anilines with nitrites and ar- senic acid: 2 parts of base-aniline are heated with 1 part of sodic nitrite and 1 part of arsenic acid, for five or six min- utes, to from 176° to 212° F. The colored mass is then treated with boiling water, the solution neutralized with an alkali, filtered, and treated with chloride of sodium, by which the new dye is precipitated. It is filtered and drained, and sent into commerce as a paste. Hofmann and Geyger (*Deut. Chem. Ges. Ber.*, v. 526) have shown that safranine cannot be obtained from pure aniline nor from crystallized toluidine, but that it must be prepared from liquid toluidine (C_7H_9N), boiling at 389° F.

$$3C_7H_9N + HNO_2 = C_{21}H_{24}N_4 + 2H_2O.$$
$$C_{21}H_{24}N_4 + O_2 = C_{21}H_{20}N_4 + 2H_2O.$$

When arsenic acid is employed as the oxidizing agent, the safranine is mixed with a large amount of secondary products, the formation of which is to a great extent avoided by using chromic acid. The safranine of commerce is either in the form of a paste or a yellowish red powder, consisting of the hydrochlorate of a base safranine mixed with calcic carbonate and sodic chloride. It may be purified by repeated solution in boiling water and precipitation by hydrochloric acid. By decomposing this salt with oxide of silver, the free base is obtained as a red solution, which yields reddish-brown crystals on evaporation, very soluble in alcohol and in water. Safranine has the composition $C_{21}H_{20}N_4$, and is nearly related to Perkin's mauveine, which appears to be phenylated safranine ($C_{21}H_{19}(C_6H_5)N_4$). In fact, safranine when treated with aniline yields a purple dye, and mauveine and safranine give similar reactions with sulphuric acid. Perkin noticed that a substance resembling safranine occurred as a by-product in the preparation of mauveine. The most characteristic reaction of safranine is that when strong hydrochloric acid—or, better, sulphuric acid—is gradually added to its solutions, the color changes first to a fine violet, and then successively to blue, dark green, and light green. On diluting the solution the same changes of color are observed in reverse order. For dyeing, the safranine is dissolved in boiling water and carefully filtered, and a very little carbonate of soda added before it is added to the dye-beck. To dye wool a rose-pink, proceed exactly as with aniline red. (See ANILINE COLORS.) To dye silk, add the solution of the color to the bath in which some castile soap has been previously dissolved; keep the bath lukewarm. To dye cotton, it is a good plan to first soak in a cold bath containing hyposulphite of soda, $\frac{3}{4}$ths ounce to the pound of cotton, to destroy the last traces of chloride of lime. For a rose-pink, mordant the cotton in either of the following ways: (1) Soak cotton half an hour in the clear solution of acetate of alumina, obtained by dissolving 2 pounds of alum and 1 pound of acetate of lead in 2 quarts of water; dry; soak half an hour in a cold fat-soap bath; dry; then dye lukewarm in the solution of safranine. (2) Soak the cotton four to six hours in a lukewarm bath to which the extract from $\frac{1}{2}$ pound of nutgalls has been added; wring; soak one hour in a cold bath containing for every pound of cotton $\frac{1}{2}$ to $\frac{3}{4}$ ounce of perchloride of tin crystals; wash; dye in a lukewarm bath to which the color is added in three or four instalments to secure an even color. For a dark-rose or cherry color use the second method, doubling the quantity of nutgalls and increasing slightly the quantity of perchloride of tin. For ponceau and scarlet, first give the cotton, after treatment with hyposulphite, a bottom of turmeric (hot), then continue by the second method. To darken the shades, let the cotton soak in the gall-bath over night. Tannin may be used in place of nutgalls, $\frac{3}{4}$ of an ounce to the pound of cotton. Lastly, pass all cotton dyed with safranine through a cold bath slightly acidulated with acetic acid. To print with safranine, thicken the paste with a mixture of "acetate of alumina standard" 1 gallon, clear water 1 gallon, starch 1 pound; boil; when cold add 1 pint of "arsenic standard." After printing steam half an hour. The alumina standard is made by dissolving 5 pounds of alum and 6 pounds of acetate of lead in 2 gallons of water; use clear solution. The arsenic standard is made by boiling 4 pounds of white arsenic (As_2O_3) in 1 gallon of glycerine till dissolved, and filtering. C. F. CHANDLER.

Safvet Pasha, a Turkish diplomatist and statesman, b. in Constantinople about 1817; trained for diplomacy under Aali and Fuad Pasha; was Turkish ambassador to Paris from about 1856 to 1866; was successively made minister of foreign affairs, minister of justice, and minister of public instruction; he is now minister of war. He is regarded as a reformer, and belongs to the peace party. L. P. BROCKETT.

Sagada'hoc, county of S. Maine, on Atlantic Ocean, bounded W. by Androscoggin, intersected by Kennebec River, and partly consisting of islands at its mouth, traversed by Portland and Kennebec, Bath and Portland, and Androscoggin R. Rs., has extensive interests in shipbuilding, lumbering, and fisheries. Staples, hay, potatoes, wool, and butter. Cap. Bath. Area, 300 sq. m. P. 18,803.

Sa'gan, town of Prussia, province of Silesia, on the Baber, has a fine palace with a beautiful park, and extensive manufactures of woollen and cotton cloth. P. 10,133.

Sagas. See ICELANDIC LANGUAGE AND LITERATURE, by PROF. CLEMENS PETERSEN, A. M.

Sage [Fr. *sauge*], the *Salvia officinalis*, a familiar garden-herb of the order Labiatæ. Its leaves are employed in flavoring force-meats and other dishes, and sage-tea, a decoction of its leaves, is a useful domestic remedy, having aromatic, stimulant, and tonic powers.

Sage, Le (ALAIN RENÉ). See LE SAGE.

Sage-Brush. See ARTEMISIA.

Sage-Cock (*Centrocercus urophasianus*), a species of grouse (belonging to the family Tetraonidæ and subfamily Tetraoninæ), also called **Cock of the Plains.** It is characterized, among the forms which are feathered to the toes but with the toes themselves bare, by the tail being much elongated and cuneate, and the constituent feathers narrow and attenuated, the nasal fossæ equal to two-thirds of the culmen, and the shafts of the feathers on the lower part of the throat very spinous. The color above is brownish-yellow, with blackish areas on the inner fields of the feathers; the wing has light-colored shafts to the feathers of the coverts; the lower portions of the breast are whitish, the abdomen marked with a broad black area. The male bird has very large, dilatable, naked, and yellow-colored air-sacs on each side of the neck, bordered by stiff, scale-like feathers. The species is the largest American representative of the family, the male having an average length of over thirty inches, and the female about twenty-one or twenty-two; but these dimensions are frequently much exceeded. It is confined to the arid plains of the West, ranging from the Black Hills in the E. to California and Oregon in the W., and in the N. from British America to Arizona in the S. In those plains the sage-brush (*Artemisia*) grows in abundance, and it feeds upon that plant, whereby a bitter flavor is imparted to the flesh; but it is said that if the bird is eviscerated at once after being killed, this taint is not so marked. The species differs from all its congeners in that in place of a gizzard there is, according to Mr. Ridgway, a simple muscular membranous bag, contrasting with the peculiarly-developed gizzard of the ordinary species. THEODORE GILL.

Sager (ABRAM), M. D., b. at Bethlehem, N. Y., Dec. 22, 1810; educated at Polytechnic Inst., Troy, N. Y.; Albany Medical School, N. Y.; Castleton, Vt.; and New Haven, Conn. In 1837 chief of botanical and zoological departments of Michigan Geological Survey; in 1845–55 professor of botany and zoology in Michigan University; in 1848 of theory and practice of medicine; and in 1850 of obstetrics and diseases of women and children; member of many scientific societies, and author of papers in medical journals, *American Journal of Science*, etc. D. Aug. 6, 1877.

Sage'town, p.-v., South Henderson tp., Henderson co., Ill., on Chicago Burlington and Quincy R. R. P. 332.

Sage'ville, p.-v., Lake Pleasant tp., cap. of Hamilton co., N. Y., on Round Lake.

Saghali'en, or **Sakhalin,** by the natives called **Taraika,** a long and narrow island off the E. coast of Asia, separated from Asiatic Russia by the Gulf of Tartary, extends from lat. 45° 54′ to 54° 24′ N. Area, about 32,000 sq. m. It belongs partly to Russia and partly to Japan. Hunting and fishing are the principal occupations; the reindeer, elk, musk-ox, and seal abound. P. about 16,000.

Sag Har'bor, p.-v., Suffolk co., N. Y., on Peconic Bay and the Long Island R. R., has 6 churches, 1 high and several private schools, 1 cotton-factory, 1 steam flouring-mill, and 2 cigar-factories. It is the principal market town for the E. end of Long Island, and is engaged in maritime pursuits. P. 1723. JOHN H. HUNT, ED. "SAG HARBOR EXPRESS."

Sag'inaw, county of E. Michigan, on Saginaw, Cass, Shiawassee, and Tittabawassee rivers, traversed by Michigan Central, Flint and Père Marquette, Saginaw Valley and St. Louis, and Marquette Houghton and Ontonagon R. Rs. Staples are hay, wool, and butter. Cap. Saginaw. Area, 900 sq. m. P. 39,097.

Saginaw, city and tp., cap. of Saginaw co., Mich., on Saginaw River, navigable for the largest lake craft, 18 miles above its mouth. It is 100 miles N. W. of Detroit, 64 miles N. E. of Lansing, the State capital, and is the eastern terminus of Saginaw Valley and St. Louis R. R., running to St. Louis, Mich., of magnetic springs fame, and to be continued to Lake Michigan; is on Jackson Lansing and Saginaw R. R., a division of Michigan Central; also on the line of Flint and Père Marquette R. R., which extends from Monroe, 40 miles S. of Detroit, to Ludington on Lake Michigan. Saginaw is immediately within the railway system of the country, having close connection with all sections, the benefit of competing roads and lake navigation. It is on an elevated plateau, amply drained, the centre of a rich farming district; has the lightest indebtedness and levies the lightest taxes of any city in Michigan of equal population. It has 9 steam saw-mills, 8 shingle-mills, 8 saltworks, 3 planing-mills, 1 measure, bale, box, and drum factory, hoop-factory, tannery, boiler-works, foundry, machine-works, axe-factory, grist-mill, boat factory, 4 carriage-factories, and various small manufactures.

It has [illegible] course—central building [illegible] school library 2400 vols. [illegible] public halls, 8 churches, 1 [illegible], 5 benevolent societies, 1 [illegible] newspaper, Wah-Wah-Sun boat-[illegible] to East Saginaw. Product in 18[illegible] lumber, 113,861 barrels of salt, [illegible] $800,000 in value of other articles. P. [illegible].

Geo. F. Lewis, Ed. "Saginawian."

Saginaw Bay, in the E. of Michigan, extends 60 miles S. W. [illegible] Huron. It is studded with fine islands, [illegible] clear and pure water and valuable fisheries. It is [illegible]0 miles in breadth.

Saginaw, East. See East Saginaw.

Saginaw River, in Michigan, is formed by the junction of Flint and Shiawassee rivers. It flows N. 30 miles to Saginaw Bay, and is navigable for 24 miles by steamers of 10 feet draught.

Sagitta'rius (Lat., "archer"), the sign of the zodiac into which the sun enters about Nov. 22. There is also a constellation S., corresponding to the sign Capricornus.

Sa'go (Malay, *sägu*), a variety of starch obtained from the medullary matter or pith of the stem of the sago palm (*Sagus* [illegible]), an East Indian tree which grows in low lands in all the islands of that part of the world. It is a low tree, with a thick trunk, of which the woody part is but an inch or two in thickness, the whole cavity being filled, at a certain stage of its growth, with the farinaceous pith. This is mixed with water, which is passed through sieves, and the starchy matter is allowed to settle. There are several varieties: common sago, which is, like other varieties of starch, insoluble in cold water, but swells to a transparent jelly on boiling; and pearl sago, which has been granulated and subjected to some process, probably involving heat, which causes it to be somewhat soluble, even in cold water. If potato starch be mixed with sago for purposes of adulteration, the microscope will detect its granules, from their greater size and more regular shape. H. Wurtz.

Saguache, county of S. Colorado, forming the N. part of San Luis Park (locally called Homan's Park), bounded N. and E. by the Rocky Mountains and W. by the Saguache range, and watered by Saguache, San Juan, and other rivers, which flow into San Luis Lake, also within the county, which has no outlet, but has a regular ebb and flow. The "park" consists of fertile natural meadows affording a rich pasturage. Staples, wheat, wool, and butter. Cap. Saguache. Area, about 2500 sq. m. P. 304.

Saguache, p. v., cap. of Saguache co., Col., in San Luis Park.

Sa'gua-la-Gran'de, town of Cuba, on the northern side of the island, on the river Sagua, 12 miles from its mouth, and connected by railway with its port, Concha, situated on the coast. In 1867 it exported 1,024,358 cwts. of sugar and 390,200 cwts. of molasses, and is steadily growing. P. 9632.

Saguenay', county of Quebec, Canada, on the N. shore of the St. Lawrence, and bounded S. W. by Saguenay River. In the census of 1871 the Saguenay district included only the sub-districts of Tadousac and Escoumains, all places N. E. of these being classed as Labrador. P. 1788.

Saguenay River, a tributary of the river St. Lawrence, entering it on the N. shore, 120 miles below Quebec; length of course, 357 miles. It drains an area of about 23,710 sq. m., generally high, very rugged and mountainous, in the centre of which is a great oblong basin of comparatively low country, about 100 miles in length by 60 in breadth, in the S. side of the middle of which is Lake St. John, 28 miles long by 20 wide, the reservoir of the Saguenay. At its head it receives the Chomouchuan or main branch, 210 miles long, from the W. N. W., and the Mistassini, 180 miles long, from the N.; on the N. side the Peribonca, 160 miles long, from the N. N. E.; on the S. side the Metabetchuan, 110 miles long, and two smaller rivers from the S. From the S. E. end of the lake the Saguenay issues, discharging a most extraordinary volume of water from its sources being in moist and densely wooded mountain regions, where winter snows are occasionally 8 feet deep; but its width seldom exceeds a quarter of a mile, till at the foot of its lowest rapid, 36 miles from the lake, it meets the influence of the tides; 7 miles below which, at Chicoutimi, which is the county-town and a seaport with a considerable export trade in lumber, it becomes navigable by large ships, and receives the river Chicoutimi, 110 miles long, on the W. Ten miles lower it expands to 2 miles in width, and with a great depth, often exceeding 100 fathoms, narrows gradually to 1 mile in width at its mouth, 75 miles below Chicoutimi. The central basin of the Saguenay is bounded on the N. E. by the Ste. Marguerite or Peribonca Mountains, varying from over 4000 to 2000 feet in height; on the S. W., S., and S. E. by the Laurentides, of similar height. It is in traversing this range, for 50 miles of its lower course, through a deep chasm, whose cliffs present precipices occasionally 1500 feet in height, that the stern and grand scenery is to be found for which the Saguenay is famed. A. J. Russell.

Sagun'tum, an ancient town of Spain, founded by Greek colonists from Zacynthus (Zante, which see), prospered and became very wealthy. In 218 B. C. it was besieged by Hannibal. After a year of energetic resistance, the Saguntines, pressed by famine, set fire to their city, and while all the women and children perished in the flames, the men issued forth to battle and were killed. This conquest by Hannibal occasioned the Second Punic war. The Romans afterward rebuilt the city and called it *Murivleres* ("the old walls"), whence the name of the city, Murviedro (which see), which now occupies the site. A theatre and a temple of Bacchus are still left of the ancient city, the former in comparatively good condition.

Sahagun', de (Bernardino), b. at Sahagun, Spain, early in the sixteenth century; was educated at Salamanca, where he became a Franciscan monk; went as a missionary to Mexico 1529; became versed in the languages, history, and antiquities of the Mexican tribes; wrote several religious treatises in Mexican, and left in MS. a number of works illustrating the ancient history of that country. D. at Mexico in 1590. His *Historia Universal de la Nueva España*, first published by Bustamante (Mexico, 1829) and by Lord Kingsborough in his great collection (1830), has been treated by Prescott and most writers as a leading authority upon Aztec customs and religion, but there is reason to believe that its accuracy has been much overrated.

Sahap'tins, Shahaptans, or **Saptins,** a family of Indians in Oregon, Idaho, and Washington territories, occupying the region on both sides the Columbia, Lewis, and Snake or Sahaptin rivers from the Dalles of the Columbia to the Bitter Root range of the Rocky Mountains. They are bounded on the N. by the Salish family, and on the S. by the Shoshone or Snake family, and include the Nez Percés or Sahaptins proper, Palus or Palooses, Walla-Wallas, Cayuses or Waiilatpus, Wascos, Yakimas, and Kliketats. They live chiefly on fish and bitter roots, and practise flattening of the head. (See H. H. Bancroft's *Native Races of the Pacific States*, vol. i., 1874.)

Sahara. See Appendix.

Saharunpoor', town of British India, presidency of Agra, in lat. 29° 58′ N., lon. 77° 36′ E., in a fertile plain, at an elevation of about 1000 feet above the sea-level. It is a military station, and has a botanical garden. P. 37,968.

Sahib, Tippoo. See Tippoo Sahib.

Sai'da, town of Syria, on the Mediterranean, in lat. 33° 34′ N. Its harbor was filled up in the seventeenth century, and is accessible now only for small boats; the adjacent country is noted for its fruit; some silk manufactures are carried on; in the neighborhood are the ruins of the ancient Sidon (which see). P. about 9000, of whom 7000 are Mohammedans.

Saïd Pasha, viceroy of Egypt. See Egypt.

Saigiidæ. See Appendix.

Saigo, b. in Satsuma, Japan, in 1825; belonged to the Samurai or "Retainers;" was well educated in Japanese and Chinese; was a strong leader against the tycoon; in 1857 was compelled to leave Yedo, being under arrest, and fled to his home in Satsuma; his friend, the prince of Satsuma, advised him to take an assumed name and go to an islet in the Pacific Ocean; he there spent three years in exile, but returned to his home in 1861, and became active once more in the attempt to restore the supremacy of the mikado. In 1862 he joined the prince of Shimadz and others in the warfare against the tycoon which resulted in the recent revolution in Japan. He was banished a second time to a more distant isle, and endured great privations for three years, but in 1866 was recalled to the service of his country, and was received with extraordinary enthusiasm. He joined the adherents of the mikado, and was made lieutenant-general of the imperial army in 1868; succeeded in negotiating with the civil dignitary, Katz, and the result was the surrender of the tycoon; continued in active service until there was entire submission to the imperial forces in 1869; then retired to Satsuma, but in 1870 was again solicited to return to the public service, and was appointed councillor of state. After the government was fully established he felt that he was no longer needed in state affairs, and retired once more to his home. F. A. P. Barnard.

Saigon', capital of the French possessions in Cochin-China, Farther India, situated in lat. 10° 47′ N., lon. 106° 45′ E., on the Dounai, a branch of the Saigon, 35 miles from its mouth in the China Sea. The Dounai, which here

winds through a district of exuberant fertility, is navigable for the largest vessels, and forms at Saigon one of the finest harbors of the E. coast of Asia, lined with stone quays and surrounded with dockyards, arsenals, and magazines, and various naval establishments. The town itself is well built, and carries on an active trade, exporting annually more than 8000 tons of cotton, rice, sugar, indigo, and dyewoods. P. 120,000, of whom 10,000 are Chinese, engaged in the retail business of the place.

Saikio, city of JAPAN (which see).

Sail [Ang.-Sax. *segel*], a sheet of canvas or other material used to propel a vessel through the water. The invention or origin of sails has not been determined, but we know of their use at a very remote period. Sails are now made by sewing cloths of canvas together with twine in a double seam, and binding the edges around with a *bolt-rope* to relieve the strain upon the canvas, the whole being so fitted as to present a flat surface to the wind. Bands of canvas are placed wherever additional strength is required or the sail is exposed to chafing, as the *reef-bands, buntline-cloths*, etc. Sails are in shape either quadrilateral or triangular. In all quadrilateral sails the upper edge is called the *head*, the lower edge the *foot*, and the sides *leeches*. When the head and foot are parallel, the upper corners are called the *head-earings*, and the lower ones *clews*. When the head and foot are not parallel, the foremost corner at the head is called the *throat* or *neck*, the after upper corner the *peak*, the forward lower corner the *tack*, and the after lower corner the *clew*. In triangular sails we find the head, tack, and clew. In all sails the foremost edge is called the *luff* or *fore-leech*, and the aftermost the *after-leech*. Sails are classed as *square sails* and *fore-and-aft sails*. The former, all quadrilateral, are those which make a large angle with the direction of the keel, and are spread by yards, as the principal sails of a ship, or by yards and booms, as the *studding sails*. The latter, either quadrilateral or triangular, are those which make but a small angle with the line of the keel. The triangular are spread by a yard, as *lateen* sails; by a stay, as *staysails*; or by a mast, as *shoulder-of-mutton* sails. The quadrilateral are extended by means of gaffs and booms, the head of the sail being attached to the gaff. In all fore-and-aft sails the luff is attached throughout its length to the yard, stay, or mast. The principal sails of a ship are—*courses*, the lowest ones; *topsails*, next above the courses; *topgallant-sails*; *royals*; and, sometimes, *skysails*. These sails are attached by the head to their proper yards, and, excepting the courses, are spread by having their clews drawn out by ropes called *sheets* to sheaves in the ends of the yards below them. The clews of the courses are in like manner drawn to the *chess-trees* and *bumpkins* on deck. Studding-sails are set beyond the leeches of the foresail, fore and main topsails, and fore and main topgallant-sails, the head being extended by a studding-sail yard, and the foot by a boom run out beyond the end of the yard next below. Staysails are hoisted upon the stays between the masts, the foot being stretched out by a rope or whip called the *sheet*. All sails take their names from the mast, yard, or stay to which they are attached. Thus, that upon the main yard is called the main-sail, above which are the main topsail, main topgallant-sail, and main royal. Vessels are named from the number of their masts and the shape and number of their sails. A ship has three masts, with square sails on each mast, while schooners have two or three masts, but fore-and-aft sails only. Boats' sails follow the rules given as to form and class, but have peculiar names. The most common are spritsails, standing lugs, dipping lugs, sliding gunters, etc.; and in many instances boats are known by the names given to their sails. P. F. HARRINGTON.

Sail'ing. Horace in one of his odes wonders at the hardihood of the man who first ventured to sea in a frail bark:

> "Illi robur et æs triplex
> Circa pectus erat, qui fragilem truci
> Commisit pelago ratem
> Primus," etc.,

but fails to inform us to what country he belonged; so that the honor has been claimed by the Chinese, the Egyptians, and the Phœnicians. Certain it is that of all the seamen of remote antiquity, the last named were the most daring and adventurous, and their voyages around the Cape of Storms and to the Cassiterides, considering the age in which they lived, were not less remarkable than the circumnavigation of the globe by the hardy mariners of the sixteenth century. Groping his way feebly at first, without nautical instruments, the mariner ventured a short distance from the shore: but little by little, with the help of a rude compass and a ruder astrolabe, his knowledge of the sea increased, until with the scientific appliances of to-day the ocean is as well known as the land. (See NAVIGATION and GREAT-CIRCLE SAILING.) FOXHALL A. PARKER.

Saimiri, a name derived from the South American Indians, and given to species of New-World monkeys (family Cebidæ) whose tail is hairy to the tip, and scarcely, if at all, prehensile; the lower jaw is moderately dilated behind, and the incisor teeth are vertical. The species have been mostly described under the generic name *Chrysothrix*.

THEODORE GILL.

Sain'foin [Lat. *Sanum fœnum*, "sound hay"], a forage-plant, the leguminous *Onobrychis sativa*, very valuable on dry chalky lands, but not much raised in the U. S. It is prized as green forage, as hay, and as a crop to be ploughed under. It is believed to be well fitted for Western Kansas and Dakota. It often stands ten years without re-seeding.

Sainsbury (W. NOEL), b. in England about 1820; became a prominent official of the British state paper office and a contributor to the reviews and other periodicals; editor of *Original Unpublished Papers illustrative of the Life of Sir Peter Paul Rubens* (1859), of the valuable *Calendar of State Papers, Colonial Series, 1574–1660* (1861), and of a second volume devoted to the papers upon the East Indies, China, and Japan 1513–1616 (1863). In 1860 he proposed to the government of the U. S. the continuation of the *Calendar*, as far as regards America, from 1668 to 1783, but the proposition was unfortunately declined.

Saint [Lat. *sanctus*, "holy;" Gr. ἅγιος, "pure," "clean," "venerable," from ἅζω, to "fear," to "venerate;" Heb. קָדוֹשׁ], in the New Testament a title of all Christians (Rom. i. 7; 1 Cor. i. 2; Eph. i. 1; Phil. i. 1, etc.), in the sense that they are called out of the world, regenerated by the Holy Spirit, and consecrated to God and to holiness. In the Apostles' Creed "the communion of saints" is one of the articles of faith, closely related to the preceding article on "the holy catholic Church," but is not found in the earlier forms of that symbol. The oldest MS. copies of the Gospels bear simply the names of Matthew, Mark, Luke, and John, without "S." attached to them. After the fourth century the term began to be applied to particular persons of special eminence in piety and services to the Church, as the apostles, evangelists, and martyrs. It became the exclusive title of a spiritual nobility or aristocracy. Special honor was paid to their memory, which gradually assumed the character of a limited Christian hero-worship, called by the scholastic divines *doulia* or *veneratio* (as distinct from *latria* or *adoratio*, which is due to God alone, and *hyperdulia*, or a peculiar degree of veneration which is claimed for the Virgin Mary as the mother of our Lord and queen of saints). The Greek and Roman churches, believing in the active intercession of the saints in heaven in behalf of the struggling Christians on earth, consider it proper and useful to pray to them; with this difference, however, that God is to be implored as the giver of all blessings, while the saints are to be implored as the friends of God, that through their advocacy of our cause we may obtain from him all necessaries of life (hence the form *Ora pro nobis*, "Pray for us"). Protestants reject the worship of saints, images, and relics as inconsistent with the First and Second commandments and the exclusive worship of God, and hence they pray directly to God and to Christ.

The question, Who are the saints? was for a long time left to the public sentiment of the Christian people in the particular nation or province or monastic order to which the saint belonged. The voice of the people was regarded as the voice of God. But to prevent the immoderate increase of the number of saints, the popes since Alexander III. (A. D. 1170) monopolized the right of canonization—*i. e.* of deciding and pronouncing a departed Christian to be a *saint*, and authorizing and prescribing his worship within the Roman Catholic Church. The act of canonization is preceded by a regular process of law, in which one acts as the accuser of the candidate, another as his advocate. The necessary qualifications for the honor are, besides the highest sanctity, the power of working miracles either during their lifetime, or after their death through their pictures or relics or the invocation of their aid. An Italian proverb says it requires a miracle to prove a miracle. This is especially true after the lapse of several centuries, which now usually intervene between the death of a saint and his canonization. The last instance occurred at Pentecost, 1862, when Pope Pius IX. solemnly canonized twenty-six Japanese missionaries and converts who died in a persecution in 1597, nearly 300 years ago. (Comp. *Descrizione delle ceremonie che si celebrano nella Basilica Vaticana per le solenni Canonizazioni dei Santi*, Rom., 1862.)

The Roman Church celebrates the memory of each canonized saint on the day of his death (which is regarded as his birthday in heaven). The Roman calendar of saints includes (1) the apostles, evangelists, and most eminent martyrs, fathers, schoolmen, and missionaries down to the

Reformation, [illegible] property of Christen[illegible] who lived after the [illegible] Protestant doctrines [illegible] a few popes. [illegible] Pius V. (1566–72), who ex[illegible].

[illegible] given rise to an immense [illegible] most learned and extensive work [illegible] *Sanctorum* of the Bollandists, [illegible] 60 vols. fol., and not yet com[illegible].

PHILIP SCHAFF.

Saint-Affrique, town of France, department of Avey[illegible], has large tanneries and trade in wool [illegible] in the neighbouring Roquefort. P. 6618.

Saint Alban's, town of England, county of Hertford, [illegible] river Ver, is historically interesting from the two battles fought here during the wars of the Roses in 14[illegible] and 1461, and has some straw-plaiting and silk-spinning industry. P. 8[illegible].

Saint Alban's, tp., Hancock co., Ill., on Chicago Burlington and Quincy R. R. P. 1147.

Saint Alban's, p.-v. and tp., Somerset co., Me., on Moose Pond. P. 16[illegible].

Saint Alban's, tp., Licking co., O. P. 1110.

Saint Alban's, city and cap. of Franklin co., Vt., 32 miles N. of Burlington and 63 miles S. of Montreal, borders on Lake Champlain, and is on Vermont and Canada R. R., which is a link in the line of the Central Vermont, of which this is the head quarters. It is also the southern terminus of Missisquoi R. R. It has 2 national banks and 2 trust companies, extensive railroad shops, a large rolling-mill for the manufacture of silicon steel capped rails, 1 considerable iron foundry, 2 daily and 2 weekly newspapers, 8 churches, a public graded school, a convent, 2 public libraries, waterworks, and gas-works. It is the chief business centre of the county. It has 6 hotels, and is quite a summer resort. Aside from railroading, its chief business is trade and agriculture. Its butter-market is famous throughout the country. P. 7014.

ALBERT CLARKE, ED. "MESSENGER."

Saint Alban's, p.-v., Kanawha co., West Va.

Saint Alban's (HARRIET **Mellon**), DUCHESS OF, b. in England about 1775, in a low condition of life; became a popular comic actress; married Mr. Coutts, a wealthy London banker; was soon afterward left a widow with one of the largest fortunes in England, and married June 16, 1827, the duke of St. Alban's. D. Aug. 6, 1837, leaving the bulk of her fortune to Miss Angela Georgina Burdett, daughter of Sir Francis Burdett and grand-daughter of her first husband, a lady distinguished for her benevolence, who has been ennobled by Queen Victoria. (See BURDETT-COUTTS, BARONESS.)

Saint Al'bert, village of British America, on the Saskatchewan, is the seat of a Roman Catholic bishop, and has an academy and an orphanage under the Sisters of Charity.

Saint Aldegonde. See MARNIX.

Saint Amand', town of France, department of Cher, at the influx of the Marmande in the Cher, carries on a considerable trade in iron, cattle, hemp, and chestnuts. P. [illegible].

Saint Amand, town of France, department of Nord, on the Scarpe, has celebrated sulphur springs, a large trade in flax, and manufactures of lace, linens, and porcelain. P. 10,2[illegible].

Saint An'drew's, town of Scotland, in Fifeshire, on a bay of the same name, has a university and other good educational institutions, and is much frequented as a watering place. P. [illegible].

Saint Andrew's, a port of entry, cap. of Charlotte co., N. B., at the mouth of St. Croix River, on Passamaquoddy Bay, 66 miles by [illegible] W. of St. John. It is the S. terminus of a branch of New Brunswick and Canada Railway. It has a good harbor, a weekly newspaper, a marine hospital, a custom house, a postal savings bank, and various public buildings. It is an attractive place of summer resort. P. of sub-district, 2981.

Saint Andrew's, tp., Charleston co., S. C. P. 3277.

Saint Anne, p.-v. and tp., Kankakee co., Ill., on Chicago Danville and Vincennes and Cincinnati Lafayette and Chicago R. Rs., has 5 churches, 1 college, 1 weekly newspaper, 3 hotels, and 4 grain houses. It is noted for its fine farming-lands, adapted to the culture of fruit, grass, and corn; also for stock-raising. P. 1385.

EDWARD PARO, ED. "GRANGER."

Saint Anselme', p.-v., cap. [illegible] of Dorchester co., Quebec, Canada, 16 miles S. of Quebec. It has a good trade in provisions and produce, and a splendid convent. P. about 700.

Saint Ans'gar, p.-v. and tp., Mitchell co., Ia., on Red Cedar River and Iowa division of Illinois Central R. R., has 1 newspaper. P. of v. 360; of tp. 893.

Saint An'thony, a former city of Minnesota, now consolidated with MINNEAPOLIS (which see).

Saint Anthony's Fire, the popular name of ERYSIPELAS (which see).

Saint Antonin', town of France, department of Tarn-et-Garonne, on the Aveyron, has large tanneries and dye-works, and a trade in prunes. P. 5152.

Saint Ar'mand, tp., Essex co., N. Y., on the head-waters of Saranac River, includes a portion of the celebrated Whiteface Mountain. P. 335.

Saint-Arnaud. See LEROY DE ST.-ARNAUD.

Saint Au'bert, p.-v. and tp., Callaway co., Mo. P. 1139.

Saint Augus'ta, p.-v. and tp., Stearns co., Minn. P. 570.

Saint Au'gustine, city, cap. of St. John's co., Fla., on the narrow peninsula formed by Matanzas and San Sebastian rivers, and behind the N. end of Anastasia Island, which separates it from Atlantic Ocean. The manufacture of palmetto-straw goods is a considerable industry, and there is a limited coasting-trade. Two lines of sailing vessels also run between this port and New York. It has 5 churches, 2 public schools, a public library, a weekly newspaper, and numerous hotels. As the oldest city in the U. S., St. Augustine rests its claims upon its past history and its antiquities, which, with its almost insular position and equable climate, make it a favorite resort for tourists and secure for it a large population of invalids during the winter. Although as early as 1512, Ponce de Leon landed in this vicinity in search of the fabled "fountain of youth," the first *permanent* settlement was made by Don Pedro Menendez de Aviles, who on Sept. 8, 1565, disembarked with some 1500 followers and took possession of the country in the name of his sovereign, Philip II. of Spain. The point of disembarkation was the site of the present city, to which its name was given in honor of "the greatest of the Fathers," on whose day (Aug. 28) the fleet arrived off the coast. During the two centuries of occupation by the Spanish the town acquired a maximum population of upward of 3000, besides a garrison of 2500, and some 900 houses of masonry were built. The Spanish population, however, very generally abandoned their residence here upon the cession of the provinces to Great Britain in 1763, leaving a poor exhibition of progress for an occupancy of nearly 200 years. Perhaps the only *finished* undertaking was the present Fort Marion, called the castle of St. Mark by the Spaniards, which was upward of 100 years in course of construction. It was mainly built by the enforced labor of Appalachian Indians and Mexican convicts. The work was essentially completed in 1756, under Don Alonzo Fernandez de Herrera, and over the main entrance is a tablet bearing an inscription to this effect, surmounted by the Spanish coat-of-arms. In 1842–43 the U. S. government added a water-battery, excepting which and some repairs the fort is essentially as completed in 1756. As early as 1690 a sea-wall of coquina (shell concrete, or shells cemented by shell lime) was commenced to resist the further encroachments of the sea, traces of which wall are still visible in parts of the city. During the years 1837–43 the U. S. government completed a substantial wall with granite copings at an expense of $100,000; it is a favorite promenade. In the Plaza de la Constitucion, as the public square is called, stands a monument erected in 1812–13 in honor of the adoption of the Spanish constitution of 1812. On its failure the inhabitants of St. Augustine contented themselves with removing the tablets denoting its object, which, however, have since been restored. The old Roman Catholic cathedral, commenced in 1793, has a bell in its tower bearing date 1682. The building now the U. S. barracks was originally a Franciscan convent, but has been so much changed that little except the foundations of the original building now remain. The present custom-house was formerly the residence of the Spanish governors. Like the last-named building, much of its ancient character has been lost by subsequent alterations. Among the early buildings of the Spaniards was a lighthouse on Anastasia Island, with fortified walls, etc., the remains of which yet exist. A new lighthouse has been erected by the U. S. on the N. end of this island and S. side of the entrance to the harbor; lat. 29° 53′ N., lon. 81° 17′ W. Traces also yet exist of the two lines of defences which stretched across the peninsula, consisting of a ditch and embankment. In 1586, Sir Francis Drake made a descent upon and destroyed St. Augustine, and it is also said that the town was burned by

order of Gov. Moore of the Carolinas, who besieged the castle for three months in 1702. During the Revolutionary war it was an important British dépôt, and here Prevost organized his expedition against Savannah in 1779. In 1821 the American flag supplanted the Spanish standard, which 256 years before had been raised by Menendez.

Old Fort St. Mark, St. Augustine.

During the Seminole war (1835–42) St. Augustine acquired some importance. The present population is about 2000, of which perhaps three-fourths are of Spanish origin. It has a mean temperature of 70°; in Apr., 1828, a severe frost occurred; also in Feb., 1835, when ice formed in St. John's River. P. in 1870, 1717. G. C. SIMMONS.

Saint Barthol'omew, one of the Caribbean Isles, in the West Indies, in lat. 17° 53′ N. and lon. 62° 52′ W., belongs to France since 1877. Area, 35 sq. m. P. 2898. On account of the scarcity of fresh water the productiveness of the soil is very small—insufficient to feed the inhabitants, who are mostly engaged in trade. The coast is skirted with coral-reefs and difficult of access, but offers on its W. side a good harbor at Gustavia.

Saint Bartholomew, Massacre of. See BARTHOLOMEW, ST., MASSACRE OF.

Saint Bernard', parish of S. E. Louisiana, between Mississippi River on the W. and Gulf of Mexico on the E., having Lake Borgne and Mississippi Sound on the N. and Isle au Breton Sound on the S. E., has a very fertile soil, producing large crops of sugar-cane. Rice and cotton are also raised. Cap. St. Bernard. Area, 620 sq. m. P. 3553.

Saint Bernard, p.-v., cap. of St. Bernard parish, La.

Saint Bernard, THE LITTLE, a celebrated pass across the Graian Alps, on the frontier of Savoy and Piedmont, Italy, S. of Mont Blanc, is 7200 feet high, leads from the valley of the Isère into that of Dora Baltea, and has near the summit a convent for the relief of travellers, believed to have been founded by St. Bernard of Menthon. The pass is comparatively easy, and is supposed to have been the route taken by Hannibal in his invasion of Italy.

Saint Bernard Pass. See BERNARD, THE GREAT ST.

Saint Brieuc', town of Bretagne, France, cap. of department of Côtes-du-Nord, on Gouet River, near the Bay of St. Brieuc, has a school of hydrography, an ancient cathedral, and a statue of the celebrated constable Bertrand du Guesclin, and is largely engaged in the whale and cod fisheries. P. in 1872, 15,253.

Saint Cath'arine, v., Liberty co., Ga. P. 128.

Saint Catharine, p.-v., Linn co., Mo., on Hannibal and St. Joseph R. R. P. about 300.

Saint Catharine's, town of Ontario, Canada, the capital of Lincoln co., on Great Western and Welland railways, 12 miles N. of Niagara Falls, is celebrated for its mineral artesian wells, which afford strongly saline waters with valuable tonic properties. There are several fine hotels, 2 daily and 4 weekly newspapers, a convent, a marine hospital, and important manufactures. The town is in a picturesque and fertile region. P. 7864.

Saint Césaire', v., Rouville co., Quebec, Canada, on Yamaska River, 33 miles E. of Montreal. It has a large trade, a fine water-power, thriving manufactures, an astronomical observatory, a museum of mineralogy and zoology, and is the site of Ste. Croix College, a commercial school, and a Presentation convent. P. 937.

Saint Chamond', town of France, department of Loire, at the confluence of the Gier and Ban, has several silk-mills, ironworks, and manufactures of ribbons and lace. The vicinity contains rich coal-mines. P. 11,626.

Saint Charles, parish of S. E. Louisiana, bounded N. by Lake Pontchartrain, S. by Lake Washa, W. by Lake des Allemands, intersected by Mississippi River, and traversed by Morgan's Louisiana and Texas and New Orleans Mobile and Texas R. Rs., and produces sugar-cane and rice. Cap. St. Charles. Area, 340 sq. m. P. 4867.

Saint Charles, county of E. Missouri, situated between Mississippi and Missouri rivers at their confluence, and traversed by St. Louis Kansas City and Northern R. R., has several ranges of hills, fertile bottom-lands, productive mines of coal, and numerous manufactories of carriages. Staples, wheat, Indian corn, oats, hay, tobacco, wool, and butter. Cattle, sheep, and swine abound. Cap. St. Charles. Area, 480 sq. m. P. 21,304.

Saint Charles, p.-v. and tp., Kane co., Ill., on Fox River and Fox River branch of Chicago and Burlington R. R., has fine water-power, several manufactories, and 1 newspaper. P. 2281.

Saint Charles, tp., Floyd co., Ia., on Red Cedar River, includes Charles City, the county-seat. P. 3374.

Saint Charles, p.-v., cap. of St. Charles parish, La., on Morgan's Louisiana and Texas R. R.

Saint Charles, p.-v. and tp., Saginaw co., Mich., at the forks of Bad River, and on Jackson Lansing and Saginaw R. R., has numerous saw-mills. P. 1185.

Saint Charles, p.-v. and tp., Winona co., Minn., on Winona and St. Peter R. R., has 1 newspaper. P. of v. 1151; of tp. 1960.

Saint Charles, city and tp., cap. of St. Charles co., Mo., upon St. Louis Kansas City and Northern R. R. and Missouri River, 20 miles from its mouth and 19 miles by rail from St. Louis. The business portion of the city is along the river-bank. For health, business, and beauty the site is fine. St. Charles is one of the earliest Spanish and French settlements. Here the first State legislature of Missouri met and the first State governor was inaugurated. The buildings in which these events occurred still stand. A few of the old French residents and their descendants remain. The population is largely German, and is thrifty and prosperous. Society is excellent. There are 13 churches, 1 national and 2 savings banks, a public library, 2 English and 2 German weekly newspapers, with other publications, a fire company, and an insurance corporation. A convent school is conducted by the ladies of the Sacred Heart, and Lindenwood Female Seminary, under the patronage of the Presbyterian Church, is known throughout the West. There are 3 public schools, 3 parish schools, 3 private schools, and 1 college. The St. Charles iron railway bridge over the Missouri cost $2,000,000, and is one of the finest specimens of the art in the world. With its approaches it is 2 miles in length. St. Charles has car-shops, woollen-mills, foundries, pork-houses, breweries, and factories where the finest starch in the world is made from the celebrated St. Charles white corn. Six steam-mills manufacture choice flour, for which St. Charles is noted. The delta between Missouri and Mississippi rivers is of unsurpassed richness. The rest of the county is good wheat and corn land, and is thickly settled by industrious people. Several counties to the N. and W. are also tributary to St. Charles, which has a steady, solid growth. A tornado swept through the chief business street Feb. 27, 1876, doing $100,000 damage. In a week's time the enterprise of the people had left hardly a trace of the visitation. P. of city, 5570; of tp. 3479. P. A. FARLEY, PROP. "NEWS."

Saint Chris'topher, or **Saint Kitt's,** one of the Lesser Antilles, in the West Indies, in lat. 17° 17′ N., lon. 60° 42′ W., belongs to Great Britain. It is 20 miles long, 5 miles broad, and traversed by a mountain-range of volcanic origin, whose highest peak, Mount Misery, reaches 3711 feet. From this range the ground slopes gently toward the coast. The soil is very fertile and eminently well adapted for sugar-plantations; it is also well cultivated, and the revenue of the island, which in 1834 amounted only to £3638, rose in 1867 to £26,317, and in 1871 to £31,000. Chief towns, Basseterre and Sandy Point. P. about 25,000.

Saint Clair, county of N. E. Alabama, on Coosa River, has a hilly surface covered with oak timber, has beds of bituminous coal, and is traversed by Alabama and Chattanooga R. R. Staples, cotton, Indian corn, and molasses. Cap. Ashville. Area, 700 sq. m. P. 9360.

Saint Clair, county of S. W. Illinois, on Mississippi River opposite St. Louis, and on Kaskaskia and Cahokia

riv[illegible] railroads leading to St. L[illegible], several coal mines, [illegible] and has very numerous [illegible], cooperage, agricultural [illegible] flour mills and breweries. [illegible], wine, and butter. Cap. B[illegible] A[illegible] P. 51,068.

Saint Clair, [illegible] E. Michigan, on St. Clair River [illegible] St. Clair, which separate it from Ontario [illegible] and Black rivers, has a rolling surface [illegible] N. W. parts, which are covered with [illegible] by Port Huron and Lake Michigan [illegible] Trunk R. Rs., is well adapted for stock-raising, and has numerous saw-mills and manufactories. Staples, [illegible], potatoes, hay, hops, wool, and butter. Cap. Port Huron. Area, 900 sq. m. P. 36,661.

Saint Clair, county of W. Missouri, intersected by Osage and Sac rivers and traversed by Sedalia division of Missouri Kansas and Texas R. R. Staples, Indian corn, wheat, oats, hay, tobacco, and wool. Cap. Osceola. Area, 650 sq. m. P. 6742.

Saint Clair, tp., Benton co., Ia. P. 811.

Saint Clair, p. v. and tp., St. Clair co., Mich., on Michigan Midland and Canada and Chicago Saginaw and Canada R. Rs., 45 miles N. E. of Detroit, has 5 churches, a union and ward school, 2 banks, 6 steam brickyards, 2 flouring and 2 saw mills, an extensive tannery, a woollen-factory, machine-shops, a carriage establishment, 2 hotels, and 1 newspaper. P. of v. 1790; of tp. 3792.

H. P. WANDS, ED. "REPUBLICAN."

Saint Clair, p.-v., Franklin co., Mo., on Atlantic and Pacific R. R.

Saint Clair, tp., Butler co., O., on Great Miami River, includes Hamilton, the county seat. P. 1187.

Saint Clair, p. v. and tp., Columbiana co., O. P. 1156.

Saint Clair, v., South Beaver tp., Beaver co., Pa. P. 232.

Saint Clair, tp., Bedford co., Pa. P. 2219.

Saint Clair, p.-b., Schuylkill co., Pa., on Philadelphia and Reading R. R., 3 miles E. of Pottsville, has 8 churches, good schools, a public library, 4 public halls, 7 large coal-collieries, on which it largely depends, 1 weekly newspaper, 7 hotels, several factories and furnaces, 1 bank, and gas-works. P. 5726.

J. WARREN LEWIS, ED. "REVIEW AND CHRONICLE."

Saint Clair, tp., Westmoreland co., Pa. P. 777.

Saint Clair, tp., Smyth co., Va. P. 1547.

Saint Clair (ARTHUR), b. at Thurso, Caithness-shire, Scotland, in 1734; was grandson of an earl of Rosslyn; educated at the University of Edinburgh; studied medicine under John Hunter; inherited a large fortune on the death of his mother; entered the British army as an ensign May 13, 1757; came to America 1758; served under Amherst at the taking of Louisburg; became a lieutenant Apr. 11, 1759; was distinguished under Wolfe at Quebec; married at Boston, May 14, 1760, Miss Phœbe Bayard, half-sister of Gov. James Bowdoin; resigned his commission Apr. 16, 1762; settled in Ligonier Valley, Pa., 1764, erecting there a fine residence and several mills; became in 1770 surveyor of the district of Cumberland; was afterward a justice of quarter sessions and of common pleas and member of the proprietary council; was in 1771 a justice, recorder, clerk of the orphans' court, and prothonotary of Bedford co.; held similar offices in the newly-erected county of Westmoreland 1773; became colonel of militia July, 1775; was in the autumn of the same year one of a commission to treat with the Western Indians at Fort Pitt; was appointed colonel of the 2d Pennsylvania regiment Jan. 3, 1776, resigning his lucrative civil offices; accompanied Sullivan in the expedition against Quebec; saved the army from capture by his judicious advice after the defeat at Three Rivers; was appointed brigadier-general Aug. 9, 1776; joined Washington Nov., 1776; was detailed to organize the New Jersey militia; rendered valuable service in connection with the battle of Princeton, Jan. 2, 1777, by his advice and by protecting the fords of Assinpink River; was for a short time adjutant general; was appointed major general Feb. 19, 1777; succeeded Gates in command at Philadelphia in March; took command at Ticonderoga Apr. 1; was forced to evacuate that post July 4, thereby incurring unpopularity and retirement from his command, but acted as a volunteer aide at the battle of Brandywine, Sept. 11, 1777; assisted Sullivan in fitting out his expedition against the Six Nations; was acquitted with honor by a court martial in respect to the surrender of Ticonderoga Sept., 1778; was a commissioner to treat with the British at Amboy Mar., 1780; was appointed to the command of La Fayette's corps of light infantry during the latter's absence Aug. 1; was a member of the court-martial on Major André; commanded at West Point from Oct. 1; took a conspicuous part in the suppression of the mutiny in the Pennsylvania line Jan., 1781; distinguished himself in the Southern campaign which terminated at Yorktown, and subsequently in that under Greene; was a member of the Pennsylvania house of censors 1783, of the Continental Congress 1785–87, being its president during most of the latter year; was president for Pennsylvania of the Society of Cincinnati 1783–89; became first governor of the North-western Territory Feb. 1, 1788; made the treaty of Fort Harmer with the Indian tribes 1789; fixed the seat of the supreme court for the Territory Jan., 1790, at a point which he named Cincinnati after the society of which he was an officer; became commander-in-chief of the U. S. army Mar. 4, 1791; made an expedition against the Indians of the Miami and the Wabash, and suffered a severe defeat near the Miami villages Nov. 4, 1791; was vindicated from all blame by a committee of investigation appointed by Congress; resigned the command of the army May 5, 1792; was removed from the post of governor by Jefferson Nov. 22, 1802, when he settled in a log house on the summit of Chestnut Ridge, near Greensburg, Pa., where he passed his remaining years in poverty and fruitless efforts to effect a settlement of claims against the U. S., but receiving small pensions both from the national and State governments. D. near Greensburg Aug. 31, 1818. He published a *Narrative of the Manner in which the Campaign against the Indians in the year 1791 was conducted* (1812), and a *Memoir* by A. T. Goodman was prepared from his papers.

PORTER C. BLISS.

Saint Clair, Lake, a body of water lying between Michigan and Canada. Through St. Clair River it receives the waters of Lake Huron, and its own waters are discharged through Detroit River into Lake Erie. It is 30 miles in length and 24 in maximum and 12 in mean breadth. Area, 360 sq. m. Elevation above the sea-level, 573 feet; above Lake Erie, 3 feet. Its mean depth is 20 feet, but the shoals off the mouth or inlet of St. Clair River, known as the St. Clair Flats, formerly obstructed the navigation of its upper part. This impediment has been removed under direction of the U. S. engineer bureau, upon a plan proposed by Brevet Maj.-Gen. T. J. Cram, U. S. engineers, with appropriations of Congress, by the dredging of a channel through the flats. The canal is 300 feet wide, with parallel dikes 5 feet high formed of the earth taken from the canal, the inside being lined with planks. The banks on either side are 40 feet wide, and are sodded and planted with willows. The depth of the canal, for a central width of 200 feet, is 16 feet.

Saint Clair River, the outlet of Lake Huron, has a total fall of 7 feet in the 33 miles of its course. It is from 40 to 60 feet deep, and flows through a fertile and picturesque region. It is a part of the boundary between Michigan and the province of Ontario.

Saint Clairsville, p.-v., Richland tp., cap. of Belmont co., O., on the National Road, in the midst of a fine agricultural region, has 2 newspapers. P. 1056.

Saint Clairsville, p.-v., St. Clair tp., Bedford co., Pa. P. 144.

Saint Claude, town of France, department of Jura, at the confluence of the Bienne and Tacon, has celebrated paper manufactures and manufactures of fancy articles of horn, bone, ebony, ivory, and tortoise-shell. P. 6316.

Saint Cloud, a small town of France, department of Seine-et-Oise, on the Seine, 6 miles S. W. of Paris, derives its name from St. Clodoald, grandson of Clovis, who founded a monastery here in 551. The place was burned by the English in 1358, and again by the Armagnacs in 1411. In the palace of St. Cloud, built in 1572, Henry III. was assassinated in 1589; and here the *coup d'état* of Nov. 10, 1799, which placed Napoleon Bonaparte at the head of the French government, was effected. The capitulation of Paris in 1815 was signed here, and also the famous decrees of Charles X. in 1830, which caused the second revolution. The duke of Orleans, brother to Louis XIV., made extensive repairs and additions to the royal château at great cost. In 1870 the palace was seriously injured by fire, but many of the valuable works of art were preserved. P. about 5500.

Saint Cloud, p.-v. and tp., cap. of Stearns co., Minn., on St. Paul and Pacific R. R. and on the W. bank of Mississippi River, 75 miles above St. Paul, contains 6 churches, a public library, the State normal school, graded schools, 4 newspapers (1 German), 2 banks, several saw, planing, and flouring mills, 1 foundry, a wagon-factory, nursery, and sash, door, and blind factories. St. Cloud is the leading commercial and manufacturing town of Northern Minnesota. P. of v. 2161; of tp. 582.

W. B. MITCHELL, ED. "JOURNAL."

Saint Colomb′, a suburb of Quebec, Canada, 3 miles up the river, has a large lumber-trade, a convent, an academy, and several schools.

Saint Croix, county of N. W. Wisconsin, on St. Croix River, which separates it from Minnesota, drained by Willow, Apple, Rush, and other rivers, has a rolling surface, mostly covered with pine forests, and is traversed by West Wisconsin and North Wisconsin R. Rs. Staples, wheat, oats, hay, hops, and butter. Cap. Hudson. Area, 750 sq. m. P. 11,035.

Saint Croix Falls, p.-v. and tp., Polk co., Wis., on St. Croix River. P. of v. 288; of tp. 543.

Saint Croix River, a part of the boundary between Maine and New Brunswick, flows from Grand Lake in a general E. S. E. course, and falls into Passamaquoddy Bay. It is navigable to Calais, Me., above which it affords fine water-power. It is 75 miles in length. It is also called the *Schoodic*.

Saint Croix River rises in La Pointe co., Wis., flows S. W. to the Minnesota line; from this point southward, for more than 100 miles, it is the boundary between Wisconsin and Minnesota. It is some 150 miles long, and is navigable 54 miles to the Dalles or Falls of the St. Croix. After passing through the beautiful Lake St. Croix it flows into the Mississippi at Prescott, Wis. At its falls it descends 50 feet in 300 yards. Half a mile below there is a picturesque cañon through which the river flows.

Saint-Cyr, village of France, in the park of Versailles, is noted for the celebrated establishment which Madame de Maintenon founded here in 1686 for the education of 250 daughters of the French nobility. The building was erected by Mansard. In 1793 it was transformed into a military hospital, and in 1806, Napoleon removed the military academy from Fontainebleau to this place.

Saint Denis′, town of France, department of Seine, 6 miles N. of Paris, on the Great Northern Railway, celebrated as the site of the ancient Benedictine abbey, the chosen place of burial of the kings of France. The abbey of St. Denis was founded by Dagobert I. in 613; a church commenced by Pepin, the father of Charlemagne, was completed by the latter and consecrated in 775. This edifice was demolished during the reign of Louis VII., and a more imposing one erected in 1144, the porch and two towers of which yet remain; the rest of the present building was reconstructed by Louis VIII. Up to the Revolution the remains of the kings and princes of France were deposited here. The Convention of 1793 ordered the removal of these bodies, and in 1795 the destruction of the building; the latter decree, however, was not fully carried out. Napoleon I. restored the church, which has been further protected by subsequent governments, and is considered one of the most beautiful specimens of Gothic architecture existing in France. P. 31,993.

Saint Denis, the capital of the French island of Bourbon, of the Mascarene group, is on the north-eastern shore, has a royal college and a botanical garden, and carries on a considerable trade. P. 12,000.

Saint Denis, p.-v., Baltimore co., Md., on the main line and on Washington branch of Baltimore and Ohio R. R. (Washington Junction).

Saint Deroin, p.-v., Nemaha co., Neb., on Missouri River. P. 276.

Saint Die′, town of France, department of Vosges, on the Meurthe, has large breweries, cotton and flax-spinning mills, ironworks, tanneries, and dyeworks, and an extensive trade in corn, cattle, and wood. In the vicinity are several rich iron and copper mines, and much fine marble is quarried. P. 9954.

Saint-Dizier′, town of France, department of Haute-Marne, on the Marne, has several iron-foundries, active shipbuilding, and a trade in iron and timber. P. 8077.

Saint Domingo. See Hayti and San Domingo.

Sainte Agnès, v., Charlevoix co., Quebec, Canada, on Murray Bay River, 9 miles N. W. of Murray Bay, a landing on the N. shore of the St. Lawrence, 90 miles below Quebec. P. of sub-district, 1615.

Sainte Anne, p.-v., Montmorenci co., Quebec, Canada, on the N. side of the St. Lawrence, 22 miles below Quebec. There is a fine waterfall near by. P. of sub-district, 1154.

Sainte Anne de la Pérade, p.-v., Champlain co., Quebec, Canada, on the N. shore of the St. Lawrence, 58 miles above Quebec, and on both sides of the river St. Anne, here crossed by a bridge 1500 feet long. The town has a large church and an active trade. P. about 1000.

Sainte Anne de la Pocatière, p.-v., Kamouraska co., Quebec, Canada, on the S. shore of the St. Lawrence, 8 miles below Quebec, and near Grand Trunk Railway. It has a weekly paper, and is the site of St. Ann's College, a Roman Catholic institution. The town is finely situated. P. of sub-district, 3134.

Sainte Anne du Bout de l'Isle, v., Jacques Cartier co., Canada, at the upper end of Montreal Island. Here is a railroad bridge, a rapid, and a canal. (See Canals of Canada.) Here Thomas Moore composed his Canadian boat-song. The village is on Grand Trunk Railway, 21 miles above Montreal. P. about 1000.

Sainte-Beuve (Charles Augustin), b. at Boulogne Dec. 23, 1804; studied medicine at Paris; entered in 1824 on his literary career as a contributor to the *Globe*; published in 1828 his *Tableau historique et critique de la Poésie française au XVI. Siècle*; removed after 1830 from the *Globe* to the *National* and *Revue des Deux Mondes*; received employment at the Mazarin Library in 1840 after publishing the first volume of his celebrated work, *Port Royal* (5 vols., 1840-60); held various positions under Napoleon III., contributing steadily to the *Moniteur*; was made a senator in 1865. D. at Paris Oct. 13, 1869. The various series of his *Critiques* or *Portraits* or *Galleries* or *Causeries*, comprising over 30 vols., contain some of the finest, most delicate, and most striking delineations of characters from history and literature which have ever been written. Selections have been translated into English: *Portraits of Celebrated Women* (Boston, 1868), *English Portraits* (1875), *Madame des Bordes-Valmore, sa Vie et sa Correspondance* (Boston, 1872). He also wrote 2 vols. of poems and a novel, *Volupté*.

Sainte Croix, p.-v., cap. of Lotbinière co., Quebec, Canada, on the S. shore of the St. Lawrence, 33 miles above Quebec. It has a Roman Catholic academy. P. about 750.

Sainte Croix, or **Santa Cruz,** an island in the West Indies, one of the Lesser Antilles, belongs to Denmark and comprises an area of 100 sq. m., with 25,600 inhabitants. It is very fertile, and produces much sugar and cotton. Chief town, Christianstad.

Sainte Foy, a suburb of Quebec, 5 miles distant, is finely situated and contains many handsome residences. P. of sub-district, 1625.

Sainte Geneviève′, p.-v., cap. of Champlain co., Quebec, Canada, 24 miles N. E. of Three Rivers. P. about 350.

Sainte Genevieve, county of S. E. Missouri, on Mississippi River, drained by Rivière aux Vases, Isle au Bois, and other creeks, has a broad belt of fertile bottom-land along the river, while the remainder of the county is rugged, but abounds in mines of lead, copper, zinc, and iron, and in marble-quarries. Staples, wheat, Indian corn, oats, tobacco, and wool. Cap. Ste. Genevieve. Area, 400 sq. m. P. 8384.

Sainte Genevieve, p.-v. and tp., cap. of Ste. Genevieve co., Mo., on the W. bank of Mississippi River, 65 miles S. of St. Louis, is an important shipping-point for the mineral products of Iron Mountain, glass sand, fruits, and wine, was one of the earliest French settlements in Missouri, and has 3 weekly newspapers. P. of v. 1521; of tp. 3409.

Sainte Julienne′, p.-v., cap. of Montcalm co., Quebec, Canada, 45 miles N. of Montreal. It has a good water-power and large trade. P. about 400.

Sainte Justine′, v. (P. O. Langevin) of Dorchester co., Quebec, Canada, 63 miles S. E. of Quebec, has a spacious monastery of Trappist monks. P. about 150.

Saint Eli′as, Mount, a volcano on the boundary-line between Alaska and British America (lat. 60° 15′ N., lon. 141° W.), the height of which has usually been estimated at from 16,000 to 18,000 feet, but which the trigonometrical observations of Dall show to be 19,000 feet, or several hundred feet higher than any other summit in North America.

Saint El′mo, p.-v., Avena tp., Fayette co., Ill., on St. Louis Vandalia and Terre Haute R. R. P. 273.

Sainte Marguerite. See Lérins.

Sainte Marie′, p.-v., Beauce co., Quebec, Canada, on the river Chaudière, 30 miles S. of Quebec, in a fertile region, has a fine Roman Catholic college, a spacious convent, a good trade, a large number of mills, and ores of copper and manganese. P. about 1000.

Sainte-Marie-aux-Mines [Ger. *Marienkirch*], town of the German empire, province of Alsace, on the Lieprvette, derived formerly its importance from the silver-mines in the vicinity, but these are now nearly exhausted, and the town is mostly engaged in the manufacture of woollen, linen, and cotton fabrics. P. 12,332.

Sainte Martine′, p.-v., cap. of Chateaugay co., Quebec, Canada, 24 miles S. W. of Montreal, has a fine water-power. P. about 700.

Saintes, [illegible] department of Charente Inférieure, [illegible] built place, but it [illegible] Roman remains, numerous breweries, [illegible] potteries, and an active [illegible], and wine. P. 11,[illegible].

Sainte Scholastique', p.-v., cap. of Two Mountains [illegible] Rivière, 25 miles W. N. W. of Montreal. [illegible] convent, and is a place of active [illegible]. P. [illegible].

Sainte Therese de Blainville, p.-v., Terrebonne [illegible], on the N. outlet of Ottawa River, [illegible] N. N. W. of Montreal. It has a large Roman [illegible] and a good trade. P. 914.

Saint-Étienne', town of France, department of [illegible], on the Furens, an affluent of the Loire, is situated in the centre of very rich coal fields, from which 600,000 tons are annually raised, and which have given to the city a most vigorous manufacturing impulse. It arose in an astonishingly short time; it had 49,614 inhabitants in 1851, 92,21[illegible] in 1861, and 110,814 in 1871, and now it is one of the most flourishing manufacturing cities of France. Its two principal branches of manufacture are ribbons and firearms; 20,000 looms, employing about 40,000 persons, are in operation, and produce ribbons to the value of over $10,000,000 annually, which are sent all over the world, and are unsurpassed in beauty of design and colors; 7000 persons are employed in the ironworks, and produce, besides large quantities of cutlery, files, nails, etc., 40,000 stand of arms annually, and are able to turn out 300,000. The appearance of the city is that of a great manufacturing place, where coal-smoke makes the sky and coal dust the rain; yet several portions are spacious and consist of fine edifices. The first railroad of France, the Chemin de fer de St. Étienne à Lyon, was constructed to carry coal to Lyons. (See RAILROADS.)

Saint Eusta'tius, an island of the West Indies, in the Leeward group, 12 miles N. W. of St. Christopher, belongs to the Netherlands, though the language spoken is English. Area, 8 sq. m. P. 2200. At the close of the eighteenth century it was often mentioned as the centre of a contraband trade, and in 1780 its population was estimated at 25,000. It is now of no importance.

Saint-Évremond. See ÉVREMOND.

Saint Ferdinand, tp., St. Louis co., Mo. P. 7214.

Saint Feréol, a beautiful village of Montmorenci co., Quebec, Canada, on the N. shore of the St. Lawrence, 30 miles below Quebec. Here are seven or eight waterfalls, whose beauty attracts many summer visitors. P. 991.

Saint-Flour, town of France, department of Cantal, on the Auzon, has manufactures of pottery and glue, which enjoy a high reputation. P. 5786.

Saint Fran'cis, county of E. Arkansas, on St. Francis and L'Anguille rivers, traversed by Memphis and Little Rock R. R. Staples, Indian corn, cotton, and sweet potatoes. Swine are numerous. Cap. Forrest City. Area, 625 sq. m. P. 6714.

Saint Francis, tp., Saint Francis co., Ark. P. 513.

Saint Francis, tp., Greene co., Ark. P. 970.

Saint Francis, tp., Phillips co., Ark. P. 5061.

Saint Francis, tp., Effingham co., Ill. P. 509.

Saint Francis, p.-v. and tp., Anoka co., Minn. P. 166.

Saint Francis, tp., Butler co., Mo. P. 246.

Saint Francis, tp., Madison co., Mo. P. 386.

Saint Francis, a river of Missouri and Arkansas, between which States it partially forms the boundary, rises in the Iron Mountain district of S. W. Missouri, and flows S. W. 450 miles, entering the Mississippi near Helena, Ark., is navigable 150 miles, passes through a continuous swamp after entering Arkansas, and spreads into numerous lakes, one of which, 50 miles long by 20 wide, is supposed to have been produced by a sinking of the soil at the time of the great earthquake of 1811.

Saint Francis Plantation, tp., Aroostook co., Me. P. 2[illegible].

Saint Fran'cisville, p.-v., Denison tp., Lawrence co., Ill., on Wabash River. P. 131.

Saint Francisville, p.-v., cap. of W. Feliciana parish, La., near Bayou Sara, on the E. bank of Mississippi River and on Feliciana and Woodville R. R., is a shipping centre for cotton, and has 1 weekly newspaper.

Saint Francisville, p.-v., Clarke co., Mo., on Des Moines River. P. 408.

Saint François', county of S. E. Missouri, on the sources of St. Francis River, has a mountainous surface, including a portion of the Iron Mountain, is traversed by St. Louis and Columbus and St. Louis and Texas divisions of St. Louis and Iron Mountain R. R., has extensive ironworks, and raises large numbers of sheep and swine. Cap. Farmington. Area, 350 sq. m. P. 9742.

Saint François, tp., St. François co., Mo. P. 1614.

Saint François, tp., Wayne co., Mo. P. 1755.

Saint François du Lac, p.-v., cap. of Yamaska co., Quebec, Canada, on the river St. Francis, near its mouth in Lake St. Peter, 60 miles below Montreal. It has a large trade and many barges are built here. P. about 800.

Saint Gall, canton of Switzerland, bounded E. by the Rhine and N. by the Lake of Constance. Area, 749 sq. m. Pop. 191,015, of whom 116,060 are Roman Catholics and 74,573 Protestants. The surface exhibits a thoroughly alpine character—mountains covered with forests, pastures, and snow and ice, and valleys studded with vineyards, orchards, and corn-fields. Agriculture, dairy-farming, and wine cultivation are the principal branches of industry.

Saint Gall, town of Switzerland, capital of the canton of St. Gall, on the Steinach, in a valley at an elevation of 2152 feet. It was formerly fortified, but its walls and ramparts have been transformed into promenades. It has a fine cathedral, many good educational institutions, 2 large public libraries, and extensive manufactures of woollen, linen, and cotton fabrics, especially fine muslins and printed calicoes. P. 16,676.

Saint Gaudens', town of France, department of Haute-Garonne, on the Garonne, has manufactures of porcelain, faïence, tiles, leather, and paper, and a trade in agricultural products. P. 5183.

Saint George, port of entry of Charlotte co., N. B., on Passamaquoddy Bay, at the mouth of the river Magaguadavic, which affords water-power and brings down abundance of timber. The town has a large lumber-trade, a custom-house, 3 gang saw-mills, 4 churches, beautiful residences, and several public buildings. P. about 600.

Saint George, v. and hundred, Newcastle co., Del., on Chesapeake and Delaware Canal. P. of v. 265; of hundred, 5075.

Saint George, p.-v. and tp., Pottawattamie co., Kan., on Kansas Pacific R. R. P. of v. 118; of tp. 435.

Saint George, p.-v. and tp., Knox co., Me., on Atlantic Ocean, at the mouth of Penobscot Bay. P. 2318.

Saint George, tp., Benton co., Minn. P. 317.

Saint George, city, cap. of Washington co., Ut., on Utah Southern R. R., 350 miles S. W. of Salt Lake City, contains a handsome tabernacle, a public-hall, 4 school-houses, a large establishment for making wine and canning fruit, a court-house, a temple of magnificent structure and proportions, and 1 newspaper. St. George produces many rare and delicious fruits, domestic and exotic. There are ten extinct volcanoes in the neighborhood, and this whole region is rich in mineral deposits. P. 1142.

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Saint George, p.-v. and tp., Chittenden co., Vt. P. 111.

Saint George, p.-v., cap. of Tucker co., West Va., on Cheat River. P. 864.

Saint George's Channel, connecting the Irish Sea with the Atlantic and separating Ireland from Wales, is 100 miles long and 65 miles broad.

Saint George's Parish, tp., Colleton co., S. C., on South Carolina R. R. P. 3993.

Saint-Germain-en-Laye, or simply **Saint-Germain**, town of France, department of Seine-et-Oise, on the left bank of the Seine, on the outskirts of the forest of St.-Germain, which comprises 10,873 acres. The magnificent palace is now used for barracks. P. 22,862.

Saint Ger'mans (EDWARD GRANVILLE **Eliot**), LL.D., EARL OF, b. in England Aug. 29, 1798; educated at Christ Church, Oxford; served for several years in various European capitals as attaché and secretary of legation; entered Parliament as a Liberal 1823; was a lord of the treasury 1827–30; was envoy to Spain 1834–35; chief secretary for Ireland 1841–45; became privy councillor 1841; succeeded to the earldom on the death of his father Jan. 19, 1845; became postmaster-general 1846; was lord lieutenant of Ireland 1852–55, lord steward of the household 1857–58, and again 1859–65, and attended the prince of Wales in his tour in the U. S. 1860.

Saint Gervais', p.-v., Bellechasse co., Quebec, Canada, 21 miles S. E. of Quebec. It has a convent and a good trade. P. about 850.

Saint Gilles, town of France, department of Gard, trades much in wine and brandy. P. 6365.

Saint Gothard', Tun'nel of. From remote ages until a very recent period most of the travel and a very large

proportion of the transport of merchandise between Italy, including her seaports on the one hand, and Switzerland, North-eastern France, Central and Western Germany, and Northern Europe on the other, were conveyed over Alpine passes having their northern terminus in Switzerland. After the construction of the three great carriage-roads—the Simplon in 1806, the Splügen in 1818, and the St. Gothard in 1830—these routes monopolized most of the transit, though the Stelvio, the Brenner, and other less conspicuous passes, and especially that of Mont Cenis, maintained an active competition with the Swiss highways. The completion of the Brenner railway from Innspruck to Verona (1867), and the opening of the Fréjus (or Mont Cenis) tunnel (1870), at once intercepted a great proportion of this important communication; and the construction of a new, direct, and independent railway route across the Alps was felt to be a matter of vital necessity to Northern Italy and Switzerland, as well as of great interest to the Rhine provinces, and indeed to all the western and central German states. A line following substantially the course of the Simplon road was at first the favored project, and, being sustained by French influence, if not by French capital, the construction was put under contract, and the grading nearly finished to the northern foot of the Alps at Brieg, and the southern at Domo d'Ossola. But it was soon seen that the importance of this route was local and not national, and that, as on the Swiss slope it was necessarily confined to the valley of the upper Rhone, and must debouch on the frontier Lake of Geneva, it would, like the Mont Cenis route, be directly tributary to French interests, and serve rather to divert traffic from Central Switzerland and Germany than to conduct it to them; and consequently the works were suspended, and the project, for the time at least, abandoned. The choice now lay between the Splügen and the St. Gothard routes, though the Lukmanier, the Septimer, and some other minor passes had their advocates. It was said that the Splügen route required a tunnel of but 4 miles in length; that the other technical difficulties were much less considerable than upon the St. Gothard line; that at the N. it might communicate directly with the Lake of Constance, and by the basin of the Lake of Wallenstadt with the Lake of Zurich, and thus furnish an eligible channel of transit to North-eastern Switzerland and Germany, while its southern junction with the Italian lines would be not less advantageous than that of the rival route. But an objection corresponding to that which had proved fatal to the Simplon route was urged with decisive effect against the Splügen—the fact, namely, that it must pass down the valley of the upper Rhine, and of course along the Austrian frontier, and accordingly, like the Simplon, be liable to interruption and control by a hostile force in case of European complications which should disturb the neutrality of Switzerland.

The St. Gothard line, on the contrary, would commence on the Lake of Lucerne in the very heart of the confederacy, pass entirely on Swiss soil, far removed from the eastern and western frontiers, to Lago Maggiore and to the Lake of Lugano, and there easily connect with the Italian lines, and especially with the port of Genoa. The only serious objection was the unavoidable necessity of a tunnel more than 9 miles in length, which of course would involve both a great expenditure and a long delay in the completion of the route. This objection was, however, overruled, the St. Gothard route adopted, and Oct. 15, 1869, a treaty was concluded between Italy and Switzerland, by which the principal points relative to route, construction, and connections were determined, and on Oct. 28, 1871, the German empire adhered to the treaty. The convention stipulated that the summit-level of the line—which naturally falls within the tunnel—should not be at a greater height than 1162½ mètres above the sea, and that the tunnel should follow a straight line between Airolo and Göschenen; the shortest radius of the curves was fixed at 300 mètres; the maximum of the grades not to exceed 25 : 1000 (or 132 feet to the mile), except for a short distance near Biasca, where, in case of necessity, 26 : 1000 might be allowed. The three contracting powers were to contribute to the enterprise 85,000,000 francs, in the proportion of 45,000,000 by Italy, 20,000,000 by Switzerland, and 20,000,000 by Germany. This convention was adopted as a basis at a conference in which the great Italian and Swiss railways and various Italian and Swiss local jurisdictions were represented, and a company formed in accordance having been incorporated and organized, proposals for construction were at once invited. This company is charged with the construction and operation of the line from the Lake of Lucerne to the Lago Maggiore and the Lake of Lugano only, the connecting lines being otherwise provided for.

On Aug. 7, 1872, a contract was concluded between the company and M. Louis Favre of Geneva for the perforation of the tunnel by him within eight years from the acceptance of the contract by the Swiss government, at fixed rates per mètre lineal measure, amounting altogether to 48,500,000 francs, with a large premium in case of completion of the works in a shorter time, and a heavy penalty in case of delay. The contract-price covers all expenses, whether direct or accessory, including revêtement where necessary, estimated at about half the length of the tunnel, and all risks and contingencies from whatever cause arising. The length of the tunnel is 14,900 mètres, or 16,295 yards, equal to rather more than 9¼ miles. Its cross-section is the same as that of the Fréjus tunnel (see Fréjus), and the same technical methods of excavation are followed; but the contractor has the advantage of employing the most improved machinery from the beginning, and of using dynamite and other explosives not known until the work on the Fréjus tunnel was far advanced. Besides this, the slopes of the overlying mountain are not so steep as to prevent the sinking of a considerable number of shafts, if necessary, though it has not been found expedient to resort to them.

The line of the tunnel leaves the St. Gothard carriage-road to the left at Airolo, and running about 5° W. of N. passes under the Kastelhorn, 2977 mètres high, the St. Anna glacier, the village of Andermatt, the river Reuss about at the Devil's Bridge, and comes out at Göschenen, at the level of that village and the carriage-road. At the southern end is a curve of junction 145 mètres in length, but, as in the case of the Fréjus tunnel, a straight gallery is excavated through the mountain from terminus to terminus. The station at Airolo is 1145 mètres above the sea. From this point the grade ascends, at the rate of $\frac{1}{1000}$th, 7400 mètres; then follows the summit-level of 180 mètres at the height of 1152.4 mètres, or 10 mètres lower than the highest limit allowed by the convention; then a descending grade of 5.82 : 1000, 7457 mètres, to the northern terminus at the station of Göschenen, 1109 mètres above the sea.

Yearly, quarterly, and monthly reports are published by the board of direction, furnishing the fullest information upon all points of interest connected with the execution of this great work. The most improved drilling machinery has been employed from the beginning. The work has been frequently impeded by the caving in of the rock and by the irruption of water from fissures in the strata. On Jan. 31, 1876, the heading, including both ends of the tunnel, had been carried 18,238½ feet, but the enlargement of the excavation had not kept pace with the progress of the heading. The St. Gothard Railway will form the shortest line of transit between the valley of the Rhine and the Mediterranean; and when we consider the geographical relations of the countries it serves to connect, and the vast political, military, and commercial interests which will be affected by it, we may safely characterize it as the great artery of European international life and circulation, and as the most important work of material improvement yet projected on that continent. The perforation of the tunnel was completed Feb. 29, 1880, but it was not then ready for use. George P. Marsh.

Saint Grégoire′, p.-v., Nicolet co., Quebec, Canada, on the St. Lawrence River, 6 miles above Three Rivers, has a large academy and a good trade. P. about 600.

Saint Hel′en, p.-v., cap. of Columbia co., Oregon, on Columbia River.

Saint Hele′na, an island of the British empire, in South Atlantic Ocean, lat. 15° 55′ S. and lon. 5° 44′ W. It is 10½ miles long and 6½ broad, enclosing an area of 47 sq. m., with a pop. in 1871 of 6241. St. Helena was discovered by Juan de Nova Castella, the Portuguese navigator, on May 21, 1501 (St. Helena's Day), but continued unknown to other nations until 1588, when it was observed by Capt. Cavendish. It remained uninhabited until the Dutch took possession of it. In 1673 it was taken from the Dutch by England, and soon after the East India Company was granted a charter by Charles II. for its possession. It has now reverted to the British crown. The only good inlet is St. James's Bay, on the N. W. of the island, possessing a good harbor, where the chief town (Jamestown) is built. Though 800 miles from the nearest land, Isle of Ascension, and 1400 miles from the nearest point of the African continent, it is one of the best known of all the solitary islands of the world, as being the place of exile and death of Napoleon Bonaparte, and because of its importance as a stopping-place for provisions and water for ships engaged in the European and East India trade.

Saint Helena, parish of E. Louisiana, between Tangiparoa and Amite rivers, has a rolling surface and a fertile soil. Staples, Indian corn, cotton, sweet potatoes, and wool. Cap. Greensburg. Area, 450 sq. m. P. 5423.

Saint Helena, p.-v., Napa co., Cal., on California Pacific R. R.

Saint Helena, [illegible] tp., cap. of Cedar co., Neb., on M[illegible] P. [illegible]

Saint Helena, [illegible] co., S. C. P. 6152.

Saint Helen's, [illegible] England, county of Lancas[illegible] [illegible] and filthy, but has extensive [illegible] copper ware, leather, and vine[illegible] [illegible]

Saint Helier's, [illegible] of the island of Jersey, on its [illegible] harbor, is fortified and defended [illegible] and carries on an extensive trade. P. [illegible]

Saint Hilaire', de (Auguste), b. at Orleans, France, [illegible] became auditor to the council of state at [illegible] accompanied the duke of Luxembourg in his voy[illegible] Brazil, spent there six years in botanical researches, [illegible] more especially the southern province and the [illegible] on the left bank of the Paraguay, and published on his return several works on the natural history of Brazil, the most important being *Flora Brasiliæ Meridionalis* (3 vols., 1825–32). He became a member of the Institute, and d. at Orleans Sept. 30, 1853.

Saint-Hilaire', de (Marco), the pseudonym of Émile Marc Hilaire, b. about 1790; was educated as a page at the court of Napoleon I., but, left without any employment after the Restoration, took up literature merely as a means of living, writing biographies of the duke of Berri and the courtesans of the Palais Royal, and commenced after 1830 to publish his books on Napoleon I., which were actually devoured: *Mémoires d'un Page de la Cour impériale* (2 vols., 1830), *Les Petits Appartements des Tuileries, de Saint Cloud et de la Malmaison* (2 vols., 1831), *Souvenirs de la Vie privée de Napoléon* (2 vols., 1838), *Souvenirs intimes du Temps de l'Empire* (6 vols., 1838–40), and many more, none of which has any historical value. One of his later works was a *Histoire de Napoléon III.* (1853).

Saint-Hilaire, Geoffroy. See Geoffroy St.-Hilaire.

Saint-Hilaire (Jules). See Barthélemy St.-Hilaire.

Saint Hy'acinthe, county of Quebec, Canada, bounded W. by the river Richelieu, and traversed by Grand Trunk Railway, Quebec division. Cap. St. Hyacinthe. P. 18,310.

Saint Hyacinthe, city, cap. of St. Hyacinthe co., Quebec, Canada, on Grand Trunk Railway and the navigable Yamaska and Black rivers, 35 miles E. N. E. of Montreal. It contains a Roman Catholic college and seminary, a hospital, and an academy, 4 large bridges, 3 convents, and numerous manufactories. Among the fine buildings are the college, bishop's palace, city hall, and market. The town has a lively trade by rail and some by steamer. There are 1 tri weekly and 3 weekly newspapers. There are three municipalities—the city proper, p. 3746; the parish of St. Hyacinthe, p. 2581; and St. Hyacinthe le Confesseur, p. 788.

Saint Ignace', tp., Mackinac co., Mich., on the N. side of the Straits of Mackinaw, opposite Mackinaw City, was the seat of an early Jesuit mission, where Father Marquette resided for some years, and which was the rendezvous of many exploring expeditions. P. 405.

Saintine', the pseudonym of Joseph Xavier Boniface, b. at Paris July 10, 1798; published a volume of poems in 1823, which was well received; became one of the most prolific writers for the stage, producing, alone or in connection with Scribe, Duvert, Masson, and others, about 200 plays, and published in 1836 his celebrated sketch *Picciola*, which ran through 40 editions, was translated into all European languages, and received the Montyon prize from the Academy. Another of his numerous sketches, a novel, *Seul* (1857), made a great sensation and was translated into English (*The Solitary of Juan Fernandez, or the Real Robinson Crusoe*, Boston, 1851), also his *Queens of the Druids* (1861), and *Myths of the Rhine* (1874) illustrated by Gustave Doré. D. at Paris Jan. 21, 1865.

Saint In'igoes, p.-v. and tp., St. Mary's co., Md., forming the peninsula between Potomac River and Chesapeake Bay. P. 1897.

Saint Ives, town of England, county of Cornwall, has a good harbor on St. Ives Bay, a large pilchard fishery, and an active trade in copper, tin, and slate. P. 7007.

Saint James, parish of S. E. Louisiana, bounded on the N. E. by Lake Maurepas, and on the S. E. by Lake des Allemands, and intersected by Mississippi River, has a level surface and an alluvial fertile soil, and is intersected by New Orleans Mobile and Texas R. R. Staples, sugar, molasses, cotton, and rice. Cap. Convent. Area, 358 sq. m. P. 10,152.

Saint James, p.-v., St. James parish, La., on the W. bank of the Mississippi River.

Saint James, p.-v., cap. of Manitou co., Mich., on Great Beaver Island in Lake Michigan, was formerly inhabited by a number of Mormons who had seceded from the main body of the sect.

Saint James, p.-v. and tp., Watonwan co., Minn., on St. Paul and Sioux City R. R. P. 141.

Saint James, tp., Mississippi co., Mo. P. 505.

Saint James, p.-v. and tp., Phelps co., Mo., on Atlantic and Pacific R. R. P. 1531.

Saint James, p.-v. and tp., Cedar co., Neb. P. 327.

Saint James, tp., Charleston co., S. C., on Goose Creek. P. 7795.

Saint James, tp., Charleston co., S. C., on Santee River. P. 2657.

Saint James, tp., Clarendon co., S. C. P. 640.

Saint Jean Baptiste', a thriving suburb of Montreal (which see), Hochelaga co., Quebec, Canada. It is connected by street railway with the city, 1 mile distant. P. 4408.

Saint-Jean d'Acre. See Acre.

Saint Jean d'Angély', town of France, department of Charente Inférieure, on the Boutonne, manufactures serge, gunpowder, and brandy, and has 6413 inhabitants.

Saint Jean Molenbeck', town of Belgium, province of Brabant, on the Senne, has iron foundries and manufactures of soap and carpets. P. 22,712.

Saint Jérôme', p.-v., cap. of Terrebonne co., Quebec, Canada, 33 miles N. W. of Montreal. It has a fine water-power, a large woollen-mill, and other manufactories. P. 1159.

Saint John, county of New Brunswick, consisting of a narrow strip extending along the N. W. shore of the Bay of Fundy. It is generally very fertile and well cultivated, and is traversed by the railways centring at St. John, the capital. P., including the city of St. John, 52,303.

Saint John, city and seaport, cap. of St. John co., New Brunswick, Canada, on a harbor of the same name in the Bay of Fundy, at the mouth of St. John River, 54 miles S. E. of Fredericton, is very regularly and handsomely laid out, some of the streets being cut through solid rock to a depth of 30 feet; is divided by a projecting rock into an upper and lower town; has several fine public edifices, including the Carleton city hall, the court-house, opera-house, academy of music, city and marine hospitals, provincial lunatic asylum, market-house, post-office, Roman Catholic cathedral, and the Dominion penitentiary, a mile outside the city; is well supplied with water from Little River; has one of the finest harbors on the Atlantic coast, always free from ice; has a fine breakwater and a magnificent lighthouse on Partridge Island, with average annual entrance of above 1100 vessels, having an average of about 400,000 tons, the annual value of imports being about $8,000,000 and of exports $4,000,000; is connected with Fredericton and with Bangor, Me., by European and North American, and with Halifax, N. S., by Intercolonial R. R.; is connected by lines of steamers with Fredericton, Annapolis, N. S., Portland, Me., and other ports on the eastern coast; receives by St. John River, and exports large quantities of lumber to the U. S. and West Indies; has extensive shipyards, where 50 to 60 ships are annually built; has important manufactures, especially of ironware, furniture, carriages, boots and shoes, paper, cotton goods, rope, and hats; has sea-fisheries of considerable value, 9 or 10 banks, public or private, 31 churches, 4 daily and 9 weekly newspapers, 3 orphan asylums, several commodious hotels, an abundance of public and private academies and schools, an historical and a scientific society, an efficient fire department, a municipal government by a mayor, 9 councilmen, and 9 aldermen, representing the same number of wards, and is connected by street cars with the large town of Portland (p. 1871, 12,520), which is practically a suburb, and with Carleton, a portion of the city situated on the W. side of the river, which enters the harbor through a rocky gorge only 160 yards wide, spanned by a magnificent suspension bridge 100 feet high. The river has at this point a fall at low tide of 12 feet, but as the tides in the harbor rise from 17 to 20 feet, the waters of the river and those of the harbor are alternately higher, and are twice each day at the same height for a few minutes, at which time vessels pass the falls with entire ease. Saint John was settled at the close of the American Revolution by loyalists, chiefly from the New England States, and received a city charter 1785. P. in 1861, 28,805; in 1875 (including Portland and other suburbs), about 50,000. Loss by the great fire, June 20, 1877, about $10,000,000.

Saint John, p.-v., Duquoin tp., Perry co., Ill., on Illinois Central R. R. P. 356.

Saint John, p.-v. and tp., Lake co., Ind. P. 1442.

Saint John, tp., Harrison co., Ia. P. 1507.

Saint John, tp., New Madrid co., Mo. P. 403.

Saint John, tp., Hertford co., N. C. P. 2016.

Saint John (BAYLE), son of James A., b. in London, England, Aug. 9, 1822; educated as an artist; resided or travelled for several years in the East and in Africa; wrote at an early age for London periodicals, and was author of *Adventures in the Libyan Desert* (1849), *Two Years' Residence in a Levantine Family* (1850), *Village Life in Egypt* (1852), *The Turks in Europe* (1853), *The Subalpine Kingdom, or Experiences and Studies in Savoy, Piedmont, and Genoa* (1856), containing some curious documents on Rousseau; *Legends of the Christian East* (1856), *Montaigne the Essayist, a Biography* (1857), and an abridged translation of the *Memoirs of the Duke of Saint Simon* (4 vols., 1857). He wrote for many London periodicals, and was foreign editor of a daily paper at the time of his death, at London Aug. 1, 1859.

Saint John (HENRY). See BOLINGBROKE.

Saint John (HORACE ROSCOE), son of James A., b. in Normandy, France, July 6, 1832; was educated under the direction of his father; studied Oriental literature; published a *Life of Columbus* (1850), *History of British Conquests in India* (1852), *History and State of the Indian Archipelago* (2 vols., 1853), and has been for many years a leader-writer and special correspondent for the London daily press. He married a daughter of Thomas Roscoe, a lady who has published *Lives* of Audubon (1856) and of Masaniello (1865), and an essay entitled *Englishwomen and the Age* (1860).

Saint John (JAMES AUGUSTUS), b. in Caermarthenshire, Wales, Sept. 24, 1801; educated at the village school, and by the aid of a neighboring clergyman acquired a good knowledge of languages, ancient and modern, including Arabic and Persian; was at an early age engaged by Mr. J. S. Buckingham as sub-editor of the *Oriental Herald*; started the *London Weekly Review* 1827; settled in Normandy 1829; travelled in Norway the same year; visited Egypt and Nubia with his family, ascending the Nile to the second cataract in a vessel chartered for the purpose; made several interesting discoveries in physical geography and archæology, including that of the site of the tomb of Osiris on the Sacred Isle; explored Lake Mœris; followed the (supposed) track of the Israelites through the Desert of Sinai; returned to England by way of Malta, Sicily, and Naples; gave an account of this journey in his *Egypt and Mohammed Ali* (1834), *Description of Egypt and Nubia* (1844), and *Isis, an Egyptian Pilgrimage* (1853); wrote at Chantilly, France, an elaborate work, *The Hellenes, or the Manners and Customs of Ancient Greece* (3 vols., 1842), in which he was assisted by his son Bayle; became nearly blind while so occupied, but subsequently partially recovered his sight; published *The Nemesis of Power* (1854), the *History of the Four Conquests of England* (2 vols., 1862), a *Life of Sir Walter Raleigh* (2 vols., 1868); several novels, including *Tales of the Ramadhan* (1835), *Margaret Ravenscroft, or Second Love* (1835), *Sir Cosmo Digby* (1844), *The Ring and the Veil* (1856), and *Weighed in the Balance* (1864); two religious treatises, *Philosophy at the Foot of the Cross* (1854) and *The Preaching of Christ, its Nature and Consequences* (1855); a biography of *Louis Napoleon, Emperor of the French* (1857); a treatise on *The Education of the People* (1858); and has edited Sir Thomas Browne's *Religio Medici* and *Hydriotaphia*, Lady Mary Wortley Montagu's *Letters from the Levant*, Bunyan's *Pilgrim's Progress*, Locke's *Philosophical Works*, Sir Thomas More's *Utopia*, Bacon's *Atlantis*, and the *Prose Works* of Milton (3 vols., 1848), the latter in Bohn's *Standard Library*.

Saint John (OLIVER), b. at Stanton, Oxfordshire, England, about 1598; studied at Queen's College, Cambridge, and at Lincoln's Inn; was called to the bar 1626; married in 1629 a lady who was nearly related both to Hampden and to Cromwell; was prosecuted by the Star Chamber 1630; was one of the counsel for Hampden in the great ship-money trial, Nov., 1637, and obtained a great reputation by his argument on that occasion; married as his second wife Elizabeth Cromwell, cousin of Oliver, Jan. 21, 1638; was elected to the Short and the Long Parliaments 1640; became solicitor-general Jan. 29, 1641, a commissioner of the great seal Nov., 1643; was one of the Parliamentary commissioners appointed to treat for peace at Uxbridge Jan., 1645; became lord chief-justice of the common pleas Nov. 22, 1648; took no part in the trial of Charles I., which he probably disapproved; was a joint ambassador to the Netherlands Mar., 1651, commissioner for the affairs of Scotland in October, and a member of the council of state in November of the same year; became afterward chancellor of the University of Cambridge; was opposed to the later policy of the Protector, but retained his office under both Oliver and Richard Cromwell; was a member of the Rump Parliament; narrowly escaped proscription at the Restoration, and lived on the Continent for some years under an assumed name. D. Dec. 31, 1673, whether in England or abroad is uncertain. He was the author of the famous "Navigation act," the chief promoter of the drainage of the "Bedford Level," and ancestor of the earls of Bolingbroke.

Saint John (PERCY BOLINGBROKE), eldest son of James A., b. at Plymouth, England, Mar. 4, 1821; accompanied his father in his Eastern travels while a boy, and early devoted himself to literature, aiding his father in the preparation of some of his works; made a tour through the U. S., Texas, and Mexico about 1840; wrote sketches of his travels and numerous Indian tales, usually first published in *Chambers's Journal*; lectured on Texas and Mexico; became Paris correspondent of the *North British Daily Mail* 1847; was a witness of the French revolution of Feb., 1848; wrote the *Book of the War* (1853), for which he received the thanks of the Greek Parliament; has written many novels and been a contributor to many magazines and literary periodicals, especially Cassell's *Illustrated Family Paper* and the *London Journal*. Among his best known books are *The Young Naturalist's Book of Birds* (1844), *The Trapper's Bride* (1845), *Three Days of the French Revolution* (1848), *Paul Peabody*, *Countess Miranda* (1861), *Arctic Crusoe* (1854), *Quadroona* (1861), *The Creole Bride* (1864), *The Snow Ship* (1865), and *Good as Gold* (1870).

Saint John (SPENSER), son of James A., b. in London Dec. 22, 1826; received a good education; devoted himself to Oriental literature; became proficient in the Malay language; was appointed secretary to Sir James Brooke, rajah of Sarawak (Borneo), in 1848; was secretary to Brooke's mission to Siam 1850; was acting British commissioner and consul-general in Borneo 1851–55; was full consul-general 1855–62; published *Life in the Forests of the Far East, comprising Explorations of the Interior of Borneo, Sarawak, etc., with Illustrations* (2 vols., 1862); went to Hayti as chargé d'affaires 1863, and visited Spain in 1866 with his father, whom he assisted at Simancas in researches preparatory to the publication of the latter's *Life of Sir Walter Raleigh*. He was afterward appointed minister-resident and consul-general in Peru.

Saint John of Jerusalem, The Order of the Knights Hospitallers of, also called the **Order of the Knights of Rhodes** or **Malta,** originated at the close of the eleventh century; its first constitution was confirmed by Pope Paschal II. in 1113, its second and final by Pope Calixtus II. in 1120. In 1048 some merchants from Amalfi founded a hospital and hostelry for pilgrims in Jerusalem, and a confraternity of pilgrims took charge of the establishment, which subsequently increased much and was largely endowed. During the siege and capture of Jerusalem by the crusaders in 1099 this confraternity, under the direction of Pierre Gérard, excited general admiration by the heroism with which it administered help to all who suffered. Godfrey of Bouillon gave it a large endowment, and several knights joined it as Hospitallers. The confraternity was then organized as a monastic order with philanthropic purposes, and the members assumed the black Augustinian garment with a white cross. After Gérard's death in 1118, Raymond du Puy succeeded as provost of the order, and he immediately undertook a reorganization of the whole institution on a military basis, adding the defence of Christianity and war against the infidels as the new and the principal purpose of the order. Many celebrated knights now joined it, great endowments were conferred on it from all Christian countries, brilliant exploits were achieved by it, and in a short time it rose to be one of the richest and most famous of the Christian orders. Soon, however, it also began to exhibit the same signs of greed, intrigue, jealousy, and dissipation which characterized the other orders, and its embroilments with the Templars caused much scandal. After the conquest of the Holy Land by the Saracens the knights removed in 1291 to Limisso in Cyprus, and hence in 1309 to Rhodes. Their life here was one perpetual war against the Turks, and in 1479, while D'Aubusson was grand master, they repelled Mohammed II., who besieged them in the city of Rhodes with a force far superior to their own. Nevertheless, in spite of many brilliant exploits, they were compelled to surrender Rhodes to Solyman II. in 1522, and at the same time they lost by the introduction of the Reformation many of their possessions in England, Germany, and the Scandinavian countries. In 1530, Charles V. gave them the

[illegible] Malta [illegible] II. attacked them in [illegible] under the grand master La[illegible] resistance, and, to the [illegible] all Europe, they finally [illegible]. Soon after, however, the [illegible] significance—less, perhaps, on [illegible] own than because the advancing [illegible] no more use for such an institution. [illegible] the knights lost their large posses[illegible]. In 1798, on his way to Egypt, Napoleon [illegible] Malta, and the English, who conquered [illegible], refused to reinstate them. In vain the [illegible], **Hompesch, resigned his dignity and** [illegible] to Paul, emperor of Russia. The pope would [illegible] a man belonging to the Greek Church as [illegible] master, and appointed some obscure Italian to the [illegible]. The exertions which the members made to re[illegible] the institution by the aid of the Congress of Vienna were in vain, and since 1798 the order has existed only nominally.

Saint John River, of Maine and New Brunswick, rises on the boundary of Somerset co., Me., and Dorchester co., Quebec, near the head of the Penobscot. It is for nearly 40 miles the boundary between the U. S. and Canada. It then traverses for 112 miles the wilds of Northern Maine, and is known as the Walloostook or Main St. John. Some 150 miles below its origin it joins with the St. Francis, and changes its north easterly to a more easterly course. Below the mouth of the St. Francis it is the N. boundary of Maine for about 75 miles. Below this part of its course **it is wholly in Canadian territory; shortly after entering** which its Grand Falls occur, 225 miles above its mouth. The river here falls 75 feet perpendicularly. From its mouth at St. John, N. B., it is navigable by large steamers for 80 miles to Fredericton, and at high water to Woodstock, 145 miles, and by small steamboats, at good stages of water, even as high as the Grand Falls, above which it is again navigable some 40 miles. At its mouth a singular phenomenon occurs. The water, here compressed into a narrow channel, falls at low tide some 12 feet in order to reach the harbor, but at high tide the level of the harbor is from five to eight feet the higher. Vessels can consequently pass from the river to the harbor, or from the harbor to the river, only at the turn of the tide. The total length of the river is 450 miles. Its drainage-area is 26,075 sq. m. Its navigation is free to U. S. citizens by the Ashburton Treaty.

Saint John's, capital of Newfoundland, on the E. coast of the peninsula of Avalon, about 65 miles N. of Cape Race, and 18 miles S. of Cape St. Francis. It contains a population of 30,000 inhabitants. Its position is lat. 47° 33′ 29″ N., lon. 52° 45′ 10″ W. The entrance to the harbor of St. John's is called the Narrows, which at the sea-surface is 360 fathoms across, and at its narrowest part, between Chain Rock and Pancake Rock, is only 220 yards. On the N. side of the Narrows is a precipitous cliff of sandstone and slate rock 300 feet high, above which is Signal Hill, 510 feet above the sea-level. On the S. side a hill or mountain rises abruptly to the height of 650 feet, having a sort of shoulder near the water, on which is erected a lighthouse called Fort Amherst. Inside the Narrows the harbor expands and trends toward the S. W. It is spacious and secure, has 90 feet of water in the centre, and is accessible for the largest vessels at all periods of the tide. The city is built on the N. side of the harbor, on a moderately steep incline which affords an admirable site. The **principal street is Water street, running parallel to the N.** side of the harbor, somewhat more than a mile in length, **containing well-constructed houses and large and sub**stantial stores; excellent wharves jut into the water, and vessels of large tonnage can at all times safely moor at them. The houses and stores in Water street are built of brick or stone, a law to that effect having been passed after the disastrous fire of 1846, by which the greater part of the city was destroyed. The houses in the other streets are, for the most part, built of wood. The Roman Catholic cathedral stands on the highest point of the declivity which forms the site of the city, this summit being 225 feet above the level of the sea. Opposite the city, at the S. side of the harbor, a lofty ridge of precipitous hills, 700 feet high, rises abruptly from the water's edge, and stretches for some miles into the interior. A small space at the base of these hills has been made available for building, and here the merchants have erected warehouses and large vats for the manufacture and storing of seal oil.

The approach to the harbor is well lit by Cape Spear and Fort Amherst lights, and vessels entering the harbor are guided through the Narrows by the following arrangement. Two red lights are exhibited every night from sunset to sunrise, intended as leading marks for vessels entering the Narrows—the lower light on the roof of the custom-house, the other 400 yards in rear, on a white post 180 feet above the sea. These lights will be readily distinguished from any other lights in the city, and keeping them in a line bearing N. W. ¼ W. will lead in the largest vessel clear of all danger. To serve as leading marks also during the day the pediment of the custom-house is painted white; this is to be kept in line with the upper lantern, also painted white. The distance from St. John's to Liverpool, England, is about 2000 miles; to Valentia, Ireland, 1640 miles; to Quebec, 900 miles; to Halifax, Nova Scotia, 540 miles.

The city is well supplied with water from a lake called Twenty-mile Pond, distant 6 miles, and elevated 150 feet above the highest part of St. John's. The waterworks were constructed at a cost of £80,000 sterling, which was raised on a government guaranty of 5 per cent. There are 2 well-organized volunteer fire companies, the Phœnix and Cathedral Fire Brigade. The city is lighted with gas. There are 3 banks. The Commercial bank has a capital of £50,000 and a note circulation of nearly the same amount. The Union bank has a capital of £50,000 and **circulates notes to the extent of £104,387. All government business is done through this institution, and the shares** are at a high premium. The savings bank is a government institution, the government being responsible for its deposits and having control of its expenditure. Its rate of interest is 3 per cent. per annum. The profits, after payment of interest to depositors, are added to the general revenue. There are 10 churches in the city. The Roman Catholic cathedral is an imposing structure. **The Church of England cathedral is also a fine edifice, though as yet incom**plete. There are 2 Wesleyan churches, 1 Established Church of Scotland, 1 Free Church of Scotland, and 1 Congrega**tional. Two-thirds of the population are Roman Catholics. The most important public edifices, in addition to the cathedrals and churches, are—**Government House, the residence **of the governor, a plain but substantial and commodious** stone building which cost £60,000; the House of Assembly, in which the legislature holds its sittings and where are the **government offices; the Union and Commercial banks;** the lunatic asylum, 4 miles distant from the city; the public hospital, market-house, and court-house; Roman Catholic **college and convents; Episcopalian, Wesleyan, and General Protestant academies; Roman Catholic and Episcopalian orphan asylums. Nineteen life, fire, and marine in**surance companies have agencies in St. John's. The joint-**stock companies are—the St. John's Gas-Light Co., General Water Co., Floating Dry Dock Co., Vail's Joint-Stock Co. for ship-biscuit baking, and St. John's Steam-tug Co. The city has 2 saw-mills, 1 gas manufactory, 1 iron-foundry, 1 distillery, 2 breweries, 4 bakeries (by machinery), 1** patent slip, 1 floating dock, 2 tanneries, 1 boot and shoe factory. The chief public societies are the agricultural, **floral, and horticultural, and the fishermen's society. The benevolent and charitable societies are numerous, the prin**cipal being the Benevolent Irish Society, Church of Eng**land asylum for widows and orphans, St. John's Industrial Society, Dorcas Society, St. George's Society, St. Andrew's Society, British Society, Society of St. Vincent de Paul, Mechanics' Society, Shipwrights' Benefit Society, and 4** temperance societies. There are 3 Masonic lodges—2 under the jurisdiction of the Grand Lodge of England, and **1 under the jurisdiction of the Grand Lodge of Scotland.** The medical society of St. John's was incorporated in 1867. Of the literary institutes, the St. John's Athenæum has a **library containing 5000 vols., and a reading-room well sup**plied with British and American newspapers and period**icals; the St. Joseph's Catholic Institute has a reading-room and library. The newspapers published in St. John's** are the *Morning Chronicle*, daily; the *Express*, *Newfoundlander*, *Public Ledger*, *Advertiser*, *Courier*, and *Times*, twice each week; the *Royal Gazette*, *North Star*, and *Patriot*, weekly; the *Commercial Journal* and the *Temperance Journal*, fortnightly. Of these newspapers, the *Royal Gazette* is the oldest, having been established in 1806.

St. John's is the seat of government, which consists of a governor, executive council, legislative council, consisting of 15 members nominated by the Crown, and a house of assembly, consisting of 31 members elected by the people. The judicial department consists of a supreme court, Sir H. Hoyles being chief-justice, and Hon. B. Robinson and Hon. John Hayward assistant judges; and a circuit court and admiralty court. There is also the district court of St. **John's. The Allan line of steamers call at St. John's on their outward and homeward passages, carrying mails and passengers. Every alternate Tuesday a steamer leaves** Halifax, N. S., calling at St. John's on her voyage to Liv**erpool, and every alternate Tuesday a steamer leaves Liv**erpool, calling at St. John's on her voyage to Halifax. This arrangement holds good for nine months of the year, and during February, March, and April the steamers run

only once a month, instead of fortnightly. Local steamers make fortnightly trips between St. John's and the principal outports N. and S. Excellent roads connect the capital with the neighboring towns and settlements.

There are few manufactures in St. John's, the population being chiefly engaged in business connected with the fisheries, which are the staple industry of the colony. The large mercantile establishments in St. John's issue supplies on a large scale for the prosecution of the seal and cod fisheries, and collect and export fish and oil. The codfish are chiefly sent to Great Britain, Spain, Portugal, Italy, the West Indies, and Brazil. The seal oil and seal skins are mainly exported to Britain. The great bulk of the imports of the colony arrives at the port of St. John's. In addition to the large mercantile establishments, there are in St. John's a large number of handsome retail shops in which a cash trade is carried on. St. John's is a place of extensive business, and much wealth is accumulated by the capitalists, who, unfortunately, are mostly non-resident and are represented by their agents. The average number of vessels entering the port of St. John's annually is 1200, having a burden of 250,000 tons. The number of sailing vessels clearing from St. John's for the seal fisheries each year was once very great, but of late years these have been largely superseded by steamers. Eighteen powerful steamers now leave St. John's each year for the seal fishery soon after Mar. 10. The great bulk of the seal oil taken is manufactured in St. John's; Harbor Grace, the second town in the colony, being the only other place where oil is manufactured.

St. John's is a place of growing importance, and will probably occupy an influential position one day. It is proposed to build a railway across the island from St. John's to St. George's Bay, on the western coast, and a steam-ferry would carry passengers and mails thence to Shippegan or Louisburg, C. B. This would constitute the shortest and safest travel-route between America and Europe, as swift steamers could make the distance between St. John's and Valentia, Ireland, in a little over four days. The distance between London and New York by this route would be traversed in seven days. M. HARVEY.

Saint John's, county of Quebec, Canada, bounded E. by the river Richelieu, and S. by the State of New York. It contains some very fertile land, and is traversed by the railways leading to St. John's, the county-seat. P. 12,122.

Saint John's, town, cap. of St. John's co., Quebec, Canada, on the W. bank of the river Richelieu, at the head of Chambly Canal, and on Central Vermont R. R., 23 miles N. of Rouse's Point. It is also the terminus of a branch of Grand Trunk and of Stanstead Shefford and Chambly railways. It is connected with Iberville by two bridges. It is the seat of the provincial lunatic asylum, and possesses fine buildings, churches, and manufactories, an active trade, commodious barracks for troops, an academy, and 2 weekly newspapers. P. 3022.

Saint John's, the capital of Antigua, West Indies, and the seat of several military and civil authorities, is beautifully situated and has a good and fortified harbor, which, however, is not accessible for large vessels. It is generally well built, though somewhat dirty, and it sometimes suffers greatly from lack of water. P. 9021.

Saint John's, county of N. E. Florida, lying between St. John's River and the Atlantic, consisting chiefly of marshes, is covered with timber, including some live-oak. Staples, sugar, molasses, and sweet potatoes. Cap. St. Augustine. Area, 540 sq. m. P. 2618.

Saint John's, p.-v., cap. of Clinton co., Mich., on Detroit and Milwaukee R. R., 100 miles W. of Detroit, has 7 churches, 2 school-houses, 2 newspapers, a large furniture manufactory, foundry, wooden-bowl factory, 1 saw and 2 grist mills, and carriage and repair shops. P. about 2500. CORBIT & ESTES, EDS. "CLINTON INDEPENDENT."

Saint John's, v., Marion tp., Mercer co., O. P. 105.

Saint John's, a lake of Quebec, Canada, forming the source of Saguenay River, is nearly circular in form, being 30 miles long and 25 broad, and lies on a high plateau sheltered N. E. by lofty mountains. Its principal tributaries are Assuapmoussoin, Mistasini, and Curious rivers.

Saint John's, Berkley, tp., Charleston co., S. C. P. 7868.

Saint Johns'bury, p.-v., cap. of Caledonia co., Vt., at the junction of Connecticut and Passumpsic and Portland and Ogdensburg R. Rs., 50 miles S. of the Canada line. It has 5 churches, a public library and reading-rooms, an academy and 6 school-houses, 2 banks, 2 weekly newspapers, the largest scale manufactory in the world, 2 foundries and machine-shops, mills of various kinds, and 2 hotels. P. 4665. WM. H. WHEELER, ED. "VERMONT FARMER."

Saint John's College, Stearns co., Minn., was founded in 1869 by the Very Rev. Demetrius Maragna, who was its first president, and d. in 1869. Its present president is Rev. Alexius Edelbrock, b. in 1843 at Dülmer, Westphalia, but educated in this country.

Saint John's, Colleton, tp., Charleston co., S. C. P. 8604.

Saint John's Plantation, tp., Aroostook co., Me. P. 127.

Saint John's River, in Florida, rises in the swamps of Brevard co., and after a course of nearly 400 miles reaches the Atlantic. It is regularly navigated by steamboats to Enterprise, 330 miles from its mouth, and small steamers have ascended some 60 miles above that point. It is a beautiful stream, having but a slight fall and a very gentle current. Its banks are clad in rich half-tropical verdure, and for nearly two-thirds of its course it is nowhere less than a mile in breadth, and often expands into spacious lakes. The general direction of the river from its mouth, in lat. 30° 20½' N., to Jacksonville is E. and W. Above Jacksonville, as far as Pilatka, it lies nearly N. and S., being parallel with the main coast and about 20 miles from it. "For nearly 100 miles from its mouth it forms a wide, sluggish sheet of water, more resembling a lagoon than a river," the distance from shore to shore in some places being fully 5 miles. The currents in the river are apparently but slightly influenced by freshets, even during the rainy season, and where most active near the mouth are without doubt mainly due to the tidal wave. After passing the bar a depth of 14 to 15 feet may be carried to Jacksonville, 10 feet to Pilatka, and 8 feet to Lake George, while small steamers ply much higher up. A minimum depth of 7 feet of water at mean low tide at present exists on the bar, with an average rise and fall of 5.4 feet.

Saint Johns'ville, p.-v. and tp., Montgomery co., N. Y., on Mohawk River and New York Central R. R., has fine scenery and important manufactures. P. of v. 1376; of tp. 2189.

Saint John the Bap'tist, parish of S. E. Louisiana, having on the N. Lake Maurepas, on the N. E. Lake Pontchartrain, on the S. Lake des Allemands, intersected by Mississippi River, and traversed by New Orleans St. Louis and Chicago R. R., has a level surface and a soil highly productive of rice and sugar-cane. Cap. Edgard. Area, 250 sq. m. P. 6762.

Saint Jo'seph, p.-v., Westmoreland co., N. B., 3 miles from Memracook. It has a Roman Catholic college and a handsome stone church. P. about 400.

Saint Joseph, county of N. Indiana, adjoining Michigan, on St. Joseph and Kankakee rivers, traversed by Lake Shore and Michigan Southern, Michigan Central, and Chicago and Lake Huron R. Rs., has a nearly level surface divided between oak-openings, prairie, and forest, has numerous manufactures and raises considerable quantities of stock. Staples, wheat, hay, Indian corn, maple-sugar, wool, and butter. Cap. South Bend. Area, 470 sq. m. P. 25,322.

Saint Joseph, county of S. W. Michigan, adjoining Indiana, drained by St. Joseph River and its tributaries, intersected by Lake Shore and Michigan Southern, Michigan Central, and Grand Rapids and Indiana R. Rs., has a rolling surface, numerous saw-mills, several manufactories, and raises considerable numbers of sheep and swine. Staples, wheat, Indian corn, potatoes, hay, sorghum-molasses, wool, and butter. Cap. Centreville. Area, 550 sq. m. P. 26,275.

Saint Joseph, p.-v. and tp., Champaign co., Ill., on Indianapolis Bloomington and Western R. R. P. 1222.

Saint Joseph, tp., Allen co., Ind. P. 1373.

Saint Joseph, p.-v., cap. of Tensas parish, La., on Mississippi River, 350 miles above New Orleans and 60 S. of Vicksburg, has 2 religious societies, good schools, court-house, jail, and clerk's office, a Masonic lodge, 1 newspaper, and a tin and blacksmith shop. P. about 350.
P. CHEW, ED. "NORTH LOUISIANA JOURNAL."

Saint Joseph, p.-v. and tp., Berrien co., Mich., on Lake Michigan, at the mouth of St. Joseph's River, on Chicago and Michigan Lake Shore R. R., is the centre of the principal peach-region of the N. W., has 2 weekly newspapers and a flourishing trade in lumber and in fruit sent to Chicago, and a handsome bridge across the river. P. 2994.

Saint Joseph, p.-v. and tp., Stearns co., Minn. P. 868.

Saint Joseph, city, cap. of Buchanan co., Mo., and the second city of commercial importance in the State, is beautifully situated on the right bank of Missouri River, on the western boundary of the State. It is one of the oldest cities in the U. S. between Mississippi River and the Pacific coast. It was founded by Joseph Robidoux, a French Roman Catholic, who was born in St. Louis in 1784, and who was one of the most noted pioneers of the West. As early as when the general government incorporated the

T[illegible] left St. Louis for the [illegible] trade with the Indians. [illegible] the hills on the river [illegible] trafficking with the [illegible] only inhabited by the In[illegible]. The steamboats from [illegible] wares and carried the valuable [illegible] received from the Indians to mar[illegible] [illegible] the Indians, whom he treated [illegible] country surrounding the trading [illegible] the "Platte Purchase," was opened to [illegible] treaty with the Indians. The fertile land [illegible] taken up, and the settlement immediately be[illegible] frontier town W. of the Mississippi. In [illegible] the original town was laid out by Mr. Robi[illegible] and named St. Joseph. In 1846, with 600 inhab[illegible] it became the county seat; in 1849 it became the great outfitting point for emigrants and gold seekers leaving the States for California, it lying directly on the great highway across the Plains. In Feb., 1851, with a population of [illegible], it became a city. The original charter is still in force, having been amended twenty two times. In Feb., 1859, Hannibal and St Joseph R. R., the first road to penetrate so far W., was completed to the city. From this the city made rapid strides in growth and population. In the following year the famous "pony express," to quickly transmit a limited mail from the States to San Francisco, was started from the city. In 1861, at the breaking out of the war of the rebellion, the city became the scene of factious disturbances on the part of the secessionists, and the war period was a gloomy one. The government occupied and fortified the city, and it became a point for the centralization and distribution of troops. The population, which was 10,000 in 1861, had dwindled to 7000 in 1865. The return of peace brought prosperity again, an immense trade flowed in, and the city grew rapidly. In 1870 the census showed a population of 19,565 and an assessed property valuation of $11,285,135. The population is now estimated at 30,000, and the assessment shows a property valuation of at least $25,000,000. The country surrounding St Joseph is one of the richest in the U. S. Since its founding the city has been the largest wholesaling point in the Central U. S. W. of St. Louis and Chicago, which supremacy it still maintains. It has 9 distinct lines of railway centring at its location, with a formidable network of connections, giving it direct communication with the great Pacific and Atlantic seaboard cities and the cities of the lakes and the Gulf, and is closely united with all the smaller cities and towns under its shadow. In 1875 its wholesale trade exceeded $20,000,000. May 31, 1873, it celebrated the completion of a magnificent iron railway bridge across Missouri River, costing $1,500,000. The city's public schools stand next to those of St. Louis in the State, and vie with those of Cleveland and Boston. The city has 32 schools and colleges, 21 churches, 4 daily and 5 weekly newspapers, 5 public libraries, 63 societies, an industrial exposition association, State asylum for the insane, the finest opera house W. of New York City, and one of the largest court houses in the U. S.

Isaac C. Phifer, Ed. "Herald."

Saint Joseph, tp., Williams co., O. P. 1844.

Saint Joseph, tp., St. Croix co., Wis. P. 265.

Saint Joseph de Beauce, p.-v., cap. of Beauce co., Quebec, Canada, 42 miles S. S. E. of Quebec. It has a large stone convent house and copper mines. P. about 150.

Saint Joseph, Sisters of, founded at Puy, in France, in 1650 by J. P. Medaille, a priest; have many houses in the U. S.

Saint Joseph's River rises in Hillsdale co., Mich., and after a tortuous course of 250 miles enters Lake Michigan at St. Joseph. Its mouth affords a good harbor, and the stream is navigated throughout half its length by small steamers to Constantine, Mich. Another stream of the same name rises in Hillsdale co., Mich., flows S. W. into Ohio and Indiana, and near Fort Wayne joins St. Mary's River to form the Maumee.

Saint Junien', town of France, department of Haute-Vienne, at the confluence of the Glane and Vienne, has 6795 inhabitants, mostly engaged in the rearing of horses, bees, and mules.

Saint-Just, de (Antoine Louis Léon), b. at Decize, department of Nièvre, France, in 1768 or 1769; studied literature; published in 1789 a large poem, *Organt*, in 20 songs; embraced the ideas of the Revolution with enthusiasm; wrote in 1791 *Esprit de la Révolution*; entered the Convention in 1792 as a member for Aisne; advocated the most extreme measures; became a member of the Committee of Public Safety; was one of the most conspicuous leaders during the Reign of Terror; became president of the Convention in Feb., 1794; brought Danton to the guillotine; attempted on the 9th Thermidor to defend Robespierre, but was arrested, and executed the next day, July 28, 1794. His *Œuvres politiques* were collected and published in 1834. His *Life* was written by Fleury in 1852 and Hamel in 1859.

Saint Lam'bert, or **South Montreal,** v., Chambly co., opposite Montreal, Canada, on the river St. Lawrence, at the terminus of the Victoria bridge and at the junction of the St. John's branch with Grand Trunk Railway. A steam ferry connects it with the city, 2 miles distant. P. about 400.

Saint Lambert, de (Charles François), Marquis, b. at Nancy, Lorraine, France, Dec. 16, 1716; served in the army; obtained a post at the court of Stanislaus, king of Poland, where he made the acquaintance of Voltaire; obtained some note as a poet, and still more by his successful rivalry with Voltaire and Rousseau for the favor of their respective mistresses. He became a member of the Academy. D. at Paris Feb. 9, 1803.

Saint Lan'dry, parish of Central Louisiana, bounded E. by Atchafalaya River, W. by Bayou Nezpeque, watered by their numerous tributaries, has an undulating surface, well adapted to agriculture and stock-raising. Staples, Indian corn, cotton, sweet potatoes, tobacco, rice, sugar, molasses, and wool. Cap. Opelousas. Area, 2200 sq. m. P. 25,553.

Saint Law'rence, county of N. New York, on St. Lawrence River, bordering on Canada, watered by St. Regis, Racket, Grass, Oswegatchie, and Indian rivers and their numerous tributaries, which afford abundant water-power, and traversed by Ogdensburg and Lake Champlain division of Vermont Central and Rome Watertown and Ogdensburg R. Rs., is thinly settled, and mountainous in its S. E. portions, which are broken by a series of parallel ridges forming part of the Adirondack region, and are covered with almost unbroken forests; is rich in minerals, especially iron ore, and well adapted to dairying, which with lumbering and manufactures of many kinds forms the chief industry, more than 30 cheese-factories existing in the county. Staples, wheat, oats, potatoes, hay, hops, flax, maple-sugar, butter, cheese, and wool, the production of the four latter articles being probably greater than in any other county in the U. S. Cap. Canton. Area, 2900 sq. m. P. 84,826.

Saint Lawrence, p.-v. and tp., Scott co., Minn., on St. Paul and Sioux City R. R. P. 315.

Saint Lawrence, tp., Waupaca co., Wis. P. 759.

Saint Lawrence River and Gulf. The river St. Lawrence, from its mouth in the Gulf to the W. end of Lake Superior, is about 2000 miles long, or to its farthest source, that of the river St. Louis, 2150 miles long from E. to W., by 745 in greatest breadth, from the sources of the Nipigon, lat. 50° 33′ N., to those of the S. branch of the Maumee, lat. 40° 13′ N. Its approximate area, as reduced by the most recent surveys, is about 510,000 sq. m.—187,440 in the U. S. and 322,560 in Canada. The tortuous watershed (5400 miles) that bounds it traverses regions very different in character and climate. On the S. side, from the Gulf westward, it interlaces the Notre Dame Mountains, 4000 to 1200 feet high, till remotely opposite Quebec it passes, by the highlands at the sources of the St. John, the Kennebec, and the Penobscot, to those of the Connecticut, and down through the picturesque hills and valleys of the Green Mountains round the S. end of Lake George to and through the lofty Adirondacks, whose highest summit rises over 6000 feet. There, at 1000 miles, it descends to the fertile regions of Western New York, encircles the sources of the Oswego and Genesee, skirts Lake Erie and the sources of the Maumee, and the S. W. shore of Lake Michigan, where its elevation is scarcely perceptible, passes northward, W. of the feeders of Green Bay, then westward, reaching the head of Lake Superior at 3000 miles—the first 1000 highly picturesque and interesting, physically and historically, the last 2000 chiefly through the finest wheat country of this continent, with the climate of the peach and grapevine. From the sources of the St. Louis the line of watershed throughout its winding course round the northern tributaries of Lakes Superior and Huron, the Ottawa, St. Maurice, Saguenay, and other rivers, is, on the contrary, monotonously unvaried, uninhabited, little known, and repulsively uninteresting, save for its many lakes and copper-bearing character. For though the Laurentian formation, that covers the northern half of the basin of the St. Lawrence, rises on Lake Superior to 1800 feet, to 2800 below Quebec, and to 4000 in the interior, it is along the watershed a generally sterile plateau, 1300 to 1500 feet above the sea (except at lon. 79° 23′ W., where it is 947), with occasional low hills. It has generally a poor sandy soil, and a climate fit only for growing barley.

The infant St. Lawrence, entering the W. end of Lake Superior as the river St. Louis, meets the accumulated waters of many tributaries, including the Pigeon River, important only from being the international boundary, and the Kaministiquia, with its great falls of 120 feet, before receiving its greatest, the Nipigon, with its mountain-guarded entrance and island-studded lake, 50 miles by 30 in extent, draining an area of 9800 sq. m. Lake Superior is 400 miles long by 160 wide, 598 feet above the sea, and 900 in mean depth. Its picturesque and rugged shores are generally unfit for agriculture, but have very rich mines of silver and copper, the latter worked by pre-historic races. The St. Lawrence leaves it a great river, 1 mile to ½ mile wide, with the surplus waters of an area of 84,700 sq. m.—including that of the lake, 32,330. Descending 23 feet, chiefly at Sault Ste. Marie, it enters Lake Huron, 240 miles long by 170 wide. Rugged and mountainous on the N. and N. E., its southern shores skirt the fertile peninsulas of Michigan and South-western Ontario. The area of its basin is 74,190 sq. m., the lake covering 21,070. Its chief Canadian tributary is the French River, from Lake Nippissing, draining over 7000 sq. m. In Lake Huron the St. Lawrence receives the waters of Lake Michigan, 345 miles long by 84 at its widest, 576 above the sea, and 1800 in mean depth. Its basin is 70,040 sq. m. in area, of which the lake occupies 22,120; five of its feeders are from 135 to 245 miles in length, mostly traversing magnificent timber forests. The St. Lawrence leaves Lake Huron as the river St. Clair, only ½ to ¼ of a mile wide; at 33 miles crosses Lake St. Clair, 25 miles long, receiving the Thames from Ontario; and at 18 more, with a descent of 11 feet, enters Lake Erie. Compared with the St. Mary, the river St. Clair seems small for what should be the greatly-augmented discharge of Lake Huron; but the proportional evaporation of Lakes Huron and Michigan must be greater than that of Lake Superior, whose low surface temperature (40° F.) should rather cause precipitation in warm weather; and the volume of the St. Clair is hidden by its great depth and velocity of 6 miles an hour. Lake Erie is 244 miles long by 60 at its widest, and 90 feet in mean depth. Its area is 9600 sq. m., including which its basin embraces 39,680, of which the river Maumee drains 7000, the Grand River of Ontario 2430.

From Lake Erie the St. Lawrence flows rapidly, ¾ of a mile wide, 20 to 40 feet deep. Expanding around Grand Island and many lesser ones, at 22 miles it descends the Falls of Niagara with its enormous mass of 389,000 cubic feet of water in each second of time. Then narrowing to ¼ of a mile, it surges down its deep precipitous ravine, through its fierce Whirlpool, and at 35 miles, with a total descent of 330 feet, overcome by the Welland Canal, enters the S. side of Lake Ontario, 190 miles long by 60 at its widest, and 412 feet in mean depth. Passing 170 miles through it, it receives on the S. the Genesee, draining 3000 miles, and the Oswego, with its eight lakes and branches, 5600 miles, and on the N. the Trent, of the same area. Leaving Lake Ontario augmented by the waters of its basin of 29,760 sq. m., including the lake-surface of 6300 miles, passing through the romantic Lake of the Thousand Isles, then gradually narrowing to ¾ of a mile at 66½ miles, the St. Lawrence enters on the series of alternate rapids, overcome by the Canadian canals and slackwater reaches, by which it descends 176 feet in 96 miles to Lake St. Louis, with a volume of 510,000 cubic feet per second, by the Canadian canal commissioners' report. The depth of water is so great that many large vessels, including passenger steamers, run down through the rapids to Montreal, using the canals only in going up.

We have now traced the St. Lawrence first for 600 miles through the rugged and solitary Laurentian and Huronian land of its origin; then for over 900 miles of its middle course, where its vast sea-like waters, after expanding through the great fertile and generally Silurian plain countries of the rapidly-improving lake States and province of Ontario, with their many prosperous cities and shipping-ports, here descend to the great plain of Lower Canada, 350 miles in length by 60 at its widest, bounded by the Laurentian mountain-range on the N. and a continuation of the Green Mountains on the S., till they converge in the St. Lawrence below Quebec, the site of the dense old settlements of the French race, rich in historical associations of events and usages linked to mediæval times. Traversing Lake St. Louis, 15 miles, to Sault St. Louis, the St. Lawrence descends 44½ feet, and at 8½ miles enters the harbor of Montreal, the commercial metropolis of Canada, frequented by Atlantic steamers and large sea-going vessels. Partly in Lake St. Louis and partly below the island of Montreal it receives the Ottawa, draining over 60,000 sq. m., whose volume of 85,000 cubic feet per second where measured is increased by lower tributaries to over 90,000, swelling that of the St. Lawrence to over 600,000. Their waters continue long visibly distinguished in color. Those of the Ottawa, amber-tinted, are much purer than the clear pale-blue waters of the St. Lawrence, which by analysis have three times as much solid matter, calcareous salts, in solution. Above this the St. Lawrence varies, it is said, not more than one-twentieth in volume by drought or flood, though rising sometimes very slowly 3 feet. Here it becomes subject to the floods of the Ottawa (an unusually high one has at present raised the St. Lawrence 2 feet over the wharves at Montreal, where the width is 1¾ miles, with strong current). Fifty miles lower, above Lake St. Peter, 30 miles long, it receives the Richelieu from Lake Champlain, draining about 9200 sq. m. In Lake St. Peter it receives the Yamaska, with 2000 sq. m., and the St. Francis from the Eastern Townships, 3500 sq. m. of area. At Three Rivers, 86 miles, it meets the tide, and receives from the N. the St. Maurice, draining about 16,000 sq. m., but discharging a most unaccountably great volume of water, even considering that the discharge of the eastern tributaries of the St. Lawrence is, for their areas, nearly double that of the western feeders. From Montreal to Quebec its average width is about 1¾ miles. Narrowing to ¾ of a mile at Quebec, under Cape Diamond, but 150 feet deep, it expands below the city, and passing the island of Orleans, at 35 miles it flows 11 miles wide of fresh water, soon becomes brackish, and gradually salt. At 120 miles below Quebec it is 16 miles wide, receiving from the N. the Saguenay, draining 23,716 sq. m., through its vast gloomy chasm in the Laurentides. Fed by the frequent rains and winter snows (6 to 8 feet deep) of mountainous and elevated northern regions, it is of extraordinary volume, as also are the large rivers Bersiamis, Outard, and Manicougan, and other tributaries eastward. Widening to 36 miles at Metis, the St. Lawrence expands to 90 at its mouth, at the W. end of the island of Anticosti, where the volume it pours into the Gulf is probably about 1,000,000 cu. ft. of water each second of time. For the last 200 miles on the S. side, and 300 on the N., its shores are but sparsely settled at favorable points for fisheries or the manufacture and shipment of lumber, and in the interior not at all, except in the basin of the upper Saguenay.

The St. Lawrence presents the extraordinary characteristic of being navigable for large ships from the head of Lake Superior, almost its source, to the sea, a distance of about 2000 miles, its obstacles being overcome by 71¾ miles of canals passable for ships of 700 tons, and with improvements now in progress it soon may be so for vessels of 1300 tons, being equalled in that respect only by the Amazon, which it exceeds in the greater sea-room for sail navigation afforded by its great lakes, but subject to the drawback of its canals being closed for four months, and its lower course for five months, in winter.

The commerce of the St. Lawrence and its lakes is very great. The total tonnage of vessels cleared outward and inward, between the U. S. and the province of Ontario, in the year ending June 30, 1875, was 3,822,247 tons, of which 2,038,293 was U. S. tonnage. In 1874 the downward tonnage to Montreal was 777,016, besides the grain and flour, 1,400,834 tons, shipped at Oswego and Buffalo for the Erie Canal route. There cleared from Montreal seaward that year 441 vessels, tonnage 315,502, and from Quebec 1041 vessels, 840,065 tons, chiefly timber-laden, and 35 from Three Rivers and Rimouski, with 21,621 tons, of sawed lumber chiefly.

The *Gulf of St. Lawrence* lies between lat. 45° 6′ and 51° 17′ N., and lon. 55° 23′ and 65° W. It is 490 miles long north-eastward and 275 wide, and includes an area of about 64,000 sq. m. It is bounded on the N. W. from the mouth of the river St. Lawrence, at the W. end of Anticosti, to the Straits of Belle Isle, 356 miles, by the rugged Laurentian coast of Inner or Canadian Labrador, hilly but rarely mountainous, with occasional fertile spots suited only for hardy vegetables and hay-crops. It has many harbors for fishing-boats and vessels, and is sheltered by clusters of small islands. Its fisheries are very rich. On the S. E. side the gulf is bounded for 300 miles of its extent by the hilly W. coast of Newfoundland, of Calciferous and Carboniferous formation, which has much good land and timber, and a climate in the S. parts suitable for agriculture, but is uninhabited generally, being frequented exclusively by French fishermen. Then, crossing the main outlet of the gulf, 75 miles wide, the W. coast of Cape Breton Island for 115 miles completes the S. E. boundary to the Gut of Canso. On the S. it is bounded for 140 miles by Nova Scotia, and on the W. for 245 miles by the coasts of New Brunswick and Gaspé, to the mouth of the St. Lawrence. This southern and western circuit of the gulf coast, from Cape Breton to Gaspé, inclusively, contrasts strongly with the more northerly portion of it. Being of generally favorable soil, surface, and climate for agriculture, and of varied and favorable geological formation, with numerous and excel-

[illegible] harbors, [illegible] studded with important towns and [illegible] and intelligent population [illegible] in agriculture, shipbuilding, [illegible] general commerce, in addition [illegible] several thousand inhabitants [illegible] Magdalen Islands, out in the [illegible] occupied. The populous little prov[illegible] [illegible] Island, 2134 sq. m. in area, in the [illegible] is pre-eminent in agriculture. The [illegible] 4000 sq. m. in area, of Silurian forma[illegible] [illegible] soil though interior climate, is almost en[illegible] [illegible] unvisited, owing to want of harbors and to far[illegible] [illegible] of stratified limestone.

[illegible] bays of the gulf are the Baie des Chaleurs, between Gaspé and New Brunswick, 90 miles long and 20 in general width, into which falls the large river Restigouche, with 18 miles of farther ship navigation and rich salmon fisheries, as are four other strong rivers falling into the bay. The equally large river Miramichi of New Brunswick enters a smaller bay. The most important on the W. coast of Newfoundland is St. George's Bay, off which there are at times dangerous currents. The gulf has three outlets—the main one mentioned, the Gut of Canso, 15 miles long and 2 in average width, and the Straits of Belle Isle, 60 miles long and 11 to 24 miles wide, the most direct to Europe. By it a strong current sets in, bringing with it icebergs in early summer. The value of the fisheries of the gulf is very great. What was taken in 1875 by the Canadian fishermen resident on its shores amounted to about $3,666,000 in value; to which is to be added the value of the products of the very extensive U. S. gulf fisheries, and that of the French on the whole of the W. coast of Newfoundland. Their amount is not officially ascertained, but may be estimated as over $3,000,000 more. A. J. Russell.

Saint Leg'er (Barry), b. in England about 1730; entered the British army as ensign 1756; served as captain at Louisburg 1758, and at Quebec under Wolfe 1759; became lieutenant colonel May, 1772; was sent to Canada 1775; commanded the unsuccessful expedition against Fort Schuyler Aug., 1777, with the local rank of brigadier, and became colonel Nov., 1780. D. in England in 1789.

Saint Leon'ard Mid'dleton, town of England, in Lancashire, 5 miles N. N. E. of Manchester, has extensive manufactories of cotton and silk, numerous good schools, a fine market house, and other public buildings. P. 9876.

Saint Leonards (Edward Burtenshaw **Sugden**), D. C. L., Baron, b. in London, England, Feb. 12, 1781, son of a hair-dresser; studied law at Lincoln's Inn; became a leader of the chancery bar and a bencher of Lincoln's Inn; was made king's counsel 1822; entered Parliament for Weymouth as a Tory 1828; was knighted and appointed solicitor-general 1829; was a strenuous opponent of the Reform bill; was lord chancellor of Ireland 1835, and again 1841–46, and lord chancellor of England 1852, when he was raised to the peerage; was a privy councillor, high steward of Kingston-on-Thames, and deputy lieutenant of Sussex. D. at Thames-Ditton Jan. 29, 1875. He was generally recognized as the highest English authority on property law, a subject which he treated in several useful manuals, from the *Concise and Practical Treatise of the Law of Vendors and Purchasers*, published as early as 1805, to the *Handy Book on Property Law*, issued in 1858 and revised in 1869. In his later years he was a cautious advocate of local reforms. Lord St. Leonards, who had written much in reproof of carelessness in the execution of wills, gave an interesting practical illustration of the necessity of placing them where they might be secure and accessible. His will, which he was known to have drawn up with great care, could not be found after his death, and it was at last (1876) admitted to probate as repeated verbally from memory by his daughter, Miss Charlotte Sugden, who had been for many years his secretary and amanuensis.

Saint Liboire', p.-v., cap. of Bagot co., Quebec, Canada, on Grand Trunk Railway, 38 miles E. of Montreal. P. about 150.

Saint Lin, p.-v., L'Assomption co., Quebec, Canada, 32 miles N. of Montreal. It has fine red, black, and gray building limestones, a convent, and extensive manufactures of lumber. P. about 900.

Saint Lo, town of France, capital of the department of Manche, on the Vire, 155 miles W. by N. from Paris, has manufactures of druggets, flannels, serges, calicoes, and laces, 6 large printing establishments, and an active trade in cattle, horses, poultry, honey, wax, and butter. The church of St. Croix, built in 805, is one of the completest, best preserved, and most interesting specimens of Saxon architecture. P. 9810.

Saint Louis', capital of the French possessions in Senegambia, West Africa, on an island at the mouth of the river Senegal, is fortified, has a good harbor, and carries on an important trade; in 1864 it exported 20 cwts. of ivory and 32,000 cwts. of gum. P. 17,600.

Saint Lou'is, county of N. E. Minnesota, bounded N. by Rainy Lake and River, S. by Lake Superior, watered by St. Louis, Vermilion, Embarras, and many other rivers, and including Vermilion Lake, a body of water of considerable extent; is mostly covered with timber, settlements being as yet confined to the shore of Lake Superior. Northern Pacific and Lake Superior and Mississippi R. Rs. have their common terminus at Duluth, the county-seat. Area, 6500 sq. m. P. 4561.

Saint Louis, county of E. Missouri, occupying the peninsula between Missouri and Mississippi rivers, S. of their confluence, and drained by the Maramec, has a low and level surface along the rivers, but broken in the interior; embraces extensive deposits of coal and marble, and is traversed by the numerous railroads centring at St. Louis. Manufactures form a very extensive industry, representing an annual value of $158,761,013. Staples, wheat, Indian corn, potatoes, hay, wine, wool, butter, and cheese. Cap. St. Louis. Area, 550 sq. m. Pop. 351,189.

Saint Louis, p.-v., Gratiot co., Mich., on Saginaw Valley and St. Louis R. R., 33 miles W. of Saginaw, has excellent water-privileges, good schools, a public hall, 2 banks, 1 newspaper, extensive saw-mills, and several hotels. The Michigan Magnetic Springs are located here. P. 888. J. B. Graham, Ed. "Herald."

Saint Louis, city, St. Louis co., Mo., situated in N. lat. 38° 37′ 37.5″ and lon. 6° 0′ 45.29″ W. from Washington. It is on the W. bank of the Mississippi River, 20 miles below the mouth of the Missouri, and has a commanding site, with beautiful suburbs and fine harbor. The city is built on a limestone formation, undulating back and rising to quite an elevation. The climate is temperate, the water good, fuel cheap and abundant. A natural drainage has greatly facilitated the construction of sewerage, and as a consequence the rate of mortality is lower than that of any other large city on the continent. It was founded Feb. 15, 1764, by Pierre Laclede Lingueste, and was designed at first as a mere trading-post, and named in honor of Louis XV. of France. Next year, however, the arrival of St. Ange de Bellerive and his command from Fort Chartres, which had been surrendered to the English, gave additional importance to its establishment, and constituted it thenceforth the capital of Upper Louisiana. Although subject to the authority of Spain by the treaty concluded at Paris in 1763, St. Louis was practically under French control, and remained so until formal possession was taken by Don Pedro Piernas Nov. 29, 1770. In 1800 the territory of Louisiana was retroceded to France, and on Apr. 30, 1803, was purchased by the U. S. The transfer of this vast domain took place in St. Louis Mar. 9, 1804. There is not much of historic importance attached to the early annals of the village. Its interests were interwoven with the romance of frontier-life; its events were those occurrences of special moment to its safety; its chronicles were the expressive designations of a simple people. The attack by Indians in 1780 was known thereafter as *L'année du grand coup*, or "The year of the great blow;" the extermination of some river-pirates in 1788 became memorable as *L'année des dix batteau*; the flood of 1785 was designated *L'année des grandes eaux*, or "The year of the great waters;" and subsequent events were similarly noted as "the year of the hard winter," "the year of the galleys," "the year of the small-pox." The population was hardy, mirthful, adventurous; the French element largely predominated; trade pushed its voyageurs up all tributary streams; quite a commerce in peltries was established abroad; and at the date of its acquisition by the U. S. St. Louis is said to have contained 150 houses, with 1500 inhabitants, making yearly shipment of $200,000 in furs. The town was incorporated Nov. 9, 1809. Its distance from Louisville was then a twenty-five days' journey. A two-month voyage from New Orleans was held a good trip; tangled tow-paths were the main reliance for speed; the batteau the navigator's sole defence against the waters. It was not until Aug. 2, 1817, that the first steamboat landed at its wharf—the Pike, Capt. Reed, low-pressure, built on the Ohio. This constituted an era in the history of the city, and an American population soon began to flow into the place. John Jacob Astor located the Western department of his company there in 1819. Previously, Lewis and Clarke had made it the starting-point of their celebrated expedition, and from there also Gen. Ashley subsequently set forth to explore the passes of the Rocky Mountains. By this time, however, great change had taken place. Various industries had been organized, capital was

abundant, enterprise buoyant. A cathedral decorated with original paintings by Rubens and Raphael replaced the humbler house of worship. A university was established, complete in its appointments and containing a library of 8000 vols. imported from Europe. Ten subordinate schools were put in operation. Three newspapers were published; a bank was organized; a museum of curiosities founded, and every aspect attested it as a centre of rare prosperous fortune in the then wilderness of the West. As a striking illustration of the adventurous spirit which characterized the early population of St. Louis, the journey of Russel Farnum may be worthy of historical preservation. He had been employed for some time in the trade of Mr. Astor, and was sent with orders to the stations around Astoria. Having delivered his despatches, and being possessed of a desire to explore unknown parts, he started forth again northward along the Pacific coast, visited the Hudson Bay settlements, reached Behring Strait, passed over on the ice in the winter of 1813–14, entered Siberia, and proceeded alone and on foot across its vast expanse to St. Petersburg. He introduced himself to the American minister, was sent forward by the czar to Paris, and finally returned to St. Louis, where he died of cholera in 1832.

The Territorial organization of Louisiana which had been enacted by Congress in 1812 was not adapted to the wants of the communities W. of the Mississippi, and the demand for a State government being more and more imperative each year, St. Louis, as the centre of population, became naturally the focus of political agitation. It was at this time the slavery question first obtruded upon our national arena, taking shape in the so-called "Missouri restriction." The Compromise of 1820 which followed was supplemented by the calling of a convention to frame the State constitution, and its discussions, connected necessarily with exciting themes, brought into political prominence many of those citizens of St. Louis whose reputations afterward became national. Benton and Bates, Barton, Lucas, O'Fallon, Geyer, and Gamble, are names that will live in the history of the country not less than in that of the city. A new charter was given to St. Louis Dec. 9, 1822, William Carr Lane being the first mayor elect. This was amended from time to time, and occasionally an entirely novel charter was furnished by the legislature, and nearly always with injurious effect upon some of the great property interests designed to be protected. At last the evil became so serious as to demand constitutional intervention, and the city charter has finally been placed under the ægis of the fundamental law of the commonwealth. For five-and-twenty succeeding years unprecedented growth and prosperity attended upon St. Louis. Within that period many of its largest public improvements were inaugurated, and the foundations laid of that great commerce which now extends to every part of the world. A period of depression, however, was in store to try its energies to the uttermost. The financial reverses beginning in 1837 and extending through the next decade were serious inflictions upon a young metropolis; but the great flood of 1844, desolating all the fertile valleys and surpassing even that of 1785, followed by the fearful ravages of the cholera, beginning in 1848 and sweeping off a sixth of the entire population, and succeeded in turn by the great fire of 1849, which destroyed one-third of the city and almost obliterated its marine, gave it a great shock that to almost any other community would have proved irreparable. Confidence, however, revived with the new year, and the inauguration of railway enterprise gave a stirring and attractive impulse to the business connections of St. Louis. The Pacific R. R. was commenced in 1851, the Ohio and Mississippi in 1852, the Chicago and Alton in 1853, and the Iron Mountain and Southern R. R. in 1854, thus attesting the zeal with which these new commercial agencies were developed. The city subscribed largely to most of the railroad enterprises, incurring thereby the greater portion of its existing public debt.

The growth of St. Louis, again for some years exceedingly rapid, was brought to a stand by the breaking out of the civil war. One of the earliest collisions of the war occurred in its streets, and the first Federal victory of any moment was achieved in the capture of a hostile camp of State militia located in its suburbs. This secured to the government the arsenal, a great store of arms, eventual possession of the State, and a consolidation of the whole North-west in its support. Proximity to the theatre of hostilities suspended all business other than the supplying of armies, and at the close of the war St. Louis found itself with no trade, a worthless shipping, and a legacy of bad debts. One great benefit had resulted, however, which was the abolition of slavery. The prejudice in Northern sections of the country against this institution had already begun to operate unfavorably against its business interests prior to the war, and to favor a concentration for exchange at some point on free soil; but rid of this incubus, and stimulated by large expenditures of the government, and encouraged by an immense Eastern immigration which poured into the city, everything soon assumed a new aspect. The trade of the South was swiftly regained, that of the North was eagerly contended for, and that of the West was immensely developed. Unprecedented activity prevailed likewise in extending railroad connections. Direct routes were built to unite more closely with the great central lines of New York, Pennsylvania, and Maryland; the Kansas Pacific and the Atlantic and Pacific were pushed forward to completion; and all rail routes were established to Texas and the Gulf of Mexico. Thus, the next decade enabled it to become the third city in magnitude in the U. S. The subjoined table of population well illustrates its history and progress:

1799	925	1852	94,000
1810	1,400	1856	125,200
1820	4,928	1860	185,587
1830	5,862	1866	204,327
1840	16,469	1870	310,864
1844	34,140	1873	428,126
1850	74,439	1876	498,182

The government of St. Louis consists of a mayor elected for two years, a council consisting of two members from each of the twelve wards, and various commissions having in charge the waterworks, the health, police, fire, and other departments. Changes are in preparation, however, under the provisions of the new State constitution, which will materially modify this distribution of powers, and perhaps involve a very large extension of the area of the city.

The bonded debt of St. Louis is $16,270,000, with a floating debt, the larger part of which is litigated, of $1,027,000. Its assets in the shape of property, including a sinking fund, are valued at $13,045,363. The real and personal estate within the corporation limits amounts to $166,999,660. The rate of assessment for municipal purposes, exclusive of a tax to pay interest on bonded debt, is limited to 1 per cent. The credit of the city is good, and its renewals negotiate in London at a premium. Statistics of the engineer department show the length of wharf or river front to be $11\frac{3}{10}$ths miles, of which about 3 miles are paved. Of macadamized streets there are 225 miles; of Nicolson pavements 10 miles, chiefly confined to the business sections; and of paved alleys and courts 41 miles. The system of sewerage is admirable, embracing in mains, branches, and district sewers 168 miles, besides 51 miles of private drainage. The mains have a diameter of 20 feet, the territory finished comprises 3334 acres, and the whole cost is estimated at $6,241,600. The waterworks constitute an important feature in the internal economy of the city. The supply is drawn from the Mississippi River some miles above, is received in four immense settling-basins, thence pumped up into distributing reservoirs, and pressure maintained by an elevated water-tower. The average consumption of water is 20,722,293 gallons daily; the largest quantity ever used in any one day was 29,580,343, as gauged at the basins. The receipts from water-rates in 1875 were $564,860, as against an expenditure of $579,391. The extent of pipe laid down is 165 miles. The city is in litigation for possession of the gasworks, held as the property of two private corporations. The total of lamps erected is 6189. The price of gas is $3.25 per M. feet; the regulation standard 13 candle-power. There are 275 miles of fire-alarm and 50 miles of police telegraph in operation. A paid fire department has added much to the security of property. Its equipment consists of 18 steam fire-engines, 3 hook and ladder companies, and 1 chemical engine; the staff consists of 1 chief, 5 assistants, 1 secretary, and 90 men. The total running expenses for the year $256,315. Total loss by fire, $335,322, on which the insurance was $286,137. A salvage company, supported by the underwriters, has been found of great service, and yearly saves many thousands of dollars. A well-appointed and well-disciplined police force has long been a source both of pride and protection to St. Louis. Recent extensions of territory, however, render an increase of its numbers desirable, as in that respect it is inferior to most well-organized cities. It consists of 1 chief, 6 captains, 43 sergeants, 12 detectives, and 350 men. The pay-rolls amount to $390,000, besides a contingent expense of $110,000, making a total of $500,000 annually for the support of the establishment. The number of buildings erected in 1875 was 1774, of improvements, 198; valued in all at $5,622,930.

The public parks present one of the most attractive features of St. Louis. With wise provision a great many spacious squares were early reserved for pleasure-grounds, and time and taste have so added to their adornment that they now offer delightful retreats in the midst of the busy life of the city. More conspicuous still, however, are the greater parks, which almost connect in a semicircle from the river on the N. to the river on the S. The first of these is

O'Fallon P[illegible] [illegible] acres, strikingly picturesque in [illegible] view of the Mississippi, and [illegible] growth. The Fair Grounds, [illegible] embracing only some 83 acres [illegible] features other than the [illegible] has attained such renown. Its am[illegible] [illegible] amphitheater, with a greater seating ca[pacity] [illegible] in the world, its art halls, its gal[leries] [illegible], its ample course for trials of speed, its [illegible], designed to embrace the largest coll[ection] [illegible] on the continent,—all combine to render it [illegible] resort for the multitude. The Forest Park suc[ceeds] [illegible] its immense area of 1374 acres, threaded with [illegible] and roadways, and forming a continuity of beauti[ful] [landscape]. The Missouri Botanical Garden, of 40 acres in the highest state of cultivation, then intervenes, with its immense carpet of flowers, its arboretum embracing every tree known to the temperate climate, and its cabinet of curiosities enriched by innumerable rare and interesting statues. Tower Grove Park, which adjoins, is 350 acres in extent, planted with great care and taste, and handsomely cared for under an appropriation of $25,000 a year. Its improvement is very thorough, its roadbeds costing $60,000 a mile, and the expenditure upon it has already exceeded by threefold the original estimates. It is the munificent gift of a private gentleman to the city of St. Louis. Carondelet Park stretches away to the S., and completes the environment. It is not so well adorned as some of the others, but has many features which in time will give it great beauty. In the extension of the city limits to take in all the parks for police and other purposes, as provided by law, it is designed to connect them all by a boulevard sweeping from one extreme to the other, and constructed in a manner that will endure for ages. Access from the city proper is had by various steam roads that intersect the several parks, as also by extensions of the different tramways penetrating the leading avenues of the city. These latter are numerous and well equipped, covering more than 70 miles of streets, transporting daily 100,000 passengers, and representing an outlay of $3,000,000.

In outward look St. Louis shows many marks of its origin, and has but little of that newness so common with American cities. It presents a solid and substantial, rather than a costly, aspect. There are, however, many fine buildings, whilst the character of private residences is rapidly taking luxurious and ornate shapes. Thus, the new custom-house in course of erection on Seventh street is designed to be one of the largest and handsomest public edifices in the U. S. It is estimated to cost $4,000,000, but will probably reach twice that sum if finished according to the present design. The adaptation is very perfect. The material is red and gray granite, supplied in large part from quarries in the State of Missouri. The Merchants' Exchange, on Third street, is another imposing structure. It is just completed at a cost of near $2,000,000. The front is 233 feet, the depth 187 feet, the material sandstone, the order Renaissance. The grand hall is 222 feet by 93 feet, with an elevation of 60 feet, and unobstructed by columns throughout. The Four Courts is a very conspicuous building, combining the attributes of a prison and a place of justice, and furnishing likewise appropriate quarters for the police. All the criminal business of the city is transacted here. The court house, erected on ground donated in 1823, was half a century in constructing, and has involved an outlay of $1,2[illegible]. It is built in the form of a Greek cross, with porticoes and columns on either front, and an iron dome of rather excessive proportion in the centre. The various civil courts are congregated there, as also the revenue service, the law library, and the records of land titles. The insane asylum, built upon the most improved hygienic plans, occupies an elevated site in the suburbs, and presents a most imposing architectural display. In the attempt to secure pure water for the institution an artesian well was sunk to the depth of 3852 feet, but stopped in granite without the desired success. The building cost $900,000, and has a capacity for 200 patients. The Mercantile Library Building is interesting rather from the treasures of art and literature which it contains than from any striking appearance. Like the Polytechnic, it has well served the purposes of an earlier time, and the foundation laid in each for extensive and useful libraries gives great future promise. Plans for enlarged fireproof structures are being canvassed, and it cannot be long before they will be carried into effect. They together contain about 90,000 volumes. The Emigrants' Home and the Widows' and Infants' Asylum, two noble charities that are faithfully administered, were endowed by private legacies. They form conspicuous objects of interest to visitors, and will long endure as witnesses to the worth that established them. The institution for the blind, under the management of the State, is an extensive building, on Morgan street, that has recently been much improved and furnished with extensive workshops, designed to give trades to the inmates. It has a capacity for receiving about 200 pupils. Another smaller institution for the deaf and dumb, where great success is attained in teaching them to converse intelligently by articulation, is situated on Bremen Avenue. Hotels are numerous and capacious, comprising several splendid edifices, most prominent of which are the Laclede, Southern, and Lindell. Others on still more extensive scales are projected. A tunnel under one of the principal thoroughfares and a union depôt at a central point have added largely to the facilities of the travelling public. The most noted structure of St. Louis, however, is the bridge across the Mississippi, which from the boldness of its engineering and the magnificence of its proportion has attained a world-wide celebrity. The entire length is 2225 feet; it contains 5000 tons of steel and iron, whilst its cost has exceeded $10,000,000. The superstructure consists of three arches supported by abutments on either shore, and two massive granite piers, built up from the rock foundations 110 feet below the level of the river. Two of the spans are 500 feet each, and the central one 520 feet, being the longest span ever erected. These are framed of steel tubes, sustaining truss-ribbed arches, fastened by braces of charcoal iron. Built without the erection of false works, regardless of inclement seasons, with few fatalities attending the work, it will remain an enduring monument to the genius and energy of its architect, Mr. James B. Eads. Many fine churches adorn St. Louis and attest the liberality of its citizens. Of these there are enumerated in the directory 13 Presbyterian, 2 Unitarian, 28 Roman Catholic, 18 Methodist, 9 Baptist, 3 Christian, 4 Congregational, 10 Episcopal, 16 German Evangelical, 4 Hebrew, and 4 missions. Of the different hospitals, that of the quarantine is situated some distance below on the river, that of the city in the southern portion, and that of the Sisters in the northern suburbs. There are also under denominational charge the Alexian Brothers, Good Samaritan, Marine, Female, St. Louis, and two lying-in charities. Somewhat kindred institutions are presented in the Woman's Christian Home, Girls' Industrial Home, Widows' Home, Little Sisters of the Poor, and various orphan and half orphan establishments. Organized societies for the relief of the indigent are connected with most of the Church associations. Provision is also made at public expense for gratuitous furnishing of medicines and medical advice from a city dispensary.

In educational progress St. Louis has in no wise disappointed the promise given in its early day. Colleges of great excellence, many academies of repute, and private schools without number have grown up with the growth of the city. Of sectarian institutions there are not less than 36 Roman Catholic, 12 Lutheran, and 15 of other denominations, of which the most prominent are the St. Louis University, the Academy of Loretto, the Sacred Heart, the Visitation, and the Ursuline. Of those non-sectarian, the Washington University, Mary Institute, and Bonham School are the more important. But the fame of St. Louis has gone forth even amongst European educators for the excellence of its public-school system rather than its private establishments. This is admirably organized and largely endowed. In 1812, Congress donated certain vacant lands and common lots within the district of St. Louis to the support of public schools. In 1831 the grant was made effective by additional legislation, and in 1833 the first school board was elected under the new charter and entrusted with custody of the property so acquired. The first building was erected and first school opened in 1846. It was not until 1849 that a permanent city tax of 1 mill, afterward in 1865 increased to 5 mills, was voted for school purposes. In addition, the public-school system derives its proportionate share of the general school fund, which is 25 per cent. of the gross revenue of the State. An enhancement of the values of real estate, increased general revenue, and high assessments by the city have enabled the school board to organize with ample means at its command. As one consequence, no charge is made for tuition; as another, only the best talent is employed, and that well remunerated. The property schedule of the board for 1875 exhibits the following: real estate used for school purposes, $2,386,620; held for future uses, $1,289,991; receipts are, from rents, $52,855; from State school moneys, $91,083; from city taxes, $645,176; from other sources, $60,398; making a total of $849,513. Results show a most efficient application of these large resources. A conclusion has been reached which seems to combine the maximum of effect with the minimum of expenditure. Thus, there are now 56 commodious school buildings completed, and 5 temporarily rented, containing a total of 32,070 seats. The number of registered pupils is 43,852; average belonging, 29,309, and average attending, 27,100. The average number of teachers is 769, with

salaries aggregating $522,350. The average of attendance is practically 94 per cent.; average cost of tuition per scholar, $19.21; average of incidentals, $2.53. There are 44 schools, with 74 teachers, having German and English classes, embracing 11,527 German-American and 5670 Anglo-American scholars. Drawing has been introduced systematically throughout all the grades of advancement. Admission is had at six years of age. Corporal punishment is discountenanced. The classification is that of a normal school, high schools, district schools, and recently there has been attached the Kindergarten for very young children. Evening schools, introduced some years since, have met with marked success. The course of study and method of instruction arrived at cannot be analyzed in any brief space, but it can be said that it stands second to none in the success attained. The present system is the product of careful, persistent, enlightened work, in which the practice of other cities and the labored research of other nations have been freely laid under contribution. It has thus been a creation rather than a growth, and the high educational standards wrought out confer distinguished honor upon its superintendent, Mr. William T. Harris, who has devoted years of scholarly toil to its perfecting.

The financial system of St. Louis consists of 7 national, 31 State, and 19 private banks not in the clearing-house, with a combined capital of $19,559,542. The savings and time deposits are $16,144,337; demand deposits, $24,562,084; cash and exchange, $11,778,495; loans, discounts, and bonds, $45,928,085. The circulation of the national banks is only $706,690, and the aggregate bank-clearings for the year, $1,151,372,654. The ordinary rate of discount is from 8 to 10 per cent. Total taxation on real estate, including State, county, city, and schools, for 1876 was 3.48½ per cent. The insurance business has been very successfully prosecuted in St. Louis. Of home companies there are organized under the laws of the State 12 stock and 14 mutual, all having their head-offices here. There are also 10 European companies, and of the 139 companies of other States carried on the books of the insurance department almost all have offices in the city, with a cash capital of $35,280,000, assets $84,505,000, liabilities $33,164,000, and surplus $16,060,000. The business of the stock companies is of gross assets $4,301,352, liabilities $890,288, income $1,951,586, expenditure $1,645,971; of the mutuals, premium notes $4,619,000, liabilities $104, income $370,000, and expenditure $323,000.

As a manufacturing city St. Louis, according to the last census, ranked fourth in the U. S., and since then a comparison made with great care, showing the capital employed and the production of 40 leading manufacturing interests, demonstrates an increase of 36 per cent. The total amount is now estimated at $200,000,000. The great resources of the State in minerals, timber, earths, and other materials has been one cause of this rapid growth, which may be well illustrated by an announcement made on the completion of the new exchange that the granite in its foundations, the sandstone of its walls, the framework of iron, and the finishing of wood, the lead, and the zinc, the glass, and the paints for its frescoes, all came from Missouri. The vast coal-fields which lie underneath its very site, and which intersect the bluffs across the river, extending for many miles, supply cheap and inexhaustible fuel, and the process of desulphurizing, recently applied with such success, must give increased activity to many of its large manufacturing enterprises, especially those of steel and iron. In fact, this branch of its business is as yet in its infancy, although numerous furnaces are congregated along the river, and one of the largest rolling-mills in the world for the manufacture of steel rails has just been completed. The Board of Trade report for 1876 presents an elaborate summary of the leading industries of the city well worth being consulted. Probably no better evidence could be adduced of the extent to which the manufactures of St. Louis command the markets of the world than the facts that its brands of flour rank highest in England; it supplies machinery to the mines of old Mexico; it sends railway iron to Brazil; and has recently shipped a large order of steamer engines to the Sea of Okhotsk. The ores of the State are sent from its wharves to all the large furnaces of every country, its manufactures of hollow-ware have large sales even in Germany, and its meats are on the market in the cities of remotest India.

The commerce of St. Louis, which depended for a long time upon river navigation, received great impulse from the railroad connections as they were made, and its increase was commensurate with their extension. Latterly, a demand for cheap freights, modifications in constructing steamers, the introduction of a system of barges and tows, are bringing the great water-ways into prominence again. Deepening of the channel of the Mississippi at its mouth, so as to admit sea-going vessels of the largest size, and confining its waters along the whole length by levees, promise to give to St. Louis more importance still as a dépôt where the grain of the North-west will collect for shipment to Europe. There are now 14 trunk-lines of railroad entering the city, with an estimated arrival and departure of 200 trains daily. The receipt of freights by them aggregated 3,232,770 tons for the year. The total arrival of steamers was 2201, of barges 743, and freights 663,525 tons.

Custom-house exhibits for 1875 show collections $1,186,202, foreign value warehoused $1,635,793. Great attention has been devoted latterly by the merchants of St. Louis to the removal of barriers between consumer and producer, and to facilitating in every way the interchange of commodities. A bureau of freights has been organized at the exchange, custom-house regulations that impeded direct importation have been abolished, and extensive European connections established which give promise of large results hereafter. In fact, the commercial advantages of St. Louis are in many respects unequalled. It commands more than 6000 miles of direct river navigation, made accessible to steamers and barges for a large part of the year. Situated, too, at a point where the open flow to the South breaks away from the frozen streams of the North, where deeper channels give opportunity for more commodious vessels, and where the growths of the far West meet the manufactures of the East, immense transfers of freights will necessarily be involved, and the foundations thereby laid of a city which in time to come may rival the ancient queens of commerce. B. Gratz Brown.

Saint Lou'isville, p.-v., Newton tp., Licking co., O., on Lake Erie division of Baltimore and Ohio R. R. P. 166.

Saint Luce, p.-v., cap. of Brevard co., Fla.

Saint Luci'a, an English island of the Windward group, West Indies (lat. 14° N., lon. 61° W.), 24 miles S. E. of Martinique and 21 N. E. of St. Vincent; is 26 miles in length by 11 in breadth; has a circumference of 150 miles, an area of 250 sq. m., and a p. in 1871 of 31,811, of which number only 910 were white. The surface is mountainous and covered with valuable timber and dyewoods, and an extinct volcano supplies an inexhaustible quantity of sulphur. The climate is warm and unhealthy, and destructive hurricanes are not infrequent. Staple productions, sugar and cacao. The government is in the hands of an administrator, an executive and a legislative council, resident at Castries, and subject to the governor-in-chief of the Windward Islands. Settled by the English in 1609, the colony has several times been held by the French, and was finally recaptured 1803.

Saint Malo', town of France, department of Ille-et-Vilaine, near the mouth of the Rance, on a small island in the English Channel, connected with the mainland by a causeway 650 feet long. The harbor, which is perfectly dry at ebb tide, has from 40 to 50 feet of water at flood-tide, is large and safe, and defended by fortifications both on the mainland and on the island. Cod and herring fishing in the Channel and for seals and whales in the Arctic Ocean, trading along the coast and to foreign ports, shipbuilding, and the manufacture of sailcloth, ropes, and every kind of naval fittings are vigorously carried on. P. 12,316.

Saint-Marc Girardin. See Girardin (Saint-Marc).

Saint Marie', p.-v. and tp., Jasper co., Ill., on Embarras River. P. 1452.

Saint Marie, tp., Green Lake co., Wis. P. 705.

Saint Mark's, tp., Clarendon co., S. C. P. 480.

Saint Mar'tin, one of the Lesser Antilles, in the West Indies. Area, 30 sq. m. The northern part belongs to France, and has 3450 inhabitants; the southern to the Netherlands, and has 3157. From its extensive salt marshes more than 300,000 vats of salt are made annually.

Saint Martin, parish of S. Louisiana, bounded E. by Atchafalaya River, S. by Lake Chetimaches, and drained by Bayou Teche, has a level surface and a fertile soil. Staples, cotton, sugar, and molasses. Cap. St. Martinsville. Area, 500 sq. m. P. 9370.

Saint Martin, tp., Stearns co., Minn. P. 556.

Saint Martin (Alexis). See Beaumont (William).

Saint Martin' (Antoine Jean), b. at Paris, France, Jan. 17, 1791, was the son of a tailor; studied Oriental literature under Sylvestre de Sacy, and took part in politics under the Bourbons. D. at Paris July 20, 1832. Author, among other works, of *Mémoires historiques et géographiques sur l'Arménie* (2 vols., 1818–22) and of treatises on the chronology of the Ptolemies and on the zodiac at Dendera.

Saint-Martin, de [illegible] Marquis, gen [illegible] Le Philosophe Inconnu, [illegible] et Loire, France, Jan. [illegible] in the army, but lived sub- [illegible] himself to the study of [illegible] specially the mystics Martinez [illegible] Bohme. D. at Paris Oct. [illegible] *Des Erreurs et de la Vérité*, par [illegible] (1775), *Tableau naturel des Rap-* [illegible] *l'Homme et l'Univers* (1782), [illegible] *De l'Esprit des Choses* (1800), *L'Homme* [illegible], etc., are all against sensualism and mate- [illegible]. In France they made no great impression, but [illegible] were translated into German. See Matter, [illegible] *le Philosophe inconnu*, 1862.)

Saint Martin's, p.-v. and tp., Worcester co., Md., on [illegible] Wight Bay. P. 1133.

Saint Martin's Island, Delta co., Mich., in Lake Michigan, at mouth of Green Bay. P. 191.

Saint Martinsville, p.-v., cap. of St. Martin parish, La., on Bayou Teche, has 2 newspapers. P. 1190.

Saint Mary, parish of S. Louisiana, bounded N. E. by Lake [illegible], S. E. by Atchafalaya River, and S. by [illegible] and Côte Blanche bays, has a marshy but productive soil. Staples, sugar, molasses, rice, and Indian corn. Cap. Franklin. Area, 860 sq. m. P. 13,860.

Saint Mary, tp., Waseca co., Minn. P. 737.

Saint Mary's, port of entry of the district of Placentia and St. Mary's, Newfoundland. The fisheries and agriculture are carried on. The harbor is excellent. The town is 60 miles by land S. W. of St. John's. P. 650.

Saint Mary's, p.-v., Perth co., Ont., Canada, on the N. W. branch of the river Thames, at the junction of the London branch with Grand Trunk Railway, 22 miles N. of London. It is a prosperous and well built town, has a large trade in grain, quarries of fine limestone, 2 splendid railway viaducts, important manufactures, and 2 weekly newspapers. P. 3120.

Saint Mary's, county of S. Maryland, lying between Patuxent River on the N. E., Chesapeake Bay on the E., and Potomac River on the S. W., watered by numerous small bays and creeks. Staples, tobacco, wheat, and Indian corn. Cap. Leonardtown. Area, 250 sq. m. P. 14,944.

Saint Mary's, p.-v. and tp., cap. of Camden co., Ga., on St. Mary's River. P. 702.

Saint Mary's, tp., Hancock co., Ill. P. 1650.

Saint Mary's, tp., Adams co., Ind. P. 925.

Saint Mary's, tp., Mills co., Ia. P. 279.

Saint Mary's, tp., Pottawattamie co., Kan. P. 1205.

Saint Mary's, p.-v., Marion co., Ky., on Louisville and Nashville and Great Southern R. Rs. P. 113.

Saint Mary's, tp., Perry co., Mo. P. 1940.

Saint Mary's, p.-v. and tp., Ste. Genevieve co., Mo., on Mississippi River. P. 397.

Saint Mary's, tp., Wake co., N. C. P. 2124.

Saint Mary's, p.-v. and tp., Auglaize co., O., on Miami Canal, has 1 weekly newspaper. P. of v. 1370; of tp. 2120.

Saint Mary's, p.-b., Elk co., Pa., on Philadelphia and Erie R. R., has 3 churches, a convent, and seminary, 1 bank, 1 newspaper, 2 foundries, 2 flouring and 2 planing mills, and several wagon and carriage manufactories. Principal business, lumbering and mining coal. P. 1084.

G. C. Brandon, Ed. "Gazette."

Saint Mary's, p.-v., cap. of Pleasants co., West Va., on Ohio River.

Saint Mary's Hall, an Episcopal school for girls, situated at Faribault, Minn., 56 miles from St. Paul, was founded in 1866 by the Rt. Rev. H. B. Whipple, bishop of Minnesota. In 1872 the school came under the control of a board of trustees. The bishop is president of the board and rector of the school. It has accommodations for 70 resident pupils. Its curriculum embraces a preparatory department, followed by a four years' course in history, English literature, Latin, modern languages, mathematics, and natural sciences. Music, drawing, and painting also receive special attention. It has a corps of 10 teachers, including the principal, Miss S. P. Darlington. It has property amounting to $[illegible],000, including a valuable telescope, philosophical and chemical apparatus, a museum, and library.

R. W. L[illegible].

Saint Mary's Mission, p.-v., St. Mary's tp., Pottawattamie co., Kan., on Kansas Pacific R. R., and on the Pottawattamie reserve, 23 miles from Topeka, has 1 weekly newspaper.

Saint Mary's River, connecting Lake Superior with Lake Huron, is not a continuous stream, but a series of small lakes. Mud Lake is entered from Lake Huron through several broad and deep outlets; this lake is about 20 miles long. Thence to the foot of the falls (Sault), 40 miles farther, there are two channels, the navigable one through Lake George, and a shorter one through Hay Lake, which it is proposed to improve. From the head of the falls to Lake Superior (15 miles, making total length 75 miles) the river is partly a lake and partly a gradual expansion into Lake Superior. The total fall is estimated at $21\frac{7}{10}$ feet, of which 18 feet are at the falls. Ste. Mary's Falls Canal was built to enable vessels to pass around these rapids. In 1850 a grant of 750,000 acres of land was made to the State of Michigan, by act of Congress, to defray the cost of building the canal. Work was commenced in 1853 by a company under contract with the State, and on June 18, 1855, the canal was opened to navigation. It is supposed that it cost the company about $1,000,000. As originally built, the canal was 5400 feet in length, had a width of 100 feet at the water-line, with paved slopes of $1\frac{1}{2}$ to 1, and a depth of 12 feet at mean stage. The locks, located near the foot of the canal, were two in number, combined, each 350 feet long, 70 feet wide, lift 9 feet. There was a guard-gate near the upper end of the canal. The capacity of the canal and locks was soon found to be inadequate to the rapidly-developing navigation to and from Lake Superior. To ameliorate these evils the improvement of the canal was taken in hand by the U. S., and work commenced in 1870. When completed, the improvements will consist of a new lock parallel to and at a clear distance of 100 feet from the old locks; an enlargement of the old canal so as to uncover the approaches to the new lock; deepening the canal to a depth of 16 feet; removing the old slope-walls, and substituting for them a timber revêtment with a vertical face; the lock-chamber will be 515 feet long, 80 feet wide, with a lift of 18 feet and a depth of 17 feet of water on the sills. To facilitate repairs, a pair of guard-gates will be placed both above and below the lock-chamber. The estimated cost of the improvement is $1,800,000. The great cost of both the original work and the improvement is due to the difficult character of the excavation in sandstone overlaid with a compact bed of gravel and boulders, to the remoteness of the work from sources of supply, and to the severity of the winters.

G. Weitzel.

Saint Mary's River, of Georgia and Florida, rises in Okeefenokee Swamp, and throughout a large part of its course of 100 miles is the boundary between the two States. Its bar has 13 feet of water at low tide, and 18 or 20 feet at high tide. Large vessels ascend 9 miles to St. Mary's, and small steamers can go up many miles farther.

Saint Mat'thew's, tp., Wake co., N. C. P. 2192.

Saint Maurice', county of Quebec, Canada, extending N. W. from the St. Lawrence, and reaching far into the northern wilderness. Its S. E. portion is fertile. Iron ore is found. The lumber-trade is important. There are large manufacturing interests in the vicinity of Three Rivers, the capital. P. 19,558.

Saint Maurice For'ges, p.-v., St. Maurice co., Quebec, Canada, on the navigable St. Maurice River, $7\frac{1}{2}$ miles from Three Rivers. Here bog-iron ore is extensively collected, smelted, and cast for stoves. Six miles E. is the beautiful St. Maurice Village, Champlain co., where bog-ore, moulding-sand, limestone, fireproof stone, etc. abound. P. of the Forges, about 300; of St. Maurice Village, about 250.

Saint Maurice River, a northern tributary of the St. Lawrence, which it enters at the city of Three Rivers, 9 miles below Lake St. Peter, in the province of Quebec. From its source, 216 miles N. N. W. from the city of Montreal, it flows N. E. 66 miles, then 167 miles S. E., then 130 miles southerly to its mouth; total length of course, 363 miles; extreme length of valley, 225 miles, width 140 miles; area, about 16,000 sq. m. Its chief tributaries are the Mattawin, 120 miles long; the Bostonnais, 75 miles long; the Croche, 85 miles long; the Vermilion, 115 miles long; and the Mannowan, 90 miles long. The St. Maurice is navigable for steamboats from the Grand Pilles, 34 miles above its mouth, to La Tuque Rapids, 66 miles farther up. The climate is generally too cold for the growth of wheat, though suitable for it in the lower two-thirds of its valley. Its forests contain much valuable timber, that with its iron, which is abundant and of an excellent quality, constitutes its chief wealth and its principal export. About 500,000 saw-logs of pine and spruce are cut annually on the St. Maurice. The wild scenery of the river is highly interesting. Apart from Niagara, the Falls of Shawenegan, 22 miles above the mouth of the St. Mau-

rice, 160 feet in height, are incomparably the greatest and most sternly impressive of the waterfalls of old Canada. The ordinary discharge under the two bridges of 1400 and 600 feet in length, that span its channels near its mouth, is about 40,000 cubic feet per second. A. J. RUSSELL.

Saint Mi'chael, the largest of the AZORES (which see), in lat. 37° 44′ N., lon. 25° 30′ W., comprises an area of 340 sq. m., with about 81,000 inhabitants. It is the most fertile and best cultivated of the Azores, and exports annually to England alone 100,000 boxes of oranges, valued at £60,300. Grain is exported to Portugal, coarse linen and pottery to Brazil. Chief towns, Ponta Delgada and Ribeira Grande.

Saint Michael's, p.-v. and tp., Talbot co., Md., on St. Michael's estuary, has 1 weekly newspaper, several shipyards, and a considerable trade in oysters. P. of v. 1095; of tp. 3448.

Saint Michael's, tp., Madison co., Mo. P. 1325.

Saint Michel' de Bellechasse', p.-v., cap. of Bellechasse co., Quebec, Canada, on the S. shore of the St. Lawrence and on Grand Trunk Railway, 15 miles below Quebec. It has a convent, a commercial college, a lumber-trade, and 2 steamers plying to Quebec. P. about 700.

Saint Mihiel', town of France, department of Meuse, on the Meuse, has manufactures of yarn, stockings, hosiery, cotton cloth, and leather. P. 5467.

Saint Nazaire', town of France, department of Loire-Inférieure, at the mouth of the Loire, has a large and commodious harbor, recently constructed. As the navigation of the Loire becomes more difficult every year on account of the amount of sand which it carries with it, St. Nazaire seems most likely to become the chief entrepôt of the great traffic of this river. It had 2391 inhabitants in 1851, 6500 in 1861, over 15,000 in 1871.

Saint Nich'olas, p.-v., Mahonoy tp., Schuylkill co., Pa., on East Mahanoy branch of Philadelphia and Reading R. R.

Saint Nic'olas, town of Belgium, province of East Flanders, has the largest flax-market in the world, and extensive manufactures of linen, woollen, cotton, and silk fabrics, hosiery, hats, soap, leather, salt, and tobacco. It is situated in one of the most fertile and most densely-peopled districts of Belgium, and besides the exportation of its manufactured goods its home trade is very important. P. 23,388.

Saint Nicolas, v., Levis co., Quebec, Canada, on the S. shore of the St. Lawrence, 15 miles above Quebec, with which it is connected by steamer. It has a large lumber-trade and many manufactories. P. about 600.

Saint Olof, p.-v. and tp., Otter Tail co., Minn. P. 408.

Saint Omer', town of France, department of Pas-de-Calais, on the Aa, is fortified and well built, and has extensive manufactures of salt, beetroot-sugar, soap, brandy, and clay pipes. P. 22,381.

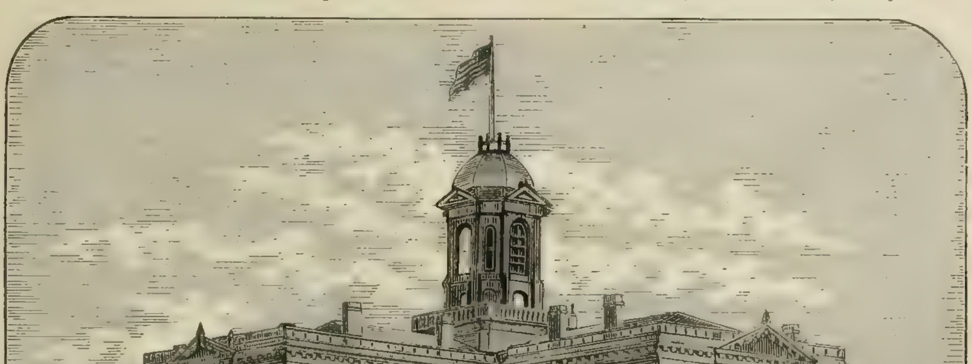
Saint Ours, p.-v., Richelieu co., Quebec, Canada, on the E. bank of Richelieu River, 12 miles from its mouth, has a good trade, manufactures of shipping and of bricks, a mineral spring, and a convent. P. 701.

Saint Par'is, p.-v., Champaign co., O., on Pittsburg Cincinnati and St. Louis R. R., has 5 churches, a public school, 3 warehouses, 1 newspaper, 1 bank, 2 carriage-factories, 1 flouring and 2 planing mills, and 2 saw-mills. Large quantities of grain, flour, stock, and lumber are exported. P. about 1200.
W. H. GRIBBLE, ED. "NEW ERA."

Saint Paul, town of the French island of Bourbon, on the western side of the island, has a good harbor and considerable trade. P. 16,262.

Saint Paul, p.-v., Adams tp., Decatur co., Ind., on Indianapolis Cincinnati and Lafayette R. R. P. about 500.

Saint Paul, capital and largest city of Minnesota, county-seat of Ramsey co., on Mississippi River, 2082 miles from its mouth, in lat. 44° 52′ 46″ N. and lon. 93° 4′ 54″ W. It is built mainly on the E. bank, but by a recent extension of its corporate limits now includes a considerable area on the W. side of the river, the two sections being connected by a free bridge. It is built on three tables of land, the lowest being the "river-bottom;" the second, a plateau on which the main portion of the city is built, which is surrounded by an amphitheatre of hills on which are some elegant residences. A considerable portion of the second plateau is underlaid by a bed of limestone of great value for building purposes. The first house was built in 1838, and the city derives its name from a Roman Catholic mission chapel erected in 1841; incorporated as a town in 1849, and as a city in 1854. Its pop. in 1850 was 1083; in 1860, 10,401; and in 1870, 20,030. The present area of the city is 13,583 acres. Its educational system is very complete, having 13 school buildings, valued at $189,000, with 4911 scholars enrolled, 84 teachers, a fine high school, etc., all costing annually $81,000. There are also 2 female seminaries of high order and several private schools, while the Roman Catholics have parochial schools with over 2000 scholars. There are 38 churches, some of them very large and costly, and 2 theatre buildings. There are 3 public libraries, ranging from 7000 to 10,000 vols. each, and an academy of natural sciences. Two daily, 1 tri-weekly, and 9 weekly papers are published in five languages. The city owns a park of



City Hall, St. Paul.

[illegible] several public squares [illegible] a horse railroad with a [illegible] extent. The city is sup[illegible] a large and beautiful lake on the [illegible] creating a natural pressure. [illegible] a limitable system of sewerage. [illegible] force, an efficient paid fire [illegible] fire-alarm telegraph. There are [illegible] and 3 private banking houses, total [illegible]. There are 2 orphan asylums, a hos[illegible] the friendless, 2 Magdalen reformatories. [illegible] school is located on the edge of the [illegible] U. S. has a granite custom house and post office [illegible] costing $400,000, in which the U. S. courts are held. [illegible] capitol, built in 1853 and subsequently enlarged, is [illegible] plan. There are 8 railroads terminating at the city, and one or more steamboat lines. There are 2 extensive grain elevators, a number of wholesale houses, many fine business blocks, hotels, etc. The principal manufacturing is agricultural implements, machinery, furniture, boots and shoes, etc. The assessed valuation of property is $27,000,000. J. F. WILLIAMS.

Saint Paul, p.-v. and tp., cap. of Howard co., Neb., on Loup fork of Platte River.

Saint Paul, p.-v. and tp., Robeson co., N. C. P. 1052.

Saint Paul de Loan′da, capital of the Portuguese dominions in Lower Guinea, Africa, at the mouth of the Bengo, in lat. 8° 48′ S., lon. 13° 13′ E. Its harbor is excellent and strongly fortified; some parts of it are well built of brick, with roofs of tiles; it exports beeswax and ivory. P. [illegible]600, of whom 1600 are white.

Saint Pau′lin, p.-v. of Maskinongé co., Quebec, Canada, 33 miles N. W. of Three Rivers. Here is a splendid cataract, and great quantities of lumber are sawn in the vicinity. P. about 200.

Saint Paul's, tp., Clarendon co., S. C. P. 960.

Saint Paul's Bay, p.-v., cap. of Charlevoix co., Quebec, Canada, on the N. shore of the St. Lawrence, 60 miles below Quebec. It has a good trade, a court-house, a convent, iron and plumbago mines, saline and sulphur springs, and limestone and garnet rocks. Steamers ply to Quebec. P. of sub-district, 3625.

Saint Paul's Parish, tp., Colleton co., S. C. P. 4656.

Saint Pe′ter, p.-v., cap. of Nicollet co., Minn., on Minnesota River, at the junction of Winona and St. Peter and St. Paul and Sioux City R. Rs., has 9 churches, schools, 1 bank, 5 hotels, 2 newspapers, a furniture establishment, foundry and machine-shops, and 2 flouring mills. The Minnesota hospital for the insane is located here. P. 2124. J. K. MOORE, ED. "ST. PETER TRIBUNE."

Saint Peter's, seaport of Richmond co., Cape Breton Island, on St. Peter's Bay. A canal half a mile long and 13 feet deep leads hence to the Bras d'Or. P. about 250.

Saint Peter's, port of entry of Gloucester co., N. B., at the mouth of Big Nepisiguit River, opposite Bathurst, with which it is connected by a handsome bridge. It has an academy and a large lumber trade, and shipbuilding is carried on. P. about 600.

Saint Peter's, tp., New Kent co., Va. P. 1122.

Saint Pe′tersburg, government of European Russia, bordering N. on the Gulf of Finland and Lake Ladoga, comprises an area of 17,260 sq. m., with 621,808 inhabitants, exclusive of the capital. The ground is low and level, the climate damp and cold, the soil thin and little productive. Marshes and forests cover two thirds of the surface. [illegible] hemp, flax, and rye are the common crops; market gardening is extensively carried on around the capital.

Saint Petersburg, capital of Russia, the residence of the czar, and the seat of the government, in lat. 59° 56′ 30″ N., lon. [illegible] E., on the delta of the Neva, about 20 miles E. of its port, Cronstadt. Its location is not very favorable. The [illegible], the Neva is covered with ice for five months, and [illegible] mean winter temperature of 18°; the thermometer is [illegible] to have fallen to −31°. A bar across the mouth of the river prevents vessels drawing more than 9 feet of water from reaching the city, and the elevation of the site above the [illegible] is so small that, although both the river arms and the canals are lined with high stone quays, destructive inundations have taken place now and then, as, for instance, in 1824. [illegible] the ground itself is marshy and [illegible], and in spite of extensive and costly draining typhoid fevers are frequent. To form a sufficiently solid foundation for the Nikolaevski bridge three sets of piles had to be driven into the ground, one on the top of the other, and the foundation of the church of St. Isaac is said to have cost $1,000,000. Nevertheless, Peter the Great, who founded the city in 17[illegible], and declared it his capital in 1712, and Catharine II., were very solicitous for its growth and prosperity, succeeded in building up here one of the most brilliant capitals of Europe, and forming a commercial and industrial centre of great importance. The city consists of two parts—the Great Side (*Bolshaya Storona*), situated on the main land, on the southern side of the Great Neva; and the Petersburg Side, situated on the numerous islands formed by the arms of the Neva, Vasili Ostrov, Volni, Petrovski, Citadel Island, Aptekarski, Krestovski, Kamennoi, and Velaginski. Only one permanent bridge leads across the Great Neva—namely, the Nikolaievski, from the English quay in front of the admiralty building on the southern branch to the Vasili Ostrov shore. It is a magnificent structure of granite, 1200 feet long, resting on seven elegant arches, and completed in 1850. The other bridges across the Great Neva are all temporary, supported on boats and removed each autumn when the frost comes. The Annitchkoff bridge, across the Fontanka Canal, is also a splendid structure, 110 feet long, and decorated with four groups of wild horses. About 150 bridges connect the islands with each other. The Great Side is the most elegant part of the city, containing a great number of palaces, churches, government buildings, etc., all of which are of immense dimensions, generally gorgeously decorated, and often of a fine architectural effect. The Nevski Prospekt, leading in a south-eastern direction from Admiralty Square, is one of the finest streets in Europe, 130 feet broad, 4 miles long, lined with palaces, and planted with trees. The Petersburg Side is principally the seat of the commercial and industrial interests; some of the islands are occupied by villas and gardens. The most remarkable of the public buildings is the church of St. Isaac, 330 feet long, 290 feet broad, 310 feet high, built in the form of a Greek cross, entered from each side through a magnificent peristyle composed of twelve or sixteen monolithic columns of polished granite 60 feet high and 7 feet in diameter at the base, and surmounted by a dome rising 120 feet above the peristyles, resting on 30 columns, covered with copper, and richly gilded. In the church of St. Peter and St. Paul, whose elegant gilt spire rises 208 feet, and can be seen from all parts of the city, the Russian czars have been buried since the time of Peter the Great. In the church of St. Alexander Nevskoi the body of this saint is preserved in a sarcophagus of solid silver. The Winter Palace, one of the largest palaces in the world, forms a square 455 feet long, 350 feet broad, contains immense wealth in its decorations and furniture, and is inhabited, when occupied by the czar, by 6000 persons; it was burnt down in 1837 and rebuilt in 1839. The Hermitage, built by Catharine II., and connected with the Winter Palace, contains one of the most valuable picture-galleries in the world, rich especially in works of the Spanish school, collections of statuary, gems, vases, arms, a library of 120,000 vols., a theatre, etc. The Annitchkoff Palace was the residence of Nicholas I. Of the public squares, Admiralty Square is the largest. The Palace Square contains the Alexander column, 150 feet high, whose shaft is a monolith 80 feet high, of red granite. In Peter's Square stands a fine equestrian statue of Peter the Great. The educational and benevolent institutions are numerous and good. The imperial library contains over 1,000,000 vols. and 35,000 MSS. The Academy of Sciences, founded by Peter the Great, has a library of 120,000 vols., an excellent ethnographic museum, large numismatic and anatomical collections, etc., and a botanical garden with the largest palm-house in Europe. The university, founded in 1819, was attended by 1413 students in 1872. The mining school has the best collection of minerals in the world. Many special schools and female gymnasia are established, and a number of compulsory elementary schools were opened in 1873. A celebrated institution is the foundling hospital. The manufactories, imperial and private, comprise glass, porcelain, and malachite ware, Gobelins tapestry and embroidery, arms, surgical and optical instruments, linen, woollen, cotton, and silk goods, paper, soap, tobacco, etc. About 3080 vessels enter the harbor annually, and railways connect the city with Moscow, Warsaw, and Berlin. P. 667,026, of which about 40,000 are Germans. CLEMENS PETERSEN.

Saint Petersburg, p.-v., Clarion co., Pa., 90 miles N. of Pittsburg, has 3 churches, an opera-house, excellent graded schools, 1 bank, a driving-park, 1 carriage factory, 2 hotels, a fire department, waterworks, 1 newspaper, and head-quarters for 2 important pipe-lines. Annual exportation of crude petroleum, 2,000,000 barrels. P. about 1800. F. H. BARCLAY, ED. "PROGRESS."

Saint Peter's Church. See PETER'S, ST., CHURCH.

St. Peter's Port, capital of Guernsey, has a good harbor and many fine villas and cottages. P. 16,388.

St. Pie de Deguire, v., Yamaska co., Quebec, Canada, on the river La Vache, in a forest-region, 25 miles

E. S. E. of Sorel. It has iron-mines, furnaces, foundries, charcoal-works, and a good water-power. (P. O. RIVER DAVID.) P. about 225.

Saint Pierre′, town of the French island of Bourbon, in the Indian Ocean, on the southern shore of the island, has a good harbor and a rapidly increasing trade. P. 14,135.

Saint Pierre, town of the French island of Martinique, in the West Indies, on the western coast, is elegantly built, has a good harbor, and carries on a very lively trade. It has many educational and benevolent institutions, several fine churches, and a handsome theatre. P. about 30,000.

Saint Pierre and Miquelon, a group of three small islets at the mouth of the Gulf of St. Lawrence, near the S. coast of Newfoundland, constituting a French colony, valuable only as a rendezvous for the vessels engaged in the cod fisheries, of which some 1500 annually enter the port. Area, 81 sq. m. P. 4750. St. Pierre, the capital, has a p. of 800.

Saint-Pierre, de (CHARLES IRÉNÉE CASTEL), ABBÉ, b. near Harfleur, department of Seine-Inférieure, France, Feb. 18, 1658; was educated by the Jesuits at Caen; entered the order; became chaplain to the bishop of Orleans in 1702, subsequently almoner to the duchess of Orleans; accompanied Cardinal Polignac to the Congress of Utrecht; published here in 1713 his *Projet de Paix perpétuelle*, and in 1718 *Discours sur la Polysynodie*. In this latter work he censured the government of Louis XIV. very freely, and was immediately expelled from the Academy, of which he had been a member since 1695. He continued, however, to write on moral and political subjects, and even repeated his criticisms of Louis XIV. in a much sharper form in his *Annales politiques*. His *Ouvrages de Politique et de Morale* appeared in 16 vols. at Rotterdam (1735–41). D. at Paris Apr. 29, 1743. His *Life* has been written by Goumy and by Molinaro, both in 1861.

Saint-Pierre, de (JACQUES HENRI BERNARDIN), b. at Havre Jan. 19, 1737; commenced his education for an ecclesiastical career at Caen; went in 1750 to Martinique as a sailor, returned a few years after; attended the school of engineering at Rouen, but lost in 1760 his position in the army on account of insubordination; went to Malta to become engineer to the knights, but was not appointed; gave lessons in mathematics in Paris; worked as an editor at Amsterdam; went to St. Petersburg, and was appointed a captain in the engineering corps of Finland, but failed to interest Catharine II. in his schemes of a model republic; left the country in 1766; fought against the Russians in Poland, inspired by a Polish princess; then again in Saxony against the Poles, to avenge himself on his former inspiration; returned to France and received a position as an engineer in the Isle de France; returned in 1771 to Paris and determined to devote himself to literature; associated much with Rousseau, who exercised a considerable influence both on his style and his ideas; published in 1773 *Voyage à l'Isle de France*, etc. (2 vols.), which was well received; in 1784, *Etudes de la Nature* (5 vols.), which gave him rank among the best French prose-writers; in 1788, *Paul et Virginie*, which became one of the most celebrated books of the age and was translated into all European languages; in 1790, *La Chaumière indienne* and *Le Café de Surate*, etc.; was made director of the botanical garden in 1792, professor in morals at the normal school in 1794; received a pension under the Empire. D. at his estate, Eragny-sur-Oise, Jan. 21, 1814. Aimé Martin, who married his widow, gave a collected edition of his works in 12 vols. in 1818–20; his posthumous works, letters, and a biography in 4 vols. in 1833.

Saint Pierre-les-Calais′, town of France, department of Pas-de-Calais, manufactures leather, beetroot-sugar, files, linens, and tulles, for which latter product it is celebrated. P. 15,008.

Saint Pol de Léon′, town of France, department of Finisterre, near the English Channel, has manufactures of linen and a trade in flax, hemp, wax, honey, horses, and cattle. P. 6704.

Saint Pöl′ten, town of Austria, province of Lower Austria, on the Trassen, is surrounded by walls, is the see of a bishop, and has a fine cathedral, several good educational institutions, and manufactures of glass, paper, and earthenware. P. 5800.

Saint Quentin′, town of France, department of Aisne, on the Somme, has extensive manufactures of cotton yarn which employ over 5000 hands; of linen, tablecloths, lace, muslin, and gauze, in the production of which latter article 500 weavers are employed; besides large distilleries and soapworks. It contains a celebrated Gothic church, and is surrounded by beautiful promenades occupying the site of its old fortifications. P. 34,811. A battle took place here on Aug. 10, 1557, between the army of Philip II. of Spain and the French, in which the latter were defeated; and on Jan. 18, 1871, the French army of the North met here with the 1st German army. The former, under the command of Gen. Faidherbe, pushed forward from the northern fortresses toward Paris, in order to attack the besieging German army; the latter, under the command of Gen. von Göben, was sent against it to prevent the attack. Faidherbe had 40,000 men and 70 pieces, and occupied the hills to the S. of the city, on both sides of the canal of Crozal. Gen. von Göben had 39 battalions of infantry, 53 squadrons of cavalry, and 162 pieces, with which he attacked the French position early in the morning of Jan. 19. At four o'clock in the afternoon the French army began to retreat, and at seven o'clock it was in full flight toward Cambrai and Guise. It lost 9000 prisoners, 3000 wounded, and 6 pieces; the German loss was 94 officers and 3369 men. In the evening St. Quentin was occupied by the Germans.

Saint Re′gis, p.-v., situated partly in Bombay tp., Franklin co., N. Y., and partly in St. Regis tp., Huntingdon co., Quebec, Canada, on St. Lawrence River, opposite Cornwall, with which it is connected by ferry. It is inhabited by the St. Regis Indians, an Iroquois tribe speaking the Mohawk dialect. They are mostly Roman Catholics, but a few are Methodists. They are divided into two parties, the British and the American, and owe their allegiance not according to residence, but according to descent in the female line. Their reservation in the U. S. is 14,000 acres, and that in Canada rather larger. Their ancestors settled here in 1760. The American party numbered 683 souls in 1872, and the British about 800. (P. O., ST. REGIS, Huntingdon co., Quebec, Canada, or HOGANSBURG, N. Y.)

Saint Remy′, town of France, department of Bouches-du-Rhône, contains interesting remains of the ancient *Glanum*, among which is a triumphal arch in honor of Drusus. Large manufactures of silk are in operation. P. 6348.

Saint Romuald, or **New Liverpool,** p.-v., Levis co., Quebec, Canada, on the S. side of the St. Lawrence, 5 miles above Quebec, to which steamers ply daily. It has a large lumber-business. P. about 700.

Saints' Days, in the calendar of the Church are days set apart for the special commemoration of any saint. In the Roman Catholic Church the number of saints is very great, and a considerable number of saints are commemorated on each day of the year; but it is the custom to assign to particular countries, districts, or dioceses a certain number of saints for special commemoration. These saints' days constitute the calendar for that district. Any day not a saint's day in the local calendar, and not a festival nor a Sunday, is called a *feria*; other days are either holy days of obligation, doubles, semi-doubles, or simples, according to the solemnity of the occasion and of the service for the day. These points, with other information with regard to the festivals, are set forth in a yearly publication called the *Ordo*.

Saint Sebast′ian, town of Spain, capital of the province of Guipuscoa, on a peninsula in the Bay of Biscay, is surrounded with strong walls and defended by a citadel. Its streets are broad and straight and lined with elegant houses; its harbor, though not safe, is frequented by large vessels. A large import-trade in French and English goods is carried on, and during the summer the town is much resorted to as a watering-place. P. about 14,000.

Saint Servan′, town of France, department of Ille-et-Vilaine, at the mouth of the Rance, opposite St. Malo. It has two good harbors and an active commerce. It is fortified, and much frequented as a watering-place. P. 12,704.

Saint-Simon′, de (CLAUDE ANNE), MARQUIS, b. at the castle of La Faye, France, in 1743; studied in the military school at Strasbourg; served in Flanders and in Poland; became brigadier 1770; sailed for Martinique 1779 with the regiment of Poitiers, and had during the voyage three engagements with Admiral Rodney; entered the Spanish service as field-marshal Mar. 1, 1780; commanded the French contingent of 2000 men in the Yorktown campaign, during which he received several wounds; was a deputy to the States General 1789; soon afterward again entered the Spanish service; defended Madrid against the French 1808, for which he was condemned to death, but reprieved at the solicitation of his daughter, and became captain-general and a grandee of Spain on the return of Fernando VII. in 1814. D. in Spain Jan. 3, 1819.

Saint-Simon, de (CLAUDE HENRI), COUNT, b. at Paris Oct. 17, 1760; received a military education and enjoyed the instruction of D'Alembert in mathematics; entered the army in 1777; went to America in 1779, and distinguished himself at Yorktown in 1781, but was captured by the English when attempting to return to France, and brought to Jamaica, where he was held till peace was concluded in

1783. Meanwhile, other and larger plans had arisen in his mind. He laid before the viceroy of Mexico a plan of connecting the Pacific and the Atlantic by a canal, of which, however, no notice was taken; and on his return to France he gave up the military career and went in 1785 to Holland, where he proposed to organize a Dutch-French expedition against the British East Indies; and in 1786 to Spain, where he proposed to connect Madrid with the sea by a canal. But all such plans failed to attract any attention. The Revolution he received with enthusiasm, but not finding in the general confusion a place which exactly fitted his talents and his aspirations, he formed in 1790 a partnership with a certain Count de Redern and began to speculate in the confiscated real estate of the émigrés. During the Reign of Terror he was imprisoned for eleven months; by his partner he was cheated, it is said; nevertheless, he succeeded in retiring in 1797 from the toils and perils of this period of his life with a fortune of 150,000 francs. He now began to study the sciences and form immense plans for a fundamental reconstruction of human society; kept an elegant *salon*, where many scientific men gathered; married in 1801, and lived in splendor and luxury for about one year. In 1802 the fortune was spent. But a brilliant idea presented itself to his mind. Baron von Stael-Holstein had just died. St. Simon divorced his wife, repaired to Coppet, and proposed to Madame de Stael, confident that she would be immediately carried away by his world-reforming plans, compared with which the Revolution itself would be an every-day event. The lady declined, and under very straitened circumstances he now began his literary activity by his *Lettres d'un Habitant de Genève à ses Contemporains* (Geneva, 1803), which fell flat to the ground. A short time after, he received a small clerkship in the office of the Mont de Piété at Paris, and lived in obscurity till Diard, a former friend of his, took him into his house, and furnished him with means for the publication of his *Introduction aux Travaux scientifiques du 19me Siècle* (Paris, 2 vols., 1808), which also remained almost unnoticed. In 1810 Diard died, and St.-Simon now often suffered from actual want; there are letters from him to Cuvier, Dégérando, Cambacérès, and others in which he begs for something to eat. Nevertheless, he continued to pursue his literary plans. In 1814 appeared *Réorganisation de la Société européenne*; in 1817–18, *L'Industrie, ou Discussions politiques, morales, et philosophiques*; and in the mean time the striking criticisms which his works often contained, the fertile hints which he threw out now and then, and the mental vigor which characterized even his confusion, attracted to him young men of great talents, such as Augustin Thierry, Auguste Comte, and others, who helped him both with money and with ideas. In 1820 he commenced a social journal, *L'Observateur*, and was indicted for saying in the first number that the death of 1000 workingmen was a greater loss to a community than the death of 1000 office-holders or the whole royal family; the jury acquitted him. This attracted some attention, and in 1821 *Le Système industriel* was published with some effect. Yet the success, the triumph, would not come; he fell into despair, and Mar. 9, 1823, attempted to commit suicide. He only lost one eye. He lived two years longer, and in a more collected state of mind wrote his two best works—*Catéchisme industriel* (1824) and *Nouveau Christianisme* (1825). D. at Paris May 19, 1825. *Œuvres choisies* (3 vols., 1859), *Œuvres complètes*, in connection with those of Enfantin (20 vols., 1865–69). (See SOCIALISM.) CLEMENS PETERSEN.

Saint-Simon, de (LOUIS DE ROUVROI), DUKE, b. Jan. 16, 1675; received a very careful education; entered the army in 1693; distinguished himself at Fleurus and Neerwinden, but left the army in 1702 for the court, where he acquired considerable influence, both under Louis XIV. and the regent, and developed a great activity, partly in futile intrigues, partly in important diplomatic negotiations. At the death of the regent, in 1723, he retired to his family estate. D. Mar. 2, 1755. This long term of leisure he employed to prepare his *Mémoires*, which were intended to be published by his grandchildren. But at his death the government seized them, and a multitude of unauthentic extracts came into circulation and considerable curiosity was excited. At last, Charles X. returned the manuscript to the family of the author, and two authentic and complete editions have appeared—in 21 vols. (1829–30) and in 20 vols. (1856–58). The work proved to be a document of great historical value and still greater literary interest.

Saint-Simonianism. See SOCIALISM.

Saint Ste'phen, port of entry of Charlotte co., N. B., pleasantly situated on the E. bank of St. Croix River, opposite Calais, Me., with which it is connected by a bridge. It is the terminus of a branch of New Brunswick and Canada Railway, is lighted by gas, does a heavy business in manufacturing and shipping lumber; has 5 churches, 2 weekly newspapers, a custom-house, a bank, and many fine residences. P. 6515.

Saint Stephen's, p.-v., cap. of Washington co., Ala., on Tombigbee River. P. 1214.

Saint Stephen's, tp., Richardson co., Neb. P. 601.

Saint Stephen's, tp., Charleston co., S. C. P. 3094.

Saint Stephen's College, at Annandale on the Hudson, was established in 1860 to provide special instruction for persons who at mature age had devoted themselves to the ministry. It was soon found necessary to enlarge its sphere, that young boys might be encouraged to devote themselves to the same work. Mr. John Bard of Annandale gave a number of acres of land, and also built a chapel at an expense of $34,000. He has also been an annual subscriber to defray its expenses. In 1860 a charter was obtained. Rev. George F. Seymour, M. A., was appointed its first head with the title of warden. He was succeeded in 1861 by Rev. Thomas Richey, D. D. Dr. Richey resigned in 1863. Rev. Robert B. Fairbairn, D. D., was appointed the third warden. The powers of the college have been enlarged, and the authority to confer degrees has been granted. It has been brought under the visitation of the board of regents of the University of the State of New York. The professorships of Latin, of Greek and Hebrew, of mathematics and natural philosophy, of history and of English language and literature, of moral philosophy, and of logic and metaphysics have been created and filled. Besides the chapel, the college has received the gift from Elizabeth Ludlow and her sister, Cornelia Ann Willink, of a spacious hall.

Saint Tam'many, parish of S. E. Louisiana, bounded E. by Pearl River, S. by Lake Pontchartrain, drained by Bogue Chitto and many other small streams, and crossed in its S. E. corner by New Orleans Mobile and Texas R. R., has a sandy surface, several brick manufactories, and shipyards. Staples, rice and molasses. Cap. Covington. Area, 1200 sq. m. P. 5586.

Saint Thom'as, an island off the western coast of Africa, in the Gulf of Guinea, in lat. 0° 27′ N., lon. 6° 3′ E., belongs to Portugal. Area about 140 sq. m. Pop. about 20,000, of whom very few are white. The island is high, of volcanic origin, exceedingly fertile, but extremely unhealthy. Sugar was formerly the principal product; coffee is now more extensively cultivated. Forests abound, yielding excellent timber and the finest varieties of wood. Chief town, St. Thomas.

Saint Thomas, p.-v., cap. of Elgin co., Ont., Canada, on London and Port Stanley and Canada Air-line railways, 9 miles N. of Port Stanley, on Kettle Creek. It has a large grain-trade and 2 weekly newspapers. P. 2197.

Saint Thomas, v. (P. O. MONTMAGNY), cap. of Montmagny co., Quebec, Canada, on the S. shore of the St. Lawrence, 48 miles below Quebec, and on Grand Trunk Railway. It has a college and a convent. P. about 1650.

Saint Thomas, v. (P. O. PIERREVILLE), Yamaska co., Quebec, Canada, partly inhabited by Abnaki Indians. It is on St. Francis's River, opposite St. François du Lac, 60 miles by steamer below Montreal. Barges are built and firewood, grain, lumber, and buck and moose skin goods are largely exported. There are large steam-mills in the vicinity. P. about 1200.

Saint Thomas, one of the Virgin Islands, in the West Indies, in lat. 18° 20′ N., lon. 64° 55′ W., belongs to Denmark. Area, 45 sq. m. P. 15,500. Since the forests have been cut down the rivers and brooks have dried up, and the light, sandy soil, exposed to the scorching sun, has become almost totally unproductive on account of lack of water. The island is important only on account of its excellent harbor, Charlotte Amalie.

Saint Thomas, p.-v. and tp., Franklin co., Pa. P. of v. 389; of tp. 1902.

Saint Thomas and Saint Dennis, tp., Charleston co., S. C. P. 2119.

Saint Trond, town of Belgium, province of Limburg, has large breweries and distilleries and manufactures of lace and beetroot-sugar. P. 11,573.

Saint Valery-en-Caux, town of France, department of Seine-Inférieure, on the English Channel, carries on extensive herring and mackerel fisheries, besides an active coasting-trade. P. 5377.

Saint Valier', de (JEAN BAPTISTE DE **LACROIX**), CHEVRIÈRE, b. at Grenoble, France, Nov. 14, 1653; became chaplain to Louis XIV.; was appointed vicar-general of Quebec by Bishop Laval 1684; arrived in Canada July 30, 1685; returned to France Nov., 1687; was consecrated bishop of Quebec Jan. 25, 1688; arrived in Canada in August of the same year; founded the general hospital at Quebec; was captured by the English at sea while return-

ing from a visit to France July, 1704, and remained a prisoner until 1709. D. at Quebec Dec. 26, 1727. Author of *État présent de l'Eglise et de la Colonie française dans la Nouvelle France* (1688).

Saint Viateur', Congregation of, a congregation of Roman Catholic priests first established at Vourles, France, by J. L. J. Querbes; received papal approbation in 1833 and 1838; introduced into North America in 1847; devoted to the work of religious and other instruction.

Saint Vin'cent, one of the Lesser Antilles, in the West Indies, in lat. 13° 13′ N., lon. 61° 15′ W., belongs to Great Britain. Area, 131 sq. m. P. 35,688. The surface is high, volcanic, and mountainous, the highest peak, La Soufrière, rising 3000 feet above the level of the sea. The climate is hot and very moist, though not unhealthy. The soil is very fertile, and sugar, rum, and molasses are exported annually to the value of nearly £300,000. Chief town, Kingston.

Saint Vincent, Cape. See CAPE ST. VINCENT.

Saint Vin'cent de Paul, p.-v., Laval co., Quebec, Canada, on Isle Jésus, 11 miles from Montreal, is the site of the provincial reformatory prison, a well-managed institution, having a fine building. P. about 1000.

Saint Vincent, EARL OF. See JERVIS (Sir JOHN).

Saint Vi'tus's Dance. The form of disease that received this name was a species of chorea which broke out at Strasbourg in the year 1418, following the plague. The same disease appeared in Aix-la-Chapelle as an epidemic in the fourteenth century, and was then known as "St. John's Dance." Almost simultaneously a malady originated in Italy, there called *tarantism*, and identical with the dances of St. John and St. Vitus. These several conditions presented common symptoms, consisting of jumping, fantastic dancing, and involuntary cries; with these strange symptoms there was catalepsy, when the victim would have visions of either St. Vitus or St. John. These seizures would last until the sufferer was entirely exhausted. On the feast-day of St. John the disorder made its appearance. The people in the course of their dissipation would kindle large fires through which men and women leaped, believing that the attacks would be aborted by this procedure. The excitement attendant upon this undoubtedly brought on the disease. The dance of St. Vitus received its name from the fact that the sufferers went when afflicted to the chapel of St. Vitus, assured that this holy person would listen to their prayers and those of the priests, who also sang masses and interceded for them. All persons of this class who before had St. John's dance now had the dance of St. Vitus.

This name is applied to the disease even at the present day as a common term. In the seventeenth century the disease changed its character somewhat, hysteria being a prominent symptom, and there was a disappearance of a great many of the maniacal outbursts. The condition known as tarantism was supposed to be due to the bite of the tarantula, but in reality it was caused by actual morbid fear of the consequences of a bite. The patients were dull and moody until they heard certain kinds of music. They would then leap into the air in a state of frantic excitement, and dance in an extravagant manner; some would be impelled to cast themselves into the sea, and others would commit disgraceful sexual excesses. They usually danced until utterly worn out, and then fell to the ground. Wind instruments and drums produced the music which seemed to influence them the most quickly. There are numerous cases of chorea recorded in late years that closely simulate the tarantism of several hundred years ago. Dr. Kinder Wood of England had a patient who suffered from this form of chorea; the roll of a drum would stop the attacks. A species of dancing disease very closely allied to St. Vitus's dance appears in certain parts of Africa, particularly in Abyssinia. The disease is known as *tigritier*. The malady begins in an acute form, and runs at first the course of an ordinary continued fever. The priest is appealed to, who arranges the programme and conducts the ceremonies. He leads the patient out into the market-place; when music is played by a band of his dusky friends he begins to dance, and continues all day; he then stops, turns irresolutely, and starts off on a run, and goes a great distance, not stopping till utterly fatigued, when some one of the tribe strikes him on the back with the flat part of the blade of a large knife, and asks him his name. If the disease has disappeared and the mind cleared up, of course he will be able to tell it. Full particulars of this interesting condition are given by many of the English travellers.

It seems as if these same superstitious diseases were not confined to the Middle Ages or to barbarous people. Frequent illustrations of a modern form are shown at the present day among the many fanatical sects affected by kindred conditions. Dancing Shakers, dancing dervishes, and the members of religious societies in France known as *Convulsionnaires* have these peculiar choreiform attacks as a part of their religious ceremonies. Our own camp-meetings abound in examples. Attacks of the disease last frequently for months, and young women often become the victims of a peculiar morbid emotional state which frequently renders their incarceration in an asylum a matter of necessity. These attacks result from a depressed condition of the system, as a sequence of a long-continued state of emotional excitement, of fasting, and, to a certain extent, contact with other individuals affected like themselves. Schele de Vere relates in his *Modern Magic* that in the consecration of a magnificent church at Liege a great many people affected with St. Vitus's dance gave themselves up to shameless dances, and falling exhausted, after spasms and convulsions, requested friends to press violently upon their chests, and thus a seizure was stopped.

The violent forms of chorea of modern times differ from the ancient St. Vitus's dance so far as the mental condition is concerned. The victims of the disease now rarely believe themselves to be possessed. The superstition and ignorance of the Middle Ages did much to foster a general belief in possession by the devil. This is evident from the manner in which cures were effected, by the laying on of hands and exorcising by the priests. Of course the power of advanced religious knowledge and increased ability for reasoning, improved morals, and increase of Christian faith have entirely changed the barbaric character of the disease. ALLAN MCLANE HAMILTON.

Saint Wen'dell, p.-v. and tp., Stearns co., Minn. P. 356.

Saint Yrieix', town of France, department of Haute-Vienne, has large manufactures of porcelain, earthenware, glass, linen, and leather, and a trade in agricultural products. P. 7613.

Sai'vas, the members of one of the three great modern groups of sects of the Hindoo religion, designating those who pay exclusive or pre-eminent adoration to Siva in his various incarnations, especially under the form of the linga. (See HINDU RELIGION, by PROF. JOHN DOWSON.)

Sakhalin Ula Hotun, or **Aigun,** town of Mantchooria, on the right bank of the Amoor, in lat. 50° 15′ N., lon. 127° 40′ E., in fertile surroundings. It is a military station, is well built, and has some trade. P. estimated at 15,000.

Sa'ki, the rice-beer of Japan, is usually heated before drinking. It has an unpleasant taste and a very heady quality. Its use in Japan is very extensive.

Sak'tas [Sansk. *sákti*, "power" or "energy"], the members of one of the three great modern groups of sects of the Hindoo religion, designating the votaries of the female consorts of the gods of the Triad. (See HINDU RELIGION, by PROF. JOHN DOWSON.)

Sakti. See SAKTAS.

Sakunta'la, the heroine of a considerable cycle of ancient Sanskrit mythology, commemorated in the *Vedas*, the *Mahabharata*, the *Puranas*, and especially in the celebrated drama of *Kalidasa*, which was the first work translated into English by Sir William Jones (1789). Editions of the Sanskrit original are numerous, as also translations in many languages.

Sakya-Muni [Sansk. *Saint Sakya*], one of the most usual designations of the founder of the Booddhist religion. (See BOODDHA.)

Sa'la, town of Italy, province of Principato Citeriore, is beautifully situated. P. 6994.

Sala (GEORGE AUGUSTUS HENRY), b. in London, England, of Italian parentage, in 1828; educated as an artist, but at an early age devoted himself to literature as a constant contributor to Dickens's *Household Words* and other periodicals, especially the *Illustrated London News* and the *Cornhill Magazine*; visited the U. S. 1863–64 as correspondent of the *Daily Telegraph*; represented the same paper in Algeria 1864, and again 1875, at the Paris Exposition 1867, on the Continent during the Franco-German war 1870–71, and in Spain, Morocco, and Venice 1875. Author of several novels and works of travel, and founder and editor of the *Temple Bar* magazine.

Salaam' [Arab. *selam*, "peace"], the Oriental salutation, of which there are various forms, mostly accompanied by the words "Peace be with you!" and sometimes by an inclination of the body. Strict Mohammedans never give the salaam to an unbeliever.

Salaam Convulsions, a rare and remarkable disease of children, accompanied by rapid bowing of the head. It sometimes occurs periodically. It is a clonic spasm of the sterno-mastoid muscles. Its cause, nature, and treatment are very obscure. Iron, zinc, and nux vomica have been recommended. The disease may possibly pass away

with the completion of the teething process, but epilepsy or idiocy sometimes follows.

Salaberry (CHARLES **Michel**), **D'Iraberry, Seigneur de Chambly et de Beulac,** b. at Beauport Manor, Canada, Nov. 19, 1778, son of a member of the legislative council, and descended from a noble family in Navarre; entered the British army at an early age; served eleven years in the West Indies; was engaged in the Walcheren expedition July, 1809; returned soon after to Canada; organized and commanded the regiment of voltigeurs; repulsed Gen. Dearborn at Lacolle 1812, and with Gen. Prevost defeated Gen. Wade Hampton at Chateaugay Oct. 26, 1813, for which services he received a gold medal, the order of the Bath, and the thanks of the Canadian legislature; was subsequently a senator and a member of the legislative council. D. at Chambly Feb. 26, 1829.

Sa'la Consili'na, town of Southern Italy, province of Salerno, about 10 miles S. W. of Potenza, is believed to occupy the site of the ancient *Marcellana,* destroyed by Totila. It is in a healthy position, is tolerably well built, contains five churches, and the episcopal palace is a handsome edifice. The neighboring country is very rich in pasturage, and the hills are beautifully wooded. P. 7700.

Sal'ad [It. *salato*, "salted"], a preparation of uncooked herbs with condiments, as salt, oil, sugar, vinegar, and pepper, often mixed with boiled eggs, deviled lobster, or other animal matter. The principal salad herbs are lettuce, cresses, samphire, celery, chicory, chives, onion-tops, endive, etc. The use of salads is regarded as very salutary.

Sal'adin (SALAH-ED-DIN YUSSUF), a son of Ayub, the founder of the dynasty of the Ayubides, b. at Tekrit on the Tigris in 1137, a Kurd by descent and a subject of Noureddin, sultan of Syria; accompanied in 1163 his uncle, Shirkuh, to Egypt, where he soon gained celebrity for his military talents. Shirkuh was sent to Egypt by Noureddin to reinstate the emir Shawer, who had been expelled; but when Shawer discovered that Noureddin aimed at the subjugation of Egypt, he allied himself with the crusaders and a desperate struggle ensued, which ended with the rout of the Franks and the decapitation of Shawer. Shirkuh now governed Egypt as Noureddin's emir, and after his death Saladin, who showed still greater talents as a civil governor than as a military leader. The country prospered, and after the death of Noureddin in 1173 it became an independent empire under the rule of Saladin. He also interfered in the controversies in Syria between the heirs of Noureddin, and in 1184 made himself complete master of this country too, and was confirmed by the caliph of Bagdad as sultan of Egypt and Syria. In 1186 he attacked Palestine. The Christian knights, especially those belonging to the various orders—the Templars, the Hospitallers, etc.—lived here as they did in Europe, chiefly by robbery. In spite of treaties agreed upon and sworn to, they repeatedly fell upon the Mohammedan caravans of pilgrims journeying to Mecca and plundered them. To put an end to these outrages, Saladin invaded Palestine with an army of 80,000 men, routed the Christians completely at Tiberias (July 4, 1187), and conquered Jerusalem Oct. 2. The king and the poor people he treated with courtesy and magnanimity; the Templars and Hospitallers he put to death. When these tidings came to Europe the third crusade was preached, and Frederick Barbarossa of Germany, Philippe Augustus of France, and Richard Cœur de Lion of England took the cross and led great armies toward the Holy Land in 1189. Frederick died soon, and after the conquest of Acre, Philippe Augustus returned, but between Richard Cœur de Lion and Saladin a long tournament took place, in which the most brilliant exploits of valor and chivalry were performed by both parties. Sept. 2, 1192, a truce of three years was concluded, by which the coast of Palestine from Tyre to Jaffa was ceded to the Christians. Shortly after, Richard Cœur de Lion returned to Europe, and Saladin died at Damascus Mar. 4, 1193. His fame was very great. He was considered a model of chivalry, and his fantastic gallantry sprang from real magnanimity and a strong feeling of justice. He was a great conqueror, though he suffered several heavy reverses in his wars, and he brought his vast empire, comprising Egypt, Syria, Palestine, Arabia, and Mesopotamia, into a flourishing condition.

Sala'do, a river of the Argentine Republic, South America, has its source in an outlying spur of the Andes, flows S. S. E. 600 miles, and enters the Paraná near Santa Fé. It is navigable for vessels of light draught through most of its course, and forms the southern limit of the Gran Chaco.

Salado, p.-v., Bell co., Tex., on Salado Creek.

Sal Aëra'tus [Lat., "aërated salt"]. The commercial product known by this name, formerly a very large article of domestic consumption, has during the present generation been chiefly displaced by the cheaper and in every way preferable compound, bicarbonate of soda, known as "cooking soda," sometimes "soda salaëratus." *Sal aëratus* is a somewhat impure and imperfectly carbonated bicarbonate of potash, made by exposing a concentrated solution of neutral potassic carbonate to an atmosphere of carbonic acid gas proceeding from fermentation or other source; hence the name. The finely granular form of the commercial article is probably a result of agitation during the absorption of the carbonic acid. Medicinally, a purer *crystalline* bicarbonate of potash is used, which is, or should be, fully charged with 2 equivalents of carbonic acid for 1 of potash. The true constitution of these so-called bicarbonates is, with reasonable probability, that of a compound of neutral potassic carbonate with carbonic monohydrate, which latter hydrate is not yet known in separate form; thus: $K_2O.CO_2 + H_2O.CO_2$. Consistently with the views of the hydroxyl school of chemists, however (see SALT-RADICALS), this must be viewed as composed of the three radicals, *hydroxyl*, *potassoxyl*, and *carbonyl;* thus: $H_2K_2C_2O_6 = 2(HO.KO.CO)$. HENRY WURTZ.

Sal Alem'broth, or **Salt of Wisdom,** a compound of corrosive sublimate and sal ammoniac, once used in medicine, but now discarded.

Salaman'ca, town of Spain, capital of the province of the same name, on the right bank of the Tormes, which is here crossed by a magnificent bridge of twenty-seven arches. It is surrounded with old walls, but several portions within the walls have been in ruins since the occupation of the city by the French in 1812. The streets are mostly steep, the town being built on three hills, narrow, crooked, and dark, but they are often lined with lofty edifices most interesting in architectural respects. The university was founded in 1200, and in the fifteenth century it was attended by 12,000 students. It is still the first institution of its kind in Spain, and enjoys a high reputation all over Europe. P. 17,700.

Salamanca, tp., Cherokee co., Kan., includes the village of Columbus, the county-seat. P. 708.

Salamanca, p.-v., Cattaraugus co., N. Y., at the junction of Atlantic and Great Western with Erie R. R., about midway from New York and Cincinnati, has good schools, railroad repair-shops, an extensive saw-mill, and 1 newspaper. Lumbering is extensively carried on. P. 1881.

FERRIN & WEBER, EDS. "REPUBLICAN."

Sal'amander [anglicized from the Latin *salamandra*], an English name, vaguely applied to numerous forms of the order Gradientia, but more especially restricted to species of SALAMANDRIDÆ (which see). THEODORE GILL.

Salaman'dridæ [*Salamandra*, the ancient Latin name of the species], a family of amphibians of the order GRADIENTIA (which see), including the typical salamanders and newts of the Old World. The skull has no anterior axial bone; the palatines emit separate posterior processes extending over the parasphenoid, and which have teeth on the inner margins; no dentigerous plates on the parasphenoids; prefrontals and pterygoids are developed; the parietals are separated from the prefrontals by the broad frontals; the orbitosphenoids are confluent with the prootic; there is no postfrontal; the occipital condyle sessile; the vertebræ are opisthocœlian—*i. e.* concave behind; the carpus and tarsus are ossified. The family, thus limited by Cope, includes two genera—*Salamandra* and *Triton* —both of which are represented in Europe and temperate Asia. THEODORE GILL.

Sal'amis, the modern *Kolouri,* an island of Greece, in the Gulf of Ægina, comprising an area of 36 sq. m., with about 5000 inhabitants. It is mountainous, well wooded, and produces cotton, olives, and wine. In the narrow strait, barely a mile in width, between Salamis and Attica, was fought the famous naval battle in which the Greeks under Themistocles defeated and almost destroyed the Persian fleet (480 B. C.). The village of *Ambelakia* now occupies the site of the ancient city of Salamis.

Sal Ammo'niac [Ger. *Salmiak;* synonyms, *Muriate of Ammonia, Hydrochlorate of Ammonia, Chloride of Ammonium*]. Pliny and Dioscorides speak of ἅλς ἀμμωνιακός, "Libyan salt," a Greek name for Libya being Ἀμμωνιάς or Ἀμμωνίς. Beckmann's view is, however, generally adopted, that this was a rock-salt. Sal ammoniac was first made, however, in Egypt or Libya from the urine of camels; hence the name, and our important modern word, *ammonia, ammoniac, ammoniaque.* This solid compound results from the bringing together of the two permanent gases ammonia and hydrochloric acid. The reaction, which in its nature is one of the most remarkable known to chemists, consists in the passing over of the hydrogen of the hydrochloric acid to the ammonia to form a compound

radical or clementoid substance, *ammonium* (NH_4), which has the same relations and performs the same functions as *potassium* and *thallium*. This radical unites with the chlorine to form chloride of ammonium: $HCl + NH_3 = NH_4Cl$. This view, involving the *ammonium theory* of Berzelius, derives its strongest support from a ground hitherto unnoticed by chemists in general, the study of molecular volumes. (See VOLUMES, MOLECULAR.) Indeed, the lowest recorded densities (that is, those of the lightest allotrope) of ammonium chloride (about 1.45) yield a molecular volume identical *at zero* with that from the highest recorded densities of chloride of potassium (about 2.0); while the molecule of thallous chloride (7.0—Willm) has the same volume at zero as *ordinary* sal ammoniac. These are observations of the present writer. Sal ammoniac of commerce is obtained by subliming together crude sulphate of ammonia—which has been prepared from the ammoniacal liquor of the gasworks or of bone-distilleries—with common salt, sulphate of soda remaining as a residual product. Compact cakes of sal ammoniac are thus obtained, which are free from any impurity except a little ferrous chloride. The best way to obtain *chemically pure* sal ammoniac from this is to dissolve in hot water; pass into the saturated hot solution a few bubbles of *chlorine*, which will convert the ferrous into ferric chloride; then add a little ammonia, and filter hot from the ferric hydrate which precipitates; then, on cooling, snow-white chemically pure crystals of chloride of ammonium separate. Commercial sal ammoniac, as obtained by sublimation, is in hard, compact loaves, transparent or translucent, splitting with a sub-columnar or almost fibrous fracture in a direction normal or perpendicular to the planes of original condensation. The fibres thus obtained have a characteristic toughness and flexibility, bending somewhat, without loss of transparency, before they break, though quite destitute of elasticity. Sal ammoniac has a taste at once saline, pungent, and cooling. It is one of the salts which absorb heat during solution, and is therefore often used in FREEZING MIXTURES (which see). Sal ammoniac is often found native about volcanoes, subliming and condensing in fissures, both the muriatic acid and the ammonia constituting it being presumably derived from the chloride of sodium and animal matter in ocean-water which has found its way through the oceanic floor to the volcanic focus. It has also been observed in guano. HENRY WURTZ.

Salamonie′, tp., Huntington co., Ind. P. 1485.

Salang′idæ [*Salanx*, a proper name], a family of fishes of the order Teleocephali, and related to the salmon and smelt families, as well as to the Paralepididæ. It has, however, some quite peculiar characters. The body is elongated and naked, or provided with very fine and deciduous scales; the lateral line is indistinct; the head is very much elongated and depressed, and ends in a long, flat, and pointed snout; the mouth is deeply cleft backward; the upper jaw formed above by the intermaxillaries, and at the sides by the supramaxillaries; conical pointed teeth are developed on the palate as well as jaws, of which some on the intermaxillaries and mandibles are enlarged; the branchial apertures are continuous below; the branchiostegal rays few (3–4); the rayed dorsal is small and situated far behind the ventrals, but more or less in advance of the anal; a small adipose is developed; the anal is low and oblong; the caudal forked; the pectorals pointed; the ventrals abdominal. "The entire alimentary canal straight, without bend; pyloric appendages none; ova small." But two species are known, one of which (*Salanx Chinensis*) is found on the coast of China, and the other (*Salangichthys microdon*) in the "rivers of Yedo." They seem to be rather marine than fresh-water forms. THEODORE GILL.

Saldan′ha (JOÃO CARLOS **Oliveira e Daun**), DUKE OF, grandson of the marquis of Pombal, b. at Lisbon, Portugal, Nov. 17, 1791; educated at the College of Nobles at Lisbon and at the University of Coimbra; became at an early age a member of the council of administration for the colonies; was sent a prisoner to England by the English forces 1810; was soon permitted to join the Portuguese court at Rio de Janeiro, where he served in the army; was sent to Europe in a diplomatic capacity; was made minister of foreign affairs 1825; became governor of Oporto and minister of war 1826; resigned and went to England June, 1827; afterward took part in the war against Dom Miguel at the head of the insurgents at Oporto, but was defeated, and took refuge in England; resided for a time in Paris; returned to Portugal with Dom Pedro 1832; took Oporto 1833; became generalissimo and chief councillor of Dom Pedro; directed the successful campaign in the Algarves; took Lisbon; received the capitulation of Dom Miguel at Evora 1834; was appointed marshal and commander-in-chief, but soon placed himself at the head of the opposition party; became minister of war and president of the council May 31, 1835; resigned in November of the same year; took part in the unsuccessful conservative revolution of 1836, after which he lived in exile in England and France until recalled by the queen in consequence of the rebellion of 1836; was placed at the head of the ministry after the intervention of the quadruple alliance 1847; was replaced by the second dictatorship of Costa Cabral 1849; overthrew that administration by force of arms 1851; conducted the government until the accession of Pedro V. (1856), when he became again the head of the opposition; was minister at Rome 1862–64, and again 1866–69; went to Paris as minister Mar., 1869; instigated a revolution in the palace May 19, 1870, in consequence of which he again became prime minister, but resigned in August, and was sent as minister to London, where he d. Nov. 21, 1876.

Sale, in law. See APPENDIX.

Sale′, town of Italy, province of Alessandria, on the right bank of the Po. The French army under Bonaparte and the Russian under Suwarof halted here, respectively, for two days during the campaign of 1799. P. 5850.

Sale′, or **Sla**, town of Morocco, at the mouth of the Buregreb, is surrounded by beautiful gardens, and has a strongly fortified harbor and manufactures of elegant carpets. It was formerly the chief stronghold of the pirates on the Mediterranean. P. 25,000.

Sale (GEORGE), b. probably in Kent, England, about 1680 (some authorities say fifteen years later); educated at King's College, Canterbury; became a lawyer and a ripe Oriental scholar; was associated with Archibald Bower, George Psalmanazar, John Swinton, Capt. George Shelvocke, and Dr. George Campbell in writing the *Universal History*, to which he contributed the cosmogony and portions of the Oriental history; wrote the Oriental biography and criticism for Dr. Thomas Birch's translation of Bayle, entitled *A General Dictionary, Historical and Critical* (10 vols. fol., Lond., 1734–41), and executed a translation of the *Koran* (1734), to which he prefixed a scholarly *Preliminary Discourse* upon Arabian history, manners, customs, and religion before Mohammed; which still keeps its place as the best and most accessible English summary of data upon Mohammedanism. The liberal manner in which Sale spoke of Mohammed fastened upon him the reputation of heresy. D. in London Nov. 14, 1736. He is said by the elder Disraeli to have passed his later years in indigence, and often to have lacked food, but there is reason to doubt this assertion. He left a valuable collection of Oriental MSS., now in the Radcliffe Library, Oxford.

Sale (Sir ROBERT HENRY), K. C. B., known as the "hero of Jellalabad," b. in England in 1782, son of Col. Sale of the East India Company's service; entered the army at the age of thirteen; was engaged in the storming of Seringapatam 1799, at the storming of the Travancore lines 1809, at the capture of Mauritius 1816, and the occupation of Rangoon 1824; was appointed in 1838 to the command of the first Bengal brigade in the army on the Indus, which constituted the advance-guard of the expedition against Afghanistan; commanded the storming-party at Ghuznee July 23, 1839, on which occasion he was severely wounded; was knighted and promoted to the local rank of major-general the same year; subdued the Kohistan country Sept., 1840; captured several fortresses; defeated Dost Mohammed Khan at Purwan, obliging him to surrender; stormed the Khoord, Cabool, and Jugdolluck passes and other strongholds 1841, but was compelled to retreat upon Jellalabad, where he was besieged by Akbar Khan from Nov. 12, 1841, to Apr. 9, 1842, when he attacked and utterly routed the Afghans, capturing guns, ammunition, and camp—a feat which procured him the thanks of Parliament and the highest military reputation; took part in the general action of Teezen and the recapture of Cabool; and in the Punjaub campaign of 1845 as quartermaster-general, but was mortally wounded at the battle of Moodkee, Dec. 18, 1845, and d. Feb. 28, 1846.—His wife, LADY FLORENTIA WYNCH SALE, b. in England about 1790, married in 1809; was a witness of much of her husband's gallant career in India, having been with him in Jellalabad, and wrote a narrative of thrilling interest—*A Journal of the Disasters in Afghanistan in 1841–42* (1843). She also furnished descriptions of the plates to a folio volume entitled *Sale's Defence of Jellalabad* (1846), and supplied materials to Rev. G. R. Gleig for his book, *Sale's Brigade in Afghanistan* (1846). D. at Cape Town, South Africa, in 1853.

Sa′lem, town of British India, capital of a district of the same name in the presidency of Madras, on the Toiromanni, at an elevation of 1070 feet above the level of the sea. The town is well built, and has about 25,000 inhabitants, mostly engaged in cotton and silk manufactures.

Salem, v., Nichol tp., Wellington co., Ont., Canada, on the river Irvine, 1 mile from Elora Station (Wellington

Grey and Bruce Railway, has thriving and varied manufactures. Pop. about 800.

Salem, county of S. W. New Jersey, on Delaware River, traversed by West Jersey R. R. and its branches, has a soil consisting of a sandy loam, with abundant beds of marl and some iron ore. Staples, wheat, Indian corn, potatoes, sweet potatoes, hay, grass-seed, and butter. Cap. Salem. Area, 340 sq. m. P. 23,940.

Salem, p.-v., Lee co., Ala., on Columbus branch of Western R. R. P. 2963.

Salem, tp., Drew co., Ark. P. 677.

Salem, p.-v., cap. of Fulton co., Ark.

Salem, tp., Greene co., Ark. P. 676.

Salem, p.-v. and tp., New London co., Conn. P. 717.

Salem, tp., Carroll co., Ill. P. 839.

Salem, tp., Edwards co., Ill. P. 1582.

Salem, tp., Knox co., Ill., includes Yates City. P. 1906.

Salem, p.-v. and tp., cap. of Marion co., Ill., has 2 weekly newspapers. P. of v. 1182; of tp. 3132.

Salem, tp., Delaware co., Ind. P. 1413.

Salem, tp., Pulaski co., Ind. P. 567.

Salem, tp., Steuben co., Ind. P. 1385.

Salem, p.-v., cap. of Washington co., Ind., on Louisville New Albany and Chicago R. R., 40 miles from Louisville, has 5 churches, a public library, a fine graded school, 1 bank, 1 weekly newspaper, foundry and machine-shop, 1 large woollen mill, an axe and plough factory, 3 flouring-mills, 2 carriage shops, 1 jewelry establishment, and 2 hotels. P. 1294. W. W. STEVENS, ED. "DEMOCRAT."

Salem, p.-v. and tp., Henry co., Ia., on Big Cedar River, has 1 newspaper and considerable trade. P. 1882.

Salem, tp., Allen co., Kan. P. 271.

Salem, p.-v., Livingston co., Ky. P. 50.

Salem, p.-v. and tp., Franklin co., Me. P. 307.

Salem, p.-v., one of the caps. of Essex co., Mass., on the Eastern R. R., was for a long series of years the most populous town and city in the county of Essex. It was the first permanent settlement of the old Massachusetts Colony, Roger Conant having come here in 1626, followed by John Endicott two years later, and by Mr. Higginson one year after that. Salem has at different periods in its history given to the world a long array of eminent men. Science has always found encouragement and support, the Essex Institute, the Peabody Academy of Science, and one of the State normal schools being located here. It has many interesting old houses, and the general appearance of the city is attractive. For a great many years Salem was one of the leading commercial cities of America, carrying on more trade with the East Indies at one period than all other American ports combined. It has one of the best harbors in New England, being convenient and well protected, affording good anchorage and admitting vessels of large size. It has now very little foreign commerce, but has quite a large coasting-trade, and it is a point of shipment for large quantities of coal landed here in vessels and sent to the interior by rail. The leading industry is the manufacture of leather, but in addition there are a successful cotton company, 2 lead-mills, 1 or 2 jute factories, 2 semi-weekly, 3 weekly, and 2 monthly newspapers, and a large number of machine-shops and small industries. It is an important centre of retail trade. Salem was the scene of the witchcraft delusion of 1692, though much of what transpired was in what is now Danvers. It was in Salem that the house of representatives of the province of Massachusetts resolved themselves into a sovereign political power Oct. 7, 1774, with John Hancock as chairman, and then adjourned to Concord. It was also at the North Bridge in Salem that (Feb. 26, 1775) the British commander, Col. Leslie, was impeded in his expedition in search of cannon, and compelled to return to Boston. P. 24,117.

FOOTE & HORTON, EDS. "SALEM GAZETTE."

Salem, tp., Allegan co., Mich. P. 1143.

Salem, p.-v. and tp., Washtenaw co., Mich., on Detroit Lansing and Lake Michigan R. R. P. 1216.

Salem, tp., Douglas co., Minn. P. 208.

Salem, tp., Olmsted co., Minn. P. 996.

Salem, tp., Daviess co., Mo. P. 986.

Salem, p.-v., cap. of Dent co., Mo., on St. Louis Salem and Little Rock R. R., 130 miles S. W. of St. Louis, has 2 churches, an academy, 2 newspapers, 1 steam flouring-mill, 2 iron-ore banks, and 1 steam planing-mill. P. 280.

J. E. ORGAN, ED. "SALEM MONITOR."

Salem, tp., Dunklin co., Mo. P. 470.

Salem, p.-v. and tp., Richardson co., Neb., on Atchison and Nebraska R. R., and near Big Nemaha River, has 1 newspaper. P. of v. 304; of tp. 681.

Salem, p.-v. and tp., Rockingham co., N. H., on Manchester and Lawrence R. R. P. 1603.

Salem, p.-v., cap. of Salem co., N. J., on Salem R. R. and River, 34 miles S. W. of Philadelphia, with which it has water-communication, has 11 churches, collegiate and musical institutes, good schools, 1 bank, 2 newspapers, 4 hotels, foundries and machine-shops, mills, a canning establishment, and manufactories of glass, hollow-ware, and oil-cloth. P. 4555. R. GWYNNE, ED. "SUNBEAM."

Salem, p.-v. and tp., one of the caps. of Washington co., N. Y., on Rutland and Washington div. of Del. and Hudson R. R., 46 miles N. of Albany, has 8 churches, an academy established in 1791, 1 bank, 1 newspaper, railroad repair-shops, a fine court house, county jail, 4 hotels, 2 slate-quarries, a cheese-factory, several mills, and marble-works. Principal business, farming and dairying. P. of v. 1239; of tp. 3556. JAMES GIBSON, JR., ED. "PRESS."

Salem, p.-v., Forsyth co., N. C., terminus of Salem R. R., 112 miles W. of Raleigh, contains the Salem Female Academy (1804), 1 bank, cotton and woollen manufactories, and 1 newspaper. P. about 2000.

L. V. AND E. T. BLUM, EDS. "PEOPLE'S PRESS."

Salem, tp., Pasquotank co., N. C. P. 1314.

Salem, tp., Auglaize co., O. P. 877.

Salem, tp., Champaign co., O. P. 1854.

Salem, tp., Columbiana co., O. P. 3199.

Salem, p.-v., Perry tp., Columbiana co., O., on Pittsburg Fort Wayne and Chicago R. R., 70 miles W. of Pittsburg, contains 8 churches, water and gas works, excellent schools, 2 national and 2 private banks, 2 weekly newspapers, 3 extensive machine-shops, 3 stove-foundries, the largest galvanized iron-cornice works in the U. S., and several furniture and shirt manufactories. The residents are mainly Quakers. P. of v. 3700.

J. K. RUKENBROD, ED. "REPUBLICAN."

Salem, v., Liberty tp., Guernsey co., O. P. 93.

Salem, tp., Highland co., O. P. 1029.

Salem, tp., Jefferson co., O. P. 1708.

Salem, tp., Meigs co., O. P. 1718.

Salem, tp., Monroe co., O. P. 2106.

Salem, v., Randolph tp., Montgomery co., O., on Dayton and Western R. R. P. 312.

Salem, tp., Muskingum co., O. P. 941.

Salem, tp., Ottawa co., O. P. 1687.

Salem, tp., Shelby co., O. P. 1428.

Salem, tp., Tuscarawas co., O. P. 1725.

Salem, tp., Warren co., O. P. 2102.

Salem, v. (LOWER SALEM P. O.) and tp., Washington co., O., on Marietta Pittsburg and Cleveland R. R. P. of v. 187; of tp. 1610.

Salem, tp., Wyandot co., O. P. 1103.

Salem, city, cap. of Marion co., Or., and also of the State, on the E. bank of Willamette River and on Oregon and California R. R., 50 miles S. of Portland, with which city it is connected by steamer for nine months in the year, is surrounded by fertile prairies, has good water-power from the falls of Mill Creek, which is utilized by several flouring-mills, tanneries, machine-shops, and manufactories; has 2 banks, 8 churches, 1 daily and 3 weekly newspapers, the State penitentiary, deaf-mute school, and institute for the blind, and is the seat of Willamette University. P. 1139; estimated at 6000 in 1875.

Salem, tp., Clarion co., Pa. P. 949.

Salem, tp., Luzerne co., Pa. P. 1525.

Salem, tp., Mercer co., Pa. P. 686.

Salem, tp., Wayne co., Pa. P. 2607.

Salem, b. (DELMONT P. O.) and tp., Westmoreland co., Pa., on Loyalhanna River. P. of v. 448; of tp. 2124.

Salem, tp., Orleans co., Vt. P. 693.

Salem, tp., Culpeper co., Va. P. 2178.

Salem, v. (SALEM FAUQUIER P. O.), Fauquier co., Va., on Manassas division of Washington City Virginia Midland and Great Southern R. R.

Salem, p.-v. and tp., cap. of Roanoke co., Va., on Atlantic Mississippi and Ohio and Valley R. Rs., 180 miles W. of Richmond, has 4 churches, is the seat of Roanoke College (a flourishing institution of twenty years' standing, containing a library of 10,000 volumes, and the finest mineral cabinet in the State), 1 bank, 2 weekly newspapers, a monthly journal, 2 hotels, a large town-hall, and a fine

graded school. Fine water-power exists. P. of v. 1355; of tp. 3652. EDW. A. MCCAULEY, ED. "ROANOKE TIMES."

Salem, p.-v. and tp., Kenosha co., Wis. P. 1386.

Salem, tp., Pierce co., Wis. P. 241.

Salem Chapel, p.-v., Forsyth co., N. C. P. 848.

Sale'mi, town of Sicily, province of Trapani, in an extremely fertile and healthful district, 38 miles N. E. of Palermo. Its name is of Arabic origin, and signifies "place of delight." The castle is of Arabo-Byzantine architecture, and in two windows of the round tower there are Greco-Latin inscriptions curiously interlaced. The Normans, after driving out the Saracens, made Salemi a royal city. The churches still contain some noteworthy pictures and other artistic objects, but the inhabitants, though vigorous and active, are sadly deficient in instruction. P. 14,096.

Sal'ep [Arab. *sahleb*], a substance of a mucilaginous nature, made by drying the bulbs of the male orchis (*Orchis mascula*), a plant of the Mediterranean region. Its properties are very similar to those of gum-tragacanth. The dried bulbs are very hard and horny, translucent, and swell up slowly in cold water like tragacanth, forming a mucilage. Certain medicinal virtues ascribed to salep in the East are wholly imaginary. HENRY WURTZ.

Saleratus. See SAL AËRATUS.

Saler'no, city of Southern Italy, chief town of the Principato Citeriore, now the province of Salerno. It is situated about 30 miles S. E. of Naples, on the Gulf of Salerno, with an adjacent country of the greatest fertility, and is very striking as seen from the sea. The harbor, once of some size, is now nearly filled up, though some efforts are making to improve it. The chief object of interest in the town itself is the old Norman cathedral (1084), injuriously restored in 1768, but still the most imposing specimen of Norman architecture in Southern Italy, and containing, besides rich marbles and mosaics, twenty-eight magnificent granite and porphyry columns from the temples of Pæstum. Pope Gregory VII. (Hildebrand) was buried in this cathedral, and tradition asserts that the body of St. Matthew was brought from the East in 930 and deposited in the crypt where it now lies. Several other churches here contain fine works of ancient and mediæval art. Salerno was probably settled by the Greeks at a very early period, was colonized by the Romans not far from 200 B. C., and was a place of importance during the best Roman period. Its history under Lombard, Norman, Swabian, and Angevine rulers abounds in romance, but the great and just boast of mediæval Salerno was its celebrated medical school, which, according to Prof. de Renzi, was neither a foundation of Charlemagne nor of the Saracens, but of pure native growth, and dating from a very early period. Its great reputation drew hither, during many centuries, invalids and pupils of all classes and nations. The *Schola Salernitana*, a set of hygienic rules drawn up in Latin at this school in the twelfth century, and dedicated to the king of England, was translated into many European languages, and published in very numerous editions soon after the invention of printing. The *Erbario*, a still earlier medical work, also emanated from Salerno, and was widely circulated throughout Europe. P. in 1874, 28,000.

Sales, de (FRANCIS). See FRANCIS DE SALES.

Sales (FRANCIS), b. in Roussillon, France, in 1771; was instructor in French and Spanish in Harvard College from 1816 to 1839, and of Spanish alone from that time till his death at Cambridge Feb. 16, 1854. Author of a *Spanish Grammar* (1816; 16th ed. 1860); editor of the *Don Quixote* of Cervantes (2 vols., 1836), and of several volumes of select works of Iriarte Moratin, Lope de Vega, Calderon de la Barca, La Fontaine, and other Spanish and French classics.

Sales'ville, p.-v., Milwood tp., Guernsey co., O., on Central Ohio division of Baltimore and Ohio R. R. P. 172.

Saley'er Islands, The, a group of about 30 small islands situated to the S. of the island of Celebes in the East Indies, and inhabited by between 40,000 and 50,000 Mohammedan Malays, who are ruled by native chiefs, but subject to the Netherlands. Cotton, coffee, sugar, pepper, and mustard are cultivated; also maize and *botta* (a kind of millet), but not rice, on account of certain superstitious ideas of the natives. Fine timber, both sandal and teak, abounds.

Salford. See MANCHESTER, England.

Salians. See FRANKS, by PROF. J. W. BURGESS, LL.B.

Salica'ceæ, or **Salicin'eæ** [Lat. *salix*, "willow"], a natural order of apetalous dicotyledonous plants, consisting of the willows (160 species) and poplars (about 20 species), trees and shrubs of the northern hemisphere, well marked by the diœcious flowers, both sexes in catkins, follicular fruit, and cottony-comose seeds. The wood is soft and light; the young shoots of various willows (osiers) are largely employed for wickerwork; and the bark of many or all the species yields salicine or populine, bitter principles used as febrifuges. ASA GRAY.

Sal'icine [Lat. *salix*, the "willow tree"]. All the willow tribe, of which there are said to be 130 species known, with some poplars, contain in their bark a bitter crystalline principle known by this name. Its composition is $C_{13}H_{18}O_7$. It has no alkaloid properties, like quinine, strychnine, and some other crystalline bitter principles, but is a *glucoside*. By the action of hot dilute acids or of the ferment *emulsine* or SYNAPTASE (which see), it breaks up into glucose and another compound called *saligenine*:

$$C_{13}H_{16}O_7 + H_2O = \overset{\text{Glucose.}}{C_6H_{12}O_6} + \overset{\text{Saligenine.}}{C_7H_8O_2}.$$

Salicine has conceded to it valuable medicinal virtues in the treatment of intermittents, though much less efficient than quinine. Its main interest at present, however, is in its being one source of SALICYLIC ACID (which see), which is, nevertheless, now much more readily and cheaply obtainable from another source. To obtain salicine from willow bark, Merck boils the concentrated aqueous decoction with litharge, which precipitates tannic acid, gum, and coloring-matters. Some lead that passes into solution is then precipitated from the liquid by sulphuric acid, and finally by sulphide of barium. Evaporation of the filtered liquid now yields crystals of salicine, which must be purified by repeated recrystallizations. There are other methods, for which the textbooks must be consulted. H. WURTZ.

Sal'ic Law [Lat. *Lex Salica*] was written in the fifth century in corrupted Latin, and contains the code of the Salian Franks, who shortly before had invaded Gaul, and shortly after established there a Frankish kingdom. The code exists in numerous manuscripts. The oldest contains 65 *pactus*, but new laws were subsequently added; the third oldest contains 99 *pactus*. The oldest editions are by Pardessus (Paris, 1843) and Merkel (Berlin, 1850). One of the most remarkable points of this code is the law which prevents women from inheriting any landed estate which is not an acquired but inherited possession in the family. This law prevailed in France with respect to the inheritance of the crown; and in Spain, where previously the Visigothic law prevailed recognizing the succession of women, it was introduced by the Bourbon, Philip V., in 1713, but abolished by Ferdinand VII. in 1830 in favor of his daughter Isabella.

Salicyl'ic (Hyperspinoylic, Spinoylic, or **Metaoxybenzoic) Acid** (formula $C_7H_6O_3$; *oxy-* and *paraoxybenzoic* acids have the same formula), an organic acid existing in the flowers of *Spiræa ulmaria*, and in combination as acid methylsalicylate, forming the essential oil of wintergreen (*Gaultheria procumbens*).

History.—It was discovered by Piria in 1838, who formed it by oxidizing salicylol (essential oil of *Spiræa ulmaria*) with chromic acid; in 1844, Cahours obtained it from oil of wintergreen; and in 1860, Kolbe and Lautermann discovered the mode of making it from phenol (carbolic acid). In 1874, Kolbe modified and improved his original process for the manufacture from phenol, and thereby cheapened the article so much that it could be brought into use in medicine and as an antiseptic. Some few chemists—Fleck, Feser, and Friedberger—have made experiments with it, in which they call in question the claims made for it as an antiseptic. (*Arch. f. Wissensch. u. prakt. Thierheilkunde*, 1875, Heft. 2, 3, and 4.)

Formation.—Salicylic acid may be obtained in several ways—as (1) by treatment of salicylol with an oxidizing agent, as chromic acid; (2) by fusing salicylol with caustic potassa; (3) by treating oil of wintergreen with strong potassa ley, or (4) with gaseous hydriodic acid; (5) by heating a mixture of indigo and caustic potassa to 300°; (6) by treating phenol (carbolic acid) with sodium and carbonic acid gas, (7) with sodium and ethylchlorocarbonate, (8) with acid potassium carbonate, or (9) with caustic soda, the mixture being heated and carbonic acid gas passed into it. Some five other methods of obtaining this acid might be enumerated, but they have no practical importance.

Preparation.—For use, salicylic acid is made from oil of wintergreen or from phenol. In making it from the former the oil is simply heated with strong potassa ley until methyl alcohol ceases to be evolved. The resulting product is potassium salicylate, from which hydrochloric acid precipitates salicylic acid. This is filtered off, washed, and purified by dissolving and recrystallizing from alcohol. To prepare it from phenol, the phenol is dissolved in caustic soda, the exact equivalence of each being used (an excess of one or the other having a considerable effect on the yield obtainable), and the solution is evaporated to dryness, care being taken to drive off all the water. The mass is then

placed in a retort and heated gradually, a current of carbonic acid gas being passed through it; when the temperature reaches that of boiling water, the heat is further raised. At 180° C. phenol begins to distill over, and the operation is continued until no more phenol distills over, the heat being kept between 220° and 250° C. The mass left in the retort consists of sodium salicylate, which is dissolved in water and precipitated by hydrochloric acid. It is generally colored, on account of a resinous impurity, which may be more or less perfectly removed by resolution and recrystallization or passing the solution through bone-black. In 1876, Rautert invented a process of purifying it by subjecting it to a current of superheated steam at 170° C., which affords a very pure article. In this process disodium phenol and phenol first form, which, under the action of the carbonic acid gas, is changed to disodium salicylate. Caustic potassa, baryta, or lime may be used instead of the soda, but their use is not so advantageous.

Properties and Uses.—**Salicylic acid when** pure crystallizes in white four-sided prisms, which fuse at 130° C. and sublime at some temperature above 200° C. It has a sweetish sour taste, reddens litmus strongly, and has no **action on polarized light. It is slightly soluble in cold** water (in proportion of 1 part to 1000 of water), more so in hot, still more so in alcohol, ether, and oil of turpentine. By heating with strong hydriodic or hydrochloric acid or with dilute sulphuric acid it decomposes into phenol and carbonic acid. It is a dibasic acid, forming acid and neutral salts. By treatment with chlorine, bromine, iodine, nitric acid it forms chloro-, bromo-, iodo-, and nitro-salicylic acids. In very small quantities it acts as an antiseptic, and experiments have shown its efficiency in preserving wines, beer, milk, eggs, and other articles of food from the changes which unfit them for use. Its action as a disinfectant is not so powerful as that of carbolic acid. When acting as an antiseptic it appears to undergo no chemical change. Its salts have no disinfecting or antiseptic properties. On account of its being odorless and less irritating than carbolic acid, and not poisonous, it has been used with advantage in surgical treatment, where it can be used for every purpose for which carbolic acid is used, except for the cleansing of instruments. In that case it causes the instruments to rust. In medicine, salicylic acid is used as an antipyretic, and as an internal factor as antiseptic in cases of diphtheria. The dose is from 7 to 15 grains. It is frequently dispensed in solutions of alkaline phosphates, in which it is more soluble than in pure water. It is used also in preserving wine, beer, cider, meat, and other articles of food, and its use has been proposed in the manufacture of glue, leather, etc., of perfumery, and as a dye in connection with iron salts, with which it gives a fine purple color. The production is as yet extremely limited. Von Heyden of Dresden is at present the largest manufacturer, producing 50 kilos (about 100 pounds) daily.

Literature.—Piria, *Ann. de Chem. et de Phys.*, lxix. 298; Cahours, *Ibid.* (3), x. p. 329; Kolbe and Lautermann, *Ann. Chem. u. Pharm.*, cxiii. p. 125, and cxv. 201; Fleck, *Benzoësäure, Salicylsäure, Zimmtsäure* (Munich, 1875). (For further references to the literature on the subject, see H. Endermann, *Am. Chem.*, vi. pp. 46, 121, 161, and Feb., 1876.)

E. WALLER.

Salicylol, also called (incorrectly) **Salicylic Aldehyde.** Older names are *Salicylous acid*, *hydruret of salicyl*. Its composition is $C_7H_6O_2$, and it differs, therefore, from SALICYLIC ACID (which see) by containing one equivalent less of oxygen. Salicylol occurs naturally in the essential oil of *Spiræa ulmaria* or *meadow-sweet*, in admixture with a terpene compound. It may be obtained **artificially by the action of oxidizing agents, as chromic** acid on SALICINE (which see). It is a fragrant ethereal liquid, **smelling like bitter almonds, generally reddish in** color from exposure to the air, of density 1.173, somewhat soluble in water, and reacting like salicylic acid, with a violet color on ferric salts. It forms salts with bases, indicating an acidic **nature. This compound has present** interest in connection with salicylic acid.

HENRY WURTZ.

Salien'tia (from the Lat. *salio*, to "leap"), one of the names of the order of batrachians, embracing the frogs, toads, **and tree-frogs, and of which another equally** expressive name, and one more generally used, is *Anura* (ἀ privative, and οὐρά, "tail"). The frogs are the typical **representatives of the order. Referring for information** respecting the class to the articles AMPHIBIA and BATRACHIA, **our present inquiries will be confined to the order.**

The order comprises all and only those species which have, in the mature stage, a short, stumpy body destitute of a tail, and great inequality between the fore and hind legs, the former being quite short, and the latter much enlarged and adapted for leaping: the skeleton is well ossified; most of the cranial bones are present, but the **post-orbital and supra-temporal, and, generally, the nasal bones are wanting; the frontal and parietal are coalesced, and** compose a pair of fronto-parietal bones; the ethmoid forms a kind of ring surrounding the cerebral lobes; the **coccyx is represented by an elongate style, resulting from** ossification around the primitive notochord; the inferior elements of the pelvis are applied together, and form a single vertical mass, and the ilia are very much elongated, and are attached to the sacral vertebræ in such manner as to allow of an independent motion of the pelvis. In addition to these more important characters, the skin is naked (destitute of scales or plates), and in the typical frogs is smooth, but in the toads is warty. With few exceptions, a regular metamorphosis takes place, the young coming out from the egg in a form entirely different from that which it assumes in future life, it being at first fish-like and furnished **with a long tail, without legs, and with gills ex**serted on each side of the neck. Soon, however, the **hinder legs grow out, and subsequently the fore ones (thus reversing the sequence exhibited in the salamanders), the gills** disappear, and lastly the tail is absorbed and completely atrophied, and the frog-like form is attained. These characters are applicable to the true frogs, the toads, and the **forms variously called tree-frogs or tree-toads.**

The order is a very homogeneous one, the likeness between all its species being very evident, and one which would be recognized by all. Nevertheless, there are **considerable variations, although of minor importance, in** details of structure: for example, the sternum and bones connected with it exhibit considerable differences, and on such differences the primary divisions of the order have been based by Prof. Cope. The sacral vertebræ are also variable, in some being dilated, and in others nearly **cylindrical; the tongue, although almost always present, is in two families wanting; some forms are provided with teeth on the jaws, while others are at all times destitute of them;** the ear may be perfect or defective in its superficial parts; and the tongue is variable in its insertions. There are still other variations which are more worthy of extended **remark. It has been already indicated that in almost all** the species of the order complete metamorphosis takes place, but the period during which the species remain in the tadpole state is in some very short, and in certain terrestrial and tree frogs the tadpole stage is entirely suppressed: these differences in mode of development are not, however, coincident with any structural modifications: and that they do not have the significance that would at first **appear probable is evident from the fact that common frogs** and toads may be even reproduced directly from the egg **in their adult form and without having undergone a regular metamorphosis.** These adaptations in development are indeed frequent in the animal kingdom, and in forms which are peculiar in their mode of life and in their **relations to their surroundings considerable deviations from** the normal type may occur, as among the fluviatile and **terrestrial decapod crustaceans, the fluviatile and terrestrial gasteropods, and others: again, it is a fact well known to physiologists that the tadpole condition may be indefinitely prolonged by the deprivation of the animal from proper light and heat.**

Another notable character is found in modifications for **arboreal life, almost all those species which live among the trees being provided with peculiar disc-like dilatations** at the end of the toes. It was formerly supposed that this character was of great importance, and that all the forms in which it was developed were closely related: and they were therefore united in a single family under the name Hylidæ: recent studies of the organization of all such forms have, however, shown that the species confounded under that group exhibit great differences among **themselves, while, on the other hand, they are severally very similar in other respects to frogs that have no such** dilatations. It thus now seems that the dilatations are **adaptive modifications common to all arboreal forms, and which fit those various forms for life among the trees, and** that species of any family may be so modified.

There are peculiarities of still another kind in their structure and habits which are worthy of special mention. If a common frog is examined, it will be found to have **a bend behind the middle of the back, so that, with the different segments of the hind legs, there will appear to be** four flexures: this appearance is the result of the great elongation of the iliac bones of the pelvis and the mode of their connection with the sacral vertebræ. Although most **apparent in the frogs, the same feature exists throughout** the series, and this mechanism greatly increases the ability to jump. Further, to provide for its long leaps, the frog has very large muscles, especially on the thigh, and this segment of the leg is entirely free—that is, not included within the abdominal integument—as in man; it is this

feature which confers the edible quality on the hind legs of the frog, and in this case quality and quantity are to some extent interchangeable terms.

The various sounds emitted by different kinds of frogs are familiar to residents in the country, especially in the vicinity of marshes and ponds. These noises are produced by a peculiar mechanism in the throat. According to Dr. Bishop, the arytenoid cartilages are triangular, and their apices being upward form the superior lateral boundaries of the larynx. The vocal cords pass from end to end of the bases of the triangle. Above and below the vocal cords there are sacs lined with mucous membrane and bounded by the arytenoid cartilages. In the true frogs and tree-frogs, at least, the males are provided with two sacs, which open by a straight canal into the larynx. These sacs are situated on each side of the lower jaw, and are capable of considerable distension when filled with air during the cry of the animal. These sacs doubtless exert a powerful influence on the quality of the sounds which frogs utter, analogous to the influence of similar sacs which exist in many of the higher animals. The tone of the voice is modified by the character of the vocal cords.

Although there is considerable diversity of opinion among zoologists respecting the systematic value of the variations among the anurous batrachians, and consequently respecting the natural groups into which the order may be divided, all agree in distinguishing two primary groups or series within the order: one of these (Phaneroglossa), embracing almost all the species, is distinguished by the presence of a tongue whose posterior margin is more or less free. The other group (Aglossa) is peculiar in the absence of a tongue; and, in addition, the species agree in having a completely ossified cavum tympani; in the union of the Eustachian tubes, and their outlet by a single oral opening; in the absence of vocal cords; and in the dilatation of the transverse processes of the sacral vertebræ. This second group embraces only two families—Pipidæ, which is represented by a single species (the Surinam toad), and Dactylethridæ, also represented by a single genus, confined to Africa.

The order includes a large number of species which are extensively distributed under one form or another throughout the warm and temperate regions of the earth. While they are chiefly aquatic, and developed from eggs deposited in the water, a number are terrestrial or arboreal in their habits; the waters in which they are found are always fresh, or at most brackish, none being inhabitants of the sea or of salt-water. The cis-tropical hemisphere is the home of numerous species of frogs and tree-frogs, and of a few toads, and in that hemisphere they are most numerous in the U. S. The typical toads are developed especially in the tropical American, African, and tropical Asiatic regions; the true tree-frogs and related forms are most abundant in Australia and tropical America; and the typical frogs are most numerous in tropical Asia and Africa, while they are entirely excluded from Australia.

In brief, if we divide the earth's surface into regions distinguished by combinations of the anurous batrachians, we should have (1) the cis-tropical hemisphere, (2) tropical Asia, (3) Africa S. of the desert, (4) tropical and southernmost America, and (5) Australia; and it is especially to be noted that the last two countries have much in common.

The chronological distribution of this order is very imperfectly known, no species having been found in deposits older than the Miocene Tertiary, during which epoch they were represented by several peculiar types, whose remains have been preserved in the "brown coal" of Germany, and which indicate several forms, one of which appears to have been most closely related to the family Dactylethridæ, which is now confined to Africa. THEODORE GILL.

Salie'ri (ANTONIO), b. at Legnano, Northern Italy, Aug. 19, 1750; studied music, first at Venice, then under Gassmann at Vienna; composed his first opera, *Le Donne Letterate*, in 1770; was appointed director of the Italian opera at Vienna in 1774, and chapel-master to the court in 1788; retired into private life in 1824. D. at Vienna May 7, 1825. Of his numerous operas, now all forgotten, the *Danaïdes* was brought out in Paris in 1784 under the name of Gluck, and made a great success; *Tarare* was also received with much applause at Paris in 1784. Beaumarchais wrote the libretto. He also composed some church music, among which was the oratorio *La Passione di Gesù Cristo* (1775).

Salies, town of France, department of Basses-Pyrénées, has some remarkable salt springs, which are used both for bathing and for the manufacture of salt. P. 5298.

Saligenine. See SALICINE.

Sali'na, p.-v. and tp., Kankakee co., Ill. P. 865.

Salina, p.-v., cap. of Saline co., Kansas, on Kansas Pacific R. R., in Smoky Hill Valley, 185 miles W. of Kansas City, Mo., has 7 churches, an excellent school system, 2 weekly newspapers and 1 monthly journal, 2 water-power flouring-mills, and 1 grain-elevator. P. 918. B. J. F. HANNA, ED. "HERALD."

Salina, tp., Onondaga co., N. Y. P. 2688.

Salinas, tp., San Luis Obispo co., Cal. P. 679.

Salinas City, p.-v., cap. of Monterey co., Cal., in the heart of Salinas Valley, on Southern Pacific R. R., has 8 churches, a city hall, 2 large public-school buildings, 1 bank, water and gas works, a well-organized fire department, 1 daily and 2 weekly newspapers, 2 flouring-mills, a foundry, 2 hotels, and a saw-mill. P. in 1870, 599; in 1876, 3100. ROBERT S. FORBES, ED. "DAILY RECORDER."

Saline', a river of Arkansas, rises in Saline co., flows in various directions 200 miles, and falls into Washita River. It is navigable some 80 miles from its mouth.

Saline, county of Central Arkansas, on Saline River, traversed by Cairo and Fulton R. R., has numerous marble-quarries. Staples, Indian corn, tobacco, honey, wool, and butter. Cap. Benton. Area, 800 sq. m. P. 3911.

Saline, county of S. E. Illinois, on Saline River, traversed by Cairo and Vincennes and by Shawnee division of St. Louis and South-eastern R. R., is level and well timbered, with a fertile soil, and is well adapted for stock-raising. Staples, Indian corn, tobacco, wheat, hay, sorghum-molasses, wool, and butter. Cap. Harrisburg. Area, 370 sq. m. P. 12,714.

Saline, county of Central Kansas, on Saline River and Solomon and Smoky Hill forks of Kansas River, and traversed by Kansas Pacific R. R., has a level surface, a soil fertile and well timbered along the streams, and several salt springs. Staples, Indian corn, wheat, hay, and butter. Cap. Salina. Area, 720 sq. m. P. 4246.

Saline, county of Central Missouri, bounded N. and E. by Missouri River, watered by Black and Salt forks of La Mine River, consists chiefly of prairie, has several salt springs, and some deposits of bituminous coal and lead. Cattle and swine abound. Staples, Indian corn, wheat, oats, hay, tobacco, honey, wool, and butter. Cap. Marshall. Area, 750 sq. m. P. 21,672.

Saline, county of S. E. Nebraska, on Big Blue River, intersected by Burlington and Missouri River R. R., and by its Beatrice branch, has a rolling surface and a fertile soil. Staples, Indian corn, hay, and butter. Cap. Pleasant Hill. Area, 576 sq. m. P. 3106.

Saline, tp., Dallas co., Ark. P. 488.

Saline, tp., Hempstead co., Ark. P. 1265.

Saline, tp., Hot Springs co., Ark. P. 444.

Saline, tp., Saline co., Ark. P. 1194.

Saline, tp., Sevier co., Ark. P. 353.

Saline, tp., Johnson co., Ill. P. 1282.

Saline, tp., Ellis co., Kan. P. 43.

Saline, tp., Trego co., Kan. P. 35.

Saline, p.-v., Washtenaw co., Mich., on Detroit Hillsdale and Indiana R. R., 10 miles W. of Ypsilanti, has 4 churches, a union school, 1 newspaper, 3 flouring-mills, 1 tannery. P. 1955. D. B. SHERWOOD, ED. "REVIEW."

Saline, tp., Cooper co., Mo. P. 1836.

Saline, tp., Miller co., Mo. P. 1720.

Saline, tp., Perry co., Mo. P. 1409.

Saline, tp., Ralls co., Mo. P. 1634.

Saline, tp., Sainte Genevieve co., Mo. P. 980.

Saline, tp., Jefferson co., O. P. 1922.

Saline'ville, p.-v., Washington tp., Columbiana co., O., on Cleveland and Pittsburg R. R. P. 1429.

Saling, tp., Audrain co., Mo. P. 991.

Salins', town of France, department of Jura, on the Furieuse, has rich salt springs in its vicinity, from which 40,000 cwts. of salt are annually produced. Gypsum, paper, and leather are manufactured. P. 7361.

Salis'bury (saulz'berry), town of England, capital of Wiltshire, on the Avon, has a magnificent cathedral, which perhaps is the purest and richest specimen of the Early English style. It was built 1220–58 in the form of a double cross, with a spire 400 feet high. It is 449 feet long and 81 feet high in the interior; the length of the great transept is 203 feet. The trade and manufactures of Salisbury are insignificant. P. 12,903.

Salisbury, p.-v., Litchfield co., Conn., in the north-western part of the State, is located on Connecticut Western R. R., 63 miles from Hartford. It derives its prosperity chiefly from its mining and manufacture of iron. Salisbury iron is acknowledged the world over as unsurpassed for the manufacture of railway car-wheels. There are in the town 7 ore-mines, some of which have been worked

more than 100 years; 2 [illegible] furnaces, 2 foundries, 1 car-wheel foundry, 1 [illegible] hardware manufactory, locomotive and car works of the Housatonic R. R. Co., 1 [illegible], 1 woollen mill, 1 institute for imbeciles, [illegible] 1 newspaper, [illegible] churches, 4 flouring-mills, and [illegible] lakes and mountain scenery en[illegible] "The Switzerland of America." P. [illegible]. J. L. Pease, Ed. "Conn. Western News."

Salisbury, p.-v., Duck Creek hundred, Kent co., Del. P. 97.

Salisbury, p.-v. and tp., cap. of Wicomico co., Md., on Eastern Shore and Wicomico and Pocomoke R. Rs., at the head of Wicomico River, 110 miles S. E. of Baltimore, has 9 churches and 3 chapels, 1 high, 2 grammar, and 4 primary schools, 3 newspapers, 2 large flouring mills, 1 wool carding establishment, 2 hotels, and several saw and planing mills. The town, largely engaged in the coasting and inland trade, owns a number of schooners whose tonnage exceeds 10,000. Lumber and grain are the staple articles of export, but small fruits are also shipped to the North. The Wicomico River is navigable for small boats, and the government is at present engaged in deepening the harbor for the entrance of larger vessels. P. of v. 2064; of tp. 3512.

Lemuel Malone, Ed. "Advertiser."

Salisbury, p.-v. and tp., Essex co., Mass., on Atlantic Ocean, extending from the New Hampshire line to the N. bank of Merrimack River, is on the Salisbury branch of Eastern R. R., has large interests in manufactures of cotton and woollen, 7 churches, 2 banks, and 1 weekly newspaper. P. 3776.

Salisbury, p.-v. and tp., Chariton co., Mo., on St. Louis Kansas City and Northern and Keokuk and Kansas City R. Rs., has good schools, 1 newspaper, and rich deposits of coal. P. of v. 626; of tp. 1197.

J. M. Gallimore, Ed. "Press."

Salisbury, p.-v. and tp., Merrimack co., N. H., on Black River, includes part of Mount Kearsarge. P. 897.

Salisbury, p.-v. and tp., Herkimer co., N. Y., on Canada Creek. P. 1933.

Salisbury, p.-v. and tp., cap. of Rowan co., N. C., at the junction of Western North Carolina and North Carolina R. Rs., 5 miles W. of Yadkin River, contains 6 churches, excellent schools, 1 bank, 2 newspapers, 2 foundries, several mills, gasworks, and the usual county-seat buildings. P. of v. 168; of tp. 3327.

J. J. Stewart, Ed. "Carolina Watchman."

Salisbury, tp., Meigs co., O. P. 4902.

Salisbury, p.-v. and tp., Lancaster co., Pa., on Pequea Creek. P. 3710.

Salisbury, tp., Lehigh co., Pa. P. 2860.

Salisbury, b., Lick tp., Somerset co., Pa., on Pittsburg Washington and Baltimore R. R. P. 291.

Salisbury, p.-v. and tp., Addison co., Vt., on Otter Creek and on Rutland division of Central Vermont R. R. P. 902.

Salisbury (Edward E.), professor of Arabic and Sanskrit in Yale College 1841–54, and of Arabic alone for several years later; was one of the founders of the American Oriental Society, editor of and leading contributor to its *Journal*, and endowed the professorship of Sanskrit in Yale College, now held by Prof. W. D. Whitney.

Salisbury, Marquises of, Earls of, Viscounts Cranborne (1604), and Barons Cecil (1603), a prominent family of the British nobility. The earldom of Salisbury was first held by William Longespée, a Norman noble (d. 1226), afterward by the Montacute family, of which Thomas, the fourth and last earl, was distinguished in the wars against France (d. 1428). The title was conferred anew upon Sir Richard Neville on his marriage to Alice Montacute, daughter of Thomas (1442). This nobleman was a prominent Yorkist leader, gained the victory of Bloreheath 1459, and was beheaded at Pontefract Jan. 1, 1461, by order of Queen Margaret, the day after the battle of Wakefield, in which he was taken prisoner. Subsequently, the title was borne by Margaret Plantagenet, mother of Cardinal Pole, who was beheaded as a pretender to the crown 1541. Robert Cecil (b. June 1, 1563, d. May 24, 1612), the famous secretary of state to Queen Elizabeth, noted as the enemy of Essex and of Raleigh, was made earl of Salisbury May 4, 1605, and the title still remains in his family, the dignity of marquis having been added in 1787.

Salisbury (Robert Arthur Talbot **Gascoyne-Cecil**), Marquis of, b. at Hatfield Feb. 10, 1830; educated at Eton; graduated at Christ Church, Oxford, where he became a fellow of All Souls' College; sat in Parliament for Stamford, first under the name of Lord Robert Cecil, and afterward under the courtesy title of Viscount Cranborne, from Aug., 1853, until his accession to the marquisate by the death of his father, Apr. 12, 1868; became secretary of state for India in Earl Derby's third administration July, 1866; resigned Mar. 2, 1867, in consequence of unwillingness to support the Reform bill, and accepted the same post in Disraeli's second administration Feb., 1874; succeeded Lord Derby as minister of foreign affairs in May, 1878, and was one of the English plenipotentiaries at the Congress of Berlin. He was elected chancellor of the University of Oxford, in succession to the late Earl Derby, Nov. 12, 1869; has taken an active part in politics in support of the Church of England and its institutions, and has contributed largely to the *Quarterly Review* and other periodicals.

Salish, or **Selish,** a family of Indians of the Columbian group, in Washington, Idaho, and Montana Territories, occupying the region between the Shushwap family of British Columbia on the N. and the Sahaptin family of Snake River on the S., includes the Flatheads, or Salish proper, formerly living on Bitter Root River, but since 1871 on the Jocko Valley Reservation, Mont.; the Kalispels, or Pend d'Oreilles, living in three bands, one in each of the three Territories; the Skitsuish, or Cœurs d'Alêne, on the lake of the same name; the Colvilles, or Indians near the Kettle Falls of Columbia River; the Spokanes, on Spokane River; and the Pisquouses, on the W. bank of the Columbia, between Okanagan River and Priest Rapids. They do not apparently differ much in languages or customs from the Okanagans, Atnahs, and Kootenais of the Shushwap family, which might with propriety be united with the Salish family. The Flatheads are erroneously designated by that name, as they do not practise the custom in question, which is peculiar to the Chinook Indians of the Pacific coast. Most of the tribes of this family have been wholly or in part converted to Roman Catholicism by Jesuit missionaries. (See *The Native Races of the Pacific States*, by H. H. Bancroft, vol. i., 1874.)

Sali'va [Lat.], the liquid secretion of the mouth. It comes from several glands secreting different liquids. Though numerous interesting facts are known about it, its chemistry cannot be regarded as completely studied. It has an alkaline reaction, and contains an albuminoid ferment called *ptyaline*, which has the power of converting starch into sugar, thus assisting in its digestion. For this reason it is claimed that young infants, whose lack of teeth renders mastication impossible, and who swallow their food without admixture with saliva, should not be fed upon starchy food, such as arrowroot, which to them proves indigestible. On the other hand, it is asserted that ptyaline acts only in alkaline liquids, and that in the acid liquid of the stomach it is therefore inert. Saliva, very curiously, contains *sulphocyanide of potassium* in minute proportion, but readily detectable by a ferric salt. It contains about 1 per cent. of dry solid matter, of which as much as one-fifth in some cases is made up of saline substances. H. Wurtz.

Sal'ivary [Lat. *saliva*] **Glands,** essentially three in number: (1) the parotid (Gr. παρά, "near to," and οὖς, ὠτός, "the ear"), the largest, situated beneath the integument and immediately below the ear; (2) the sub-maxillary, beneath the lower jaw; (3) the sub-lingual, under the tongue. These glands are composed of a number of sections or lobes of polygonal shape and flattened sides, the result of coaptation and pressure. Their structure is termed *racemose*, or resembling a bunch of grapes. (See Histology.) The tree or stem-like framework upon which the glandular lobes are set is a system of excretory tubules, which take up the saliva secreted by the gland, and the trunk is a common duct conveying it through the deep tissues to the surface of the mouth. The names of eminent anatomists are commemorated in the designation of these ducts, which they discovered. The parotid has one large duct, the duct of Steno; the sub-maxillary, the duct of Wharton; the sub-lingual—from eight to twenty minute ducts opening independently beneath the tongue—the ducts of Rivinius; and a few uniting to form a single duct, the duct of Bartholine, which joins that of Wharton. These ducts, their branches, and the interior of the glands are lined with epithelial cells. The process of secretion, more or less constant, is most active during the mastication of food; then saliva is abundantly formed and poured into the mouth. The saliva serves a double purpose—to aid mastication and to partially digest starchy elements of the food. The salivary glands are the seat of disease—mumps or parotiditis, a specific inflammation and catarrhal engorgement (see Mumps) of the parotid; inflammation and abscess of the parotid in low fevers; deposits of diphtheritic infiltration in some cases of that disease; not infrequently concretions of chalky matter form in the glands, or ducto-salivary calculi. *Ranula* sometimes is due to

occlusion of the sub-maxillary duct and formation of a cystic tumor.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Saliva'tion [Lat. *saliva*], a specific irritation of the salivary glands, mouth, and throat by mercury. In former years, mercury, in heroic doses, ranked as a remedy second only to bloodletting. Salivation was a frequent occurrence—intentionally produced in many cases, in others the accidental result of large doses and individual susceptibility. Children will endure large doses of mercurials without salivation; adults are relatively susceptible. An open and active state of the skin, kidneys, and bowels favors immunity from salivation, even when the mercurial taken is considerable; reversely, if opium or any remedy which checks the glandular activity and functional excretion of kidneys or bowels be taken before or at the same time, even small doses of mercury, thus detained in the system, may salivate. Mercury to-day is chiefly employed in laxative and cathartic doses, eliminating itself as it performs its intended action; also in small repeated doses for alterative effects in some intestinal disorders of children and in certain specific diseases of adults. Hence, salivation is rare to-day. Salivation is manifested by a coppery or metallic taste, by soreness of the gums, tenderness of the jaws and teeth when pressed together or closed with force, excessive secretion and flow of saliva, even dribbling from the mouth; swollen, red, ulcerated gums; swollen, coated, salvy tongue, taking the imprint of the teeth; and a foul "mercurial" breath. In grave cases, spongy, bleeding, sloughing gums, loosened teeth, swelling of the face and neck, and even gangrene of the mouth, may result. There is accompanying constitutional depression, slight irritative fever, pain, sleeplessness, and sense of choking. The condition requires prompt saline cathartics, very astringent gargles for the mouth, rich liquid food, and tonics.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Salle, de la (JEAN BAPTISTE). See LA SALLE, DE (JEAN BAPTISTE).

Sallet', von (FRIEDRICH), b. at Neisse, Silesia, Apr. 20, 1812; received a military education, and entered the Prussian army as a lieutenant in 1829; was sentenced to ten years' imprisonment in 1830 for a satirical novel he wrote on military life, but the sentence was commuted to two months; retired in 1838 from military service in order to devote himself exclusively to literary pursuits. D. at Reichau, Silesia, Feb. 21, 1843. His *Gedichte* appeared in 1835; his beautiful tale, *Schön Irla*, in 1838; his chief work, *Laienevangelium*, against the current views of religion and morals, in 1839; his collected works (in 5 vols.) in 1845.

Sal'lust (CAIUS SALLUSTIUS CRISPUS), b. in 86 B. C. at Amiternum, in the country of the Sabines, of a wealthy plebeian family; was elected *tribunus plebis* in 52; expelled from the senate in 50 by the censors on account of the dissipated and scandalous life he led; reinstated in the senatorial dignity in 47 by being elected prætor, probably by the aid of Cæsar, to whose party he belonged, and whom he accompanied to Africa in 46; was appointed proconsul of Numidia, and returned to Rome loaded with riches; formed the magnificent *Horti Sallustiani* on the Quirinalis, and lived in luxurious retirement, devoting himself to the study of history. D. at Rome 34 B. C. Of his *Historiarum Libri Quinque* only fragments are extant, but his *Bellum Catilinarium* and *Bellum Jugurthinum* have been preserved, and are much appreciated. Editions by Gerlach (3 vols., Bâle, 1823–31), Dietsch (2 vols., Leipsic, 1842–46), Kritz (3 vols., 1828–53); English translations by Sir H. Steuart (1806), by Watson (1852), and by J. R. Mongan (1861).

Salma'sius (CLAUDIUS), (CLAUDE DE SAUMAISE), b. at Semur-en-Auxois, department of Côte-d'Or, France, Apr. 15, 1588; studied at Paris and Heidelberg; embraced Protestantism; was appointed professor at the University of Leyden in 1632, and acquired an immense celebrity by his critical editions, *Scriptores Historiæ Augustæ*, etc., learned commentaries, *Plinianæ Exercitationes in Solinum*, etc., and independent essays, *De Usuris*, *De Re Militari Romanorum*, etc. At the instigation of Charles II., living in Holland as a refugee, he wrote (in 1649) *Defensio Regia pro Carolo I.*, which called forth the famous reply by Milton, and caused so much scandal among his republican friends in Leyden that he determined to accept an invitation from Queen Christina of Sweden. The climate did not agree with him, and the inhabitants of Leyden urged him to return, because "their academy could as little be without him as the world without the sun." In 1651 he left Stockholm, but d. Sept. 3, 1653, at Spa. His *Epistolæ* (Leyden, 1656) are very interesting.

Salm'on [Lat. *salmo*], a name given to several species of the genus *Salmo*, characterized by anadromous habits (that is, by their ascending from the sea into fresh waters to breed), as well as to the species of the genus *Oncorhynchus*. The species belonging to the genus *Salmo* have only about eleven rays to the anal fin, while those of the genus *Oncorhynchus* have fourteen to eighteen. All of these agree essentially in habits. Their natural home is the salt water, for there they obtain their food and rapidly increase in size; toward the fall, however, they are impelled by a breeding instinct to ascend the rivers, and this they do as near to the source as they can. During their sojourn in fresh water they almost entirely abstain from food and alter considerably in appearance; this divergence from the normal form is most apparent in the male, and is only approached in a slight degree by the female. The snout becomes attenuated and more or less hooked, and the lower jaw is modified in a similar manner; the body becomes emaciated, and the skin decked with glowing hectic colors. In the salmon of Europe and Eastern America this is temporary, and the males in considerable proportion descend to the sea, revive, and assume their pristine vigor and form. Some of the species of the genus *Oncorhynchus* of the Pacific coast, however, become so abnormally developed that after spawning they die, and their carcasses are left by myriads in the waters they have traversed. The most celebrated species of salmon, and those most interesting for Americans, are the *Salmo salar* of the Eastern coast, and the *Salmon* or *Oncorhynchus quinnat* of the Western slope.

The *Salmo salar*, as is well known, is common to the European as well as American streams. It is only found in cold waters; in the U. S. it is nowhere abundant except in some rivers of Maine, although in British America there are a number of streams in which it is found in large numbers. It is generally believed that in former times, and when the country was discovered by Europeans, the species was found farther S., and Hendrik Hudson, in the journal of his ascent of the river which bears his name, records "great stores of salmon in the river." It is tolerably certain, however, that the fish called by him *salmon* was the weakfish (*Cynoscion regalis*), a fish of the family Sciænidæ, having no relation to the Salmonidæ. The salmon-rivers of Canada are now taken charge of by the government and let to parties for private use.

The *Salmo* (or *Oncorhynchus*) *quinnat* is the common salmon of California, and is abundant also farther N.; it is a much deeper fish than the Eastern species, and is further at once distinguishable by the greater number of anal rays —fifteen or sixteen generally—which has caused it to be separated generically from *S. salar*. This species will live and flourish in much warmer waters than the Eastern species, and attempts have been lately made by the U. S. commissioner of fish and fisheries, in connection with the commissioners of several States, to introduce it into Eastern streams, but with what success remains to be ascertained. It has also been attempted, on a small scale, to introduce the Eastern species into Western waters. An extensive business has been developed of late years in the canning of salmon, and this is conducted on a large scale on Columbia River, Or. The species of the genus vary considerably at different ages. The extreme young is banded, and in this state was long known under the name of *parr*, and supposed to represent a distinct species of the family; it then has also red spots. Other names given to it in this condition are samlet, salmon fry, and pink. When about a year old, and when the spots have disappeared and it becomes of a bright silvery color before going to the sea, it is called a *smolt*; after its return from the sea into fresh water it is designated as a *grilse*; and when, finally, it has gone back to the sea and returned from thence a second time, it is known thenceforth ever after as a *salmon*. The species attain very considerable dimensions, *Salmon salar* occasionally attaining a weight of over eighty pounds, and the *Salmo quinnat* even exceeding this weight. (See also SALMONIDÆ, in APPENDIX.) THEODORE GILL.

Salm'on, tp., Klamath co., Cal. P. 136.

Salmon City, p.-v., cap. of Lemhi co., Id., on Salmon River.

Salmo'nes [plu. of *Salmo*, a generic name], a group of the family Salmonidæ, which, on account of the great importance of its members, deserves special notice. The body is nearly alike in all, being elongated and fusiform; the scales very small; the head shapely and conic, except during the breeding season, when, in certain species, the jaws become deformed and hooked; the mouth has a deep cleft, and the supramaxillaries extend under or beyond the eye; the teeth are acute and well developed (generally large), and situated on the intermaxillaries, mandibles, roof of the mouth, and tongue. The skull is distinguished by the extension of the supra-occipital bone forward between the parietals, which are consequently widely separated. Such are the most obvious common characters of numerous species of fishes known under the names of salmon, salmon-

trout, trout, and charr. The characters which they have in common with other members of the family are to be found in article SALMONIDÆ, in APPENDIX. As to the rest, they are fishes of moderate or large size, few or none of them failing to become occasionally at least a foot in length, and some of them attaining several habitually. The flesh in most is of a more or less reddish color, or of that peculiar tint which has derived its name—salmon color—from one of the species of the group. The eggs are in all the species of the genera Salmo and *Oncorhynchus* of quite large size—sometimes about as large as buckshot, or not very much less—and only in one form (*Brachymystax*) are the eggs what would be called small. Almost all the species of the group begin to spawn in the fall or early winter months, and in this respect they differ from almost all other fresh-water fishes with the exception of the cusk (*Lota*) and the white fishes (*Coregoni*). There is, however, a notable exception to this rule in the eggs of the *Salmo hucho* (or *Hucho germanorum*) of the Danube, which spawns in the spring, about April, as does also the grayling (*Thymallus*), the representative of another group (*Thymalli*) of the family.

The relations of the members of the group to each other are not yet by any means definitely determined, and the views of systematists have differed, and still differ, as to their arrangement. No reference need be made to old authors (*e. g.* Linnæus), by whom the genus *Salmo* was extended to embrace not only everything that would now be referred to the family Salmonidæ, but to others representing quite different families. The members of the present group, so far as the European species at least are concerned, were separated on the characters of the dentition of the roof of the mouth into two quasi sub-generic groups under *Salmo* by Nilsson. By Prince Charles Bonaparte the same forms were grouped into three divisions: (*a*) *Salmones* (*migratores*), including the anadromous salmons; (*b*) *Truttæ*, embracing the trouts; and (*c*) *Salvelini* (Nilsson), including the charrs.

Valenciennes in 1848 (*Hist. Nat. des Poissons*, vol. xxi. p. 163) recognized three full genera—viz. (1) *Salmo*, in which the vomer has no teeth on the body, but carries them on the chevron or front; (2) *Fario*, characterized by a single row of teeth on the body of the vomer, and also some on the chevron; and (3) *Salar*, distinguished by the position on the vomer of a double row of teeth. To the first belong, *e. g.* the salmons, charrs, etc., as well as the common trout of this country; to the second, *Salmo argenteus* and *Salmo lemanus* of Europe, and the *Salmo erythrogaster* and *Salmo Rossii* of America; and to the third the common trout of Europe (*Salmo Fario*) and the *Salmo namaycush* of America. This classification is a very unnatural one, especially as no consideration was paid to the fact that the body or shaft of the vomer may have had teeth in early life, and lost them afterward, while the development of one or two rows may be due to a more or less close conformity to, or deviation from, a median line due to approximation, etc. of the teeth. Siebold (*Die Süsswasserfische von Mitteleuropa*, Leipsic, 1863) modified this arrangement, and adopted two genera: (1) *Salmo*, characterized by the shortness of the shaft or body of the vomer, and the development of teeth only on the chevron or fore part; and (2) *Trutta*, distinguished by the elongation and extension of the shaft of the vomer, and the development of teeth thereon, which, however, are sometimes lost in the old; the chevron is sometimes provided with, and sometimes destitute of, teeth. *Salmo*, thus limited, only embraces the charrs—*e. g. Salmo Salvelinus* and the hucho (*Salmo hucho*) of Europe, while *Trutta* includes all the others—*e. g. Salmo salar*, *Salmo fario*, etc.

Günther in 1866 (*Cat. Fishes Brit. Museum*, vol. vi., p. 2) admitted three genera—viz. (1) *Salmo*, in which the scales are small, the dentition strong and complete, the maxillary long, cæca pylorica numerous, and the anal rays fourteen or less; (2) *Oncorhynchus*, whereof the scales are small, the dentition strong and complete, the maxillary long, and the cæca pylorica numerous, as in *Salmo*, but with the anal rays more than fourteen in number; and (3) *Brachymystax*, in which the scales are small, the teeth rather feeble, the maxillary short and broad, and the anal short (*i. e.* with twelve or thirteen rays). The first includes all the most common species of the fresh waters of America and Europe, as well as the Atlantic salmons; the second, eight determined and five doubtful species of salmon of the Pacific slopes of America and Asia; the third is only represented by one species, found in the Siberian rivers. The genus *Salmo*, it should be noted, is further subdivided into two sub-generic groups, corresponding essentially with Siebold's genera, *Salmo* and *Trutta*, but differently named; the "first sub generic group, *Salmones*," of Günther corresponding with the genus *Trutta* of Siebold, and the "second sub-generic group, *Salvelini*," answering to the genus *Salmo* of the older author. It is tolerably certain that these groups do not represent the correct affinities of the species in question, but the present article is no place to discuss such questions.

Great difference of opinion has also prevailed at different times, and among different naturalists during the same time even, as to the number and limits of species belonging to this group. Dr. Günther, who has published the latest complete revision of the family Salmonidæ, has admitted 91 well-determined species and 12 doubtful or unidentifiable ones in the three genera here included under the group *Salmones*; of these, *Salmo* has 82 (+ 7 doubtful) species, of which 52 (+ 2 doubtful) belong to Günther's group *Salmones*, and 30 (+ 5 doubtful) belong to the *Salvelini*; *Oncorhynchus* has 8 (+ 5 doubtful) species, and *Brachymystax* 1 species. These groups, according to geographical range, are represented as follows: Of the genus *Salmo*, group *Salmones*, three are anadromous, and of these one (*S. salar*) is found on both sides of the Atlantic, while the other two (*S. trutta* and *S. cambricus*) are confined to Northern Europe; the other species are much more limited in range, and especially do not extend so far northward. According to Günther, as far as known, 1 (*S. macrostigma*) is found in Algeria; 3 are peculiar to Italy; 5 to the alpine region of Central Europe; 1 to Hungary; 2 to France; 7 to Great Britain and Ireland; 4 to the Scandinavian peninsula and Finland; 5 to Russia and Tartary; 15 (+ 1) to Northern Asia and North-western America; 4 (+ 1) to the rivers of the eastern slope of the Rocky Mountains; and 1 to Greenland and Labrador. Of the group *Salvelini*, 13 are found in Europe, 6 (+ 5) in Asia, 2 (*S. Lordii* and *S. Campbelli*) in the western parts of North America, and 9 (*S. Hearnii*, *S. alipes*, *S. nitidus*, *S. Hoodii*, *S. fontinalis*, *S. hudsonicus*, *S. sebago*, *S. Gloverii*, and *S. oquassa*) in the northern and eastern parts of North America. Of the genus *Oncorhynchus*, 8 (+ 5 doubtful) species are attributed to the Pacific slopes of Asia and America, and of the genus *Brachymystax* a single one (*B. coregonoides*) is confined to certain Siberian rivers, tributaries of the Obi, Irtis, and Jenisey. Besides these, the *Salmones* are represented in the Pyrenean peninsula, Asia Minor, Lake Goukcha, the Hindoo Kush, and Japan, but they have not yet been specifically well determined.

An older writer on the American species (Dr. George Suckley), but whose work has only lately been published in a monograph *On the North American Species of Salmon and Trout*, recognized 43 species as inhabitants of American waters, and to these several others have been since added. With a few corrections, but without assuming any responsibility for the validity of views of the author or relationships of the species, we give the results of Dr. Suckley's studies in brief, as they will be doubtless interesting to many persons: Of the sub-genus *Oncorhynchus* there are 6 species, to which must be added 4 species—*Salmo quinnat*, *S. confluentus*, *S. argyreus*, and *S. paucidens*—retained under the name *Salmo*. Of the revised sub-genus *Salmo*, of species without red spots and not feeding in fresh water, Suckley admits 8 species—*S. salar* and *S. immaculatus* from the Eastern waters, and *S. aurora*, *S. tsuppitch*, *S. Clarkii*, *S. Gairdneri*, *S. truncatus*, and *S. Richardi* from the North-western slope, especially Columbia River. Species with red spots, feeding freely in fresh water, are grouped in three categories: (1) Anadromous species, such as *S. hudsonicus* of Hudson's Bay, Labrador, and Newfoundland, and the *S. Campbelli*, *S. Rossii*, *S. Hearnii*, *S. alipes*, and *S. nitidus* of still more remote parts; (2) species not anadromous found in flowing fresh water, of which the only one mentioned is the common trout (*Salmo fontinalis*) of the Eastern States; and (3) species not anadromous, from the sea, but found in deep rivers or lakes, and ascending streams to spawn, including the *S. oquassa* of the Rangeley Lake, Maine, and the *S. Bairdii* and *S. Parkii* of the Western slope; of the species spotted with black, some are found in flowing fresh-water streams—viz. *S. iridea*, *S. Masoni*, *S. virginalis*, *S. Lewisi*, *S. brevicauda*, and *S. Bairdii*, and others in deeper rivers or lakes, ascending the shallow streams to spawn—viz. *S. sebago* of Maine and the *S. Gibbsii* and *S. Warreni* of Fraser's River, etc. Under the name "lake-trout," passing their lives in deep fresh-water lakes, approaching the shores annually to spawn in shallow water, never entering running brooks or repairing to the sea, six are enumerated—viz. *S. namaycush* and *S. siscowet* of the great lakes, *S. confinis* of the lakes of New York, *S. symmetrica* of Winnipiseogee Lake, and *S. Hoodii* of the lakes of the Atlantic slope N. of Canada, and *S. Newberryi* of Klamath River. Besides all these, there is a peculiar species (*S. Kennerlyi*), for which the generic name *Hypsifario* has been proposed, found in Chiloweyuck Lake and Fraser's River. (See further SALMON, TROUT, etc.) THEODORE GILL.

Salmon Falls, p.-v. and tp., El Dorado co., Cal. P. 428.

Salmon Falls, p.-v., Rollinsford tp., Strafford co., N. H., on Salmon River and Boston and Maine and Portsmouth Great Falls and Conway R. Rs.

Salmon Fisheries. See APPENDIX.

Salmonidæ. See APPENDIX.

Salmon-Trout. See TROUT.

Salm-Salm (FELIX), PRINCE, b. in Austria Dec. 28, 1828; served in the U. S. army during the civil war; was at one time in command of a regiment, and afterward post-commander at Atlanta, Ga., with the rank of brigadier; went to Mexico at the close of the war; became aide-de-camp and chief of the household to the archduke Maximilian, with whom he was captured at Querétaro; was released soon after the execution of the latter; entered the Prussian service as major of the 4th regiment of grenadiers of the royal guard, and was killed at the battle of Gravelotte, France, Aug. 18, 1870.—His wife, to whom he was married in 1862, MLLE. LE CLERCQ, of New York, accompanied him in Mexico, played a prominent part at the court of the archduke, and acquired celebrity by her heroic efforts to procure the pardon of Maximilian or to effect his escape. She accompanied her husband during the Franco-German campaign up to his death. She published portions of her own and of her husband's diaries in Mexico, and issued in 1875 an interesting volume, *Ten Years of My Life.*

Salnave (SYLVAIN), b. at Cape Haytien, Hayti, in 1832; entered the army as a common soldier; had attained the rank of captain in 1858, when he took a leading part with Geffrard in the overthrow of the emperor Soulouque; rendered gallant service a few years later in repelling the Spanish invasion; was engaged in an unsuccessful rebellion, and had to flee to St. Thomas 1865; but succeeded in 1867 in overthrowing Geffrard, and was chosen president; but, having been in turn defeated after a three years' administration, he was captured by Nissage Saget, and executed at Port-au-Prince Jan. 15, 1870.

Saloma, p.-v., Taylor co., Ky. P. 73.

Sal'omon (FREDERICK), b. near Halberstadt, Prussia, Apr. 7, 1826; educated at the gymnasium of that place; became a government surveyor; served in the Prussian artillery; was in 1848 a pupil in the royal academy of architecture at Berlin; came soon after to the U. S.; became a land-surveyor at Manitowoc, Wis.; was four years county register of deeds; chief engineer on Manitowoc and Wisconsin R. R. 1857–59; entered the Union service in the spring of 1861 as captain in the 5th Missouri Vols.; was with Sigel at Wilson's Creek; became colonel of the 9th Wisconsin Vols. Aug., 1861; brigadier-general July 16, 1862; and commanded a brigade in Kansas.—His brother WILLIAM came with him to the U. S., and became governor of Wisconsin 1862–63.

Salomon Islands. See SOLOMON ISLANDS.

Salomons (Sir DAVID), BART., b. of Jewish parentage at London, England, in 1797; became a merchant and banker; was elected sheriff for the city of London and county of Middlesex 1835; filled that office by virtue of a special enabling act passed by Parliament; was high sheriff of Kent 1839–40; was chosen alderman 1835 and 1844, but could not take his seat in consequence of refusal to take the oaths "on the faith of a Christian;" was called to the bar at the Middle Temple 1849; was lord mayor of London 1855–56; chosen to Parliament for Greenwich 1851, and four times re-elected, but did not obtain a seat until 1859, when, under the law as modified the previous year, he took the oath in the form provided for Jews; was the first Jew who became an English magistrate, having served as deputy lieutenant for Kent, Sussex, and Middlesex; was created a baronet of the United Kingdom 1869, and published several pamphlets on currency, corn laws, oaths, religious disabilities, and persecution of Jews in the East. D. at London July 18, 1873.

Salo'na, village of Austria, was the ancient capital of the Roman province of Dalmatia, and a city of great importance both in commercial and military respects. The emperor Diocletian was born here, and close by he built in 303 A. D. the famous palace, covering 8 acres, to which he retired after his abdication. The city and the palace were destroyed in 641 by the Avars, but on the site of the palace and out of its ruins arose the modern town of Spalato—*Salonæ Palatium.* Since 1818 comprehensive excavations have been undertaken by the Austrian government, and the baths, an amphitheatre, etc. have been brought to light.

Saloni'ca [Turk. *Selanik;* the ancient *Therma*, afterward called *Thessalonica*], the capital of the Turkish eyalet of the same name, which corresponds to the ancient Macedonia, comprises an area of 51,649 sq. kiloms., with 1,028,141 inhabitants; traversed by the Vardar, and is rich in corn, tobacco, wine, fruit, and cotton. The city is on the north-eastern shore of a spacious gulf of the Ægean Sea, named after it; rises amphitheatrically on the steep slope of the mountain of Kortiasch, and presents from the sea a beautiful view, owing to its palaces and mosques. In the interior, however, it is narrow and irregular, but as it was of importance even in antiquity, and has gone through various vicissitudes, it contains many interesting architectural monuments. In the Greek quarter are found a hippodrome of great antiquity and ruins of a colonnade built under Nero. Most of the mosques have formerly been Christian churches. The old mosque, inlaid with porphyry and jasper, was the celebrated church of St. Demetrius. The church of St. Sophia was the prototype of the church of the same name in Constantinople, and another mosque is the former Rotunda, built after the model of the Roman Pantheon. Ancient mosaics, coins, bas-reliefs, etc. are still discovered in the old streets and in the remains of old buildings in the modern quarters. The city is fortified, has a citadel and several forts, is the seat of the governor-general of the province, a Greek metropolitan, a Jewish grand chakam, and contains numerous churches and schools of different denominations. Its commercial importance it derives from its geographical position, it being located at the termination of the road which, 70 miles long, crosses the peninsula of the Balkan from Belgrade on the lower Danube, thus connecting by land and water roads the valley of the Danube with Smyrna and the coasts of Asia Minor. This position has made it the second commercial port of the country. Numerous vessels from all nations anchor in its safe and spacious harbor, which in 1873 was visited by 3634 sailing vessels of 112,569 tons burden, and 329 steamers of 201,315 tons burden. The total commercial business of the city represented a sum of 19,788,113 thalers, which shows an increase of 3,991,655 above that of 1872, and was made up in the following manner: France, 9,192,788; Austria, 3,259,160; Italy, 2,537,858; England, 2,533,044; Greece, 783,112; Switzerland, 566,100; Germany, 464,450; Belgium, 222,026; U. S., 218,000; Malta, 115,575. The value of the imports, consisting chiefly of sugar, coffee, petroleum, silk, iron, machinery, nails, and textile fabrics, amounted to 10,327,850; that of the exports, chiefly consisting of silk and silkworms, corn, cotton, wool, hides, and tobacco, to 9,460,263. P. about 80,000, of which 10,000 are Greeks and 30,000 Jews. AUGUST NIEMANN.

Salop. See SHROPSHIRE.

Sal'pa [Gr. σάλπη, a kind of fish], an interesting genus of tunicaries, the type of the family Salpidæ. Salpians are in the adult or perfect form separate organisms, produced by true generation from the individuals of a salpa-chain, as the aggregate of compound salpians is called. Each single salpian in turn gives birth, by gemmation, to a chain of salpians, each of which is an hermaphrodite. The chains swing together in water by a serpentine movement, and single salpæ move by ejecting water from the mantle. The individuals are from half an inch to ten inches long, and are found in many seas. All are marine.

Sal Pol'ychrest [Gr. πολύχρηστος, "good for many things"], the *potassæ sulphas cum sulphure*, a compound closely resembling sulphate of potash, but of somewhat uncertain composition. It was invented in the seventeenth century by Christoph Glaeser, and was once much used in medicine, but is now seldom employed.

Salset'te, an island of British India (area, about 150 sq. m.; p. about 50,000), connected with the island of Bombay by a causeway and a stone bridge, and famous for the immense rock-cut cave-temples found at Kenery in the centre of the island and at several other places.

Sal'sify [Fr. *salsifis*], or **Vegetable Oyster,** the *Tragopogon porrifolius* and *T. pratensis*, European plants of the order Compositæ. They are cultivated for the roots, which are long, tapering, and have, when properly cooked, a taste somewhat like that of the oyster. The root is highly nutritious.

Sal Soda. See SODA, COMPOUNDS OF.

Salsomaggio're, town of Italy, province of Parma, known for its mineral springs, which are extensively used both for drinking and bathing. P. 5882.

Salt, in chemistry. See SALT-RADICALS and SALTS, CHEMICAL NATURE AND DEFINITION OF, by H. WURTZ, A. M.

Salt [Lat. *sal*]. The salt of commerce is chloride of sodium, more or less contaminated with various saline admixtures. These foreign substances may differ in quality and quantity. The differences in the kind of foreign admixtures are due to the peculiarities of the source used for the manufacture. The difference in the quantity of the impurities—so far as the same kind of saline compounds is concerned—is determined not only by the condition of the source, but also by the mode of manufacture. Natural solutions of pure salt are unknown; crystals of pure salt

may be obtained by separating carefully individual crystals from a well-developed rock-salt. The discovery of common salt belongs within the earliest stages of the human family. Wherever we find it mentioned upon the first pages of history it is spoken of as something known. Its presence in the water of the ocean, of various lakes and springs, it appears, was not less recognized than its occurrence as an exudation of the soil in particular localities. Saline exudations, so frequently found in the Orient in connection with the residues of accidental evaporation of some of those natural saline solutions previously alluded to, have furnished in all probability its first supply. The manufacture of salt for commercial purposes by artificial heat applied to iron pans, similar to our present mode of working, has been credited to the ancient Romans. Grecian and Roman writers centuries before the Christian era began already to treat of it from a scientific point of view, although sometimes under a different name. Dioscorides, at the end of the first century, speaks of its peculiar cleavage, and describes some of the differences between the salt resulting from the evaporation of sea water and of rock salt. The famous alchemist, Geber, who lived within the eighth century, was engaged in experiments to refine the commercial common salt for chemical purposes. The idea regarding the chemical constitution of *pure salt* has changed quite materially during the progress of chemistry. Our present views concerning its composition was for the first time experimentally demonstrated by Sir Humphry Davy in 1810; he produced pure salt by burning sodium in chlorine gas; hence its present scientific name, chloride of sodium or sodium chloride. Chemically pure salt is usually produced by neutralizing pure carbonate of soda with pure hydrochloric acid, evaporating the solution to dryness, and fusing the residue. The salt of commerce is obtained from three sources—namely, sea-water, brines, and rock-salt.

Sea Water.—The water of the ocean is a weak and, comparatively speaking, impure brine. It contains from 3½ to 4 per cent. of saline matter, of which about three-fourths is chloride of sodium, or salt, and about one fourth impurities. Its chief impurities consist of chloride of magnesium and the sulphates of lime, magnesia, soda, and potassa. Sea water varies but little in composition and concentration, except in localities where either a limited body of water is prevented from an unrestricted communication with the ocean or where a large influx of fresh water causes its dilution. It represents the main source of supply for the manufacture of salt in France, Portugal, Spain, Italy, the West Indies, and Central and South America; it is also largely used for the production of salt in Holland, Belgium, and England, being frequently employed for the solution of rock-salt of an inferior color. In the U. S. it has been turned to advantage but to a very limited extent. From 300,000 to 350,000 bushels cover, in all probability, our present home production of salt from sea-water.

Rock Salt.—Whenever, during the various geological epochs, a larger or a smaller body of salt water was cut off from the main ocean, either in consequence of a receding of the ocean, or infiltration into natural basins, or of changes in the level of the strata, and was subsequently placed under favorable climatic conditions for its evaporation and the subsequent preservation, either in whole or in part, of its saline residue, then a salt deposit was produced. Such saline residues, commonly known as rock-salt, have been found in almost every geological horizon from the Silurian upward, and in many localities they are still forming at the present time. Sometimes several independent deposits occur one above the other, interstratified with the rocks of the same geological basin. In consequence of the many casualties to which these saline accumulations have been exposed in the course of time, but a few entire and well-preserved marine saline deposits have been found. Quite worthy of special notice in this connection is the celebrated salt-deposit at Strassfurt in Germany, on account of the large quantities of potash compounds within its surface layers. The various saline constituents of the ocean are arranged in this deposit in an order which corresponds quite closely with the degree of their solubility in water; yet even in this one instance there are facts noticeable which leave but little doubt that portions of the deposit have been exposed to peculiar disturbing influences of a later date. The majority of salt deposits consist only of part of the constituents of the ocean which served for their production. The rock-salt occurs either in densely aggregated masses of distinctly cubical crystals, or in compact masses having a conchoidal fracture. It is in some instances colorless and transparent, yet more frequently either red, yellow, or blue—rarely green. Its most common admixtures are either sulphate of lime and the chlorides of calcium and magnesium, or the sulphates of lime, magnesia, and soda and the chloride of magnesium. Rock-salt deposits consist usually of alternating layers of salt and gypsum, or sulphate of lime, and sometimes also of clay. These various layers may differ in thickness from a few inches to many feet. They are due to successive periods of evaporation. Colorless and dry rock-salt deposits, when easy of access, are directly mined with advantage, and the salt obtained by that process is subsequently brought into a desirable form for domestic application. Colored salt deposits, or those which suffer from an access of water, or which contain a large percentage of the above-mentioned foreign admixtures or clay, or, finally, those which are located at great depths, if otherwise practicable, are usually dissolved whilst in the mine, and their solutions treated like brines for the manufacture of salt. Only in exceptional cases is the rock-salt removed from the mine and subsequently treated with water or weak brines for the preparation of strong brines. Rock-salt deposits have been noticed quite frequently in every part of the globe. The northern part of our continent contains a number of rock-salt deposits worthy of notice. Among those quite recently discovered are those upon Petite Anse Island, Vermilion Bay, La., and of Goderich, province of Ontario, Canada. The former is covered merely by a drift mass from 16 to 18 feet in thickness. The latter is buried from 700 to 800 feet beneath the surface. At present there is but little rock-salt, as such, used within the U. S.

Brines.—Brines are either artificial or natural: that is, they are prepared either by dissolving rock-salt in one of the ways previously described, or they are the natural or chance solutions of saline deposits by means of subterranean currents of water. Natural solutions of rock-salt furnish us with the brines at Saltville, N. W. Va., of Goderich in Canada, and, as is good reason to assume, of Onondaga, N. Y. In cases of natural brines we are still quite frequently ignorant of the exact location and the extent and the general character of the salt deposit from which they originate. Chemically pure natural solutions of rock-salt are unknown; both kinds of brines, artificial and natural, contain the impurities of the rock-salt mass from which they are produced. All known brines may therefore be divided, like the rock-salt, into two classes—namely, those which contain besides salt the chlorides of calcium and magnesium and sulphate of lime, and those which contain only the chloride of magnesium and the sulphates of lime, magnesia, and soda. All our prominent brines E. of the Mississippi River, including those of Goderich, belong to the first class of brines; while the second class occurs in Nebraska, and, most likely, in other localities W. of that river. Sea-water also belongs in that class of brines. The value of a brine for the manufacture of salt does not entirely depend on either concentration or relative proportion of pure salt and of foreign saline admixtures, but on the kind of the impurities; for instance, sulphate of lime and soda, within proper limits, are far less objectionable than a corresponding amount of the deliquescent and bitter-tasting chlorides of calcium and magnesium. The brines of Goderich, Onondaga, and Saltville contain less of the latter than those of Michigan, Ohio, Pennsylvania, etc. All our home-manufactured salt, coarse, fine, and dairy salt, with the exception of from 300,000 to 400,000 bushels obtained from sea-water, is still produced from natural brines.

The general character and the value of the various brines depend, as previously mentioned, to a large degree, on the relative proportion and the kind of the foreign saline substances present. The same is true, to some extent at least, in regard to the salt. A mere analytical statement giving the percentages of impurity, without specifying its kind and nature, gives no reliable standard from which to pronounce upon their commercial value, since the various impurities which the salt has retained are objectionable in a different degree; thus, a sample of salt which contains from 1 to 1½ per cent. of foreign saline admixtures, consisting almost exclusively of sulphate of lime, may claim to be a very fair article of common salt; whilst if it contains but one-half of that amount of the chlorides of calcium and magnesium, or of the sulphates of soda and magnesia together with the chloride of magnesium, or of the carbonates of lime and magnesia, it would be considered quite objectionable, at least for table and dairy purposes. As the peculiar fitness of any kind of salt for the different domestic applications—for instance, meat-packing, dairy or table use—depends not only on a fair chemical composition, but also, in some degree, on its suitable physical or mechanical condition, it is quite obvious that the selection of the mode of manufacturing salt has to be made with reference to both—namely, the quality and the general character of the brine on hand, and the kind of salt desired. The process of saltmaking is quite naturally an operation which aims at the separation of the salt or chloride of sodium from its accompanying foreign saline admixtures. The general rules which apply to a proper management of a successful

crystallization find their application here, as far as circumstances will permit.

So far as the form is concerned, there are two kinds of salt in commerce—(1) *coarse salt*, including salt made by *solar* heat and rock-salt crushed to suitable size, and (2) *common fine salt* or *boiled salt*, obtained by *artificial* heat, and thus by a more rapid evaporation. Both kinds have their special commercial value.

Coarse Salt.—The coarse qualities of salt are manufactured, as has been stated, from sea-water and from brines. In France, Spain, Portugal, Italy, the West Indies, and along the shores of both the Atlantic and Pacific oceans on our continent, nearly all the coarse salt made from sea-water is produced in basins along the sea-shores. These basins are either natural or artificial; several of them are, in either case, connected in such a manner as to admit of a systematic working of the saline solutions in their different stages of concentration. In Ohio, Virginia, Michigan, New York, Nebraska, and Kansas, where the natural brines for the manufacture of coarse salt are used, wooden vats, protected by wooden covers, are preferred; for the frequency of rain-showers throughout the more favorable portion of the year, and the low temperature at night during the spring and fall, interfere seriously with a successful evaporation, and thus economical manufacture in open basins; wooden vats with suitable movable covers secure also a cleaner article. The rules adopted in the construction and systematic arrangement of these vats or basins are prescribed by the composition of the brines or saline solutions turned to account for manufacturing purposes. A short description of our most extensive coarse-salt works—those of Onondaga, N. Y.—on account of their rational system of management, may serve as an illustration. The brines of Onondaga are of a good quality; they contain a considerable quantity of sulphate of lime (gypsum), a very small quantity of chloride of calcium and chloride of magnesium, besides traces of chloride of potassium, bromide and iodide of magnesium, and some carbonate of protoxide of iron, with free carbonic acid. The main object, under these circumstances, is to remove the entire amount of iron, more than one-half of the sulphate of lime, and as much as possible of the very objectionable deliquescent compounds, chloride of calcium and chloride of magnesium. To obtain these results the following mode of working is pursued: The brine, being in its fresh state colorless and highly charged with carbonic acid, is filled into shallow vats, and kept there until most of the carbonic acid has escaped and the protoxide of iron has been fully oxidized and settled as brown hydrate of sesquioxide of iron. The saline liquid is then drawn off to a lower set of vats, where it is left for evaporation until crystals of salt appear; during this period the excess of sulphate of lime is separated. The brine being now completely saturated with salt, is called salt-pickle; it is ready for saltmaking, and consequently removed from the separated impurities to another lower set of vats, where, by mere solar heat, the separation and accumulation of a coarsely-crystallized salt takes place. The salt is from time to time gathered, whilst the remaining mother-liquor will be discharged as soon as it reaches a concentration from 28°–30° Baumé. The less attention paid to the separation of the iron and the excess of sulphate of lime, the more concentrated the mother-liquor from which the salt has been gathered; the less the salt-crystals themselves have been washed with new pickle before their removal into perforated tops for drainage, and the less chance they have enjoyed in rendering that last process efficient, the more inferior the quality of the coarse salt produced. A good coarse or solar salt must be of a neutral reaction, hard, large-sized, white or colorless, and produce a clear solution in water. Its use is mainly confined to the packing of pork and beef for the general market.

Common Fine Salt, or Boiled Salt.—The finer granulated qualities of salt are obtained by direct or indirect application of artificial heat to iron pans, iron kettles, or wooden vats. In Europe almost all the fine salt is manufactured in a system of large shallow iron pans. These pans are usually from 15 to 17 inches deep, and vary in size from 20 feet long and 16 feet wide to 60 feet long and 35 feet wide. In most of our home saltworks hemispherical cast-iron kettles of from 120 to 150 gallons' capacity are used. The kettle system is almost exclusively used at the Onondaga works, N. Y.; in the Saginaw Valley, in Michigan, besides the kettles, large wooden vats heated by steam are employed; in Ohio and S. W. Virginia, for weak brines, the so-called furnace system is in operation, which may be considered a combination of direct heat and steam heat for evaporation. The steam heat, being applied at the more advanced stage of evaporation, produces a large-sized salt. The best brines of Virginia—for instance, at Saltville—are successfully worked in cast-iron kettles. Inferior brines—particularly those which contain larger percentages of the chlorides of calcium and magnesium—as a general rule give the best results by a slow process of evaporation; for the salt-crystals are produced in that case at a slower rate, more perfectly developed, and less liable to enclose much of the interior mother-liquors. Brines which contain a considerable percentage of sulphate of lime or of soda or of magnesia, or several of them, produce always smaller salt-crystals than those which contain less or none. The livelier the boiling of the saline solutions, the smaller are the crystals of one and the same brine. The European system of manufacturing common fine salt, and our own modes of producing it in wooden vats by means of steam heat and the furnace system of Ohio, differ in one essential point from the kettle system; they aim at the removal of certain impurities in a separate vessel, and the making of the salt in another; whilst in the kettle system the entire operation is carried out in one and the same vessel. The manufacture of salt in cast-iron hemispherical vessels is peculiar to our country; its success, as far as the quality of the salt obtained by its application is concerned, is due more to the good quality of our brines and the skill of the workmen charged with the manufacture than to the fact that this mode of making salt is based on the safest principle. In the European system the saturation of the brine is at first carried on at a quite moderate heat in an open pan, commonly called the fore-heater. As soon as the salt begins to appear, or at least the iron and a part of the sulphate of lime are removed, the clear salt-pickle is drawn into a lower pan for the manufacture of salt. The temperature applied controls the size of the salt-crystals; the slower the boiling the larger the crystals. Each operation may thus produce a uniform quality, provided the mother-liquor is at certain periods removed. In case cast-iron kettles are used for the manufacture of boiled salt—as at Syracuse, N. Y.—the following arrangement is adopted: From fifty to sixty kettles, of from 120 to 150 gallons' capacity, are placed in a double row along flues with two independent fireplaces and one common chimney. The kettles near the fireplaces are protected by suitable interrupted arches against excessive heat, while high chimneys, frequently supported by blowers, aid in conveying the heat along the row of kettles. Store-rooms for the salt are located along both sides of the boiling-works; the boiling vessels are separated from the furnace by a pathway from four to five feet wide. The entire construction is covered by one roof. The brine before being turned into the kettles has been kept in large wooden tanks for settling. For the purpose of collecting the impurities which separate from the brine during the process of concentration, an iron pan with an upright handle, covering the central bottom part of the kettles, is inserted in each one of the latter until the salt itself begins to form, when the pans are carefully withdrawn. On the skilful handling of the pan depends largely the color and, to some extent, the general quality of the article. Whenever, subsequently, a large amount of salt has been formed, it is well stirred by means of a long-handled iron ladle, and thereby washed in the remaining pickle before it is removed into baskets, which rest for efficient drainage upon sticks over one part of the kettles. After a few hours' keeping the baskets are emptied into the store-rooms; some weeks' storing suffices to render the salt dry enough for the general market.

The chemical composition of the fine salt depends largely, like that of the coarse varieties, on the quality of the pickle or mother-liquor from which it has been gathered and the degree of drainage it has enjoyed. The general physical condition, as size, hardness, etc., depends in part on the character of the brine which served for its production, and on the rate of boiling during its manufacture; the lower the temperature and the less motion of the pickle, the larger the crystals. The normal size of the salt from any brine is readily reduced by adding either quicklime, glue, fat, rosin, or soap in quite small quantities to the boiling salt water. As a general practice, it deserves but little commendation, for it necessitates a superior precaution regarding an entire removal of these substances, particularly in case of those articles of salt which serve for dairy use. A good common fine salt ought to be of neutral reaction, of a clear white color, of a pure agreeable saline taste, and of a gritty feeling between the fingers; it ought to dissolve without any particular residue in 5 to 6 parts of water, and its moisture ought not to exceed from 4 to 5 per cent. The common fine salt, being of an advantageous mechanical condition and readily dissolved in water, finds a general application for family requirements. The best qualities, if well ground and dried, are usually used as table salt or in the dairy industry. The peculiar nature of the dairy products, as well as the unusual risks involved in their successful manufacture, renders it quite necessary that none but a first-class article of salt should be applied for dairy purposes. The fitness of any

of the various kinds of salt in our markets for dairy purposes is not restricted to those from any particular source, but depends entirely on a good chemical composition and a suitable mechanical condition. A good dairy salt ought to be of a neutral reaction and a pure saline taste, free from any offensive odor and without any stain in color, of properly reduced size to favor a speedy solution, and, what is of scarcely less importance, free from colored specks. To produce such an article requires an extra exertion on the part of the manufacturer, and thus necessitates additional expenses as compared with the average quality of "common fine" and ordinary "coarse or solar" salt, neither of which, as a general rule, answers to the previous description. English manufacturers reserve frequently the first portion of the salt from a good and fresh salt pickle for dairy use, and work the remaining saline solutions into common salts used for the manufacture of soda-ash. Some of our dealers in sea-salt select the better grades of these articles and grind them into a fine material for dairy products. The American Dairy-Salt Company of Onondaga prepare their dairy salt by subjecting a good quality of boiled and of solar salt to an additional washing process, worked out in its details by the writer, before sending either one of them into the market with that brand.

The consumption of salt for the promotion of animal life far exceeds that for the cultivation of plants; the amount of salt used for meat-packing and for the dairy business is, however, much larger than either. In the industrial arts we can scarcely claim that any of our home resources have been turned to account; England turns more than one-half of its entire production of salt—from 17,000,000 to 18,000,000 bushels (56 pounds each)—into soda-ash. Our present demand for salt, which is still almost exclusively confined to its uses for domestic purposes and in agricultural industry, exceeds our home production—a fact which is not so much due to a real want of suitable home resources as to their disadvantageous local distribution. The production of salt within the U. S. amounts at present to from 18,000,000 to 20,000,000 bushels; our consumption is stated to be from 36,000,000 to 40,000,000 bushels, which represents about one bushel of salt for every head of the population of the country. This large consumption is mainly due to our extensive dairy and meat-packing business. CHARLES A. GOESSMANN.

Salt, Agricultural Uses of. In agriculture salt has, strictly speaking, two uses—that of a necessary article in the food of farm-stock and that of a fertilizer of the soil; and these must of course be considered separately. Common salt taken into the stomach is the source from which the hydrochloric acid of the gastric juice and the soda of the bile are derived; hence, under all conditions animals require a greater or less supply of this substance. In the ordinary processes of digestion a given portion of salt is used over and over again in the animal system. The salt yielding up its chlorine, the latter combines with hydrogen and forms hydrochloric acid for the gastric juice. The sodium set free combines with oxygen and forms soda, which passes to the bile and pancreatic juice. When the gastric juice and the bile, having served their respective functions, come together in the lower intestines, the hydrochloric acid and soda are mutually decomposed, and thereby reproduce the chloride of sodium or common salt. This is taken up by the absorbents and returned back to the system, to again undergo decomposition, the acid again passing to the gastric juice and the soda to the bile and the secretions of the pancreas. In this way, assuming the animal to be in a condition of comparative rest, only a small proportion of salt is necessary for its health, the salt in the system being used repeatedly. If, however, we place the animal under such circumstances as involve the excretion of salt, an additional supply is continually needed. For example, in a horse or ox hard driven a large quantity of salt is exuded by perspiration. In like manner, with milch cows a considerable quantity will be daily drawn off to provide the soda in the milk. The want of appreciation of these facts has led to the differences of opinion among theorists as to the actual necessity of salt for animals. In practice, however, farmers have learned by experience, and, without knowing the reason why, have in this respect been careful to meet the requirements of nature in the care of their farm-stock. The writer was once familiar with an instance in which, through neglect, no salt was given to a milch cow for a period of eight or ten weeks; as a result, the milk became greatly diminished in quantity, strongly tainted with a putrescent flavor and odor, and the cream required four or five times the usual amount of churning to "bring" the butter; the latter article being, moreover, practically worthless. In this case, undoubtedly, the quantity of soda in the system was scarcely equal to its demands, apart from affording any supply to the milk. The utility of salt in preventing a bad flavor to the milk when cows are fed on turnips is well known. Salt and ashes in equal quantities, given a handful once a week, are recommended by old farmers as a preventive of the bots in horses; they are, however, most effective when alternated with from four to six quarts of raw potatoes, also given weekly. Inasmuch as soda-salts, as hereinafter further explained, have the property of passing into the circulation of plants, grasses grown in places adjacent to the sea frequently contain sufficient salt for the cattle pastured on them. But in all inland regions salt should be given regularly to all kinds of stock; care must be taken, however, either to keep the supply within bounds or to gradually habituate the animals to a constant supply, as animals long deprived of salt are liable to eat it in quantities sufficient to act as an irritant poison. Many farmers follow the practice of placing a board in some sheltered corner of the pasture on which salt is spread all the time, the cattle eating as much (and no more) as they may require. An example of the results to animals deprived of salt under conditions that involved its elimination from the system is shown in the experience of Lieut. Herndon of the U. S. navy in crossing the continent of South America a number of years ago. When near the centre of the continent (where grass was the most luxuriant) the cattle and horses "were afflicted with weakness, would stagger and lie down, and could not get up again. They would drag themselves along and eat up everything within their reach, until they could drag themselves no farther, and would die of weakness and starvation, the appetite holding good to the last." The party were unable to supply the animals with salt, and the region was so far inland that the sea-breezes could not reach it. A proper supply of salt appears to afford exceptional benefits in the rearing of sheep. The fine wool of the Spanish flocks is attributed in a great measure to the abundant supply of salt given them. In England salt is supposed to be an antidote to the flukeworm, and a ton of salt is said to be the proper quantity for 1000 sheep per year. A writer of sixty years since asserts that at that time 1,000,000 tons were annually given to animals in England.

The use of salt as a manure dates back to remote periods. In China and Hindostan the fertility of the rice-fields has been dependent from time immemorial on the treatment of the soil with sea-water; and in Poland the use of salt as a fertilizer has been common for generations. There is, however, no manurial substance of less reliability, for the reason that its effects depend not only on the kind of crops raised upon the land, but on the character of the land itself, and in a no less degree on the other fertilizers with which it may be used. On sandy soils, devoted to the growth of mangold wurtzel, the results are often little less than marvellous, and under these conditions its use is common and profitable in England. Experience has shown that on stiff clay soils it is almost worthless, and in the growth of cereals—wheat, rye, barley, etc.—the chances of benefit are hardly sufficient to warrant the expense of trial. The chemical reactions that follow the decomposition of common salt in the soil are so complex that it is difficult to follow them, and hence the most unexpected results are sometimes obtained; for example, in a soil containing inert phosphate, the liberation of the soda might render the phosphate soluble, and hence increase the weight and yield of grains, for which, on ordinary soils, salt is considered inapplicable; used in connection, however, with nitrate of soda, it has been known to produce the most advantageous results, even with the small grains.

A given quantity of nitrate of soda has been found to give a far inferior result to that of the same weight mixed with twice as much of common salt. It should be applied as a top-dressing. In the absence of nitrate of soda, night-soil, mingled with five times its weight, and this incorporated with from 3 to 5 per cent. of common salt, should form a good drop-dressing for grass, provided the application be upon a sandy or light loam. Salt alone might prove advantageous in soils rich in organic matter. But this application, even with highly ammoniated manures, on stiff clay soils should be deprecated. Voelcker's experiments are of much interest in this connection. On a sandy soil, with only moderate quantities of soda and potash, and a deficiency of lime, from a given area there was obtained, without salt, 12 tons 2 cwt. and 76 pounds of mangolds; at the rate of 200 pounds of salt per acre, 18 tons 19 cwt. 93 pounds—showing an increase from the use of salt of 58 tons 14 cwt. 20 pounds per acre; 300 pounds of salt per acre gave 18 tons 4 cwt. 72 pounds—an increase of a little more than 5 tons. On increasing the amount of salt to 800 pounds per acre, the yield was 21 tons 18 cwt. 84 pounds, or an increase of 8 tons 14 cwt. as compared with that unmanured with salt; 400 pounds, however, is as

much as is commonly recommended by English authorities. Swedish turnips have given increased yield from the application of salt to the land, but only in a minor degree. An instance, however, of the manner in which a difference in the soil may upset preconceived ideas by the action of salt on manure is shown by another English experimenter, Mr. Hooker of Oaklands, Walton-upon-Thames, something more than twenty years ago. In this case the soil was somewhat stiff clay, resting on a sandy subsoil, and was treated with 400 pounds of salt to the acre, applied in portions as successive top-dressings during the season. This produced an increase in the yield of wheat of about 40 per cent. An analysis of the ash of the straw raised on salted land showed that it had 83 per cent. of silica, while that of the unsalted land yielded an ash having but 28 per cent. of silica. In this case the land was doubtless deficient in soluble silica necessary to the full development of the straw, and this being supplied by the solvent action of the soda of the salt upon the silica of the soil, the plants were able to reach a development otherwise impossible.

To a certain extent, for some unknown reason, salt tends to lengthen the period of development of full maturity of cereals and grasses; its action in this respect being just the reverse of that of highly ammoniated or stimulating manures. The effect of this is most apparent when salt is applied to grass-lands rich in ammonia; in such case the rank growth of the grass is checked; the yield in weight will be less, but the quality of the grass and its succulence will be greatly increased. It has been found that by lightly top-dressing pasture-lands with salt—say, from 100 to 200 pounds to the acre—the herbage will be much preferred by cattle and sheep, and pasturage of the coarse grasses may by this means be much ameliorated.

Salt has been often named as a specific for cabbage, but it is said by practical farmers to be a failure. Like other compounds of soda found in the soil, salt is capable of being taken up into the circulation of plants without being assimilated in their structure. It has even been found effloresced upon the surface of cabbage. It is taken up in the same manner in the structure of the mangold wurtzel, and probably other crops. Hence, when cattle are fed on mangolds raised on salted lands a supply of salt is not needed. This absorption of salt by crops makes the use of salt as a manure for sugar-beets especially objectionable, the beets being rendered useless for sugar manufacture. A very noticeable example of the manner in which soda compounds are mechanically absorbed in the structure of root-crops is afforded by sugar-beets raised in the alkali lands of the great West. The first two or three crops are worthless for sugar-making, because of the quantity of the alkali contained in them; but after a while, the alkali being thus abstracted from the soil, the absorption ceases and the saccharine matter of the beet is perfectly fit for use. JAMES A. WHITNEY.

Salt, Industrial Uses of. Salt is the source from which the soda of commerce is derived; the soda is manufactured by what is known, from the inventor, as Leblanc's process, described in all standard works on applied chemistry. Salt is therefore the real foundation of the manufacture of soaps and glass throughout the world. The manufacture of the soda from the salt also produces hydrochloric or muriatic acid, which has manifold uses in the arts. From salt, also, by processes fully set forth in ordinary textbooks, is obtained the chlorine of the bleacheries. Hence, modern textile manufacture depends in a great measure on this product of common salt. In practice, the chlorine is used in combination with lime, as the so-called chloride of lime. It is also employed for its disinfectant powers in hospitals, etc. Soda by itself is used in some of the operations of bleaching.

The preceding paragraph indicates in brief the more general industrial uses of common salt. Lack of space forbids a detailed description commensurate with their importance. One of the most common industrial uses of salt is in the preservation of animal substances used for food, as cod, mackerel, whitefish, etc., pork, and beef; to the two latter articles it is common to add a small portion of saltpetre, which has a preservative action by withdrawing a portion of the moisture from the substances to be preserved, its action in this respect being, as it were, analogous to that of alcohol. Saltpetre, however, when added to brine in which beef is immersed, combines with substances in the meat which give an unusually red color to the latter. The preservative action of salt is also increased by the addition of sugar. This is especially advantageous in the curing of hams. The preservation of butter is also due to salt, and the quality of the article depends in a great measure upon the quality of the salt, its proportion, and the thoroughness with which it is incorporated. Turk's Island and Ashton salt are always preferred for this purpose. After the butter has been salted and worked, it should be packed in well-soaked wooden tubs or firkins. Salt is sprinkled in the bottom, and the butter packed in a solid mass upon it. When the firkin is filled within half an inch of the top, a cloth is laid over the butter, and over this a layer of salt; water is then poured in, and the butter is thus covered with a saturated brine. The firkin should be placed in a cool, dry cellar, and kept several inches from the ground. It has often been proposed to employ the antiseptic properties of salt in the preservation of timber. This appears to have been first suggested by the great durability of vessels employed in the transport of salt by sea, and in the fishing trade, where large quantities of salt and fish are carried. But timber saturated with salt continually contracts moisture; its weight is increased, and the writer is not aware that the process has ever been approved to any considerable extent. Frequently, however, the joints and intersections of ship-timbers have been filled in with salt, with apparently good results. That timber to be placed in damp and wet situations, or subjected to alternations of wet and dryness, would be much more durable if seasoned by immersion in strong brine, there can be no doubt; on a small scale this could be practised by farmers in the treatment of fence-posts, hop-poles, and the like. The cheapness of salt recommends it as a preservative agent where the objections just mentioned would be of no account. Its antiseptic power is, however, inferior to that of many other substances, being stated at less than one-fourth that of saltpetre, one-twelfth that of borax (which latter has been applied to timber for the double purpose of fire-proofing and preserving), and one-thirtieth that of alum. Salt is used in most effective refrigerating mixtures. Industrially, however, these have thus far only a minor application (see REFRIGERATORS), but under all conditions where a temperature below 25° F. is desired, mixtures of salt with other substances are cheapest and practically the most efficacious. Salt 1 part and 2 parts dry snow or pounded ice will secure a reduction of temperature to $-5°$; 1 part of chloride of ammonium, 2 of salt, and 5 of snow will reduce it to $-12°$; 1 part of nitrate of ammonia and 1 of salt, combined with $2\frac{1}{2}$ parts of snow or pounded ice, will reduce it to $-25°$. A cold even more intense may be obtained by special manipulation of the materials, not necessary to mention in detail here. Freezing mixtures of salt and ice were first discovered in Italy more than 200 years ago, and suggested the modern art of making ice-cream. JAMES A. WHITNEY.

Salt (HENRY), b. at Lichfield, England, about 1780; accompanied Lord Valentia in 1802–06, in an artistic capacity, upon his travels in Egypt, India, and the East, and made a first visit to Abyssinia 1805, of which an account appeared in Lord Valentia's travels; was sent to Abyssinia in a diplomatic capacity to negotiate an alliance Jan., 1809; returned Jan., 1811; was appointed consul-general in Egypt 1815, and made fine collections of Egyptian antiquities, employing Belzoni as his agent. D. at a village between Cairo and Alexandria Oct. 30, 1827. He published a sumptuous volume of engravings of scenes in India, Abyssinia, and Egypt (1809), a *Voyage to Abyssinia, with 36 plates* (4to, 1814), *Egypta, a Descriptive Poem* (1824), and an *Essay on Dr. Young's and Champollion's Phonetic System of Hieroglyphics* (1825). His *Correspondence* was issued in 1834, with a *Biography* by J. J. Halls.

Salt (Sir TITUS), BART., b. at Morley, England, in 1803; educated at Wakefield; was for some years associated in business with his father, who was a wealthy wool-dealer; commenced business in a small way as a woollen manufacturer at Bradford 1834; rapidly acquired a fortune, and in 1853 began near Shipley, on the banks of the Aire (since called Saltaire—*i. e.* Salt-Aire), the erection of a model manufacturing village on a colossal scale, which has been truly called a "palace of industry." The factory-works now (1876) embrace more than 20 acres, and the village consists of nearly 1000 houses, built expressly for the work-people with all the appliances of comfort which the builders' art has introduced in modern times. Sir Titus was for many years a magistrate and deputy lieutenant of the West Riding of Yorkshire; served as mayor of Bradford and president of the chamber of commerce; sat in Parliament for Bradford as an advanced Liberal 1859–61, and was made a baronet Oct., 1869. He was the head of the great house of Titus Salt, Sons & Co., known as among the largest employers of labor in Yorkshire; was a liberal benefactor to orphan and lunatic asylums, hospitals, and other benevolent institutions, as well as to public parks, schools, and libraries; and, as a memorial of the esteem of the people of Bradford, was honored by the erection, in the centre of the city, of a fine marble statue, unveiled by the duke of Devonshire Aug. 1, 1874. D. Dec. 29, 1876.

Sal'ta, town of the Argentine Republic, South America, capital of the state of the same name, in lat. 24° 15′ S., lon.

64° 50′ W., on an elevated plain, on the small river Arias. It is [illegible] and [illegible] on a considerable trade, especially [illegible], but its immediate vicinity is somewhat [illegible] not healthful on account of the [illegible] of the surrounding water-courses. P. 11 .1?

Salt Creek, tp., Macon co., Ill. P. 1102.

Salt Creek, tp., Decatur co., Ind. P. 1687.

Salt Creek, tp., Franklin co., Ind. P. 1223.

Salt Creek, tp., Jackson co., Ind. P. 1963.

Salt Creek, tp., Monroe co., Ind. P. 636.

Salt Creek, tp., Davis co., Ia. P. 889.

Salt Creek, tp., Tama co., Ia. P. 1113.

Salt Creek, tp., Mitchell co., Kan. P. 40.

Salt Creek, tp., Cass co., Neb. P. 178.

Salt Creek, tp., Hocking co., O. P. 1179.

Salt Creek, tp., Holmes co., O. P. 1259.

Salt Creek, tp., Muskingum co., O. P. 1131.

Salt Creek, tp., Pickaway co., O. P. 1750.

Salt Creek, tp., Wayne co., O. P. 1593.

Salt Creek, p.-v., cap. of Juab co., Ut.

Sal'ter (RICHARD), D. D., b. at Boston, Mass. in 1723; graduated at Harvard 1739; studied both medicine and theology, and was minister of Mansfield, Conn., from June 27, 1744, to his death, Apr. 14, 1787. He gave a farm worth $2000 to Yale College to promote the study of Hebrew and Oriental languages.

Salter (WILLIAM D.), b. in New York City in 1794; entered the U. S. navy as a midshipman 1809; served on board the Constitution during her action with the Guerriere 1812; became captain 1839; retired after forty-six years' active service 1855; was in command at the Brooklyn navy-yard 1856–59; became commodore on the retired list July 16, 1862, and was a commissioner to examine vessels for the war department 1863–66. D. Elizabeth, N. J., Jan. 5, 1869.

Salti'llo, town of the Mexican confederation, capital of the state of Coahuila, on the Tigre, is regularly built, and had in 1831, 31,000 inhabitants, but has greatly declined during the wars, and has now about 15,000 inhabitants. It was founded in 1586, and incorporated under the name of Leone Vicario in 1827. Seven miles from this place was fought the battle of BUENA VISTA (which see).

Saltillo, p.-v., Lee co., Miss., on Mobile and Ohio R. R. P. 148.

Saltillo, v., Harrison tp., Perry co., O., on Cincinnati and Muskingum Valley R. R. P. 83.

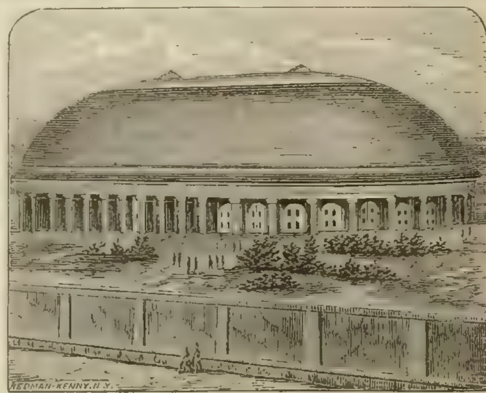
Salt Lake. See GREAT SALT LAKE, and LAKES.

Salt Lake, county of N. Utah, lying S. E. of Great Salt Lake, intersected by Jordan River and traversed in E. part by the Wahsatch Mountains; has a soil along the base of the mountains which is naturally sterile, but has been made productive by irrigation; is crossed by several railroads; has important mines of gold and numerous manufactories. Staples, wheat, potatoes, hay, wool, and butter. Cap. Salt Lake City. Area, 1200 sq. m. P. 18,337.

Salt Lake City, city, and cap. of Salt Lake co. and of Utah Territory, 11 miles from Great Salt Lake, at the

City Hall, Salt Lake City.

base of the Wahsatch Mountains, near the intersection of the 41st parallel with the 112th meridian, with other mountains 20 miles W. and S., giving it a picturesque situation. It is in every sense the metropolis of Utah and of the Mormons, who founded it in 1847, and have since extended their settlements 150 miles N. and 350 S. The census of 1870 gave it 12,854 inhabitants, and the population has increased to 20,000 since. The streets are 137 feet wide, and the blocks are 40 rods square. Water is conveyed along the streets for irrigation and other uses, and the shade and fruit trees render the city a conspicuous contrast with the country at large. The site covers more than 9000 acres, not more than one fourth of which is as yet occupied. Utah Central R. R. connects the city with Union and Central Pacific R. Rs. at Ogden, 36 miles N. This and Utah North-



Tabernacle, Salt Lake City.

ern R. R. give it rail communication to Franklin, Id., 120 miles N., to be extended to Soda Springs and the Northern Pacific ultimately, with a branch down Snake River through Idaho to the mouth of the Columbia. Utah Southern R. R. is completed to Nephi, about 100 miles S., along the base of the Wahsatch Range. From this branch off narrow-gauge roads into the mining cañons. The stem-road is the common gauge, and is to be extended as rapidly as possible to St. George and the Southern Pacific. The Utah Western is but just begun. It is designed to reach South-western Utah and South eastern Nevada. All the Utah railroads but the Utah Central and the Utah Southern are 3-feet gauge. The city is lighted by gas, and has 6 miles of street railroad. It has several graded schools, inclusive of the University of Deseret, a Territorial, a city, and a Masonic library, a museum of the productions and curiosities of the region, 3 daily and weekly newspapers, a weekly in the Scandinavian tongue, and some minor periodicals. The city hall cost $70,000, but the most remarkable building is the Tabernacle, the Mormon place of assembly for worship. It contains an organ second in size only to the big organ of Boston, cost $500,000, and will seat 7000 to 8000 people. There are Masons' and Odd Fellows' halls, Congregational, Presbyterian, Episcopal, Methodist, and Roman Catholic churches, and many relief and benevolent societies. From its founding until recently the city suffered from the exclusive policy of the Mormons, but with the advent of railroads other influences began to be felt, and the city, after a long and feeble infancy, is about entering on the race of growth and progress common to other cities centrally located with respect to large areas of country. O. J. HOLLISTER.

Salt Lick, tp., Perry co., O. P. 1349.

Salt Lick, tp., Fayette co., Pa. P. 1209.

Salt-Mines of Louisiana. An extraordinary deposit of salt was discovered in 1861 in sinking a well on the estate of Judge Daniel Avery on Petit Anse Island, on the sea-coast of Louisiana, lat. 29° 50′ N., lon. 91° 55′ W. The discovery served the Confederacy with a supply of salt during the latter years of the war. Petit Anse is an island of some 5000 acres, rising 160 feet out of the sea-marsh that lies along the coast 30 miles in width. It was covered with a forest, and has been long inhabited and cultivated. The mine was an amorphous mass of rock salt, its crest about 20 feet underground, and some 50 feet below the summit of the island. The salt was a pure muriate of soda, and was mined without dirt or other foreign matter. Its solidity was complete, without seams or cleavage, or any evidence of crystalline structure. Blocks of crystal were, however, found upon the surface of the mass. A shaft was sunk some 50 feet into the salt, and thence a 10-foot tunnel was run to the westward 100 yards, and another some distance in the opposite direction, and yet no indication appeared of coming to the margin of the deposit. Tunnelling was very difficult, because it was not aided by cleavage. Blasting marred the purity of the product. An amount of about

2000 tons was mined, and carried to the surface by an elevator. It was designed to push the tunnel to the steep portion of the island, where it would emerge above the level of the marsh, and where a bayou, navigable for schooners, would bear the freight 2 miles to Côte Blanche Bay and to the Gulf. The facilities for getting to New Orleans and the markets of the world were all that could be desired. A contract upon royalty was made in 1868, but the works were not completed when the contractor died, and the work was suspended. It has not been resumed. So vast an amount of rock-salt, so convenient to market, has not elsewhere been found on this continent. The geographical position of this mine is in the parish of Iberia, La., about 10 miles S. of Iberia, the parish-seat, upon the river or Bayou Teche. A dike and plank-road reaches the island across the marsh, about 3 miles. The alluvion of the Mississippi extends to the mouth of Vermilion River in the bay of the same name. This embraces Belle Isle, Côte Blanche, and Petit Anse, diluvial islands within the marsh that extends from the Gulf to the Teche, and onward some 30 miles in width to the westward. Several similar islands lie along the sea-coast beyond, and the phenomena invite further exploration. The sulphur-mine near Lake Charles is in evidence.

Geological Position.—Fossil remains of the Quaternary period are found thickly strewn upon and beneath the surface of the island. In sinking the shaft of the mine the remains of pottery were found in great quantities, and human bones, with darts and stone axes of various kinds, and with and above them the bones of mammoths, mastodons, elk, and deer, that seem to have frequented the salt-licks, as cattle and horses do now. From the vast amount of human remains and rude weapons, it would appear that men had been attracted thither by the great amount of game that frequented the spot. All seem to have been whelmed in one catastrophe, and the dispositions since made by nature have not borne them far from their original sepulture. The waters of the Quaternary seas overtook them suddenly, and left them very near where they perished. The depression in the Gulf-level has permitted the Mississippi River and other tributaries of the Gulf to denude the entire Gulf-coast, from an elevation of about 180 feet down to the sea-marsh level, and left this salt-block an anomaly, projecting as a peak from the Cretaceous seas in which it was probably formed.

The salt-springs of Louisiana were somewhat noted as early as the war of 1812. Salt was at that time made in the vicinity of Natchitoches, and carried to Sicily Island, Natchez, Opelousas, and even to New Orleans. The springs are 20 and 30 miles E., along the valley of the Saline Creek, nearly at the level of the Red River alluvion. They are copious, and were again worked during the civil war. They have not since been worked on account both of their distance from market and the weakness of the saline water. A series of less copious springs is traceable from far in the Cretaceous formations of the Arkansas, down past these, which issue in the Eocene Tertiary, and emerge again on the Castor, 40 and 60 miles S., and appear to pass beneath the alluvion of the Washita and the Red River. At several points in the great alluvion they make their appearance down to the coast, their connection obscured by their depth. The Cretaceous seems to underlie Western Louisiana, and to be charged with salt. Possibly the salt-mine of Petit Anse has an identical origin. C. G. Forshey.

Sal'tonstall (Gurdon), son of Col. Nathan and great-grandson of Sir Richard, b. at Haverhill, Mass., Mar. 27, 1666; graduated at Harvard 1684; was ordained minister of New London, Conn., Nov. 25, 1691; was distinguished as an orator, and took so active a part in politics that he was made governor of Connecticut 1707, and held that post until his death, Oct. 1, 1724. He bequeathed £1000 to Harvard College to educate students for the ministry.—His son, Gurdon, b. Dec. 22, 1708, graduated at Yale College 1725; became brigadier-general of Connecticut forces 1776; was cashiered for misconduct in the Penobscot expedition 1779, and d. at Norwich Sept. 19, 1785.—Dudley, son of Gen. Saltonstall, b. Sept. 8, 1738, became a commodore in the Continental navy, and d. in the West Indies in 1796.

Saltonstall (Leverett), LL.D., son of Dr. Nathaniel (1746–1815) and grandson of Richard (1703–56), b. at Haverhill, Mass., June 13, 1783; studied at Phillips Academy, Exeter, N. H.; graduated at Harvard 1802; commenced the practice of law at Salem 1805; attained eminence in his profession; was a member of several learned societies, including the Massachusetts Historical Society, to whose *Collections* (2d series, vol. iv.) he contributed an *Historical Sketch of Haverhill;* served frequently in the general court; was a State senator 1831; chosen Presidential elector 1836; was mayor of Salem 1836–38, and member of Congress 1838–43. D. at Salem May 8, 1845. By his will he gave a large portion of his library to Phillips (Exeter) Academy and a sum of money to the library of Harvard University.

Saltonstall (Sir Richard), b. at Halifax, England, in 1586, son of Sir Richard, who became lord mayor of London 1597; came to Massachusetts as assistant governor to Winthrop 1630; was associated with Mr. Phillips in the foundation of Watertown 1630, but went back to England the following year, and never returned to Massachusetts, though he continued through life an influential friend of the colony and was a patentee of Connecticut. In 1651 he wrote a letter to the Massachusetts ministers Cotton and Wilson remonstrating against the persecution of men for their religious opinions. D. in England about 1658. Through his sons, who settled in Massachusetts, he was ancestor of all who have borne the name in New England.—Richard, b. at Woodsome, Yorkshire, England, in 1610, was an early settler of Ipswich, was assistant governor 1637, befriended the regicides Goffe and Whalley, and protested against the introduction of negro slavery into the colony. D. at Hulme, England, Apr. 29, 1694.

Saltonstall (Richard), b. at Haverhill, Mass., June 14, 1703; graduated at Harvard 1722; was frequently a member of the general court and of the executive council; was a scientific and practical farmer, and also learned in the law; was chairman of the commission for settling the boundary-line between Massachusetts and New Hampshire 1737, and was judge of the superior court nearly twenty years (1736–55). D. Oct. 20, 1756.

Saltpetre. See Nitre, Nitrates, and Nitric Acid, by Henry Wurtz.

Salt Point, tp., Sonoma co., Cal. P. 1088.

Salt Pond, tp., Saline co., Mo. P. 2895.

Salt-Rad'icals, in chemistry, a term used in a certain system of chemical theory, much in vogue during the middle of the present century, and not even yet wholly abandoned by all, though the present prevailing school of theorists substitute chiefly another system of radicals, of which *hydroxyl* (HO) is the main cornerstone. The necessity, or assumed necessity, of *some* radical theory arises from an inherent attribute of the human mind. Whether from the effect of irresistible analogies, or from the profounder working of an implanted instinct, the mind of man expects to find universal harmonies extending throughout the scheme of nature. When these are not recognizable upon the surface, the mind seeks to discover them by the invention of hypotheses; and when one such hypothesis is found to reconcile and explain extended series of diversified facts, and to assist us in our belief in the harmony of nature, we call it a *generalization*, and, by those who deem it thoroughly well established, a *theory*. The vast multitude of substances known to chemists range themselves, in general, into *at least seven* natural groups, which may be thus designated (readopting two good terms used by Berzelius which have fallen into unmerited disuse): *metallic* elements, *halogen* elements, *amphigen* elements, *acids*, *bases*, *hydrates*, and *salts*. Under the latter term is included an enormous group of compounds which result largely from the bringing together of an acid with a base, another result being the simultaneous disappearance of positive acidic and basic qualities, and the appearance, in the resulting compound salt, of the negative quality called *neutrality*. It is undeniable, however, that large and important families of neutral salts—*common salt*, from which the name of the class comes, being itself an example—might be formed without the intervention of either acid or base; that is, by the interaction or combination of a metal with a halogen element, either *chlorine*, *bromine*, or *iodine*. One object of the older salt-radical theory was to generalize *all salts* under one law of formation and structure; and this was accomplished by the invention of a great number of supposititious radicals (see Radicals), there being one corresponding with every known oxygen acid. The process of nature in the formation of salts of oxygen acids, in order to conform with her supposed uniform law, involved the leaping over of the oxygen of the base to the acid, and its coalescence with the latter into a compound radical. Some examples are as follows:

Anhydrous sulphuric acid and water (SO_3 and H_2O) were supposed, when combining, to form the compound $H_2.SO_4$, SO_4 being the compound radical formed. So, likewise, if any other basic oxide be used instead of water, we must have, according to the atomicity of the metal—

In the case of monadic metals.....$M_2O + SO_3 = M_2.SO_4$.
In the case of dyadic metals........$MO + SO_3 = M.SO_4$.
With tetradic and { dioxides........$MO_2 + 2SO_3 = M.2SO_4$.
hexadic metals, { sesquioxides, $M_2O_3 + 3SO_3 = M_2.3SO_4$.

The radical SO_4 was called both "*sulphatoxygen*" and "*oxysulphion*." In the case of nitrates, another radical

(N_2O_6), called "*nitroxygen*" or "*oxynitrion*," was believed to be formed by similar transformations, M_2O and N_2O_5 giving a compound $M_2N_2O_6$. In our present prevailing method of notation for the nitrates, however, these salts, on the salt-radical theory, should contain a radical NO_3, being formed as follows:

$$M_2O + N_2O_5 = 2(M.NO_3).$$
$$MO + N_2O_5 = M.2NO_3.$$
$$M_2O_3 + 3N_2O_5 = 2(M.3NO_3).$$
$$MO_2 + 2N_2O_5 = M.4NO_3.$$

The arguments presented for the salt-radical theory, or the great congeries of hypotheses which passed under that name, are as follows: (1) It brings under the same *binary* type the different families of neutral salts, oxygen or *amphide* salts, halogen or haloid salts, and others, such as sulphur salts, all of which are believed, with reason, to constitute one natural family, and therefore necessarily to have *some* natural link or bond of relationship. The supposed salt radicals must be similar in their functions to the halogen elements, and to that known and admitted compound salt-radical *cyanogen*, CN. Some even went so far as to claim that this makes hydrated acids to be "salts of hydrogen," as it was expressed, thus virtually abolishing acid hydrates as a distinct family. (2) It explains the fact that neutral or so called "normal" monobasic salts contain in general as many equivalents of acid as there are oxygen equivalents in the base, as illustrated in the above equations. (3) It has been thought to put in a simpler light the relations of metals to hydrated acids, both in simple solution processes upon metals and in electrolysis of metallic salts. In a solution of a metal in sulphuric hydrate, for example, the reaction will be as follows: $H_2.SO_4 + M_2 = M_2.SO_4 + H_2$, parallel to that in the case of hydrochloric acid, $H.Cl + M = M.Cl + H$.

In electrolysis of a metallic sulphate in solution, the first stage is the simple decomposition of $M_2.SO_4$ into M_2 and SO_4, the metal appearing as such at the cathode, while at the anode, if this be of the same metal, the sulphatoxygen simply takes it up again to form sulphatoxide, or otherwise sulphate; the whole being precisely parallel to the electrolysis of a metallic chloride in solution.

The arguments *against* the salt-radicals are as follows, one or two of these being probably presented here for the first time: (1) The necessity of an indefinite number of distinct hypotheses, one for each known oxygen acid. (2) The failure, thus far, to isolate any of the salt-radicals, with the property of performing directly the functions of a true electro-negative radical, like cyanogen or chlorine. As an example we may cite the case of the compound SO_3, which should be the salt-radical of the *sulphites*. We might therefore reasonably expect that at least some metals would directly combine with SO_3 to form sulphites. Nevertheless, no such case is yet on record. With mercury this compound forms *sulphate*, not sulphite, with simultaneous evolution of sulphurous anhydride. On iron, zinc, and copper at the ordinary temperature SO_3 has no action at all. (3) In case of polybasic acids—like phosphoric acid, for example—each class of salts formed requires a different "*oxyphosphion*" salt-radical. In our present notation this involves real complexity, it being indeed impossible to formulate the bibasic salts or pyrophosphates in reasonable conformity with the others. Thus, while the orthophosphate and metaphosphate of soda may be $Na_3.PO_4$ and $Na.PO_3$, the pyrophosphate must have the cumbrous expression $Na_4.P_2O_7$. (4) The salt radicals, if admitted, seem to carry us *too far*. In the abolition of the class of acid hydrates is really involved, *by the same arguments*, the abolition of *all* hydrates whatever containing replaceable water or hydrogen, including *alkaline hydrates*; for if the solution of zinc, with evolution of hydrogen, by sulphuric hydrate argues the formation of such a molecule as $Zn.(SO_4)$ from $H_2.(SO_4)$, why does not the solution of the same metal by potassic hydrate, with the evolution of hydrogen, argue the formation of the molecule $Zn.(K_2O_2)$ from $H_2.(K_2O_2)$? Indeed, the prevailing school of chemical theorists—which may be called the hydroxyl school—admit the radical K_2O_2 (or rather KO) as "potassoxyl." Hence, the tendency of these speculations is to the generalization, or classification into one natural group, of all kinds of *salts*, together with all the *hydrates*, both of acids and of bases.

Of late years the aim of the leading school, indeed, with reference to acids and bases, both anhydrous and hydrated, has been to attempt what they deem a still wider generalization, which substitutes for the original salt-radicals another class of radicals, equally hypothetical, of which hydroxyl is one type, while others are known as *sulphoxyl*, *phosphoxyl*, *nitryl*, and so on. Thus, sulphuric, nitric, orthophosphoric, and metaphosphoric hydrates are assumed by them as $2HO.SO_2$, $HO.NO_2$, $HO.PO_2$, and $3HO.PO$. In these cases, apparent simplicity, at least of *notation*, is attained, at the expense, however, of an indefinite multiplication of subsidiary hypotheses. To get pyrophosphoric hydrate into this system they suppose it to be a compound of ortho- and metaphosphoric hydrates; thus, $4HO.PO.PO_2$. These modern improvements, therefore, upon the salt-radical theory would give for the corresponding sodium salts, containing *natroxyl* (NaO), as they are formed by the simple substitution of Na for H in the above hydroxyl formulæ, the following expressions:

Sodium sulphate	$2(NaO).SO_2$.
Sodium nitrate	$NaO.NO_2$.
Sodium orthophosphate	$NaO.PO_2$.
Sodium pyrophosphate	$4NaO.PO_2.PO$.
Sodium metaphosphate	$3NaO.PO$.

It will be observed here that the original idea of the older salt-radicalists, of obtaining a parallelism of constitution between the haloid and amphide families of salts, is entirely lost sight of. (For the nature and constitution of salts and acids see SALTS, CHEMICAL NATURE OF, and VOLUMES, MOLECULAR.) HENRY WURTZ.

Salt Range, or **Kalabagh Mountains,** a mountain-group of the Punjaub, India, extends from the north-eastern boundary of Afghanistan to the Jhylum, a distance of about 200 miles. It is only 2500 feet high, but its bold peaks and steep, wild precipices, consisting of granite, gypsum, and layers of almost perfectly pure rock-salt, are completely without vegetation, and present a barren and forbidding aspect.

Salt River, tp., Adair co., Mo. P. 1164.

Salt River, tp., Audrain co., Mo. P. 5602.

Salt River, tp., Knox co., Mo. P. 2120.

Salt River, tp., Pike co., Mo. P. 379.

Salt River, tp., Ralls co., Mo. P. 1337.

Salt River, tp., Randolph co., Mo. P. 782.

Salt River, tp., Schuyler co., Mo. P. 1115.

Salt River, tp., Shelby co., Mo. P. 1986.

Salt Rock, tp., Marion co., O. P. 351.

Salts'burg, p.-b., Conemaugh tp., Indiana co., Pa., on Conemaugh River and on Western division of Pennsylvania R. R. P. 659.

Salts, Chemical Nature and Definition of. (See further under SALT-RADICALS.) The importance of *salts* as a class is greater than that of any other group of chemical compounds, inasmuch as they must almost indefinitely outnumber all other groups put together. Each acid, and each simple and compound electro-negative or acidic radical, forms independently as many salts as there are basic oxides or other basic bodies that can combine with the acids, and as there are metals or basic radicals that can combine with the acidic radicals. Polybasic salts and double salts, and variations in crystal-water, combine to swell the *possible* salts to a number which is next to illimitable, and practically quite incalculable. The *classification* of such a huge number of substances is of the most essential importance to science, and until we shall have discovered those laws of molecular constitution and structure which alone can furnish a real and enduring system of classification, and a nomenclature founded on fact and not on hypothesis, some will wisely continue to prefer such provisional and imperfect groupings as present themselves upon the surface of things; some of which indeed, for all we know, may yet be found to furnish indexes to the real system of nature, as yet inscrutable to our merely superficial knowledge or masked by our prevailing artificial hypothetical views.

The best general and comprehensive *definition* of salts as a natural class that can be given is as follows: Bodies formed by the interaction of an electro-negative or acidic element, radical or compound, with an electro-positive or basylic element, radical or compound, in which *neutrality* is engendered, with mutual neutralization and disappearance of pre-existent acidity and basicity.

If we try to make a classification of salts based upon the present classification of the elements into groups according to their *atomicity*, so called—a grouping which would appear to have a certain foundation in nature—we meet soon with obstacles of a baffling character, there being many unmistakably natural groups or series of salts which present no parallelism with these atomicity-groups. To mention a few examples among the many striking ones that present themselves: Among the *basylic monads* we have silver and thallium, than which scarce any metals present less natural parallelism or relationship, either as elements or in salts, to the *alkali metals* or to *hydrogen*, among which they fall according to the accepted atomicity-groupings. Among the *basylic dyads* we have mercury and copper, classed with the natural group of the earthy metals. Among the *tetrad metals* tin, platinum, and lead fall together. Among the

acidic or *negative monads* fluorine is placed with chlorine, bromine, and iodine, which is at least dubious, its relationship to oxygen being much closer. Oxygen itself falls with the *dyad negatives*, sulphur, selenium, and tellurium, with very few satisfactory natural analogies to support the arrangement, and numerous irreconcilable differences against it. Boron is also widely separated, as a *triad*, from its natural relatives, carbon, silicon, and titanium, which are undeniably *dyadic-tetradic* elements, and is put with the phosphorus-group, with which we also find gold.

The rude provisional classification of salts, which must apparently even yet be reverted to if we wish to escape hypothetical or speculative views founded upon radical systems (such as are commented on under the head of SALT-RADICALS, which see), is that of Berzelius, this being now just half a century old, having been enounced by him upon his discovery of the group of the sulphur-salts in 1825–26. Berzelius made two general grand divisions of most salts, the *haloid* salts (ἅλς, "sea-salt") and the *amphide* salts (ἄμφω, "both," referring to the assumed existence of the acidic or negative element in *both* constituents of the salt). The haloids include those apparently simplest in constitution, consisting, like common salt, merely of two elements or radicals—one positive and the other negative—united into a compound more or less neutral. Whether this greater simplicity is real—that is, whether, as some have conjectured, the haloids may not possibly contain in their molecules *as many atoms* as the amphides—remains to be ascertained, as one result, probably, of successful studies (such as have not yet appeared at this present writing) into the subject of molecular volumes. (See VOLUMES, MOLECULAR.) A few examples of haloid salts are NaCl, NH_4Cl, KI, KCN, $NH_4.CN$, Fe_2Cl_3, Al_2Cl_6, $BaCl_2$, $AuCl_3$, $SnCl_4$, $SbCl_5$, WCl_6, by which it appears clearly enough that this classification is far from being a natural one, for even in this simplest class a very great variation exists both in types of composition and in natural relations. The haloids are further divided into acid, basic, and neutral or normal salts, these divisions being, however, largely arbitrary, and susceptible of no consistent and systematic application.

The *amphide* salts, according to Berzelius, include an enormously greater range of varieties. His group of amphigen elements, like the more modern group of dyadic negatives, contained oxygen, with sulphur, selenium, and tellurium; and he was led by his discovery of the sulphosalts, or double sulphides, to endeavor to correlate these with oxygen-salts under the general designation of *amphides*. This generalization has even been extended to the contemplation of double chlorides, double fluorides, etc., as belonging to similar types, these being called *chlorosalts*, *fluo-salts*, and so on. These latter views, however, and even the term "amphide" itself, have fallen (probably justly) into disuse of late years, though the other term, "haloid," still holds its ground to some extent by reason of a certain convenience of application it possesses. By far the most numerous and important of the so-called amphide groups of Berzelius belong now to what we term *oxygen-salts*, composed of an acidic oxide combined with a basylic oxide. Of these there is a great variety, one important occasion of this being variations in *basicity* on the part of the acid, by virtue of which variable numbers of equivalents of hydrogen or a basylic metal are required to satisfy the combining power, or "basicity," of the acidic oxide. (See PHOSPHORIC ACIDS.)

An illustration or two may be given of the vague understanding and imperfect generalization of this subject yet possessed by us; which makes it impossible, without hypothetical assumptions (such as that of "hydroxyl"), to classify salts rationally. Thus, by the view of the illustrious Graham, that *hydrogen is a metal*—which accords with its replaceability by, and interchangeability with, metals—we are inevitably forced to ignore the marked natural distinction between salts and acids, the latter becoming merely *salts of hydrogen*. Another similar but much more striking consideration arises from the fact (altogether undeniable, yet generally ignored in the school-books) that there is no essential difference in the mode of action of several highly basylic metals *on both acids and alkalies*. The so-called "hydrates" of the alkalies contain hydrogen in the same state, and replaceable by a basylic metal (zinc, aluminum, etc.) exactly in the same way as in acids, this hydrogen being expelled in a free state, with formation of compounds *of two basic oxides*; which compounds cannot consistently be called salts, and have as yet, indeed, no distinct place in any system.

An entirely consistent and comprehensive theory of acids, bases, and salts remains yet to be generalized as a consequence of further discoveries of laws and relations yet undeveloped, but which time will bring forward. H. WURTZ.

Salt Spring, tp., Randolph co., Mo. P. 3526.

Salt'ville, p.-v. and tp., Washington co., Va., on the N. fork of Holston River, is connected by a branch railroad with Glade Springs. P. 2471.

Salt'works, v., Young co., Tex. P. 20.

Salu'brity, p.-v., Pickens co., S. C. P. 1367.

Salu'da, p.-v. and tp., Jefferson co., Ind. P. 1682.

Saluda, tp., Greenville co., S. C. P. 1761.

Saluda, tp., Lexington co., S. C. P. 792.

Saluda, p.-v. and tp., cap. of Middlesex co., Va. P. 1715.

Salute' [Lat. *salus*, *salutis*, "health"] originally signified the expression of a wish for the health of another. It now denotes a complimentary notice of an officer or a ship-of-war by the military or naval authorities. Salutes are offered by the presenting of arms, the dipping of colors, the rolling of drums, the firing of guns, the manning of yards, etc. The U. S. national salute is one gun for each State. The President is saluted with 21 guns; the Vice-President with 17; governors, cabinet officers, and generals commanding with 15; U. S. or foreign envoys, ministers and major-generals, 13; brigadier-generals, 11; and foreign ships receive gun for gun for all they fire in salute.

Saluz'zo, town of Italy, province of Cuneo, about 33 miles S. S. W. of Turin, near the opening of the mountain-valley of the Po upon the plain of Piedmont. The town itself stands mostly upon the plain, while from the charming hills near and behind it the villas of the Piedmontese nobility command views of great beauty and grandeur, the giant Monte Viso forming a most striking feature. The cathedral, semi-Gothic and of the fifteenth century, the church of St. Martin and St. Bernard, of St. Domenico, etc., all contain objects of more or less interest. In one of the public squares there is a fine monument erected to Silvio Pellico, who was born here. The ancient castle of the marquises of Saluzzo is now used as a prison. Though the numerous antiquities found in the vicinity prove that it was once occupied by a dense Roman population, yet this town does not appear in history until the eighth century, and only assumes importance in the twelfth. After this time as a marquisate, sometimes of greater, sometimes of less extent, it played a conspicuous part in the mediæval history of Northern Italy, the lords of Saluzzo being always dreaded as enemies and courted as allies. War and pestilence, however, at last (1630) reduced the pop. of 30,000 to 6000. At present, industry and commerce are reviving, and the agriculture of the district is prosperous. P. 15,500.

Salvador' (JOSEPH), b. at Montpellier in 1796, of Jewish descent; studied medicine and took his degree in 1816; settled at Paris, and devoted himself chiefly to the study of history; wrote in 1822 *Loi de Moïse*; in 1828, *Histoire des Institutions de Moïse* (3 vols.); in 1838, *Jésus Christ et sa Doctrine* (2 vols.); in 1846, *Histoire de la Domination romaine en Judée* (2 vols.); in 1859, *Paris, Rome, Jérusalem, ou la Question religieuse au 19e Siècle* (2 vols.).

Sal'vage [Lat. *salvare*, "to save"], the reward paid for saving a vessel and the property on board, whether saved in war from an enemy by recapture or saved from the perils of the sea. The recapture in the first case may be from a pirate, or from a captor who is an enemy, or from one with a commission who is not an enemy. In the first case, the law of Great Britain and that of France give one-third of the value to the captor as salvage. In the second case, the usage and law of nations vary, both as to the restoration of the vessel or property—which depends on the length of time that it has been in the enemy's hand or on the condemnation by a prize court—and as to the amount of salvage in case of restoration. The law of the U. S. adopts the principle of reciprocity in regard to the restitution of the property of friendly nations when recaptured from the enemy, and to the salvage in such cases to be paid. In regard to the third case, we refer to Wheaton's *Elements* (ed. 8, §§ 360–384), which considers the whole subject carefully. T. D. WOOLSEY.

Salvage, the term used in the maritime and admiralty law to describe the special compensation which is allowed, according to the doctrines of that law, to those persons who have voluntarily saved, or assisted in saving, property, ship, cargo, and the like, from some impending peril of the sea, or have recovered it when wrecked, or when abandoned and derelict, or when captured by some hostile force. It essentially differs from the ordinary hire for services rendered, which can be recovered by the common law, in the fact that no request, express or implied, from the person benefited, and consequently no promise on his part to pay for the labor when performed, are necessary to constitute a valid claim for this species of compensation, although such a request and subsequent promise may of course form parts of

the transaction. Salvage was provided for in the most ancient codes of sea laws, and from them has been incorporated into the maritime law of all civilized countries. The proceedings enforcing it, and the judicial proceedings to determine its amount, to compel its payment by the parties benefited, or to enforce the lien upon the rescued property which arises in favor of the salvors, generally fall within the jurisdiction of the admiralty courts, and form a distinct head of admiralty jurisprudence. In the U. S. the service may be performed either on the high seas, or on tide water, or on the great inland lakes and rivers where foreign or inter-State commerce is conducted. In order that a person should be entitled to salvage he must be under no legal obligation to render the assistance. In the language of an eminent American judge, "The relief of property from an impending peril of the sea by the voluntary exertions of those who are under no legal obligation to render assistance, and the consequent ultimate safety of the property, constitute a case of salvage." Upon this principle, the crew, while their relation as crew exists, can never become entitled to salvage for rescuing their own ship or its cargo from the most extreme peril. But if the legal connection of the seamen with the vessel has been wholly and in good faith dissolved, and their contract with the owners thereby ended, for any proper service subsequently done by them their claim to be compensated is valid and complete. Such a dissolution would result from a capture of the ship, or from her voluntary and total or final abandonment done by order of the master. A passenger is not entitled to salvage for any ordinary acts in aid of the vessel when in danger; but by his extraordinary services when safety is wholly or partially the result of his assistance he becomes a salvor, and as such must be remunerated. When the service is performed by the whole or a portion of a crew acting under the direction of their superior officer, the owners of the vessel to which they belong are regarded as among the salvors, and are awarded a considerable share of the entire compensation, since they represent the ship without which no help could have been given, and the remaining part is distributed in varying amounts among the master and crew, since the service was actually performed by them, and all of them in some manner participated in it. It has been recently decided that corporations may become entitled to salvage, and companies have been formed for the purpose of rescuing vessels and their cargoes when stranded or wrecked upon certain exposed coasts of the U. S. To constitute a case for salvage there must be an actual, present, impending peril—something more than the common risks of navigation, from which a vessel can ordinarily escape without help. It may arise from any of the causes by which ships and cargoes are exposed to loss—from storms, rocks, shoals, breaking of machinery, disabled condition of the vessel, fire, public enemies, pirates, and the like; or the property may be found entirely abandoned for any cause, and derelict. Whatever be the nature of the danger, the ship, cargo, or other article must be actually rescued therefrom and brought to some port or place of safety, so that the owner can obtain possession of it; and this result must be wholly or partially produced by the persons claiming the salvage or through their instrumentality. In some countries the amount of the compensation is fixed by law. In the U. S. and in Great Britain the amount is determined by the court, not arbitrarily, but in accordance with some settled principles of apportionment, and depends largely upon the circumstances of each case. It is always more than a mere pecuniary compensation for the labor performed. The risk of person, life, and property by the salvors, the time during which they were employed, and the exertions required from them, the extent and character of the peril to which the saved property was exposed, and its value, are the principal elements which enter into the computation by which the salvage in any particular case is fixed. Its distribution among the salvors is determined by similar considerations. The master's share exceeds that of the mate, and his is larger than that of each seaman. Unless the salvage is settled and paid by voluntary agreement, it is enforced by an admiralty proceeding *in rem* against the property saved, which is sold under a decree of the court, and out of the proceeds the awards are paid to the salvors. JOHN NORTON POMEROY.

Salvagno'li (VINCENZO), b. at Caniola, near Empoli, in 1802; practised law from 1826 to 1848; took a lively part in the political movements of Tuscany in 1849, and in 1859 became an active collaborator in the journal *La Patria*, afterward in *La Nazione*; he was an influential friend and adviser of Baron Bettino Ricasoli; was minister of grace and justice in the Tuscan cabinet, and was regarded as one of the most eloquent orators in the Tuscan assembly; he was a highly talented scholar, as well as a distinguished jurist, and a short time before his death was appointed senator of the kingdom of Italy. D. at Pisa in 1861.

Salvandy, de (NARCISSE ACHILLE), COUNT, b. at Condom, department of Gers, France, June 11, 1796; entered the army in 1813; was made master of requests in 1819, but dismissed in 1821 on account of his liberal views; travelled in Spain; devoted himself to literature, and wrote, besides a number of political articles and pamphlets, *Don Alonzo, ou l'Espagne* (4 vols., 1824), *Islaor* (1824), *Histoire de Pologne avant et sous le Roi Jean Sobieski* (1827). After the revolution of 1830 he sided with the Doctrinaires; was made a count, ambassador to Madrid and Turin, and minister of public instruction 1837–39 and 1845–48. After the revolution of 1848 he retired to his estate, Graveron, department of Eure, where he d. Dec. 15, 1856.

Salvator Rosa. See ROSA.

Salvia. See SAGE.

Salvi'ni (TOMMASO), b. in Milan in 1829. His father was a professor of literature, and gave him an excellent education. A precocious talent took him at the age of fourteen to the stage, under the administration of Gustavo Modena; was connected with the royal theatre at Naples, and afterward for six years played with success at different Italian theatres, several times with Ristori; in 1874 came to America and visited Havana, playing his chief parts, Othello, Hamlet, Saul, and Orosmanes. Salvini has extraordinary talent as a comedian, but his reputation is in tragedy, where he ranks with the greatest artists of his time. He is a man of culture and scholarship, as well as of professional accomplishment. O. B. FROTHINGHAM.

Salvi'sa, p.-v., Mercer co., Ky. P. 153.

Sal'yersville, p.-v., cap. of Magoffin co., Ky. P. 106.

Salz'brunn, town of Prussia, province of Silesia, on the Salzbach, consists of three small villages—Ober-, Nieder-, and Neu-Salzbrunn—and contains 8 rich salt springs, from which 2,500,000 bottles of water are annually exported.

Salz'burg, town of Austria, capital of the duchy of Salzburg, is most picturesquely situated at the foot of the Noric Alps, on both sides of the Salza, which here rushes forth from a narrow defile and winds through the city toward the Inn, surrounded by beautiful forest-clad hills crowned with magnificent castles and monasteries. The city is old, with crooked and narrow streets, but it contains many elegant monuments and edifices built of white marble. It is surrounded with walls pierced by twenty gates, of which the most remarkable is the Sigismund Thor, 425 feet long, hewn through the Mönchsberg. It is the see of an archbishop, has a fine cathedral, two good public libraries, a botanical garden, a college, an ecclesiastical seminary, a medical school, and many other educational and benevolent institutions. It has manufactures of paper-hangings, musical instruments, lead-pencils, mirrors, and type, several oil-mills and cotton-spinning and weaving factories, and carries on a very lively trade with Vienna and Bavaria. P. 20,336.

Salzkam'mergut, district of the Austrian province of Upper Austria, between Salzburg and Styria, and remarkable both for the beauty of its scenery and for its saltworks. It does not form a political division; it is simply an imperial domain, comprising an area of between 200 and 300 sq. m., with about 18,000 inhabitants. On account of the alpine character of the district, agriculture is almost impracticable; the inhabitants are mostly engaged in cattle-rearing and dairy-farming and in the manufacture of salt from the salt springs. About 40,000 tons are annually produced. The most striking features of the scenery are the lakes, which, enclosed by lofty mountains clad with forests and covered with pastures, lift their heads into the region of perpetual snow. The highest peak, Grosse Priel, reaches an elevation of 7931 feet. The most celebrated of the lakes is that of Traun, formed by the river Traun. The richest saltworks are those of Ischl and Hallstadt.

Salz'wedel, town of Prussia, province of Saxony, on the Jeetze, has manufactures of oil, needles, gloves, tobacco, liqueurs, and woollen and linen fabrics. Hops are extensively cultivated in its vicinity. P. 7201.

Samakov', town of European Turkey, in Bulgaria, has large ironworks and about 5000 inhabitants.

Samar', one of the Philippine Islands, East Indies, comprises an area of 13,020 sq. m., with 110,103 inhabitants, most of whom are mestizoes. The mountains of this island are higher and wilder than those of the other islands. The chief town is Catbalogan, on the W. coast. The principal articles in which trade is carried on are wax, cabinet woods, palm oil, and mat-work.

Samara', government of European Russia, bounded E. by the Kirgheez steppes and W. by the Volga, comprises an area of 61,210 sq. m., with 1,837,081 inhabitants. It is very fertile and well adapted to agriculture, but as yet only thinly peopled.

Samara, town of European Russia, capital of the government of Samara, on the Volga, has an extensive trade in grain, fish, caviare, tallow, and hides. P. 34,494.

Samarang', town of Java, East Indies, the capital of the Dutch residency of the same name, on the northern coast of the island, at the mouth of the river Samarang. It is tolerably well built, and carries on an important trade, though its climate is unhealthy and its harbor shallow, and in the wet season even unsafe. Sugar, rice, and pepper are extensively cultivated in its vicinity, and it is the entrepôt for the products of the central part of the island. P. 30,000.

Samarcand', or **Samarkand,** capital of a province of the same name, comprising the southern part of Russian Toorkistan, is situated at an elevation of 2154 feet above the level of the sea, 8 miles S. of the river Serafshan. By the Arabian poets of the Middle Ages it is described as a paradise on account of its beautiful surroundings, and under the dynasty of the Sassanides (833–1000 A. D.) it flourished as a home for learning and all the arts of peace. It lost much by the occupation of Genghis Khan in 1219, but it rose again toward the close of the fourteenth century, when Timur made it the capital of his immense empire, and adorned it with architectural monuments of all kinds—the tomb of Kasim-bin-Abbas, the mosque of Timur, the citadel, Timur's tomb, the Medresse, etc. By the Mohammedans of Central Asia the city is still considered the principal seat of Mohammedan learning, and its 86 mosques and 23 colleges attract numerous pilgrims and students. In 1868 it was seized by Russia, together with the whole district of the Serafshan. P. about 30,000.

E. SCHLAGINTWEIT.

Sama'ria [Heb. שֹׁמְרוֹן, *Shomerôn*, "watch-height"]. (1) An ancient city of Central Palestine, some 6 miles N. W. of Shechem, and about halfway between the Mediterranean and the Jordan. It was founded 923 B. C. by Omri, the sixth of the nineteen kings of the northern kingdom of Israel, who made it his capital, and called it after the name of the man (Shemer) of whom he bought the hill on which the city was built (1 Kings xvi. 24). This hill, oblong and flattened, swells up to the height of some 300 feet out of a basin about 5 miles in diameter, surrounded on every side by mountains still higher. The Mediterranean is in full view from the top of the hill. "It would be difficult," says Dr. Robinson, "to find in all Palestine a situation of equal strength, fertility, and beauty combined. In all these particulars it has very greatly the advantage of Jerusalem." The city shared in the stormy fortunes of the upper kingdom. Twice it escaped capture when besieged by the Syrians. In 722 B. C., after a siege of two years, commenced by Shalmaneser of Assyria, it was taken by his successor, Sargon, who put an end to the kingdom of the ten tribes. Repeopled by Esarhaddon, it was next captured by Alexander the Great (332 B. C.), and again by John Hyrcanus (109 B. C.). It was splendidly rebuilt by Herod (40–4 B. C.), who named it *Sebaste*, in honor of his patron, the emperor Augustus. The modern Arabic *Sebustieh* is simply a corruption of the Greek name. Nearly 100 limestone columns still standing in their places, some 60 of them in a single colonnade, attest the magnificence of the Herodian city. The partially-ruined church of St. John, now a mosque, dates probably from the twelfth century. In the fourth century it was claimed that John the Baptist had been buried there, as well as the prophets Elisha and Obadiah. The modern village, on the S. E. shoulder of the hill, contains about 60 houses, with a pop. of 400 to 500. The people are noted for their rudeness and insolence to travellers. (2) The name also of one of the three provinces into which Western Palestine was divided by the Romans. Its boundaries are given by Josephus (*J. W.*, iii. 3, 4).

R. D. HITCHCOCK.

Samar'itans. After the destruction of the kingdom of Israel, and the removal of its inhabitants into captivity in 722 B. C., in the first year of Sargon, king of Assyria (2 Kings xvii. 6; xviii. 11; Rawlinson, *Com. in loco;* Smith's *Assyrian Canon*, p. 125; Schrader, *Keilinschrift. u. d. A. T.*, p. 160), Central Palestine was left desolate and uninhabited except by a remnant of the poorer classes and fugitives (2 Chron. xxxiv. 6, 9; Jer. xli. 5), until the removal thither by Sargon in 722, and again in 715 B. C. (2 Kings xvii. 24; Smith, p. 128; Schrader, p. 162), and Esarhaddon in 680 (?) (Ezra iv. 2–10; Rawlinson, *in loco;* Smith, p. 138; Schrader, p. 241), of colonists from Babylon, Syria, Arabia, and other Eastern lands. Hence the people (called Samaritans from Samaria, the capital) became an exceedingly mixed race, the main body, however, being of the Aramaic stock. They at first worshipped every tribe its own god, but being plagued by the wild beasts, they united in the worship of the God of the land, being instructed thereto by a priest sent to them from the exiles by the king of Assyria, who restored the worship at Bethel (2 Kings xvii. 24–41). When the Jews returned to Jerusalem (536 B. C.), the Samaritans desired to unite with them in their work, but were rejected by Zerubbabel, owing to their corrupt religion and their mixed or heathen origin (Ezra iv. 3). Henceforth, the Jews and Samaritans entertained the most bitter hatred of each other. This was intensified by the secession of one of the sons of Joiada, the son of Eliashib, the high priest (Neh. xiii. 28), son-in-law of Sanballat, the Samaritan governor (called by Josephus, *Ant.*, xi. 7, 2, Manasseh, the brother of Jaddua, the high priest). Under the leadership of this priest and others of the Jews, who with him were expelled on account of their refusal to separate themselves from their heathen wives, the worship was reorganized (409 B. C.) on the basis of a copy of the Pentateuch that Manasseh carried with him. Gerizim was made the centre of worship, in accordance with the tenth commandment added by the Samaritans to Ex. xx. and Deut. v., and a temple was erected there, probably in the time of Alexander the Great, which continued until it was destroyed by John Hyrcanus (129 B. C.; Josephus, *Ant.*, xiii. 9, 1). The Samaritans shared the fortunes of Palestine during the constant wars between Egypt and Syria, and also under the Roman dominion. They were severely chastised by Pilate for their rebellious spirit, then again by Vespasian and others, until finally, in the reigns of Zeno and Justinian, on account of outrages committed against Christians, they were almost totally destroyed. A remnant, however, clung to their holy place, dwelling in Nablus, the successor of the ancient Shechem, or dispersed in Alexandria, Cairo, Damascus, Aleppo, etc., where they retained the religion of their fathers. And thus they continued during the Mohammedan rule, dwindling until at present they are limited to a community of from 100 to 200 souls at Nablus. They were lost sight of by the learned world until the sixteenth century, when Joseph Scaliger opened a correspondence with them. They then gained an interest that they have since retained, owing to their ancient copy of the Pentateuch, and their religious rites and doctrines, as well as their language and literature. Their religion is based on

The Samaritan Pentateuch.—The original MS. is in the synagogue at Nablus. This they claim to have received by tradition from Abisha, the great-grandson of Aaron, whose name is inscribed upon it. It is mentioned by Cyril of Alexandria, Eusebius, Jerome, Procopius of Gaza, etc. among the Fathers, but was lost sight of subsequently until 1616, when Pietro della Valle procured a copy of it at Damascus, which was then published in the Paris Polyglot of 1645, and subsequently in Walton's Polyglot of 1657. At once a hot dispute arose as to its value, which continued for two centuries—Morinus, Houbigant, Poncet, and Hassencamp exalting it above the Masoretic text; Hottinger, Ravius, J. D. Michaelis, and Tychsen advocating the superiority of the latter. Gesenius, in his work *De Pent. Sam. Origine* (1815), was the first to thoroughly compare the two texts. His results have been generally accepted by modern scholars—that whilst the text is an independent one in its origin, it has yet been improved by the Samaritans in order to avoid obscurities and in the interest of their own religion, at times betraying an ignorance of Hebrew grammar and exegesis. It has many features of resemblance to the LXX. (Gesenius calculates them at more than 1000), which have attracted the attention of scholars, so that on the one side Hottinger, Hassencamp, Eichhorn, and Kohn have contended that the LXX. had been translated from the Samaritan, and on the other side Grotius, Usher, etc., that the Samaritan was made from the LXX. But these views are impossible, and have been abandoned by most recent scholars, who give the text an independent authority. It was, then, either with the LXX. derived from a common older MS. of Jerusalem, as Gesenius, Nutt, and others, or, as the differences between them are quite numerous, they are based on independent original MSS., the original of the Samaritan text having been brought from Jerusalem by Manasseh. The text has been published since Walton by Blayney (Oxford, 1790) in Hebrew square characters, and the variations from the Masoretic text have been noted in the appendix to Petermann's *Versuch einer hebräischen Formenlehre nach der Aussprache der heutigen Samaritaner* (Leipsic, 1868; also *Deutsch. Morg. Gesells.*, v. 1). The text has been discussed in Smith's *Bib. Dict.* by Deutsch, and in Kitto's *Cyclop.* (3d ed.) by Samuel Davidson, as well as by those mentioned above.

The Samaritan religion is based on the Pentateuch, and differs from that of the Jews in the rejection of the rest of the Old Testament, and in their regarding as the tenth commandment the obligation to worship God on Mount Gerizim. Their religion is monotheistic, the name יהוה being lost, and *Shêma* ("the name") substituted for it. They

believe in the existence of good and evil spirits, עזאזל (Lev. xvi. 10) being interpreted as a "devil," and the נפלים of Gen. vi. 4 as "evil spirits." They believe in the Messiah (John iv. 25), on the basis of Deut. xviii. 15, as a prophet, who is like Moses, but not greater than Moses, who remains for all time the greatest. The Shiloh passage, Gen. xlix. 10, they refer to Solomon, in whose time the ten tribes separated from Judah. The Messiah will appear [illegible] years after the creation, and enter into judgment with the world on Mount Gerizim. Here they find all the sacred places of the past and future. Here Adam was created, here the ark rested; here Adam and Noah erected their altars, Abraham offered Isaac, and the heavenly ladder appeared to Jacob, etc. They do not offer sacrifices, on account of the destruction of the temple, but keep the feasts of the Pentateuch, circumcise their boys on the eighth day, and observe the Sabbath in their synagogues like the Jews. The Samaritans had their sects after the analogy of the Jewish sects, called Essenes, Sebuæans, Gorthenians, and Dositheans, mentioned by Epiphanius, *Adv. Hæres.* i. 11, fourth century. (For these, and a full description of their present customs in the keeping of the feasts, see Petermann, art. "Samaria," Herzog's *Realencyklop.*; Stanley's *Jewish Church*; and Nutt's *Samaritan History, Dogma, and Literature* (London, 1874).)

The *Samaritan language* is a mixture of the Aramaic and Hebrew, in many cases having side by side the two forms, *e. g.* the article of the Hebrew and emphatic state of the Aramaic; the relatives אשר and ד; the Niphal and Ithpe'el, Aphel and Hiphil; the plurals in ים and ין, ות—and ן. The letters are 22 in number, their order being the same as in Hebrew, but their *form* is like the ancient Hebrew and Phœnician, and not like the square character adopted by the Jews subsequent to the Exile. In pronunciation they are the same as Hebrew, except the gutturals, which are all quiescent and interchange readily with one another, being exceedingly weak. The vocabulary is essentially the same as the Hebrew and Chaldee, although many words have been introduced from Arabic, Latin, and Greek. (Cf. Uhlemann, *Inst. ling. Samarit.* (Leipsic, 1837); Nicholls, *Grammar of the Samaritan Lang.* (London, 1858); Petermann, *Brevis Ling. Samarit. Gr.* (Berlin, 1873).)

The Samaritan literature is quite limited in extent. (1) The *Samaritan Targum* is ascribed by tradition to Nathanael the high priest, who d. 20 B. C. There is no reason to doubt that it was composed about the same time as the Targum of Onkelos, with which it has many points of agreement, although certainly an entirely independent version. The translation is exceedingly literal and close, even where the sense was not clear to the translator. (Cf. Winer, *De Versionis Pent. Samaritanæ indole* (Leipsic, 1817); Petermann, *Pent. Samarit.*, Fasc. I. Genesis (Berlin, 1872); Brüll, *Samarit. Targum zum Pent.* (Frankfort, 1875), in Hebrew square characters. Cf. also *Fragments of a Samaritan Targum*, with an introduction by Nutt (London, 1874), and *Krit. Studien über manuscript. Frag. des Sam. Targ.*, von Brüll (Frankfort, 1875).) This Targum is also printed in the great Paris and Walton Polyglots. The Samaritans had also a Greek version, mentioned by some of the Fathers as τὸ Σαμαρειτικόν, which has been lost; also an Arabic version, which they still possess. (2) *Chronicles.*—First in importance is the Samaritan Chronicle, or book of Joshua, composed probably in the thirteenth century, taking some of its material from the Hebrew book of Joshua, but adding thereto much of a legendary character, showing that the Jews were from the time of Eli apostates and their oppressors, continuing the narrative until about 350 A. D., where it concludes abruptly. It was published by Juynboll (Leyden, 1848), with Latin translation and commentary. There is also the chronicle *El Tholodoth* ("The Generations"), professedly by Eleazar ben Amram (1142 A. D.), and then continued by many others until 1859, giving the calculation of sacred times, the age of patriarchs, list of high priests until the present. It was published by Neubauer in *Journal asiatique* (1869). Then comes the Chronicle of Abulfath, in the middle of the fourteenth century, a digest of the two previous works, with fresh legendary material, published by Vilmar (Gotha, 1865). Other minor works, corresponding with the Jewish Hagada literature, are found. (3) *Liturgies and Hymns.*—Nutt (p. 143) says that there are nineteen volumes of these in the British Museum, besides those known in the *Carmina Samarit.* of Gesenius (Lips. 1824) and *Karme Shomeron* of Kirchheim (Frankfort, 1851). Petermann publishes specimens in his *Gram.* and *Chrest.* The present Samaritans have two collections, called *Durrân* ("String of Pearls") and *Defter* ("Book"). These hymns and prayers belong to widely different periods. The earliest are ascribed to the angels. Heidenheim has published many of them in his *Vierteljahrsschrift.* (4) There are also commentaries, theological tracts, and a few quite recent grammatical works, written in Arabic. (Cf. art. "Samaria" in Herzog's *Realencyk.*, by Petermann; Smith's *Dict.*, by Deutsch; Kitto, *Cyclop.* (3d ed.), by Davidson; and Nutt, *Samaritan Hist., Dogma, and Literature* (London, 1874).) C. A. BRIGGS.

Samar'rah, town of Asiatic Turkey, 65 miles N. W. of Bagdad, on the left bank of the Tigris, is surrounded with substantial walls, and contains two temples, which enjoy a high reputation among the Mohammedans of the Sheeah sect, and annually attract about 10,000 pilgrims. Close by are the ruins of the ancient Opis and the Median wall, which extend for several miles along the Tigris.

Sambas', town of the island of Borneo, East Indies, the capital of a state of the same name which occupies the western part of the island and is subsidiary to the Netherlands, on the river Sambas, 30 miles from its mouth, in lat. 1° 15′ N., lon. 109° 20′ E. Its situation is very low; the houses, or rather the huts—for they consist only of boards and palm-leaves—are raised on piles, and all communication is by boats. The best part of the city is that inhabited by the Chinese, who are largely represented here, and are mostly engaged in gold-washing. P. about 10,000.

Sambia'se, town of Southern Italy, province of Catanzaro, very near Nicastro. This town suffered severely from the earthquake of 1783. P. 7887.

Sam'bor, town of Austria, in Galicia, on the left bank of the Dniester, in a beautiful and fertile plain, is well built, and has some linen manufactures and a lively trade. P. 10,507.

Sam'bre, a small river of Europe, rises in the department of Aisne, France, flows in a N. E. direction, and joins the Meuse at Namur in Belgium after a course of about 100 miles. It is navigable for a great part of its course, and forms an important part of the system of canals in Northern France and Belgium.

Sambu'ca Za'but, town of Sicily, province of Girgenti, in a very fertile vine and olive bearing district. P. 8673.

Sam Mil'ler, tp., Albemarle co., Va. P. 4959.

Sam'my Swamp, tp., Clarendon co., S. C. P. 960.

Sam'nites [Lat. *Samnites*, plu. of *Samnis*], the people of ancient Samnium, a region of Central Italy. They finally became masters of Campania, Lucania, and a large part of Southern Italy. They were of Sabine stock, and were of several tribes, of which the Pentri and Hirpini were the chief, and the Caudini, Caraceni, and perhaps the Frentani, were less important. The Samnites were a brave, frugal, and religious people, who were often at war. The first Samnite war with Rome (343–341 B. C.) resulted in favor of the Romans and secured a Samnite alliance during the Latin war (340–338 B. C.). The Second Samnite war (326–304 B. C.) was a terrible contest, in which the Romans (321 B. C.) were shamefully defeated at the Caudine Forks, but were finally successful. The Third Samnite war (298–290 B. C.) saw the overthrow of the Samnites and Gauls by Fabius at Sentinum. The Samnites took the part of Pyrrhus, of Hannibal, of the Socii, and of Marius; and at last Sulla undertook their complete extirpation, and for more than a century after his time their land was a scene of desolation, and the Samnite name is thenceforth unknown as having a separate existence. Though nearly allied in blood to the Romans, the Samnites were ever their bitterest enemies, "the eternal enemies of the Roman name." They appear to have been a rude pastoral people, devoted to the preservation of that liberty which Rome sought successfully to destroy.

Samnium. See SAMNITES.

Samoan Islands. See NAVIGATOR'S ISLANDS.

Sa'mos, an island of the Ægean Sea, near the coast of Asia Minor, from which it is separated by a narrow channel, called by the Turks *Little Boghaz*, at the foot of *Mount Mycale*, where in 479 B. C. the fleet of Xerxes was defeated and dispersed on the same day that his army was beaten and nearly destroyed at Platææ. Samos, whose area is estimated at about 165 sq. m., with a population of about 50,000, is one of the finest islands in the Ægean Sea. It is mountainous, but its high, picturesque mountains are rich in marble, silver, lead, and copper, covered with forests of oak and pine, and enclosing beautiful valleys, where wheat, olives, grapes, and fruits are produced in abundance and of superior quality. In olden times it was one of the most flourishing of all the Greek islands, and its inhabitants were famous as sailors. In the Greek war of independence the Samiots excelled by their valor; and although they were not allowed to unite with their countrymen, they enjoy a somewhat independent position, only paying a tribute to the sultan. Chief town, Khoran.

Samothra'ki [anc. *Samothrace*], an island in the Ægean Sea, belongs to Turkey, and comprises an area of 30 sq. m., with 1500 inhabitants. It is mountainous, with steep, harborless coasts and peaks rising to the height of over 5000 feet. In ancient times it was very famous as the seat of a mysterious religious worship.

Samoyedes', a people of Northern Russia, both in Europe and Asia. They appear to be allied to the Lapps and Finns, but are more degraded than either. They are mostly heathens or nominal Christians, small, filthy, indolent, and much addicted to intoxication, but peaceable and harmless. The herding of reindeer and the collection of fish and furs afford them subsistence. They are stated to number 20,000, of whom one-fourth are European. They speak several dialects. Their country is one of the coldest and most desolate of inhabited lands. They call themselves *Khasovo* or *Nenetch*, signifying "men."

Sam'phire [a corruption of *St. Pierre*], the *Crithmum maritimum*, an umbelliferous plant growing on cliffs near the sea in Europe. It is a choice salad-herb and makes a very fine pickle. It is extensively raised in English market-gardens. The golden samphire is *Inula crithmoides*, a composite sea-coast plant resembling the above, growing in the same situations and having the same uses. Marsh samphire is *Salicornia herbacea*, a chenopodiaceous salt-marsh plant of Europe and North America. It is marketed for pickling.

Sam'pit, tp., Georgetown co., S. C. P. 960.

Samp'son, county of S. E. North Carolina, on South and Black rivers, has a rolling surface, covered with vast forests of pitch-pine. Staples, wheat, cotton, sweet potatoes, rice, honey, wool, and butter. Sheep and swine are numerous. Cap. Clinton. Area, 940 sq. m. P. 16,436.

Sampson, v., Neave tp., Darke co., O. P. 346.

Sampson (Deborah), b. at Plympton, Mass., Dec. 17, 1760; adopted male attire; enlisted under the name of Robert Shurtleff in the 4th Massachusetts regiment during the war of the Revolution; was wounded in a skirmish near Tarrytown, N. Y., and served through the campaign of Yorktown, her sex having never been discovered. She married Benjamin Garnett, a farmer of Sharon, Mass., received a pension, and d. there Apr. 29, 1827. Her account of her military experiences appeared in a volume entitled *The Female Review* (Dedham, 1797), of which a new edition, with introduction and notes by Rev. John A. Vinton, was issued in 1866.

Sampson (Ezra), b. at Middleborough, Mass., Feb. 12, 1749; graduated at Yale College 1773; became pastor of the Congregational church at Plympton, Mass., Feb., 1775; was chaplain in the army at Cambridge 1775–76; was settled at Hudson, N. Y., 1796; was there associated with Harry Croswell in the editorship of *The Balance*, one of the first literary journals established in the U. S., 1801–04; contributed essays for many years to the *Connecticut Courant*, which he edited 1804, and became judge of Columbia county 1814. D. in New York City Dec. 12, 1823. Author of *Beauties of the Bible* (1802), *The Sham Patriot Unmasked* (1803), *The Historical Dictionary* (1804), which passed through several editions, and *The Brief Remarker on the Ways of Man* (1817; new ed. 1855).

Sampson (Francis S.), D. D., b. in Goochland co., Va., in 1814; graduated at the University of Virginia 1836; studied theology at the Union Theological Seminary of Virginia, in which he became professor of Oriental languages and literature 1848, having been ordained to the Presbyterian ministry 1841. D. in 1854. After his death a *Critical Commentary on the Epistle to the Hebrews* (N. Y., 1856) was edited from his MS. notes by Dr. R. S. Dabney.

Sam'söe, an island of Denmark, in the Cattegat. Area, 40 sq. m. P. 5500. It is low, with an undulating surface and very fertile soil.

Sam'son [שִׁמְשׁוֹן, "sunny," "sunlike" (Nöldeke, *Z. D. M. G.*, xv. 806). The other etymologies are forced attempts to place in the word the *ἰσχυρός* of Jos., *Ant.*, v. 8. 4. (See Fürst, *Heb. Lex.;* Maurer, Bertheau, Keil, *in loc.;* LXX. Σαμψών, a trace of a pronunciation different from that of the Masorah; comp. Arab. شمس)], one of the Hebrew judges, whose history is related Jud. xiii. 2—xvi. 31.

Time.—1116–1096 B. C. He judged Israel twenty years (xv. 20; xvi. 31), falling within the forty years (xiii. 1) of Philistine dominion, terminated by Samuel's victory at Eben-Ezer (1 Sam. vii. 11–13), and commencing shortly before the capture of the Ark (1 Sam. iv. 11; comp. vi. 1; vii. 12).

History.—Son of the Danite Manoah of Çorah (xiii. 2), living in Mahaneh-Dan (xiii. 25; xvi. 31; comp. xviii. 11–12). To his mother, long barren, the birth of a son is announced by an angel (comp. Luke i. 7, 13). He is a Nazarite from the womb (comp. 1 Sam. i. 11), the first of whom mention is made in the Old Testament (Ewald, *Gesch. Is.*, ii. 517). He is first inspired in his own home to the performance of some deed now lost to us (xiii. 25). His subsequent recorded history may be arranged in three periods: (1) His connection with the Philistine maiden of Timnath, and the consequent complications with the Philistines (xiii. 15). (2) His visit to Gaza (xvi. 13). (3) His connection with the harlot (דְּלִילָה; comp. Arab. دَلّالة, "bawd"); her treachery and his loss of strength, imprisonment, and death (xvi. 4–31).

Character.—He differs from all the other judges in the personal and individual character of his work. He does not appear as delivering the people from the oppression of the enemy, so much as avenging on the Philistines his personal wrongs. His working was entirely confined to the narrow limits of the hill-country along the border between Judah and Dan; only twice do we find any mention of him away from here. We have no proof of his general recognition as judge, and in one instance we find him rejected by the tribe of Judah (xv. 10). Shut out by his Nazarite vow from the use of wine, his passions find another outlet, and his weakness toward women furnishes the key to his wasted life and strength. Throughout all his actions and words runs a fine vein of humor (Herder, *Geist der heb. Poesie*, ii. 204) and reckless carelessness of his God-bestowed strength. The moral standard of his age and position, living on an enemy's border, must be taken into consideration before his life can be explained or understood.

Literature.—Very meagre; most valuable are the various commentaries on Judges, especially Cassel in the Lange series (Am. ed.), and by Bachmann (1869).

T. C. Murray.

Samson (George Whitefield), D. D., b. at Harvard, Mass., Sept. 29, 1819; graduated at Brown University 1839, at Newton Theological Institute 1843; was for many years pastor of a Baptist church at Washington, D. C., and president of Columbian College, D. C., 1859–71, when he became president of Rutgers Female College, New York City. He travelled in Europe and the East 1848, publishing a series of letters and essays on Italy, Egypt, Palestine, and Sinai; has written several theological pamphlets and critical essays on art, and is author of *To Daimonion, or the Spiritual Medium* (1852), reissued in an enlarged form under the title *Spiritualism Tested* (1860), *Outlines of the History of Ethics* (1860), *Elements of Art Criticism* (1867), and *Physical Media in Spiritual Manifestations* (1869), and is understood to be engaged (1876) upon an important work which will present novel views upon the history and development of the ancient Oriental and classical philosophies, religions, and mysteries.

Samson (Joseph Isidore), b. at St. Denis, France, July 2, 1793, in humble circumstances; acted for several years in the provinces, subsequently in Paris, and became in 1832 a member of the Théâtre Français; retired in 1863. D. at Paris in 1871. His representations both of ludicrous and grave characters, numbering about 250, were distinguished by an individuality and elegance which hardly any other actor of his time attained. He was also highly appreciated as a teacher; Rachel and the two Brohans received instructions from him.

Sam'uel [Heb. *Shemuel*, "heard of God"], a Hebrew judge, lawgiver, and prophet, whose history is recorded in the first of the two biblical books of Samuel, b. at Ramathaim Zophim in Mount Ephraim, probably in the twelfth century B. C.; was consecrated by his mother, Hannah, to the service of Jehovah as a Nazarite before his birth; brought up in the household of the chief priest, Eli, at Shiloh; received in childhood a divine message foreboding the downfall of the family of Eli; assumed the judgeship of Israel about twenty years after the death of Eli, at which time he headed a successful expedition against the Philistines; resided at Ramah (probably the same as Ramathaim Zophim); visited annually the three principal sanctuaries, Bethel, Gilgal, and Mizpeh, and made his sons deputy judges, but in consequence of their misconduct was commissioned by Jehovah to accede to the popular clamor for a king; to which end he anointed Saul as first monarch of Israel, and on his disobedience to a divine command anointed the youthful shepherd, David, in his place. He d. shortly before the close of the reign of Saul, and his spirit was successfully invoked by the "witch of Endor" to announce to Saul the fatal result of the battle in which he lost his life. Samuel is regarded as the founder of the "schools of the prophets," and by the Talmudists as the writer of the first of the books which bear his name. This opinion, however, is rejected by nearly all modern critics; but another school of commentators, of which Bishop Colenso is the most prominent English representative, con-

siders that large portions of the Pentateuch and the books of Joshua and Judges were compiled by him, or under his direction by the members of the prophetical schools. The chronology of the life of Samuel is obscure, and great differences of opinion exist, some regarding him as the immediate successor of Eli in the judgeship, others maintaining that the exploits of Samson fell within the interval between the two judges. The resemblances of the incidents of the birth of Samuel and of Samson are obvious; both of them, moreover, having been Nazarites by parental vow, and both have been taken as archetypes in this respect of Christ. The song of thanksgiving uttered by Hannah, the mother of Samuel, presenting a marked parallelism to that of Mary, the mother of Jesus. Comp. 1 Sam. ii. 1-10 and Luke i. 46-55. The traditional tomb of Samuel is still shown at Neby Samwil, a short distance N. W. of Jerusalem, on an eminence overlooking that city—a spot which is identified by some with Ramah, by others with Mizpeh. PORTER C. BLISS.

Sam'uel, The Books of, in the Old Testament, are two in number in the modern editions of the Hebrew text, but this arrangement only dates from the edition of Bomberg in the sixteenth century. The books are said in the Talmud to have been written by Samuel, but the work begins with his time and ends at a point many years after his death. Its real authorship and date are quite unknown, but it appears to have been based upon more ancient annals, from which source, perhaps, were derived the famous passages parallel with others in the books of Chronicles. The LXX. and Vulgate call the two books of Samuel the "First" and "Second" Book of Kings, while the First and Second of Kings in the common English version are in the LXX. and Vulgate named the Third and Fourth Books of Kings.

Sanaa', city of Yemen, Arabia, in an elevated valley nearly 4000 feet above the sea, surrounded with beautiful orchards and gardens enclosed by walls. It is well built, though parts of it are in ruins, and sufficiently provided with water, though rain never falls except in July, and sometimes not for several years; the climate is so dry that meat may be kept in open air for eight days without spoiling. The bazaars are well stocked with silks and satins, spices, fruits, coffee, sugar, dates, and tobacco, and an extensive trade in coffee is carried on. P. about 20,000. It is described by Pliny as a large commercial centre and splendidly built. In 930 it became the capital of Yemen, and in 1872 it was taken by the Turks.

San Andre'as, p.-v. and cap. of Calaveras co., Cal., has 2 churches, good schools, 2 newspapers, 1 hotel, court-house and jail, and express, post, and telegraph offices. Principal business, mining, farming, and stock-raising. P. about 800. WM. O. SWENSON, ED. "CALAVERAS CITIZEN."

San Ang'el, v., Bexar district, Tex. P. 41.

San Anto'nio, tp., Marin co., Cal. P. 451.

San Antonio, p.-v., Monterey co., Cal. P. 761.

San Anto'nio, city, cap. of Bexar co., Tex., on San Antonio and San Pedro rivers, on the routes of the International, the Gulf, Western Texas and Pacific, and the Galveston Harrisburg and San Antonio R. Rs., all of which are now (1876) expected to be soon completed to this point. San Antonio was the capital of Texas under the Spanish and Mexican governments, and one of the oldest settlements in the State, having been founded in 1714 as the fortress of San Fernando, and in 1718 as the mission of the Alamo, both originally on the right bank of San Pedro River, on the site of the present suburb known as Chihuahua, formerly called San Antonio de Valero. The chief settlement, with the fort and the mission, was soon removed to the left bank of the San Pedro, to what is now the "old town" of San Antonio de Bexar (often called simply Bexar), situated between the two rivers. This is still the business centre, containing the plaza, Roman Catholic churches, the public buildings, and many fine stores, but the most elegant residences are at Alamo, the suburb E. of San Antonio River, where the German element prevails, as does the native Mexican element at Chihuahua. The city stands in the midst of a level and fertile plain, bounded on one side at a distance of a mile by a range of limestone hills, affording the materials from which it has been built. It has 10 churches, 5 banks, 2 daily, 1 tri-weekly, and 3 weekly newspapers, a college, a convent, a hospital, and a female orphan asylum, all under Roman Catholic control; a good fire department, 3 flouring-mills, 3 breweries, a soap and candle factory, a meat extract factory, 2 ice factories, several free public schools, English and German, and an extensive public park embracing the sources of San Pedro River. The fortress of the Alamo, celebrated in Texan history, is situated within the plaza and the suburb, which both bear the same name. The city is divided into four wards, is governed by a mayor and aldermen, having been incorporated as a city in 1873, and is provisionally connected with the present railway termini at Kingsbury and Cuero by daily lines of stages. P. 12,256, about equally divided between persons of Mexican, German, and American descent.

San Antonio River rises in Bexar co., Tex., flows S. E. 200 miles, and falls into the Gulf of Mexico at Espiritu Santo Bay. The city of San Antonio and village of Goliad are upon its banks.

San Augustine', county of E. Texas, on Angelina River. Staples, cotton and Indian corn. Cap. San Augustine. Area, 650 sq. m. P. 4196.

San Augustine, p.-v., cap. of San Augustine co., Tex. P. 250.

San Benedet'to del Tron'to, town of Italy, province of Ascoli Piceno, not far from Fermo. The town is on the crest of a hill near the Adriatic, and commands magnificent inland and sea views, but the streets are narrow, crooked, and steep. The suburb below, however, which is built around the small harbor, contains comfortable houses, and the place is much resorted to in summer for sea bathing. P. in 1874, 6112.

San Benedetto Po (also called **Polirone**), town of Italy, province of Mantua, on the right bank of the Po and on the left of the Lirone, about 12 miles from the city of Mantua. It has a fine church belonging to the Benedictines, but the vast monastery founded in 1004, and celebrated as the abbey of San Benedetto di Po, is now employed for secular uses. The town is subject to malarious fevers. P. 10,319.

San Beni'to, county of W. California, lying at the W. base of the Coast Range, and consisting chiefly of the valley of the San Benito or upper Salinas River, and crossed by Southern Pacific R. R. Agriculture and stock-raising are the leading industries. The county was formed in 1874 from the E. portion of Monterey co. Cap. Hollister.

San Benito, p.-v. and tp., San Benito co., Cal., on San Benito River and Southern Pacific R. R. P. 529.

San Bernardi'no, county of S. E. California, bounded N. E. by Nevada and E. by Arizona, from which it is separated by Colorado River, crossed by Amargosa, Mohave, and Santa Ana rivers, and traversed by the Coast Range and some spurs of the Sierra Nevada, consists in greater part of dry, dismal deserts and volcanic mountains, dotted with a scanty growth of cacti and yuccas, and interspersed with hot springs and salt marshes abounding in sulphur and soda, forming "sinks," in which the streams are lost. The "Death Valley" in the N. E. between the Amargosa and Panamint ranges, in which Amargosa River disappears, is 100 miles long and from 100 to 250 feet below the level of the sea, and is uninhabitable from extreme heat. Only the S. W. corner is settled, comprising the beautiful San Bernardino Valley, lying between the San Bernardino and Temescal ranges and watered by many tributaries of Santa Ana River. Gold and silver are found in the Sierra Nevada, and tin, copper, marble, and alabaster in the Temescal region. Willows and sycamores abound along the streams, and pine, cedar, hemlock, and maple on the mountains of the Coast Range. Agriculture and stock-raising are the chief industries, the staples being barley, hay, fruits, wine, wool, and butter. Mount San Bernardino is the loftiest peak of the Coast Range. Cap. San Bernardino. Area, about 16,000 sq. m., or nearly twice the size of the State of Massachusetts. P. 3988.

San Bernardino, p.-v., cap. of San Bernardino co., Cal., on Southern Pacific R. R., 80 miles from the coast, has 6 churches, excellent schools, 2 banks, 2 daily and 3 weekly newspapers, 2 good hotels, several rich-yielding mines, and good water. The climate is beneficial for consumptives and persons troubled with throat affections. It is one of the most energetic towns on the Pacific slope. P. 3064. W. H. GOULD, ED. "DAILY ARGUS."

San Bonifa'cio, town of Italy, province of Verona, near the left bank of the Adelgo, an affluent of the Adige, and about 14 miles E. of the city of Verona. The neighboring valley of Roncà is remarkable for its minerals. P. 5653.

San'bornton, p.-v. and tp., Belknap co., N. H., on Great Bay. P. 1236.

San Bru'no, tp., San Mateo co., Cal., on Southern Pacific R. R., 14 miles S. of San Francisco. P. 1269.

San Buenaventu'ra, p.-v., cap. of Ventura co., Cal., on the coast, 30 miles S. E. from Santa Barbara, has an excellent harbor, 4 churches, a high-school building, 1 bank, 1 newspaper, court-house, waterworks supplying the town with water for irrigation and manufacturing purposes, a planing-mill, and a library and reading-room.

It is a favorite place of resort for tourists and invalids, owing to its climate and the presence of hot springs. P. 2491. W. E. SHEPHERD, ED. "SIGNAL."

San Car'los, town of Venezuela, South America, in a beautiful valley surrounded with plantations of coffee, sugar, and cotton. P. 8000.

San Cascia'no de' Ba'gni, small town of Italy, province of Siena, situated in a picturesque country full of mineral springs. The baths here have been celebrated from a very remote period, and they are still much frequented for rheumatic affections. P. 3585.

San Cascia'no in Val'di Pe'sa, town of Italy, province of Florence, celebrated for its baths. The principal village of the commune is a place of considerable traffic, and was formerly surrounded by walls and well fortified. P. of commune, 12,388.

San Catal'do, town of Sicily, province of Caltanissetta, in a very healthy and fertile district, abounding in grain and every variety of fruit grown in the island. The sulphur-mines here are also highly productive. P. 12,700.

Sanchoni'athon [Gr. Σαγχουνιάθων], a Phœnician historian or theologian and cosmologist, said by Philo of Byblus to have been a native of Berytus (Athenæus and Suidas make him a Tyrian). He is supposed by Father Martin to have flourished as early as the fourteenth century before Christ; by others, as Creuzer, 1250 B. C. (Suidas makes him contemporary with Semiramis). He is said to have been chief hierophant among the Phœnicians—to have been secretary to Adonilabnas, the reigning king of Byblus. Three works are attributed to him: one, on the physical system of Hermes (Thoth or Taaut); a second, on Egyptian theology; a third, upon the history of Phœnicia. Philo of Byblus is the reputed translator of the original into Greek in the second century A. D. His translation was in nine books, and is believed to have included the three works mentioned. Porphyry, writing against Christianity, appeals to the authority of Sanchoniathon against Moses. Eusebius, replying to Porphyry in his *De Præparatione Evangelica* (i. ch. 10), has preserved the only fragments which have come down to us from Philo's translation. These contain the outlines of a cosmogony and theogony. In the learned work of Cumberland (London, 1770) these are rendered into English. The world is represented as originating from a "dark and windy air and a turbulent evening chaos;" these things at first were without form and void, but "the wind fell in love with its own principle, and a mixture called Desire or Cupid arose;" creation began, and Môt—mud, or a putrefaction of watery mixture—was begotten, and thence came the seeds of the universe; zophesemin or egg-shaped overseers of heaven were born; light shining through the air produced the clouds and rains; thunder and lightning produced intelligent animals, awaking them from unconscious matter by fright. The theogony introduces us to the Greek gods, and represents them as historical personages of Phœnicia, some of them being especially distinguished as inventors and founders—*e. g.* of houses and clothing, of fire, navigation, worship, metallurgy, fishing, magic, dog-training, civil society, medicine, the art of writing, etc. Thus appear Uranus and Gæa, Cronus, Rhea, Astarte, Poseidon, Vulcan, Artemis, Eros, Athena, Persephone, Dione, Hercules, Nereus, Hermes, and others. In fact, the work seems to be an attempt to give—after the manner of Lucretius and the atomistic Epicurean school to which he belonged—first, a materialistic theory of the origin of nature and man; and secondly, a naturalistic explanation of the Greek theogony as found in Hesiod and Orpheus, by making the gods and goddesses to have been historical personages resident about the eastern shore of the Mediterranean. If any Phœnician work was the basis of Philo's work, it must have been almost entirely obscured by his conjectural interpretations and his identification of Phœnician and Greek mythology. Some have thought that Porphyry forged the work from which he pretended to quote. In 1836–37, Wagenfeld published a work which purported to be a German translation of the complete work of Philo from a manuscript discovered in 1835 at a convent in Portugal. This was pronounced by scholars, after careful examination, to be a forgery. J. C. Orelli (Leipsic, 1826) published the best edition of the fragments of Sanchoniathon. WILLIAM T. HARRIS.

San Colomba'no, town of Italy, province of Milan, near the right bank of the Lambro, about 10 miles from Lodi. The old castle of San Colombano is one of the most ancient, vast, and best preserved in Lombardy. It is now converted into a charming villa, the property of the family Belgiojoso. This town, which was not without its share in the mediæval history of Lombardy, is now an active and thriving place. P. 7000.

San Cristo'bal [formerly *Ciudad Real*], city of Mexico, cap. of the state of Chiapas, 450 miles S. E. of Mexico, in a fertile valley at the E. base of the Cordillera. Mines of iron and lead are found in the vicinity. The manufacture of earthenware and the weaving by hand of woollen and cotton cloths are industries of some importance, though the chief wealth of the city consists in cattle-raising and beef-packing. Founded in 1528, it was the seat of a bishopric, first filled by Las Casas, whence the city is often called San Cristobal las Casas. A monument in his honor has been erected here. P. about 12,000.

San'croft (WILLIAM), D. D., b. at Fresingfield, Suffolk, England, in 1616; educated at Bury School and at Emmanuel College, Cambridge, where he became fellow 1642; was deprived of his fellowship by the Long Parliament 1649; became chaplain to the bishop of Durham 1660, in which year he assisted, privately, in the revision of the Prayer Book; obtained from that prelate the rectory of Houghton-le-Spring and a prebend in Durham cathedral; was elected master of Emmanuel College, Cambridge, 1662; was promoted successively to the deaneries of York 1663, and of St. Paul's, London, 1664; spent large sums on the repair of St. Paul's cathedral; was presented by Charles II. to the archdeaconry of Canterbury 1668, and to the archbishopric of Canterbury 1677. He attended Charles II. on his deathbed, and temporized with James II. in regard to the acts of that monarch's illegal ecclesiastical commission, but had sufficient courage to draw up the famous petition against the Declaration of Indulgence, signed by himself and seven other prelates, for which they were committed to the Tower June, 1688; tried for misdemeanor before the king's bench, and acquitted June 29, 1688. Notwithstanding his grievances, he did not take part in the conspiracies against James; refused to take the oath of allegiance to William and Mary; was deprived of his see Feb., 1691; refused to recognize his deposition; retired to his native place, and attempted, with the aid of the numerous nonjuring clergy, to maintain an episcopal succession. D. at Fresingfield Nov. 24, 1693. Author of several volumes of sermons, letters, and political essays. Many of his unedited MSS. are in the Bodleian Library, Oxford.

Sanctifica'tion. I. MEANING OF THE WORD (Lat. *sanctum facere;* Gr. ἁγιάζειν).—1. To make sacred, to consecrate or devote, applied to times, places, things, or persons (Matt. xxiii. 17, etc.); (2) to render morally pure, to cleanse from sin, to render holy (John xvii. 17; 1 Thess. v. 23). This moral purification is to be considered in two distinct stages: (*a*) Its commencement, called regeneration, or new birth; (*b*) its progressive accomplishment unto ultimate perfection, which progress is called sanctification. In the language of Protestant theology, justification is a forensic term, and indicates a change of relation effected by a divine sentence declaring that the law is satisfied with respect to the believer in consideration of what Christ has done, and that he is endowed with the rights secured by Christ's merits. Regeneration and sanctification, on the other hand, mark the beginning and progress of the real moral change wrought in the soul by the Holy Ghost.

II. REGENERATION, or the commencement of moral purification, is expressed in Scripture as a "creating anew" (Eph. iv. 24), "begetting" (James i. 18), "quickening" (John v. 21), "calling out of darkness into marvellous light" (1 Pet. ii. 9). The subjects of it are said to be "alive from the dead" (Rom. vi. 13), to be "new creatures" (2 Cor. v. 17), to be "born again" (John iii. 3–7), to be "God's workmanship" (Eph. ii. 10). It is variously conceived by different schools according to their various views of the nature of the soul and its relation to God, of original or habitual sin, and of divine grace.

1. *Pelagians* hold (1) that free-will, in the sense of an absolute power of choice at any moment between good and evil, is essential to moral character and responsibility; (2) that there are no permanent moral habits in man preserving and transmitting identity of character and controlling action, and consequently there is no original or habitual sin, since moral character can be predicated only of acts, not of states; (3) that responsibility is always limited by ability—that is, by natural power. Hence, regeneration is a self-determined change in the general moral course of man's life, an act of the man himself, without any gracious assistance other than that involved in instruction and favorable providential conditions. This was taught by Pelagius in the early part of the fifth century, has been adopted by no historical Church, but has been reproduced in various combinations by Rationalists and Socinians.

2. The *Semi-Pelagian* doctrine taught by John Cassian (d. 440) always contested the palm of orthodoxy in the Roman Catholic Church with Augustinianism, and is now supreme

through the triumph of the Jesuits. This admits that divine grace (prevenient) is necessary to enable a sinner to return unto God and be holy. Yet it follows from the nature of the human will that man must first spontaneously, of himself, desire and attempt to choose and obey God. They deny prevenient and admit *co-operative* grace.

3. The Arminian view of regeneration admits total depravity, and consequent moral impotency. Nevertheless, man is not really responsible until there is redemptively bestowed upon him for Christ's sake *sufficient* grace to re-endow him with ability (gracious substituted for natural) to obey God, which grace becomes *efficient* when the sinner co-operates with it, and thus effects the end intended.

4. The *Synergistic* view, virtually the same as the former, was held by a party among the Lutherans who departed from the traditions of their Church. At the Leipsic Conference (1548) Melanchthon said, "There concur three causes of a good action—the word of God, the Holy Spirit, and the human will assenting, not resisting the word of God." (*Loc. Com.*, p. 90.)

5. The *Lutheran* standard, the *Formula Concordiæ*, teaches: (1) human nature is spiritually dead; (2) the Holy Ghost is the sole efficient agent who quickens the dead soul to life, without the least co-operation of the will of the subject. But the non-regeneration of the unbeliever they refer not to the absence nor to any deficiency of grace, but to the positive resistance of the man himself. (*Formula Concordiæ*, pp. 662, 666, 582, 677.)

6. The *Reformed* doctrine: (1) As to the *nature* of regeneration, (*a*) there are in the soul, besides its several faculties, habits or dispositions, innate or acquired, which lay the foundation for the soul's exercising its faculties in a particular way. (*b*) These dispositions (moral) are anterior to moral action, and determine its character as good or evil. (*c*) In creation God made the dispositions of Adam's heart holy. (*d*) In regeneration God recreates the governing dispositions of the regenerated man's heart holy. It is therefore essentially the communication of a new spiritual life, and is properly called a "new birth." (2) As to its *efficient cause*, it is effected by divine power acting supernaturally and immediately upon the soul, quickening it to spiritual life, and implanting gracious principles of action. (3) Conversion (*conversio actualis*) instantly follows as the change of action consequent upon the change of character, and consists in repentance, faith, holy obedience, etc. (*Thirty-nine Articles*, art. 10; *Can. of Synod of Dort*, ch. iii. art. 3; *West. Conf.*, ch. x.)

7. The *Mediæval and Papal* doctrine admits original sin and necessity of grace. The efficacy of grace in a given case is made to depend (1) by the Augustinian party (Jansenists) on the purpose of God and the specific power of the grace itself. (2) The Council of Trent places it in the co-operation, or at least non-resistance, of the subject. (Sess. 6, can. 4, chs. 5 and 6, and sess. 7, cans. 6 and 8.) But all agree that it is exercised only through the instrumentality of baptism, which acts as an *opus operatum, ex vi actionis ipsius*, effecting regeneration and the entire removal of sin, and consequently of guilt, from every infant, and from every adult who does not wilfully resist (*non ponentibus obicem*). (*Counc. Trent*, sess. 7, can. 6; Bellarmin, *De Sacramentis*, 2. 1.)

8. *Baptismal Regeneration* is held by members of the Church of England and others in various senses. (1) Some hold that the Holy Spirit through the instrumentality of baptism implants a germ of spiritual life in the soul, which may long remain latent, and may be subsequently developed (in conversion) or blasted. (2) Others hold that there are two regenerations—one a change of *state* or *relation*, and the other a change of *nature*; the first is baptismal and the second moral, though both are spiritual, since both are wrought by the Holy Ghost.

III. SANCTIFICATION is the progressive completion of the spiritual change of character commenced in regeneration.

1. *Pelagian and Rationalistic View.* See above.

2. *Mediæval and Roman.*—(1) They refuse to distinguish between justification and sanctification. (2) Their definition makes justification to be sanctification—that is, the cleansing from sin, and the infusion of gracious habits by the Holy Ghost for Christ's sake by the instrument of baptism, upon which subjective change the removal of guilt and divine favor is conditioned. (*Counc. Trent*, sess. 6, can. 7.) (3) It is therefore progressive, and is advanced (*a*) by good works, which possess real merit, and deserve and secure increase of grace (*Counc. Trent*, sess. 6, can. 32); (*b*) by penances, prayers, fastings, etc., which satisfy God's justice and purify the soul (*Counc. Trent*, sess. 14, ch. 8; sess. 6, cans. 29 and 30); (*c*) it is possible, even before death, for a believer to perfectly conform to all the demands of God's law as graciously adjusted to this life (*Counc. Trent*, sess. 6, ch. 16, can. 25); (*d*) it is even possible, out of love, to perform supererogatory service by obedience to the councils of Christ, which are advisory, but not obligatory until voluntarily undertaken: these are voluntary poverty, celibacy, and obedience to monastic rule, and merit more than the mere salvation of the person, and contribute to the "treasury of merits" at the disposal of the Church, which is imputable at the discretion of those holding the jurisdiction to believers on earth or in purgatory not yet fully justified (Bellarmin, *De Monachiis*, chs. 6 and 7); (*e*) if the believer dies before the process of deliverance from sin is perfected, he must complete it in purgatory, the pains of which are expiatory and purifying: and there he may be assisted by the prayers and masses and dispensing power of the Church on earth. (Bellarmin, *Purgator.*, ii. 9.)

3. The *Mystical* view of sanctification, though never embodied in any Church creed, has existed as a doctrine and as a tendency in all ages and among all Christian denominations. A Mystic (from Μυέω) is one to whom secret things have been revealed. Christian mysticism more or less depreciates the dependence of the soul for light upon the objective revelation of the word of God, and the necessity of the means of grace and human effort, and emphasizes spiritual intuition, the regulative value of religious feeling, the physical communion of the soul with the substance of God, conditioned on quiet and passivity of mind, etc. Such views gained great currency in the Church after about A. D. 523, when the *Celestial*, and *Terrestrial Hierarchy*, and *Mystical Theology*, falsely attributed to Dionysius the Areopagite, were published and translated into all languages. They qualified the works of the eminent evangelical Schoolmen and writers—Bernard of Clairvaux, Hugo and Richard of St. Victor, and subsequently Thomas à Kempis. They were taught with great influence by Schwenkfeld (1490–1561), Paracelsus (1493–1541), Weigel (1533–88), and Jacob Böhme (1575–1620), after the Reformation, among the Protestants; and by St. Francis of Sales (1567–1622), Molinos (1640–97), Madame Guyon (1648–1717), and Archbp. Fénelon (1651–1715), among the Roman Catholics. The original Quakers held similar views, as is seen in the writings of George Fox (d. 1691), William Penn (d. 1718), and Robert Barclay (1648–90). (See Barclay's *Theologiæ veræ Christianæ Apologia*); Vaughan's *Hours with the Mystics*; Ullmann's *Reformers before the Reformation*; Dorner's *Hist. Person of Christ* and *Hist. Protest. Theol.*)

4. *The Doctrine of Sanctification common to* LUTHERAN *and* REFORMED *Churches, and styled* EVANGELICAL.—(1) The soul after regeneration (*a*) continues dependent upon the constant gracious operations of the Holy Spirit, (*b*) but is, through grace, able to co-operate with them. (2) The operations of the Spirit are (*a*) supernatural, (*b*) yet effected in connection with and through the instrumentality of means. (3) The Spirit gradually completes the work of moral purification commenced in regeneration; this includes (*a*) the cleansing of the soul from sin and emancipation from its power, and (*b*) the development of the implanted principle of spiritual life and infused habits of grace, until the subject comes to the stature of perfect manhood in Christ. (4) It spiritually and morally transforms the whole man, intellect, affections, and will, soul and body. (5) This work proceeds with various degrees of thoroughness during life, but is never consummated in absolute moral perfection until the subject passes into glory. (6) The *means* of sanctification are (*a*) *internal*, as faith and the co-operation of the regenerated will with grace, and (*b*) *external*, as the word of God, sacraments, prayer, Christian fellowship, and the providential discipline of our heavenly Father.

IV. The doctrine of PERFECT SANCTIFICATION in this life is held in four forms:

1. *Pelagian.*—According to the principles of Pelagianism, stated above, a man is perfect who obeys the law of God to the measure of his present natural ability, since the moral law is a sliding scale, adjusting its demands to the varying ability of its subject.

2. *Mystical* perfectionism consists in absorption in the Divine essence.

3. *Roman* or *Ritualistic* perfectionism consists in perfect conformity to the law of God, graciously for Christ's sake adjusted to the capacities of the regenerated man in this life, and even in the rendering of supererogatory service in the way of extra-legal self-denial from a principle of evangelical love; and this perfection is attained by means of meritorious works and penances, prayers, fasts, acts of voluntary self-denial, and ecclesiastical obedience.

4. *Evangelical Perfection*, as taught by the followers of Wesley, includes the following principles: (1) The satisfaction and merit of Christ has made it consistent with divine justice to offer salvation to men on easier terms than the old Adamic law of absolute perfection. "The gospel, which is the law of love, the 'law of liberty,' offers salva-

tion upon other terms, and yet provides for the vindication of the broken law. The condition of justification at first is *faith alone*, and the condition of continued acceptance is *faith working by love*. . . . Perfect faith and perfect love is Christian perfection. Christian character is estimated by the conditions of the gospel; Christian perfection implies the perfect performance of these conditions, and nothing more." (Wesley's tract on *Christian Perfection; Methodist Doctrinal Tracts;* Dr. George Peck's *Christ. Doc. of Perfection;* Owen on the *Holy Spirit and His Work;* Marshall on *Sanctification;* Rev. Wm. E. Boardman, D. D., *Higher Christian Life;* Upham's *Life of Faith* and *Interior Life;* Hagenbach's *Hist. of Christ. Doctrines;* Hase, *Libri Symbolici Eccles. Evangelicæ* (Lutheran); Niemeyer, *Collectio Confessionum* (Reformed); *Canons and Decrees of the Counc. of Trent.*) A. A. HODGE.

Sanctuary. See ASYLUM.

Sand [Ang.-Sax. *sand;* Ger. *Sand;* Dutch, *zand*], a term which is applied, both in common parlance and often even in scientific literature, in a broad and vague sense to include any granulated mineral material destitute of coherence when dry. Thus, in this broad sense any known mineral may form a sand, and we have silicious sand, calcareous sand, magnetic iron sand, coral sand, and other varieties highly diverse in nature and origin. This unfortunate vagueness extends to *sandstones*, which always go by this name when made up by the conglomeration or concretion of such previously-granulated material, whatever its mineralogical nature may be. A familiar example in America is the brown "sandstone" from the Connecticut Valley and from New Jersey, so extensively used for building purposes, which the present writer some years since discovered to be mainly made up of angular grains of *feldspar*, often containing scarce a grain of silicious sand in its substance. In the lithological nomenclature of Brongniart, Naumann, and Cotta it is a feldspathic *psammite*, and not a sandstone. Rocks are converted into sands by the forces of moving water, moving ice, the winds, the freezing of water in crevices, the disintegrating action of vegetation, decomposition by chemical action, and other agencies, for which see Dana's *Manual of Geology*, p. 758. (Further upon silicious sand see SILICA.) H. WURTZ.

Sand (GEORGE), the pseudonym under which AMANTINE LUCILE AURORE DUPIN (MADAME DUDEVANT) published her celebrated novels and dramas. She was b. at Paris in 1804, and educated first at the Château de Nohant, department of Indre, by her grandmother, Madame Dupin, a natural daughter of Marshal Saxe, and afterward (1817–20) in an Augustinian convent in Paris. In 1822 she married Baron Dudevant, formerly an officer in the army of Napoleon, to whom she bore two children, but in 1831 separated from him, determined to support herself by literary work; removed to Paris with her daughter, and assumed male dress in order to move about with greater freedom. In connection with Jules Sandeau she wrote *Rose et Blanche* (5 vols.), which was published in 1831 under the pseudonym of "Jules Sand," and the reception it found offered her an opportunity of publishing immediately after a novel written by her alone, *Indiana* (2 vols.), under the pseudonym of "George Sand," which she afterward retained. In 1832, *Valentine* (2 vols.) made her name celebrated, and in 1833 her celebrity rose to sensation with *Lélia* (2 vols.). The book touched in a somewhat peculiar manner the very delicate question of love and conjugal fidelity. In company with Alfred de Musset she then made a journey to Italy, but at Venice they parted, and in 1836 he published *Confessions d'un Enfant du Siècle*, to which she answered in 1859 with *Elle et Lui*, which produced an immense sensation. The violent movement into which her mind was thrown by her relation to Musset is very apparent in her *Letters d'un Voyageur* (2 vols.) and *Jacques* (2 vols., 1834), and is still more visible in *André* and *Léone Leoni* (1835). But by degrees it subsided. In 1836 she was divorced from Baron Dudevant, and both her children came to live with her. About the same time began her intimate friendship with Chopin, which lasted until 1847, and to which are due those many beautiful passages on music which are found in her later books. To this period of her life (1835–41) belongs a series mostly consisting of minor novels—*Le Secrétaire intime* (2 vols.), *Lavinia, Métella, Mattéa, La Marquise, Mauprat* (2 vols.), *La Dernière Aldini, L'Uscoque, Pauline*, etc.—in which her wonderful talent of artistic representation appears perfectly developed and in its full ripeness. They were published in the *Revue des Deux Mondes*, but in 1841 she fell out with the editor, and *Horace* was rejected. She in the mean time had made the acquaintance of Lamennais, Michel the republican, Pierre Leroux the Socialist; and, truly feminine in her innermost nature, accepting fearlessly any influence which seemed to correspond with her own impressions, and always transforming to the watchword of an enthusiastic crusade the idea which is in the minority and in opposition, she now burst upon the world as the spokesman of very singular and very advanced social and political, moral and religious views: *Lettres à Marcie* (1837), *Spiridion* (1838), *Les Sept Cords de la Lyre* (1840), and especially *Horace* and *Consuelo* (8 vols., 1842), *La Comtesse de Rudolstadt* (4 vols., 1843), *Le Meûnier d'Angibault* (1845), *Le Péché de Monsieur Antoine* (1846), etc. With *Jeanne* (8 vols., 1844) she again returned to the purely artistic novel without any tendency, and now followed (1844–48) some of her most beautiful productions—*La Petite Fadette* (2 vols.), *La Mare au Diable* (2 vols.), *François le Champi* (2 vols.), etc.—but in 1848 she plunged with all her passionate enthusiasm into the very midst of the Revolution—wrote proclamations, founded newspapers, etc., and was about losing herself in the confusion. After the Revolution she wrote during a long period chiefly for the theatres, and some of her plays were very successful. They are, nevertheless, nothing but dramatized novels, without any genuine dramatic effect. Her talent is the novel, more especially the descriptive and reflective novel, and in this genre even her latest books, *Mlle. la Quintinie* (1863), *La Confession d'un Jeune Fille* (1865), *Cadio* (1868), *Journal d'un Voyageur pendant la Guerre* (1871), *Impressions et Souvenirs* (1873), are brilliant and powerful productions. Her *Histoire de ma Vie* (1854) disappointed people, but perhaps the fault was not hers. D. June 8, 1876. CLEMENS PETERSEN.

Sand (KARL LUDWIG), b. at Wunsiedel, Franconia, Oct. 5, 1795; received a good education; studied theology at Tübingen, Erlangen, and Jena, and was much liked both by his professors and fellow-students, though he was reticent, melancholy, dreamy, and given to solitude. Mar. 9, 1819, he repaired to Mannheim, called at Kotzebue's house at 11 o'clock A. M., and was requested to call again between 4 and 5 P. M. He came, was received by Kotzebue in his study, stabbed him two or three times in the heart with a dagger, and walked away. Arrived in the street, he spoke as if in a trance to the gathering crowd of what he had done, and then attempted to stab himself. He failed, was brought to a hospital, cured, tried, sentenced to death May 5, 1820, and executed May 20. During the whole trial he showed perfect confidence in the righteousness of what he had done, and died calm and collected.

San'dal-Wood [Sans. *chandana*, whence *sandalum* in the earliest European accounts and the *Santalum* of botanists], the agreeably aromatic and precious wood of several species of *Santalum* and of one or two other trees. The original sandal-wood of India is yielded by *Santalum album*. Three kinds or hues were known in Europe as early as the eleventh century—white, yellow, and red, the latter of which may have been confounded with the inodorous wood of red sanders or SANTAL-WOOD (which see). After the discovery of the Sandwich Islands a large part of the supply of the sandal-wood of commerce came from two or three species of *Santalum* peculiar to those islands, and later from *S. Yasi* of the Feejee Islands and from *S. Austro-Caledonicum* of New Caledonia; also from *Fusanus spicatus*, a tree of Western Australia of the same natural order. The high price which this wood brings has caused the reckless extirpation of the tree from the more accessible stations, but in India the original sandal-wood tree is now protected by government. It is employed as a perfume and for the fabrication of small articles—glove boxes, caskets, etc. Much is consumed in India in the celebration of sepulchral rites and for medicinal purposes, where the powder, made into a paste with water, is used for making the caste mark. But the principal market is China, where it is most largely used for incense in temples, etc. The Malabar sandal-wood there brings three or four times the price of that of the South Sea islands. The wood yields 1 per cent. of a peculiar essential oil, on which the characteristic fragrance depends. ¶This oil, largely extracted in some parts of India from the fresh wood, has been used in medicine as a substitute for copaiba. The famous and richly-carved gates of the temple of Somnauth, supposed to be 1000 years old, are of sandal-wood. ASA GRAY.

San Damia'no d'As'ti, town of Italy, province of Alessandria, about 9 miles from Asti. This town, once of considerable military importance, is now largely engaged in producing the favorite wine known as vino d'Asti. P. 8427.

San'darach [Gr. σανδαράκη], a gum-resin from the *Thuja articulata*, a small coniferous tree which grows in Barbary. It occurs in pale-yellow oblong grains or tears, covered with a fine dust, is transparent and brittle, with a vitreous lustre on the fracture. According to Unverdorben and Johnston (see *J. pr. Ch.*, xvii. 157), it consists of three resinous acids. The a-resin forms a white or yellow powder, slightly soluble in alcohol and not easily fusible, and is

present in but small quantities. The β-resin forms about [illegible] of the whole, is bright yellow, softens at 212° F., and [illegible] alcohol. The γ resin is a [illegible] in boiling alcohol, and melts with [illegible] at the same time. Sandarach was [illegible], and entered into the composition of [illegible] ointments and plasters. It is now [illegible] as incense and in varnishes. Its powder is [illegible] paper after erasures have been made to prevent the spreading of ink. C. F. CHANDLER.

Sand Bar Plantation, tp., Somerset co., Me. P. 15.

Sand Beach, p. v. and tp., Huron co., Mich. P. 666.

Sand-Blast. The term "sand blast process" is applied to a method devised by Gen. Benjamin C. Tilghman of Philadelphia for cutting, boring, grinding, dressing, pulverizing, and engraving stone, metal, glass, wood, and other hard or solid substances by means of a stream of sand or grains of quartz, or of other suitable material, artificially driven as projectiles rapidly against them by any suitable method of propulsion. The abrading power of sand is well known. It is seen frequently on a grand scale in nature, and man has successfully utilized it in the arts. When carried by running water, sand has played an important part in the erosion of rocks, and when driven by the wind it depolishes the glass in the windows of the fisherman's hut upon the seashore and destroys the transparency of the glass in the lanterns of sea coast lighthouses. One of the best examples of the abrading power of sand carried by the wind is given by Prof. W. P. Blake in his *Report of a Geological Reconnaissance in California in 1853*. The pass of San Bernardino is an opening through the ridge of the Southern Sierra Nevada, leading from the valley of San Bernardino to the Colorado desert. This pass is 2 or 3 miles wide, and is bounded on the one side by the snow capped Bernardino Mountains, and on the other by the sharp imposing peak of San Gorgoño. The latter, which is 7000 feet high, is mainly composed of granite, which stands out in projecting spurs on the side of the mountain. The whole surface of this granite over considerable areas is deeply grooved and polished by the attrition of the sand carried by the constantly-blowing westerly wind; in proof of which there are large banks or drifts of sand on the lee or eastern side of the ridge. Since the constituent minerals of the granite are differently worn by the action of the drifting sand, the surface is very irregular, those minerals projecting most which are the hardest. In some places garnets are supported upon long pedestals of feldspar, which they have protected from the erosion, and thus they stand, pointing out, like jeweled fingers, the direction of the prevailing wind.

It was a general idea of the cutting power of sand when driven by water or air against hard substances that led Gen. Tilghman to make his first experiments. A simple form of air blast, producing a few ounces of pressure only, was fitted up, and by means of an extemporized concentric jet of glass this air was made to drive the sand against the object to be cut. In this way holes were bored through ordinary window glass in a few seconds. It was but a step now to improve the apparatus so as to get increased efficiency; and the preliminary trials having demonstrated the great practical utility of the process, a patent from the U. S. was applied for and granted on Oct. 18, 1870. This patent is numbered 108,408; its claims are as follows: (1) The cutting, boring, grinding, dressing, engraving, and pulverizing of stone, metal, glass, pottery, wood, and other hard or solid substances by sand used as a projectile, when the requisite velocity has been artificially given to it by any suitable means. (2) The artificial combination of a jet or current of steam, air, water, or other suitable gaseous or liquid medium, with a stream of sand, as a means of giving velocity to the sand when the sand is used as a projectile as a means of cutting, boring, grinding, dressing, engraving, and pulverizing stone, metal, glass, pottery, wood, and other hard or solid substances. (3) The combination of a rotary fan, centrifugal machines, and other machines capable of giving direct mechanical impulse with a stream of sand, as a means of giving velocity thereto when the sand is used as a projectile as a means of cutting, boring, grinding, dressing, engraving, and pulverizing stone, metal, glass, pottery, wood, and other hard or solid substances. (4) As a new manufacture, articles of stone, metal, glass, pottery, wood, and other hard or solid substances which have been cut, bored, ground, dressed, engraved, or pulverized by sand used as a projectile, when the requisite velocity has been artificially given to the sand by any suitable means. (5) As a new manufacture, articles of stone, metal, glass, pottery, wood, and other hard or solid substances which have been cut, bored, ground, dressed, engraved, or pulverized by sand used as a projectile, to which the requisite velocity has been artificially given by a jet or current of steam, air, water, or other suitable gaseous or liquid medium. (6) As a new manufacture, articles of stone, metal, glass, pottery, wood, and other hard or solid substances which have been cut, bored, ground, dressed, engraved, or pulverized by sand used as a projectile, to which the requisite velocity has been given by a rotary fan, centrifugal machine, or other machine capable of giving direct mechanical impulse. (7) When a jet or current of steam, air, water, or any other suitable gaseous or liquid medium is employed to give velocity to sand used as a projectile, as a means of cutting, boring, grinding, dressing, engraving, or pulverizing stone, metal, glass, pottery, wood, and other hard or solid substances, the use of the following devices for introducing the sand into the jet of steam, air, water, etc.: First, the suction produced by the jet of steam, air, water, etc.; second, a strong, close vessel or sand-box, into which the pressure of the steam, air, water, etc. is introduced, and through which, when desired, a current of it may be made to pass.

In actual practice, two kinds of work are performed by the sand-blast, which may be called, respectively, heavy and light work. For the former a high pressure and a correspondingly great velocity are required; for the latter the pressure is light and the velocity low. The simplest form of apparatus which can be used for this latter purpose is that in which the requisite velocity is given by the force of gravity. The sand is simply fed into the top of a high vertical tube and allowed to fall. Its velocity increases as the air within the tube is set in motion, until finally the point is reached at which it will readily depolish glass. In some experiments made by the writer glass was depolished in half a minute by No. 20 emery falling through a tube ten feet in height. Ordinarily, however, the necessary velocity is given to the sand by means of an air-blast produced either by a rotary fan or positive blower, or by the pressure of the atmosphere acting toward a vacuum maintained by a fan or a steam-jet. For simply depolishing glass or making the so-called ground glass, the current of air is conducted into a rectangular trough of any desired length, narrowed at the bottom to an opening an inch wide, and having its top perforated by small tubes for the admission of the sand. For each square inch of cross-section of the lower opening the amount of sand required is 20 cubic inches. The glass is carried slowly across the opening of this huge jet, and about an inch below it, by means of a travelling apron. The grain which the surface receives from the sand depends both on the fineness of this sand and on the pressure of the blast. The sand used varies from that which will pass through a sieve of fifty wires to the inch down to the finest powder. The pressure employed varies from one to ten inches of water. With sand of average fineness and a pressure of four inches of water ordinary glass can be depolished perfectly in ten seconds. Air is preferred to steam for light work, since with steam the sand becomes damp and clogs the surfaces. Of course, this depolishing action is not confined to glass. A fine stippled surface may in this way be given to rolled zinc, the grain of which may be made coarse or fine at pleasure. This surface is of use in zincographic printing. The remarkably bold and brilliant frosting which has recently appeared upon silver tableware is also the work of the sand-blast.

If the surface of the glass or metal, instead of being plain, is to be ornamented (or engraved, as it is commonly termed), it is obvious that this may be perfectly accomplished simply by protecting from the action of the blast those portions of the surface which it is desired to leave in their polished condition. This may be done by covering these portions with the desired pattern cut out of some suitable resistant medium, the chief requisite of which seems to be pliability and toughness in distinction from brittleness. A fresh fern-leaf, for instance, attached to a sheet of glass by gum-water, will perfectly protect the surface beneath it from erosion, while the unprotected portions are completely depolished. If the action of the blast be continued, the softer parts of the leaf are first removed, and thus the venation of the frond is faithfully reproduced on the glass. A signature written upon any hard surface with a pen dipped in liquid glue protects this surface, so that after the action of the sand blast the removal of the glue leaves the autograph indelibly traced in transparent lines. The thin and delicate lace-paper which is used in ornamental confectionery, bobinet lace both plain and figured, and other similar tissues, may be used to cover the glass, and so to transfer their respective designs to its surface. By means of the blocks used in printing wall-papers or oil-carpets designs in oil-paint may be stamped upon the glass. These when dry protect the surface from being depolished, and the pattern is left unground. In actual practice, however, it is necessary that the patterns to be transferred should be capable of being prepared and attached to the

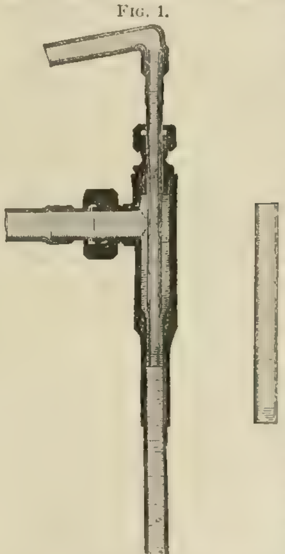
glass by unskilled labor. Several methods of doing this have been employed. In one of these stencils of the required design are prepared in sheet copper or brass. These are held by the operator, usually a boy, firmly upon the glass, and a brush dipped in melted beeswax is drawn over the whole. Upon raising the stencil its pattern is left in exposed glass, and may be fixed there by the blast. Or a piece of tin or lead-foil is fixed to the glass by a little gum-water, the stencil is laid upon it, and its outline drawn through the foil by a sharp point. The foil which is now removed is either the superfluous portions around the pattern—in which case, after brushing with beeswax and again removing foil, the pattern itself is left clear as before, or the pattern itself is removed; when, on covering with beeswax and taking off the rest of the foil, the pattern is reproduced on the glass in wax, and after depolishing appears as a clear design upon a ground surface. A modification of this process has been extensively used, which consists in the employment of a mixture of beeswax and gutta-percha rolled into sheets. This is laid on the glass, the stencil placed upon it, and the design traced through as before. On removing the portions which it is desired to have depolished, and pressing the remaining coating firmly down, the glass is ready for the blast. Still another method, which has been found practically successful, is one in which, by means of the stencil-plates already referred to, the designs are either cut or punched out of lead-foil by the hundred. Girls are employed to attach these to the glass with gum-water, and the operation is proceeded with as before. Sometimes certain portions of the foil are allowed to remain until after the action of the blast. On again covering with beeswax, and stripping off this remaining foil, a new pattern is developed, which may be etched by hydrofluoric acid in the ordinary way, thus producing three entirely different surfaces upon the glass, and giving contrasts of great beauty. Some exquisite designs have been executed in this way upon plate-glass for interior decorations. The lead-foil method now described is extensively used for ornamenting glass gas-globes. Two girls, one to put on the patterns, the other to tend the automatic depolishing-machine, can easily do 300 globes per diem, the most elaborate ornamentation costing scarcely more than the most simple. In the same way table-glass may be ornamented, either with the initials or monogram of the owner or with fancy designs. Chemical glass and glass used in business may also be marked in this way easily and cheaply.

Ornamenting glass in color is another feature of sand-blast work. Most of the colored glass in use is, as is well known, simply plain window-glass, on one side of which is flashed a thin layer of colored glass. By protecting the surface of this layer by a resistant design, it is possible to remove by the sand-blast all the colored layer in the exposed parts, leaving them white and depolished. On removing the protecting material, the design appears in color upon a white ground. Whether the device shall be in color on a white ground, or white upon a colored ground, depends simply on the question which shall be left exposed by the pattern.

But the most beautiful results of the operation of the light-pressure sand-blast are obtained with the aid of the gelatine process in photography. As is well known, this process, in brief, consists in covering a plate of glass with a warm solution of gelatine to which has been added a suitable quantity of potassium dichromate. This operation must be performed in the dark. If this plate, when cold, be placed beneath an ordinary photographic negative and exposed to light, the portions of the gelatine film unprotected by the negative will be acted on by the light, and by an oxidation of the gelatine caused by the dichromate will be rendered insoluble in warm water. If, therefore, the plate, after exposure, be placed in warm water, the parts which were protected by the negative—corresponding to the lights of the original picture—are dissolved away, leaving the glass clear, while the unprotected parts having been rendered insoluble by the action of the light, are not affected and remain on the glass, forming a resistant layer. On drying the plate and submitting it to the action of the sand-blast the glass is depolished in the lights of the picture, while it is left clear in the shades. On removing mechanically the insoluble gelatine, the picture appears, the amount of light coming to the eye being less in the transparent portions, which thus constitute the shadows. Most accurate and beautiful reproductions of line engravings have been in this way transferred to glass with marvellous fidelity even to the minutest detail: and this at a cost which is merely nominal. It is probable, moreover, that the sand-blast process will not long be limited to line engravings. Experiments which have been made to test the matter show that gradations of tone may be secured by its use. Where, for example, there are half tones in the photographic negative, the light which passes through is too faint to render the gelatine beneath entirely insoluble. On washing it, therefore, it is partially removed, and on exposing the film to the action of the blast, these thinner portions are cut away by the blast just before the operation is finished. In this way a more or less imperfectly depolished surface is produced, which corresponds to the half tones. Another application of the gelatine process is to the production of raised surfaces. By using a suitable material on which to work, and by suitably proportioning the character of the blast, any desired pattern may be obtained in relief. This, then, may be used as a block, and by any of the ordinary printing processes the design thus prepared may be printed directly on paper. If a photographed device be thus engraved on a surface—such as that of pitch, for example—either in relief or in intaglio, it may be used as a mould from which to obtain a cast in wax, and this by the electrotype process may be reproduced as a letter-press cut.

The second class of work which the sand-blast is called upon to perform is that which requires a high velocity for the sand. This velocity is generally given to it by a jet of steam or air issuing at a high pressure, though a jet of water or of any other liquid or gas, or even a direct mechanical action, such as the blows of a revolving fan or the centrifugal force of a revolving tube, may also be employed to produce it. Steam is most readily obtained, and, as it cuts twice as fast as air under the same pressure, is generally preferred. It has been employed under all pressures up to 400 pounds to the square inch, and it has been proved that its efficiency increases rapidly with the pressure. It should be dry and entirely free from condensed water. If used at a distance from the boiler, the pipes should be well wrapped, and a purger should be employed to separate the water. The steam is used in a jet, technically called the "blast-pipe" or "gun." As shown in the accompanying sectional drawing (Fig. 1), it consists of a hollow bronze cylinder of about $1\frac{1}{2}$ inches external diameter, having a lateral opening near its upper end (by which the steam enters), and tapering somewhat at its lower. Through the top of this cylinder an iron tube passes, secured by a stuffing-box. This is called the "sand tube;" its exterior diameter is somewhat less than that of the opening through the cylinder, and it tapers with it at its lower end, though somewhat less rapidly, thus leaving a narrow concentric aperture for the passage of the steam. The adjustment of this part of the apparatus is most important. The exterior cylinder is prolonged beyond this concentric opening to form a socket for a supplementary or directing tube called the "nozzle-tube" (seen separately on the right). This tube, being the only portion of the blast-pipe which is exposed to wear, is made of sheet steel, or sometimes of chilled iron. It is easily replaceable when worn through by use. From this description it will be seen that the steam enters the gun laterally, surrounds the sand-tube, issues through the annular space below into the nozzle-tube, and creates a partial vacuum in the sand tube which draws the sand into the blast. Hence it is evident that the effectiveness of the blast depends upon the accurate adjustment of the tubes and apertures to each other for any given pressure of steam. The sand used for this purpose should be sifted so as to be of uniform size, and should be clean, hard, sharp, and dry. Experiment has shown that sand which will pass through a sieve of 40 holes to the inch, and not through one of 48 wires, will cut faster than a sand which will pass through one of 20 and not one of 30 holes. The action of the gun is as follows: As soon as the steam is let on, it issues with great velocity from the annular opening in the jet, producing a partial vacuum in the sand tube which it encloses, and consequently in the rubber tube which connects it with the sand box above. On opening a sliding valve in the bottom of this sand-box a stream of sand—in amount about one or two pints per minute—is drawn through the tube into the jet of steam, and is forced by it through the nozzle-tube, striking at a high velocity

Fig. 1.



Sand-Blast.

the stone to be cut, which is placed about an inch distant from it. The waste steam, together with the fragments of the stone and sand, escapes laterally, and if the gun be at rest a conical hole is gradually cut into the material. The angle which the sides of this cone make with each other varies, increasing with the hardness of the stone and diminishing with increase of pressure in the blast. If it is desired to have the sides of the cut parallel, the gun is slightly inclined and slowly revolved about a vertical axis. The angle of inclination varies of course with the hardness of the stone and with the pressure of the steam employed. In cutting granite, for example, with a steam-jet of 300 pounds pressure per square inch, an inclination of 1 in 9 has been found to give a parallel cut. A rather soft-burned brick, however, gave a straight cut under the same circumstances without inclining the jet at all. It is important that free escape should be afforded for the waste steam and sand. Hence, if a deep hole is to be drilled, its diameter must be sufficient to allow this free escape around the gun. In boring holes with the sand blast there is a decided advantage in having the blast pipe bent at its lower third to an angle of about 1 in 9, and to have the nozzle-tube only two inches long. By rotating such a jet about its main axis, a hole of almost any shape can be cut through stone, which shall have parallel sides; or, if required, the sides may even be undercut, as is sometimes necessary in making pockets for purposes of blasting.

In order to cut long narrow grooves in stone for the purpose of quarrying it, the gun is somewhat modified by attaching to it, on opposite sides of the opening of the nozzle-tube, two parallel guide plates of steel. The object of having these plates is to prevent the divergence of the blast laterally, and thus to make the edges of the groove more regular. The gun is carried on a railway, and is automatically moved so as to traverse the stone to be cut along the line of the required division at a suitable rate. It is inclined at an angle such as has been found by experiment to give a vertical cut on one side of the groove. After one cut is made to a depth of two or three inches, a second groove is cut about three inches from the first and parallel to it, the gun being so inclined that the two parallel surfaces face each other. When this is completed, the intermediate prism of stone, whose cross-section is the shape of an inverted V, is split out by a blunt chisel. Two other grooves are then cut to the same depth, and the operation above given is repeated, until finally a cut three inches wide, three feet or more in depth, and of any desired length, is made in the rock. The mass may then easily be detached by known methods. By mounting the blast-pipe on the end of a radial arm moving around a horizontal axis, a circular groove of the above depth may be cut as the circumference of a tunnel. Then a single charge of nitro glycerine, exploded at the centre, would bring away the entire mass.

The chief uses of the heavy sand blast, however, are found in dressing and ornamenting stone after it has been quarried. By experiments made for the purpose, it has been ascertained that in dressing stone under a pressure of 50 pounds of steam the blast will cut away five cubic inches of American marble, and three cubic inches of Italian marble or of granite, per minute. The amount of material removed, however, varies very much with the conditions of the experiment, being much greater, for example, when the blast pipe is moved over the surface than when it is still. Oblique incidence too (from 30° to 45°) increases the rapidity of the cutting effect, probably because the issuing particles of sand are not met and their force deadened by the rebounding ones. So, too, and probably from the same cause, the material is more rapidly cut away when the jet is held four or five inches distant from the stone than when but one inch. If, however, it be desired to limit the action strictly to the region to be cut, as when a narrow groove is to be made, it is best to direct the gun squarely at the face of the stone, and as near it as possible. Moreover, the rapidity of the action is also affected by the quantity of sand used. For hard rocks, in which the action is to be limited to a small area, the amount of sand above specified—one or two pints per minute—gives the best result. But when the stone is soft, and the cutting is to be done over a large surface, two or three times this quantity of sand may be used to advantage. In dressing stone the first operation is to produce a flat surface. This is best effected by cutting first a narrow groove about half an inch deep along one edge of the surface to be dressed, then breaking or splitting off the overhanging edge, and so on, repeating the operation across the entire face. Since most varieties of stone vary in hardness in different portions of the same mass, careful watching is necessary on the part of the workman when using the sand blast. He must continue the action a little longer upon those parts which are harder, and shorten it on those which are softer than the average. Used in this way and with sufficient care, the sand-blast has been found an efficient means of cleaning and refreshing discolored wrought-stone surfaces of buildings and monuments.

For purposes of ornamentation in stone the sand-blast process has no rival. The method employed is simply to protect those portions of the stone which are not to be cut away with a suitable mat or template of rubber or other more or less elastic material. The gun is mounted on a traverse having a to-and-fro motion adjustable for distance, which carries it forward and backward over the length of the stone. At the same time the frame has a motion at right angles to this, given to it by a ratchet-wheel and pawl working the pinion of a rack, and so adjusted that at the end of every passage of the jet to and fro the pawl pushes the ratchet-wheel forward one or more teeth. In this way the gun is made to pass each time over a fresh portion of the stone, the operation being continued until the required depth is attained. In general, the design which is to be engraved on the stone is cut out of sheet rubber one-sixteenth of an inch, or thereabouts, in thickness. The mat or stencil thus made is cemented on the stone with a solution of rubber in benzol. When the cement is dry the stone is placed immediately under the blast, and at one or two inches' distance from it. The wear which this rubber stencil undergoes is very trifling. In a single case one had been used with the steam-blast under a pressure of 50 pounds and at 2 feet distance to cut 50 slabs of marble each to the depth of a quarter of an inch. This is equivalent to 12½ inches of solid marble, and—as the rubber was one-sixteenth of an inch thick—to 200 times the thickness of the rubber itself. Yet no wear was perceptible on the surface of the stencil. In much of the easier kinds of ornamentation, such as that of marble and glass, patterns of metal are used, generally of iron. When letters are to be cut, for example, alphabets are prepared either of the letters themselves or of their stencils, and by selecting those which are desired and cementing them to the stone, they may be rapidly engraved. Ornamental designs may thus be cut deep into glass, the surface being beautifully frosted. The wear of the iron is very slight. By these various methods the most elaborate ornamentation of stone can be secured at a cost which is comparatively insignificant, since the complication of the pattern is entirely without influence. The stonework of the new Academy of the Fine Arts in Philadelphia was all ornamented by the sand-blast. Exquisite tracery-work has been cut by it out of thin white marble by cutting the pattern half through the slab, then reversing and cutting from the other side completely through. The bevelled edges of the design meet in the centre of the slab, and the open tracery thus made, when placed before a background of colored marble, produces a most excellent effect.

Experiments have also been made with the high-pressure sand-blast for the purpose of turning blocks of granite and other rocks into fancy forms in the lathe. A block of granite, for instance, having been given a roughly-cylindrical shape by the hammer, is placed in the lathe and accurately centred. The axis of the gun is of course perpendicular to that of the block, and is so placed that the blast strikes the block tangentially. If the block be slowly revolved, and at the same time the blast-pipe be carried along parallel to the axis by a motion like that of a slide-rest, a true cylinder of granite will in this way be turned out. But if, instead of moving in a straight line, the gun be made to follow any outline by means of a device similar to any of those employed in turning irregular forms, almost any desired form can be reproduced in the granite. Balcony pilasters which require fourteen days to cut by hand can be finished in half a day by the sand-blast. Another ingenious application of the sand-blast which has proved entirely successful is its use for cleaning castings of brass, iron, etc. from the sand and slag upon them as they come from the moulds. A moderate jet of steam working a blast of sand cleans them perfectly. In the case of iron castings, however, an advantage of the method has arisen which was not foreseen. In the old method of cleaning the castings were pickled, or placed in dilute sulphuric acid, for a short time. But it has been ascertained that the nascent hydrogen evolved by the action of the acid upon the iron is absorbed or occluded by the metal, thus diminishing greatly its strength, confirming fully the general opinion of iron-founders that the castings were weakened by pickling. Hence the sand-blast, by furnishing a new mode of cleaning these castings, prevents the weakening of the iron which results from the occlusion of hydrogen during pickling.

Upon wood the sand-blast acts slowly. The large block type which are used in printing posters may be cut out by the sand-blast, however, very rapidly and cheaply, simply

by cementing the stencils on the ends of the blocks and placing them all together under the moving jet for a few minutes. The letters are clear and sharp, and they work well in the press.

Many other applications of the sand-blast have been suggested. Millstones have been dressed by its means; metals have been cut, cleaned, stippled, and engraved; and all hard materials have been worn away by it. Alterations in the form of jet have been made, and in some cases the sand has been enclosed in a strong box and forced from the jet by the pressure of the steam admitted to the reservoir. But all these are obvious modifications and extensions of one leading principle.

The theory of this extraordinary action of a jet of sand is very simple. The material acted on is worn, not by an abrading action, but by actual pulverization by impact, each grain of sand acting by its own velocity and momentum, like a bullet or projectile, pulverizing, cutting, or indenting the object it strikes. That the impact even of sand-grains must be considerable at these high velocities is quite obvious; moreover, a dull red light may be observed where the sand impinges on the stone or glass. The evidence which may be adduced to prove the correctness of this theory of impact may be arranged under two distinct heads. In the first place, the rapidity with which a substance is cut away seems to have no particular relation to its hardness or softness as such, but is in the exact ratio of its brittleness. While the steam-blast at 50 pounds pressure scarcely affects india-rubber, wood is cut by it with moderate rapidity, marble and granite are attacked energetically, and glass is cut most rapidly of all. With a supply of steam equal to that which would be required in an engine to yield 1½ horse-power, at a pressure of 100 pounds to the square inch, quartz-sand being used in the blast, the cutting effect produced was equal to the removal per minute of 10 cubic inches of sandstone, 4 cubic inches of American marble, and 1½ cubic inches of granite. In sawing with sand, where the effect is unquestionably due to abrasion, marble cuts twelve times faster than granite. An air-blast at 80 pounds will perforate glass a quarter of an inch thick in four or five seconds, and a steam-jet at the same pressure will cut a hole through glass an inch thick in twenty seconds. Moreover, the effect of high velocity is apparent from the fact that when steam is used directly at high pressures—say at 50 pounds to the inch—it cuts fifty times as fast as if the same steam were employed to drive a fan producing one-sixth of a pound pressure of air. Again, abrasion, as is well known, takes place most rapidly at oblique incidences, and not at all at perpendicular incidences. Now, the sand-blast produces its maximum effect at perpendicular incidences, provided only that free space be allowed for the escape of the sand. Hence, a plate of copper, though one of the softest metals, resists the action of the sand-blast at a perpendicular incidence quite as well as a plate of hardened steel. But at oblique incidences, owing to the abrasive action, the copper is far more rapidly worn.

In the second place, the most satisfactory proof that this action is of the nature of pulverization by blows is the fact that the sand which is employed will rapidly cut substances which are much harder than itself—a fact impossible on the abrasion theory. Thus, for example, common quartz-sand, driven by steam at 50 pounds pressure, has cut a slot through a hardened steel file three-sixteenths of an inch thick in four minutes, and through a crystal of *corundum* three-quarters of an inch thick in ten minutes. When it is remembered that corundum is the hardest substance in nature except the diamond, the significance of this action appears. But even these results, marvellous as they are, have been exceeded. In a series of experiments made in New York by Prof. Egleston, in which quartz-sand was used, driven by an air-pressure of 70 pounds, one crystal of topaz lost 94 per cent. of its weight in one minute, and another had a hole drilled nearly through it in the same time, losing 22 per cent. of its weight. Under these circumstances even the diamond itself was attacked by the blast, a fragment of the black variety, weighing 1.2607 grammes, losing 0.0869 grammes in weight in eight minutes. Moreover, it has been proved experimentally that no advantage is obtained by using emery in the blast in place of quartz-sand; for, although it is much harder, it is also much heavier, and hence for a given pressure does not acquire so high a velocity in the blast as the lighter quartz. Now, since the force of impact increases as the square of the velocity, but only as the first power of the mass, it is obvious why a high velocity is so advantageous. In further proof of this second position is the very remarkable fact that a plate of quartz has been drilled by fine lead shot driven by an air-blast, as well as by an iron sand composed of fine particles of cast iron. Glass, too, has been depolished by a blast of marble-powder or chalk. Moreover, the new hardened glass of M. de la Bastie, which the diamond only scratches, but does not cut, is readily depolished by a blast of sand. But the peculiar condition of tension of this glass, due to its rapid cooling, renders it impossible to remove any but the thinnest layer from its surface without causing it to fly into a thousand pieces.

From its novelty and effectiveness, the sand-blast process has attracted much attention both here and in Europe. Patents in several foreign countries have been secured, and the process is already in successful operation in a number of them. G. F. Barker.

Sand'crack, a crack in the hoof of a horse. It constitutes an unsoundness, since it springs from a constitutional brittleness of the hoof and leads to serious lameness. It is made worse by overdriving and bad shoeing. It may be treated by paring, firing, and blistering the coronet. The horse should be well fed or turned out to pasture.

Sand Creek, tp., Bartholomew co., Ind. P. 1149.

Sand Creek, tp., Decatur co., Ind. P. 2029.

Sand Creek, tp., Jennings co., Ind. P. 930.

Sand Creek, tp., Union co., Ia. P. 328.

Sand Creek, tp., Scott co., Minn. P. 1520.

Sandeau' (Léonard Sylvain Jules), b. at Aubusson, department of Creuse, France, Feb. 19, 1811; studied law at Paris, but devoted himself subsequently to literature; wrote his first novel, *Rose et Blanche*, in connection with Madame Dudevant (George Sand), and published it under the pseudonym of "Jules Sand." In 1853 he was appointed keeper at the Mazarin Library, and in 1858 was elected a member of the Academy. His most successful novel was *Mlle. de la Seglière* (2 vols., 1848; as a drama 1851). His best comedy is *Le Gendre de M. Poirier*, written in connection with Émil Augier (1854). Also the novel *La Maison de Penarvan* (1858) has been transformed into a drama (1863).

Sand-Eel, or **Sand-Lance,** a name given to fishes of the family Amodytidæ and genus *Amodytes*. They are elongated, nearly rectilinear species, with an elongated, pointed snout, forked caudal, and silvery body; they burrow in the sand, and are of little or no use except as bait for other fishes, for which they are sometimes extensively employed. Species are found on the northern shores of all countries. The common American species is *Amodytes Americanus*. Theodore Gill.

Sandeman (Robert), b. at Perth, Scotland, in 1718; studied at Edinburgh; became a linen-draper; married a daughter of Rev. John Glas (or Glass), the founder of a sect called the Glasites; became an elder in the congregation; established in 1762 a congregation of the new sect at London, where the adherents became known under the title of Sandemanians; came to America and established a society 1764, and settled in the following year at Danbury, Conn., where he d. Apr. 2, 1771. Glas, the real founder of the sect, was b. at Dundee, Scotland, Sept. 21, 1698; was educated at St. Andrew's; became minister of a country parish; published *The Testimony of the King of Martyrs* (1727), directed against the alliance of Church and State; was thereupon deposed from his ministry by the Scottish General Assembly, and formed his adherents into a separate society. D. at Dundee in 1773. His numerous scattered writings were collected into 4 vols. (Edinburgh, 1762; Perth, 5 vols., 1782).—Sandeman wrote a number of theological and controversial treatises. The Sandemanian Church still maintains a feeble existence, chiefly at Dundee, Edinburgh, and Danbury, Conn., the total membership not exceeding 2000 persons. Among their leading peculiarities, besides several ascetic practices, are the weekly love-feast, eaten on Sunday, and the "kiss of brotherhood;" the washing of feet, formerly one of their practices, has been discontinued.

Sandemanians. See Sandeman.

Sand'erling, a name given to species of *Calidris*, a genus of the family Scolopacidæ, and closely related to *Tringa*, from which it in fact differs chiefly by the absence of the hind toe. The bill is straight, rather longer than the head, and widened toward the end; the color above is light ashy, interspersed with elongated spots of brownish-black on the head, back, scapulars, and shorter quills; that on the rump and upper tail coverts is black, in fine transverse lines; beneath it is white. The total length is about eight inches—the bill one, tail two. The species is widely distributed, and occurs more or less in the temperate regions of the entire northern hemisphere, and also extends in winter into South America. Theodore Gill.

Sanders. See Sandal-Wood and Santal-Wood.

Sanders (Charles W.), b. in Herkimer co., N. Y., in 1805; author of two series of *School Readers*, the first commenced in 1838, the second issued in 1860, and of several music-books for the young. More than 15,000,000

[illegible] his books have been used in American schools.—H[illegible] assisted him in the preparation of the [illegible] and was the author of an *Analytical* [illegible] (1840).

Sanders (Daniel Clarke), D. D., b. at Sturbridge, Mass., May 3, 1768; graduated at Harvard 1788; taught [illegible] grammar school while studying theology; [illegible] licensed to preach 1790; was Unitarian minister at V[illegible], Vt., from June 12, 1794, to 1799, when he re[moved] to Burlington; was the first president of the University of Vermont from Oct. 17, 1801, to Mar. 24, 1814, and pastor of the Unitarian church at Medfield, Mass., from May 21, 1815, to May 17, 1829, and was a member of the Massachusetts constitutional convention of 1820. D. at Medford Oct. 18, 1850. Author of *A History of the Indian Wars with the First Settlers of the U. S., particularly in New England*, printed at Montpelier, Vt., in 1812, and of more than 30 published sermons.

Sanders (George Nicholas), b. at Lexington, Ky., Feb. 21, 1812, grandson of Col. George Nicholas, the proposer of the "Kentucky resolutions" of 1798; became at an early age an eloquent Democratic orator and politician; was appointed by Pres. Pierce U. S. consul at Liverpool, and by Pres. Buchanan navy agent at New York; was a prominent supporter of Douglas in the campaign of 1860; resided in Europe during the civil war as a commissioner of the Confederate States, associated with Mason and Slidell; took part with Messrs. C. C. Clay and James P. Holcomb in the peace conference with Horace Greeley at Niagara Falls, July, 1864, and after the war settled at New York, where he d. Aug. 12, 1873.

Sanders (John), b. in Kentucky in 1810; graduated from the U. S. Military Academy, and appointed brevet second lieutenant of engineers July 1, 1831, captain 1838; was engaged for many years upon the improvement of Ohio River and the construction and repair of the defences of New York harbor. In the war with Mexico he participated in the battle of Monterey and the siege of Vera Cruz, gaining the brevet of major for gallantry at Monterey. With a brief interval he was subsequently engaged in improving Delaware River and Bay and in the construction of Fort Delaware, till his death, which occurred at that fort July 29, 1858. Author of *Memoirs on the Resources of the Valley of the Ohio*, etc., and of a translation of M. Poncelet's *Memoir on Stability of Revetments and their Foundations*.

Sanders (Nicholas), D. D., b. at Charlewood, Surrey, England, about 1527; educated at Winchester School and at Oxford, where he became fellow of New College 1548 and regius professor of canon law 1557; left England on account of the religious innovations of Elizabeth; was ordained priest at Rome 1560; accompanied Cardinal Stanislaus Hosius to the Council of Trent, where he gained great renown by his skill in disputation; went to Poland with Hosius; resided thirteen years at Louvain, Holland (1566–79), as assistant to Sir Francis Englefield, who was the almoner of the aid granted by Philip II. of Spain for the relief of English Roman Catholic churchmen; was sent by Pope Gregory XIII. as nuncio to Ireland; accompanied the Spanish soldiery thither 1579, and is alleged to have there perished miserably while wandering in the woods and bogs to escape from falling into the hands of the English, but whether in 1581, 1582, or 1583 authorities differ, and some discredit the account altogether. Sanders was styled by Anthony à Wood "the most noted defender of the Roman Catholic cause in his time." Author of *The Supper of our Lord* (Louvain, 4to, 1565), a work in defence of the "real presence," in reply to Jewell's *Apology* and Nowell's *Challenge*, and in turn answered by the latter in his *Confutation*; *The Rocke of the Churche* (Louvain, 1566), *A Treatise of the Images of Christ* (1567), directed against Jewell, and of several other polemical works, of which the best known was a Latin treatise against the English Reformation, *De Origine ac Progressu Schismatis Anglicani* (Cologne, 1585), which was several times reprinted and translated into French, but never into English.

Sanders (William P.), b. in Kentucky in 1833; graduated at the U. S. Military Academy in 1856, when he was appointed brevet second lieutenant of dragoons; served in California and Kansas 1856–57, and on the Utah expedition 1857–61. In May, 1861, he was appointed captain in the 6th U. S. Cavalry, and served with his company in the defences of Washington until the opening of the Virginia Peninsular campaign of 1862, when he was engaged before Yorktown, in the battles of Williamsburg, Mechanicsville, etc., and in the Maryland campaign of that year. In Mar., 1863, he accepted the coloneley of the 5th Kentucky Cavalry, which he led in the pursuit of Morgan on the latter's raid through Indiana and Ohio. In September he was appointed chief of cavalry, department of the Ohio, but the following month was promoted to be brigadier-general of volunteers, and assigned to the 23d corps. He participated in the engagements of Blue Lick Springs, Lenoir, and Campbell's Station, and was mortally wounded in action before Knoxville, Tenn., Nov. 17. D. Nov. 19, 1863.

San'derson, p.-v., cap. of Baker co., Fla.

Sanderson (John), b. near Carlisle, Pa., in 1783; studied law at Philadelphia; became a teacher in, and subsequently one of the proprietors of, Clermont Seminary; wrote in early life in Dennie's *Portfolio* and the *Aurora* newspaper; prepared with the aid of his brother, James M., the first 2 vols. of the *Biography of the Signers of the Declaration of Independence* (1820), which was completed in 7 vols. by Robert Waln, Jr., and others (1820–27; new illustrated 4to ed. by William Brotherhead, 1865); successfully opposed in a pamphlet the plan to exclude the classical languages from Girard College (1826); resided in Paris 1835–36; wrote an amusing and instructive work, *Sketches of Paris, in Familiar Letters to his Friends* (1838), which was republished in London under the title *The American in Paris* (1838), and translated by Jules Janin into French (1843); commenced a similar work, *The American in London*, of which portions were published in the *Knickerbocker Magazine*, and on his return to the U. S. became professor of Latin and Greek in the Philadelphia High School. D. at Philadelphia Apr. 5, 1844. He was a gentleman of ripe classical culture and of eminent social virtues. (See notice in Griswold's *Prose Writers of America*.)

Sanderson (John P.), b. Feb. 13, 1818, in Lebanon co., Pa.; admitted to the bar in 1839; elected to the lower house of the legislature of Pennsylvania in 1845, and to the State senate in 1847; editor of the *Daily News* of Philadelphia from 1848 to 1856; appointed chief clerk of the war department Mar. 4, 1861, which he resigned to accept the position of lieutenant-colonel 15th U. S. Infantry; appointed colonel 13th U. S. Infantry July 4, 1863; in Feb., 1864, was assigned to duty as provost-marshal-general department of the Missouri. D. at St. Louis, Mo., Oct. 14 of the same year. His important service to his country during the war was the very full exposition made by him of the secret political organization in the Northern and Western States known as the "Knights of the Golden Circle" or "Order of American Knights," causing the disruption of the order.

Sanderson (John Scott Burdon), M. D., F. R. S., b. at Newcastle-on-Tyne, England, Dec., 1828; educated at the University of Edinburgh; was medical officer of health for Paddington 1855–56; became physician to the Middlesex Hospital; was employed by the royal commissioners to make investigations respecting the cattle-plague 1865–66, the epidemic of cerebro-spinal meningitis in North Germany 1865, and the sanitary condition of the Cornwall mines 1869, on all which subjects he published elaborate *Reports*; introduced the sphygmograph into England; wrote the *Handbook of the Sphygmograph*, and became professor of physiology in University College, London, 1874.

Sanderson (Robert), D. D., b. at Rotherham, Yorkshire, England, Sept. 19, 1587; educated at Lincoln College, Oxford, where he became fellow 1606 and reader in logic in 1608; published lectures upon that subject, *Logicæ Artis Compendium* (1615), which passed through several editions; took orders in the Church of England 1611; became in 1619 rector of Boothby Pennell, Lincolnshire, which post he retained more than forty years; became prebend of Lincoln 1629 and rector of Muston 1633; was indebted to his great reputation as a casuist for the appointment of chaplain to Charles I. 1631, by whom he was made D. D. 1636, regius professor of divinity at Oxford and canon of Christ Church 1642; was named by Parliament one of the "Assembly of Divines" convoked at Westminster 1643, but refused to sign the Covenant, and had his living sequestered; attended the king as ecclesiastical councillor at Oxford, at Hampton Court, and in the Isle of Wight; was ejected from his professorship 1648, but restored 1660, and shortly after made bishop of Lincoln, and took part in the Savoy Conference 1661. D. at Lincoln Jan. 29, 1663. Author of several Latin treatises on cases of conscience, the obligation of an oath, etc., written for the guidance of Charles I., and other tracts, collected in his *Works* (Oxford, 6 vols.), edited by Bishop Jacobson. His *Life* was written by Walton. His sermons are masterpieces.

Sanderson (Robert), b. at Eggleston Hall, Durham, England, July 27, 1660; educated at St. John's College, Cambridge; became a lawyer in London, clerk of the rolls, usher of the court of chancery, and a distinguished antiquary. D. Dec. 25, 1741. He wrote a *History of Henry V.* (unpublished) and other works, but is chiefly remembered as the assistant of Thomas Rymer in the preparation of his *Fœdera*, and completed that great work after the death of the latter by the publication of vols. xvi.–xx. (1717–35).

Sanders's, tp., Jackson co., Ala. P. 158.

San'dersville, city, cap. of Washington co., Ga., on the ridge between Oconee and Ogeechee rivers, 135 miles N. W. of Savannah, has 3 churches, an academy, 2 weekly newspapers, 2 carriage-factories, court-house and jail, Masonic and "United Friends of Temperance" lodges, and a grange of "Patrons of Husbandry." The city government consists of a mayor and five aldermen. P. about 1500.

ROBERT L. RODGERS, ED. "HERALD AND GEORGIAN."

Sand'ford (Sir DANIEL KEYTE), D.C.L., son of Daniel Sandford, D. D., bishop of Edinburgh (1766–1830), b. at Edinburgh, Scotland, Feb. 3, 1798; educated at Christ Church, Oxford; became at the age of twenty-one professor of Greek at the University of Glasgow; was an accomplished and enthusiastic classical instructor, and an eloquent advocate in Parliament of the Reform bill and other liberal measures, and was knighted 1830. D. at Glasgow Feb. 4, 1838. He was one of the editors (along with Dr. Thomas Thomson and Allan Cunningham) of the *Popular Encyclopædia*, to which he contributed valuable articles. Author of several textbooks for Greek, of many articles on classical subjects in the reviews, of a work *On the Rise and Progress of Literature*, and of a *Sketch of the Literature of Greece*.—His brother, JOHN, b. at Edinburgh Mar. 22, 1802; graduated at Baliol College, Oxford; became archdeacon of Coventry, Bampton lecturer at Oxford 1861, and a royal commissioner for revising the forms of clerical subscription 1864, and author, besides theological treatises, of a biography of his father, Bishop Sandford, accompanying the *Remains* of that prelate. D. Mar. 22, 1873.—The wife of Archdeacon Sandford was author of *Woman in her Social and Domestic Character* (1832) and *Lives of English Female Worthies*. — CHARLES WALDEGRAVE, son of Archdeacon Sandford, b. 1828, was educated at Oxford, and became bishop of Gibraltar 1874.

Sand'ford (EDWARD), brother of Lewis H., b. at Ovid, N. Y., in 1809; received an academic education; became a teacher and lecturer in the Rensselaer Institute at Troy; studied law at Albany; began a successful career at the bar in New York City 1833; became a judge of the criminal court in that city 1842; was a member of the State senate 1843; contributed to the *Knickerbocker* and other periodicals, and was lost in the steamship Arctic, Sept. 27, 1854.

Sandford (LEWIS H.), b. in Onondaga co., N. Y., about 1805; studied law at Syracuse; settled in New York City 1833; became assistant vice-chancellor of the first circuit Mar., 1843, vice-chancellor 1846, and associate justice of the superior court 1847, retaining that post until his death, at Toledo, O., in 1852. Author of *New York Chancery Reports* from Apr., 1843, to June, 1847 (4 vols., 1846–50), and *New York Superior Court Reports* (5 vols., 1849–52).

Sand'gate, p.-v. and tp., Bennington co., Vt. P. 705.

Sand-Grouse, a name given to the species of the family PTEROCLIDIDÆ (which see).

Sand Hill, p.-v. and tp., Scotland co., Mo. P. 784.

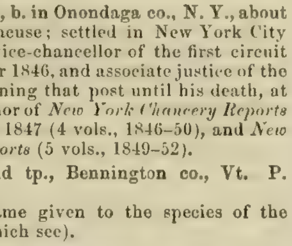
Sand Hill, tp., Lenoir co., N. C. P. 400.

Sand Hill, tp., Moore co., N. C. P. 268.

Sand Hill, tp., Marshall co., West Va. P. 951.

Sandhill Crane (*Grus Canadensis*), a rather large bird, characterized by the plumbeous plumage of the adult; the development on the head of a warty space on a line with and above the eyes, which is bifurcated behind by the extension forward in an angle of occipital feathers; the bill longer than the middle toe; and the color of the primaries, which are brown with white shafts; the length is about forty-eight inches; the tarsi nearly ten. The species is quite common, and found to a greater or less extent throughout all of the Mississippi Valley and western portions of the U. S., as well as Florida. THEODORE GILL.

Sand'hopper, or **Beach Flea,** names given in the U. S. to *Talitrus quadrifidus* and *Orchestia longicornis*, and in Great Britain to *T. locusta* and *saltator*, small amphipod crustaceans found under sea-weeds and stones at low tide. They have marvellous powers of leaping, and of burrowing in wet sand. Another European sandhopper is *Orchestia littorea*.



The Sandhopper, magnified.

Sand'hurst, town of Australia, colony of Victoria, 82 miles N. W. of Melbourne, is the centre of a rich gold-mining district, and has about 25,000 inhabitants.

Sandhurst, Berks co., England, the seat of the royal military college of that name, which comprises both a staff school and a junior department for educating pupils (received between the ages of thirteen and fifteen) for the infantry and cavalry. P. 3211.

Sandhurst (Right Hon. WILLIAM ROSE MANSFIELD), BARON, b. in 1819; educated at the Royal Military College, and entered into the army as ensign in 1835; served with the 53d regiment in the Sutlej campaign of 1846 as captain; major in 1847, and in command of the regiment in the Punjaub campaign 1849; lieutenant-colonel in 1851, and engaged in operations on the Pewasher frontier 1851–52; attached to the British embassy at Constantinople with the rank of brigadier-general, and as such proceeded to the Crimea; consul-general at Warsaw at the close of the war, but on the outbreak of the mutiny in India was nominated chief of staff, with the local rank of major-general, participating in all the operations of that campaign, and wounded at the battle of Cawnpore; received the thanks of Parliament; in 1863 sent to India as commander-in-chief; lieutenant-general in 1864; transferred to Ireland as commander-in-chief in 1870; created a peer in 1871 with the title of Lord Sandhurst. The order of knight of the Star of India was bestowed upon him in 1866; in 1862 obtained the coloneley of the 38th regiment. D. June 23, 1876.

San Die'go, county of S. California, bounded E. by Arizona, from which it is separated by Colorado River, S. by Lower California, and W. by Pacific Ocean, traversed from N. W. to S. E. by two branches of the Coast Range, which separate into three sections, differing widely in general features. The E. section is a part of the Colorado desert, some of which is below the level of the sea, is without vegetation, extremely hot, and has a lake of boiling mud half a mile long. The central or mountainous section has a delightful climate, mines of gold and silver, good farming-lands in the valleys, where the vine, the orange, and wheat grow to perfection, and forests of valuable timber. The western section, sloping with gentle undulations from the Coast Range down to the ocean, is well watered, has a semi-tropical climate, with good farming lands, and is well adapted to pasturage. The county will soon be traversed by Southern Pacific and Texas Pacific R. Rs., having a common terminus at San Diego. Cattle and sheep are numerous. Staples, wheat, barley, hay, and wool. Cap. San Diego. Area, 13,500 sq. m. P. 4951.

San Diego, city, seaport, and port of entry of S. California: lat. 32° 41′ N., lon. 117° 13′ W.; 480 miles S. E. of San Francisco. The harbor is fully described in the *Pacific Coast Pilot* of the U. S. Coast Survey, which says: "Next to that of San Francisco, no harbor on the Pacific coast of the U. S. approximates in excellence the Bay of San Diego." It was discovered by Cabrillo Sept., 1542. The first settlement was made in May, 1769, by Father Junipero Serra, who then established the mission of San Diego, the earliest of the California missions. The growth of the present city dates from 1867, when the new town was begun on the water-front of the bay. Present pop. 4500, of county (assessor's census), 13,500; total pop. of county in 1867, 2100, in 1870 (U. S. census), 4951; net gain 1875 (*Chamber of Commerce Report*), 2513. There are 4 wharves, 3 warehouses, custom-house, fine county buildings and grounds, city hall, public hall, 5 churches, 2 academies, 5 public-school buildings, county hospital, lodges of all the secret orders, public reading-room, 2 banks, chamber of commerce, benevolent association, etc.; waterworks, public park reservation of 1400 acres; iron-foundry and machine-works, tannery, steam flouring-mills, several steam planing-mills, large saltworks, several carriage and wagon factories, and many other minor industries. There are 2 daily newspapers: *The Union*, daily and weekly, was established in 1868. By act of Congress, San Diego is made the Pacific terminus of the Transcontinental R. R. on the 32d parallel, or Southern Pacific R. R. The principal products of the county are wheat, wool, honey, cattle and horses, sheep and hogs. There are gold-mines 50 miles N. of the city, where five or six quartz-mills are employed. Fruit-raising is becoming an important, and will soon be a leading, industry: it has only been begun since 1869, when there were (assessor's returns) less than 600 fruit trees of all kinds in the county: there are now 160,000, the orange, lemon, almond, and olive being largely cultivated. San Diego is the principal honey-producing county in California: the yield in 1875 was 550,000 pounds, the estimated yield in 1876 exceeds 1,250,000 pounds. A railroad is at present (1876) projected to run directly northward to the town of San Bernardino, 100 miles, to connect with a road building southward from Salt Lake, which connection will give the Union Pacific R. R. a Pacific outlet at San Diego. With the completion of this and the Southern Pacific road, San Diego will become the second city in commercial importance on the Pacific coast of the

U. S. The climate of San Diego is shown, by the recorded observations of the U. S. Signal Service station established here, to be the mildest and most equable of which any knowledge exists. The city is a popular resort for invalids from all parts of the U. S.

DOUGLAS GUNN, ED. "THE UNION."

San'disfield, p.-v. and tp., Berkshire co., Mass., on Farmington River, has some manufactures, and is noted for its maple sugar. P. 1482.

Sand Lake, p.-v., Kent co., Mich., on Grand Rapids and Ionia R. R., 25 miles N. of Grand Rapids, has good schools, 1 newspaper, a foundry, a stave factory, 3 hotels, and 1 planing, 4 lumber, and 4 shingle mills. Principal business, lumbering. J. L. TAYLOR, ED. "SENTINEL."

Sand Lake, p.-v. and tp., Rensselaer co., N. Y. P. of v. 604; of tp. 2633.

Sand-Lance. See SAND-EEL.

Sand Lick, tp., Buchanan co., Va. P. 1580.

San Domingo. See SANTO DOMINGO.

San Do'na, town of Italy, province of Venice, on the left bank of the Piave, about 30 miles N. E. of the city of Venice, occupying a site near that of the ancient *Altinum*. P. 7829.

San'doval, p.-v. and tp., Marion co., Ill. P. 958.

Sandoval, de (PRUDENCIO), b. in Spain about 1560; became a Benedictine monk at Naxera, where he devoted himself to the study of the civil and ecclesiastical antiquities of Spain; was made an abbot at Valladolid and historiographer to Philip III., and published in that capacity several works, the most important being *Historia de la Vida y Hechos del Emperador Carlos V.* (1604), and *Historia de los Reyes de Castilla y de Leon* (1615). The former work is a leading authority for the period of which it treats, and appeared in English in two abridged translations—*The Civil Wars of Spain* (1652), by James Wadsworth, and *History of Charles V.* (1703), by Capt. John Stevens. Sandoval became bishop of Tuy 1608, and of Pamplona 1612. D. at Pamplona Mar. 17, 1621.

San'down, p.-v. and tp., Rockingham co., N. H., on Nashua and Rochester R. R. P. 496.

Sand'-paper, paper one side of which is covered with wet glue, upon which sharp sand or powdered glass is evenly sifted.

Sand'piper, a name given to many species of snipe-like birds belonging to the family Scolopacidæ. They have little in common, except as members of the same family, but a short and straight bill and a comparatively small size. They associate together in flocks, especially on the beaches of the ocean and lakes. The name is applied in the U. S., according to Baird and Coues, to the following species: *Micropalama himantopus*, the stilt sandpiper; *Ereunetes pusillus*, the semi-palmated sandpiper; *Tringa minutilla*, the least sandpiper; *Tringa Bairdii*, Baird's sandpiper; *Tringa maculata*, pectoral sandpiper; *Tringa fuscicollis*, the white-rumped sandpiper; *Tringa maritima*, the purple sandpiper; *Tringa alpina*, the black-bellied or red-breasted sandpiper; *Tringa canutus*, the red-breasted sandpiper; *Tringoides macularius*, the spotted sandpiper; *Actiturus Bartramius*, the Bartramian sandpiper; *Tringites rufescens*, buff-breasted sandpiper. Allied species are, however, known by other names, and therefore the word *sandpiper* is not strictly synonymous with any scientific designation. THEODORE GILL.

Sand Point, v., McNab tp., Renfrew co., Ont., Canada, on the river Ottawa and on Brockville and Ottawa Railway, 45 miles above Ottawa. It is an important shipping-point.

Sand Prai'rie, tp., Tazewell co., Ill. P. 1046.

Sands (BENJAMIN FRANKLIN), U. S. N., b. Feb. 11, 1812, in Maryland; entered the navy as a midshipman Apr. 1, 1828; became a lieutenant in 1840, a commander in 1855, a captain in 1862, a commodore in 1866, a rear-admiral in 1871; retired in 1874; served on the W. coast of Mexico during our war with that country, and commanded the Fort Jackson in both the Fort Fisher fights; recommended for promotion by Rear-Admiral Porter in his official despatch of Jan. 28, 1865. F. A. PARKER.

Sands (ROBERT CHARLES), b. at Flatbush, L. I., May 11, 1799; graduated at Columbia College 1815; studied law in the office of David B. Ogden, and was admitted to the bar 1820, but devoted himself chiefly to literature; wrote many essays and poems while at college and while studying law, some of them being in literary partnership with James Wallis Eastburn (d. 1819), especially the poem *Yamoyden* (1820); wrote for the *Literary Review* 1822–23 and the *St. Tammany Magazine* 1823–24; edited the *Atlantic Magazine* 1824, and with W. C. Bryant the *New York Review* 1825–27; was assistant editor of the *Commercial Advertiser* 1827–32, and wrote with Bryant and Verplanck the *Talisman* annual (3 vols., 1827–30). D. at Hoboken, N. J., Dec. 17, 1832. His collected *Works* were edited, with a *Memoir*, by G. C. Verplanck (2 vols., 1834).

Sand Spring, p.-v., South Fork tp., Delaware co., Ia., on Dubuque South-western R. R.

Sand Springs, tp., Limestone co., Ala. P. 588.

Sand Star, a name sometimes given to species of star-fishes, of the orders Asterioidea and Ophiurioidea.

Sandstone. See GEOLOGY, by PROF. J. W. DAWSON; and STONE, BUILDING, by PROF. J. S. NEWBERRY.

Sand'stone, p.-v. and tp., Jackson co., Mich. P. 1598.

Sand'tuck, p.-v. and tp., Elmore co., Ala. P. 1421.

Sandus'ky, county of N. Ohio, on Sandusky Bay in Lake Erie, intersected by Sandusky and Portage rivers, and traversed by several railroads, has a low surface, partly marsh and reclaimed swamp-lands, which are highly productive. Staples, wheat, Indian corn, oats, hay, apples, cheese, and wool. Sheep and swine are numerous. Cap. Fremont. Area, 425 sq. m. P. 25,503.

Sandusky, tp., Crawford co., O. P. 665.

Sandusky, city and port on Lake Erie, cap. of Erie co., O., at the mouth of Sandusky River, on a bay 15 miles long and 4 wide, one of the best harbors on the lake. It is the Lake Erie terminus of Baltimore and Ohio and Cincinnati Sandusky and Cleveland R. Rs., and is on the northern division of Lake Shore and Michigan Southern R. R., 61 miles W. of Cleveland. Lines of steamers run to Detroit, Toledo, Cleveland, and the islands of Lake Erie. It has 30 churches, the best of public-school buildings, its high-school building being the most costly in the State. It is the largest fresh-fish market in the world. Its trade is fish, lumber, limestone, manufactured woodwork, grapes, and native wine, steelworks, engine and boiler and threshing-machine works. It is now completing waterworks. It is out of debt save waterworks bonds. It has a paid fire department, 3 national banks, and 1 private banker. Its receipts from the country are largely wool and grain. Its coal-business is large over Baltimore and Ohio R. R., and thence by lake to Detroit and the N. Its receipts by water are chiefly iron ore, lumber, and fish. It has 3 newspapers. Its chief manufacturers are the Sandusky Wheel Company, Woolworth's Handle-Factory, the Sandusky Coal Company, the Converse Machine-works, Klotz & Kramer Engine-works, the Nes Silicon Steelworks. Its fisheries employ over 1000 hands; its grape-and-wine business still more. P. in 1870, 13,000; in 1876, 18,000.

I. F. AND J. T. MACK, EDS. "REGISTER."

Sandusky, tp., Richland co., O. P. 682.

Sandusky, tp., Sandusky co., O. P. 1570.

Sand-Wasp. See HYMENOPTERA and SPHEGIDÆ.

Sand'wich, municipal borough of Kent, England, on the coast of the North Sea, at the mouth of the Stour, 4 miles N. of Deal, on the South-eastern Railway, is one of the Cinque Ports, is surrounded by ancient fortifications, is irregularly built, but has several notable mediæval edifices, and was once the principal seaport of London. Near at hand the walls of the Roman city of *Rhutupium* (or Richborough) are still standing. The principal imports are coals; and exports, agricultural products. It forms with Deal a parliamentary borough. P. 3096.

Sandwich, county-seat of Essex co., Ont., Canada, on Detroit River, nearly opposite Detroit, has 2 weekly newspapers, a convent and Roman Catholic college, and mineral springs which make it a favorite place of resort. P. 1160.

Sandwich, city of De Kalb co., Ill., on Chicago Burlington and Quincy R. R., 58 miles S. W. of Chicago, contains 7 churches, 2 graded schools, 1 bank, and 2 weekly newspapers. Incorporated as a city in 1873. P. 1844.

H. F. BLOODGOOD, ED. "FREE PRESS."

Sandwich, p.-v., Barnstable co., Mass., on Old Colony R. R., 60 miles S. of Boston, contains 1 library, 10 churches, excellent schools, 1 bank, 1 newspaper, a foundry at North Sandwich, 5 hotels, a jewelry-box factory, marble-works, a railroad-car manufactory at West Sandwich, and another at Pocasset. There are Masonic and Good Templar Lodges. It is a famous summer resort for tourists. P. 3694. J. H. STEVENS, ED. "SEASIDE PRESS."

Sandwich, p.-v. and tp., Carroll co., N. H., on Squam Lake. P. 1854.

Sandwich Islands, the name given by Capt. Cook, after Lord Sandwich (fourth earl), to the group whose proper name is HAWAIIAN ISLANDS (which see).

Sandy, tp., Winston co., Ala. P. 302.

Sandy, tp., Stark co., O. P. 1116.

Sandy, tp., Tuscarawas co., O. P. 1163.

Sandy Creek, p.-v. and tp., Oswego co., N. Y., on Rome Watertown and Ogdensburg R. R., 44 miles N. of

Syracuse, has 4 churches, 2 excellent schools, 1 newspaper, 2 banks, 2 tanneries, 2 foundries, 3 grist, 2 planing, and 5 saw mills, 4 hotels, and a machine-shop. P. of v. 986; of tp. 2629. H. SOULE & SON, EDS. "NEWS."

Sandy Creek, tp., Franklin co., N. C. P. 1453.

Sandy Creek, tp., Warren co., N. C. P. 2753.

Sandy Creek, tp., Mercer co., Pa. P. 734.

Sandy Creek, tp., Venango co., Pa. P. 1391.

Sandy Grove, tp., Clarendon co., S. C. P. 317.

Sandy Hill, p.-v. and tp., Worcester co., Md., on Chincoteague Sound. P. of v. 146; of tp. 2176.

Sandy Hill, p.-v., one of the caps. of Washington co., N. Y., on Glens Falls br. of Renss. and Saratoga R. R., has 7 churches, a fine union school, 4 paper-mills, 1 bank, a court-house, 1 newspaper, several furnaces and machine-shops, stone-quarries, and 6 saw-mills. Lumbering is extensively carried on. P. 2347.
JOHN DWYER, ED. "HERALD."

Sandy Hook, p.-v., cap. of Elliott co., Ky.

Sandy Hook, tp., Washington co., Md., on Potomac River, opposite Harper's Ferry, and on Baltimore and Ohio R. R. P. 1316.

Sandy Hook, a low sandy peninsula somewhat famous in connection with the lower bay and entrance to New York harbor, as all Transatlantic navigation to or from New York passes near its northern extremity. The great beacons by which approaching vessels make the entrance—the Navesink lights—stand on highlands of that name at the very origin of Sandy Hook, whence, continuing the sandy beach-line, it projects northward 5 miles, with a width varying from a few hundred feet to ¾ of a mile. A growth of cedars covers the wider areas of the Hook. At its northern extremity is a large bastioned fort (commenced 1858) in an unfinished condition. The Sandy Hook light (lat. 40° 27′ 40″, lon. 74° W.) is ⅔ of a mile S. from the northern end, at which very extreme there is a beacon-light. New Jersey Southern R. R., to Long Branch, Camden, etc., has its terminus on the bay side of Sandy Hook, about midway of its length.

Sandy Lake, p.-b. and tp., Mercer co., Pa., on Franklin division of Lake Shore and Michigan Southern R. R. P. of v. 428; of tp. 1028.

Sandy Marsh, p.-v. and tp., Buncombe co., N. C. P. 894.

Sandy Mush, tp., Madison co., N. C. P. 458.

Sandy Ridge, tp., Lowndes co., Ala. P. 2180.

Sandy Ridge, tp., Union co., N. C. P. 1690.

Sandy River, tp., McDowell co., West Va. P. 848.

Sandy River Plantation, tp., Franklin co., Me. P. 111.

Sandy Run, tp., Cleveland co., N. C. P. 1191.

Sandy Run, tp. Lexington co., S. C. P. 643.

Sandys (EDWIN), D. D., b. at Hawkshead, Lancashire, England, in 1519; graduated from St. John's College, Cambridge, 1539; took orders in the Church of England; embraced the principles of the Reformation; became vicar of Haversham and master of St. Catharine's College 1547, prebendary of Peterboro' 1549 and of Carlisle 1552; vice-chancellor of Cambridge University 1553; preached a sermon in favor of the royal claims of Lady Jane Grey; was consequently deprived of the vice-chancellorship in July of the same year; was imprisoned in the Tower and the Marshalsea for refusing to proclaim Queen Mary; was liberated and allowed to proceed to the Continent May, 1554; returned at the coronation of Elizabeth 1558; was made bishop of Worcester Dec. 21, 1559, and of London 1570, and archbishop of York 1576; was one of the translators of the "Bishops' Bible" 1565, and came near being the victim of a malicious plot to charge him with infamous conduct 1582, but its author, Sir Robert Stapleton, was detected and punished. D. at the archiepiscopal palace of Southwell July 10, 1588. A volume of his *Sermons* was published 1585, was repeatedly reprinted, and was edited for the Parker Society, with a *Biography*, by Rev. John Ayre (1841).

Sandys (Sir EDWIN), son of Archbishop Sandys, b. at Worcester, England, about 1561; studied at Christ Church, Oxford, under Richard Hooker; obtained a fellowship 1579, and a prebend in York minster 1581, though never ordained; travelled extensively over Europe; was a supporter of the dynastic claims of King James I., by whom he was knighted 1603 and employed in several important commissions; was associated with Bacon in drawing up the "Remonstrance" of 1604; was a leading member of the second Virginia Company, of which he became treasurer 1619; was instrumental in securing a charter for the Pilgrims of the Mayflower and in planting representative government in the colony of Virginia, thereby becoming obnoxious to the "Spanish party" at court, and was imprisoned, along with Selden, 1621, for having opposed the royal projects in Parliament. D. at Northborne, Kent, in Oct., 1629. He founded a lectureship on metaphysics at Oxford, and wrote at Paris, in 1599, *Europæ Speculum, or a View on Survey of the State of Religion in the Western Part of the World*, which was surreptitiously printed 1605, translated into French and Italian, and passed through many editions. A volume of *Sacred Hymns* (1615), containing translations of 50 select Psalms, is attributed to him.

Sandys (GEORGE), son of Archbishop Edwin, b. at the palace of Bishopsthorpe, York, in 1577; educated at St. Mary's Hall and Corpus Christi College, Oxford; travelled through various parts of the Turkish empire, including Greece, Asia Minor, Palestine, and Egypt, 1610-12; published a *Relation* of his journey (1615), with illustrations, often reprinted, and considered of great value by Orientalists; went to Virginia as colonial treasurer 1621; completed at Jamestown a translation of Ovid's *Metamorphoses* (1626), of which the first five books had previously appeared; built the first water-mill, the first ironworks, and the first ship in Virginia; returned to England 1624; printed poetical paraphrases of the Psalms (1636), Job, Ecclesiastes, Lamentations, etc. (1638), and the Song of Solomon (1641), some of the pieces being adapted to music by Henry and William Lawes; and translated from the Latin of Grotius the tragedy of *Christ's Passion* (1640); was for some years gentleman of the privy chamber to the king, and passed his later years at Bexley Abbey, Kent, where he d. in Mar., 1644. A *Life* was published by Rev. H. J. Todd, prefixed to a *Selection from Sandys's Metrical Paraphrases* (1839), and a complete edition of his poetical works, with introduction and notes, was given to the world in 1872 by Rev. R. Hooper.

Sandy Spring, p.-v., Montgomery co., Md.

San'dyston, tp., Sussex co., N. J., between the Blue Ridge and Delaware River. P. 1230.

San'dyville, p.-v., Sandy tp., Tuscarawas co., O., on Tuscarawas River and Tuscarawas branch of Cleveland and Pittsburg R. R. P. 227.

San'dywoods, tp., Scott co., Mo. P. 777.

Sanel, p.-v., Mendocino co., Cal. P. 371.

San Elizario, p.-v., El Paso co., Tex., on the Rio Grande. P. 1120.

San Fe'le, town of Southern Italy, province of Potenza, about 3 miles from Melfi, in a hilly but not unproductive country. In its ancient castle, still standing, Henry of Sicily was strangled by order of Conrad. This town was much injured by the earthquake of 1851. P. of commune, 10,536.

San Feli'ce [anc. *Circeii* or *Circæum*], town of Italy, province of Velletri, standing on a promontory near the sea, about 12 miles W. of Terracina. The modern town occupies a higher position than did the ancient *Circæum*, and the views from it are very beautiful. It is, however, chiefly interesting for the very choice antiquities found in its immediate vicinity—rare marbles, mosaics, coins, inscriptions, etc.—from the luxurious Roman palaces which once stood here.

San Felice à Cancello, town of Southern Italy, province of Caserta, in a fertile region, and considerably frequented for its mineral waters. P. 7375.

San Felice sul Panaro, town of Italy, province of Modena, about 9 miles from Mirandola. It is a walled town, and its remarkable tower, dating from the tenth century, sustained desperate sieges during the fourteenth century. The town was generally in the possession of the house of Este throughout the period of its greatness. P. of commune, 9034.

San Felieu de Guixols, town of Spain, province of Gerona, has a good harbor and 6515 inhabitants.

San Feli'pe, town of Venezuela, South America, was founded in the middle of the last century by emigrants from the Canary Islands, who are extensively engaged in the cultivation of coffee, sugar, cacao, and indigo. P. 7000.

San Felipe, p.-v., Austin co., Tex., on Brazos River. P. 238.

San Felipe, tp., Kinney co., Tex. P. 161.

San Feli'pe de Aconca'gua, town of Chili, in an elevated valley watered by the river Aconcagua and well cultivated. It has copper-mines in its vicinity, but lacks good drinking-water. P. 12,000.

San Feli'pe de Ja'tiva, town of Spain, province of Valentia, at the confluence of the Albayda and Guadamar, contains many Roman and Moorish remains, is regularly

built, and has extensive quarries of rock-salt in the vicinity. It is the birthplace of Ribera. P. 15,631.

San Fernan'do, city of Spain, on the Isla de Leon, 7 miles S. E. of Cadiz, is connected with the mainland by a substantial Roman bridge. It has manufactures of salt extracted from vast marshes along the shores, soap, leather, and liquors. P. 18,000.

San Fernan'do de Apu're, town of Venezuela, South America, on the Apure, is finely situated, but has suffered severely several times from conflagrations. The climate is extremely hot, but not unhealthy. P. about 6000.

San Filip'po d'Argi'ro, town of Sicily, province of Catania, near the Salso, is the birthplace of Diodorus Siculus, and has large marble quarries in its vicinity. P. 11,204.

San'ford, county of N. W. Alabama, bordering on Mississippi, watered by affluents of Tombigbee River, has a rolling surface and a fertile soil. Staples, Indian corn, cotton, sweet potatoes, and butter. Cap. Vernon. Area, 600 sq. m. P. 8893. Name of co. since changed to LAMAR.

Sanford, p. v., Orange co., Fla., on St. John's River, at the head of large steamer navigation, 200 miles S. of Jacksonville, has 3 churches, a good school, a money-order post office, and 1 newspaper. P. about 400.

FRED. L. ROBERTSON, ED. "SOUTH FLORIDA JOURNAL."

Sanford, p.-v. and tp., York co., Me., on Portland and Rochester R. R. P. 2397.

Sanford, p. v. and tp., Broome co., N. Y., on Delaware River and Erie R. R., includes v. of Deposit. P. 3249.

Sanford, p.-v., Moore co., N. C.

Sanford (EDWARD), son of Chancellor Nathan, b. in New York City in 1805; graduated at Union College 1824; studied law; was editor of a newspaper in Brooklyn, afterward of the New York *Standard*, of the *Times* (1836–37), and associate editor of the Washington *Globe*, organ of the Van Buren administration; returned to New York 1838; became assistant naval officer at that port; was elected in 1843 to the New York senate, in which he exercised great influence as a Democratic leader, and was a frequent contributor of poems and essays to the New York *Mirror*, *Spirit of the Times*, and *Knickerbocker Magazine*. Specimens of his graceful and humorous verse may be found in the collections of Hoffman, Griswold, Duyckinck, and Bryant.

Sanford (NATHAN), b. at Bridgehampton, Long Island, N. Y., Nov. 5, 1779; studied law, and began practice in New York City 1799; was appointed by Jefferson U. S. district attorney for New York 1803, a position which he held twelve years; was elected to the New York assembly 1811; became Speaker of that body, and afterward State senator; was a member of the State constitutional convention 1821; served two terms in the U. S. Senate (1815-21 and 1825–31), and was the successor of Kent in the chancellorship of New York, holding that office from 1823 to 1825, when he resigned on account of ill-health. D. at Flushing, N. Y., Oct. 17, 1838.

San Francis'co, county of W. California, consists exclusively of the city of SAN FRANCISCO (which see).

San Francisco, the chief city of North America on the western coast, and cap. of San Francisco co., Cal., in lat. 37° 48' 26.6" N. and lon. 122° 24' 39.6" W., on the end of a peninsula there 6 miles wide and 20 miles long, separating the S. arm of the bay of the same name from the Pacific Ocean. In law it is designated as "the city and county of San Francisco," the functions of city and county government, usually separated elsewhere in the U. S., being consolidated. Its area is 42 sq. m., including, besides the entire end of the peninsula across to the ocean, Goat Island, with 141 acres, 2 miles E. of the peninsula; Alcatraz Island, with 30 acres, 1 mile N. of the peninsula; and the Farallones, six rocky islets 24 miles off shore in the ocean. Nearly half the area is a high rocky hill, rising in several points to 800 feet above the sea, and about 4 sq. m. in the N. W. are sand-dunes. The site now shows a large area of level land, but much of this has been supplied by art, the original inequalities of the surface having been graded away. Not less than 300 acres of the bay have been filled in, and the total expense of grading has been $30,000,000 or more. The business part of the city covers a district about a mile square in the N. E. corner of the peninsula, and the residences extend several miles farther to the W. and S. The harbor is part of a bay 50 miles long and 5 miles wide, has an entrance 35 feet deep at low tide and 1 mile wide, and on the anchorage along the city front there is abundant room, with excellent holding ground and a depth of 40 feet, which increases to 100 feet in the narrowest part of the Golden Gate, as the outlet of the bay is styled. The conformation of the country W. of the Rocky Mountains is favorable to the maintenance of a great city on the Bay of San Francisco, the converging point of the most convenient channels of trade in the interior of the continent, possessing the only large, deep harbor easy of entrance between Mazatlan and the Strait of Fuca, a distance of 2000 miles, with a rich country in the vicinity and navigable streams and good routes leading inland. The coast is peculiarly poor in good harbors, and this poverty contributes to give San Francisco its great relative pre-eminence, monopolizing, with trifling exceptions, the exports and imports on a coast as long as that from Florida to Maine, and having one-fourth of the entire population of the western slope of the U. S., while New York has not one-twentieth on the Atlantic side.

The city is supplied with water from Pilarcitos Valley, 20 miles to the S., where the rain-water is caught in a large reservoir, and artesian water is found at depths varying from 120 to 160 feet, though from many wells the water must be raised by pumping. Some hotels and mills are supplied in this way. The climate, a description of which may be found in the article on CALIFORNIA, is salubrious, the city being protected by the almost unbroken coolness of its temperature and the strength of its breezes, blowing fresh from the ocean every day through the Golden Gate, against many of the influences that elsewhere foster disease. The yearly number of deaths for each 1000 inhabitants is 20, a proportion exceeded in all other seaport cities of equal size. The heavy fogs in summer are pernicious to asthmatics, and consumptives find better climates in other parts of the State. In the year ending June 30, 1875, there were 210 coroners' inquests, including 68 accidental deaths, 58 suicides, and 29 murders.

Wealth, etc.—The assessed value of the land within the city limits is $126,000,000, of the buildings $42,000,000, and of the personal property $68,000,000, but the real total value of the city property—though the assessor's report, excluding mortgages, shows only $236,000,000—is not less than $400,000,000; and the residents and business-men of the city own $200,000,000 elsewhere; so that the wealth of San Francisco may be set down at $600,000,000. There are 21 commercial banks, with $40,000,000 banking capital and deposits, and there are 11 savings banks, with 71,000 depositors and $60,000,000 deposits. The dividends paid in 1875 by companies incorporated in the city amounted to $26,000,000, including $15,500,000 by mining companies, $6,000,000 by banks, $2,100,000 by Central Pacific R. R. Co., $1,500,000 by the gas and water companies, $900,000 by miscellaneous companies. More than two-thirds of these dividends are derived from property situated outside of the city; and the companies which paid the $26,000,000 dividends do not own one-twentieth part of the property in the city. The sales of city real estate amounted to $35,000,000, and of mining stocks in the stock boards to $260,000,000 in 1875. The speculation in mining stocks is a prominent and peculiar feature in the business of San Francisco. When the silver-lodes in Nevada were discovered the capitalists of San Francisco were required to supply money to open the mines and to build mills, and having incorporated the companies and kept among themselves the books in which the ownership of the shares is registered, they thus anchored the chief market for the sale of the stock. Though the aggregate of the transactions is far less than in the stock boards of New York, London, Paris, or Berlin, yet the fluctuations are more rapid and greater in percentage, and the influence is more keenly felt in general business. It was a wonderful piece of good luck for a comparatively small city to get complete control of such wealth as the Comstock Mines, but their ownership has two sides to it; for while one set of mines had paid out $70,000,000 in dividends, another set had collected $40,000,000 in assessments before the end of 1875. Three companies had collected each more than $2,000,000 in assessments; five others, each more than $1,500,000; three others, each $1,000,000 or more; and ten others, each more than $500,000; and most of these assessments were levied to work mines that never paid a dividend, and never succeeded even in finding any considerable body of ore; while many of the most productive mines had to spend large sums before the rich deposits were reached. The annual tax paid in the city for State and municipal purposes is $5,500,000, in addition to $9,400,000 for Federal purposes ($8,000,000 as duties on foreign imports, and $1,400,000 as internal revenue), making a total of $14,900,000 paid as taxes in San Francisco in one year. The funded debt, after deducting money in the sinking funds, is about $3,500,000 in gold, and the rate of interest is 6 or 7 per cent.

Commerce, etc.—Business is wonderfully active. Most of the people, having come to California ,as adventurers, are energetic; wages, rents, rates of interest, and the value of land are high; and the statistics show that in proportion

to the tributary population no city on the shore of the Atlantic has commercial or financial transactions so extensive. Land is sold by the foot of frontage on the street, the depth being usually from 70 to 130 feet, and the price without buildings on the most thronged portion of California street is $4000 a foot, while on parts of Montgomery, Market, and Kearny streets it is half as much or more. The imports direct from foreign countries (considerable quantities of imported merchandise are brought by rail, steamer, and sail from New York) were in 1875 worth $33,000,000, including 6000 tons of coffee, 9500 tons of tea (of this 6500 tons were sent by rail to New York), 25,000 tons of sugar, 540,000 tons of coal, and $5,200,000 of treasure. The total receipts of treasure from domestic and foreign sources were $48,600,000; the exports of treasure were $42,900,000, and of merchandise $31,000,000, making a total of $73,000,000 of exports. The leading articles of merchandise exports were wheat, flour, canned and salted salmon, quicksilver, wool, hides, leather, lumber, silver ore, and borax. The commercial statistics of CALIFORNIA, as given under that heading, belong almost exclusively to San Francisco. The lumber received in 1875 was 300,000,000 feet, board measure. The number of passengers who arrived by sea was 32,200, and by rail from the Eastern States 74,900; of those departed by sea, 12,600, and by rail 30,400, leaving a net gain to the population of the Pacific States and Territories of 64,000. The sea-going vessels that arrived in San Francisco numbered 4350, measuring 1,590,000 tons, including 3626, measuring 858,000 tons, from domestic Pacific ports, leaving 624, of 732,000 tons, from foreign and domestic Atlantic ports. Forty-three ocean steamers run from San Francisco, including 8 to China, 6 to Panama, 3 to Australia, 17 to domestic ports on the southern coast, and 9 to domestic ports on the northern coast; and 30 steamboats built for inland navigation run to points on the bays and rivers tributary to the Golden Gate. By reason of the deep strait on the N. and the bay on the E., the only railroad entering the city comes from the S.; but Oakland, Vallejo, Donahue, San Quentin, and Saucelito, where the other roads of the State terminate, send a steamboat after the arrival of every regular passenger-train to San Francisco, which is thus made practically the main terminus of the entire railroad system of California, traversing all its main valleys, reaching to the end of the Sacramento Valley in the N., to the Colorado desert in the S., and connecting in the E. with the network of the Atlantic States. In 1875 there were 553 manufacturing establishments, employing 18,000 men, and producing articles worth $40,000,000 a year. In making cigars 4000 persons were employed; in boots, shoes, and slippers, 2300; in iron foundries, 1240; in bedstead and furniture factories, 1200; in pickling establishments, 950; in woollen mills, 900; in shirtmaking, 750; and in sash and door factories, 500. Among the articles manufactured are billiard-tables, boxes, brooms, brushes, candles, carriages, cordage, flour, glass, furs, gloves, belting, fire hose, jewelry, shot, lead pipes, lasts, macaroni, matches, dynamite, rolled iron, saws, silk thread, silk ribbons, shirts, soap, leather, type, windmills, and willow-ware.

Architecture, etc.—Among the notable features in the appearance of San Francisco are the large proportion of wooden houses, the elegance of their external ornamentation, the abundance of bay windows, the extensive use of asphaltum for sidewalks, the number and magnificence of the hotels, and the lack of shade trees. Of the 25,000 houses, 20,000 are built of wood, which is preferred because it is less liable to injury by earthquakes, it does not soak up moisture as readily as does brick (the only other common building material), and it is cheaper. Many of the wooden houses are three, four, five, and some even six stories high. The wood renders ornamentation cheap, and is usually painted on the outside with a light color. The bay windows are liked, and shade trees disliked, because the average temperature, even in midsummer, is too cool for comfort in idleness, and the people want to catch all the sunshine within reach. The general condition of the roadways in the streets is bad. Cubical blocks of trap and granite and cobble-stones are used for paving, and many of the streets where the land is cheap are covered with fir planks 4 inches thick; most of the sidewalks are made with planks 2 inches thick. The Palace Hotel, reputed to be the largest and most commodious building of the kind in the world, is 350 by 275 feet on the ground and 7 stories high, with accommodations for 1200 guests. The site cost $1,000,000; the building, $1,750,000; the furniture, $500,000; making a total investment of $3,250,000. The Baldwin Hotel, erected at a cost of more than $1,000,000, has a front of 186 feet on Market and 275 on Powell street, a height of 6 stories, and 480 rooms, with accommodations for 600 guests. The Palace was finished in 1875 and the Baldwin in 1876, and before their erection the hotels of San Francisco were considered unsurpassed in excellence. The Occidental and Cosmopolitan hotels can each accommodate 400 guests, the Lick House 350, and the Grand Hotel 300, so that there are now accommodations for 3250 guests in first-class hotels in San Francisco. There are 5 theatres used for dramatic representations of high character. Wade's Opera house has seats for 2500 persons, the California Theatre for 1800, Baldwin's Opera house for 1700, Maguire's Theatre for 1600, and Maguire's Opera-house for 1200, or 8800 seats in all, exclusive of concert-halls, lecture-rooms, Chinese theatres, and places of low grade. Among the notable public buildings are the Mint, Custom-house, and Appraisers' Store; an unfinished city hall, that is to cost when complete $4,000,000 or more; the Merchants' Exchange; the banks of California and Nevada; the Pioneer Hall; the Mercantile Library House; the Safe Deposit Building, which has 4600 safes or steel boxes let out to the general public; the Federal Marine Hospital; the City Hospital, with room for 384 patients; the Almshouse, with capacity to accommodate 500 persons; the Industrial School; the House of Correction; and hotels, theatres, churches, and many magnificent private buildings used for business and residence. There is a stone dry dock capable of receiving a vessel of 6000 tons. Formidable fortifications defend the entrance of the harbor. A public park of 1050 acres, 3 miles long and half a mile wide, offers a beautiful drive to the ocean-beach, where a strong surf rolls perpetually, and from its more elevated points the park commands extensive views of the ocean, bay, Golden Gate, and city, and mountain ranges and peaks to the N., E., and S. There are besides 11 public squares, and a pleasure-garden open to the public, with a rich variety of botanical, zoological, and artistic attractions. The accumulation of wealth, the activity of business, the excitement of speculation in the stock-market, the excellence of the hotels, the elegance of the private dwellings, the luxurious mode of living, the variety, the multitude, and the merit of the institutions of amusement and instruction, and the throng of visitors from all parts of the world, have made San Francisco a favorite pleasure resort; and there most of the Americans who make fortunes in the interior W. of the Rocky Mountains hope to enjoy their money.

Education, etc.—The city has an academy of sciences, a microscopical society, an art school, and a mechanics' institute, which last holds industrial fairs on a large scale nearly every year. Besides these, James Lick has given $540,000 for a school of the mechanic arts, and valuable property (estimated to be worth at least $1,000,000, and perhaps twice as much, the residue of a great estate devoted to philanthropic objects) to be equally divided between the Academy of Sciences and the society of California Pioneers, the latter association being formed, as its constitution declares, for "moral, benevolent, literary, and scientific" purposes. There are 18 public libraries, with 140,000 volumes, the largest being the Mercantile, the Mechanics', and the Odd Fellows', with 100,000 volumes. There are 3 literary colleges and 1 medical college. The free schools number 69, with 510 teachers, and an average daily attendance of 21,000 pupils, maintained at an annual expense of $800,000, and 10,000 children attend private and sectarian schools. Of periodicals there are 84, including 13 daily and 34 weekly newspapers, and 6 semi-monthly and 29 monthly publications. The benevolent associations, exclusive of the secret orders, number 30, including one for each of the leading nationalities represented in the local population. There are 3 government and 5 private hospitals, 4 asylums for foundlings and orphan children, and 1 for destitute or friendless women; and James Lick has given $150,000 for a free bath-house and $100,000 for an old women's home, not yet erected. There are 30 lodges or associations of the Masonic order, 25 of Odd Fellows, 16 each of Druids and Improved Red Men, 12 of Knights of Pythias, 9 each of Hibernians and Independent Red Men, 7 each of the B'nai B'rith and Kesher Shel Barzel, 5 of the American Protestant Association, 4 of Knights of the Red Branch, and 1 each of the Foresters, Seals, White Men, Knights of St. Patrick, and Grand Army of the Republic, making 145 lodges or societies with jurisdiction not extending beyond the city; and in addition to these there are about a dozen grand lodges of these same secret orders with more extensive jurisdiction. The city has 85 religious congregations or churches, of which 5 are Jewish, 14 Roman Catholic, and 66 Protestant, the last representing 18 different sects. Six European languages besides English are used in regular Christian worship, and in half a dozen buildings occupied by Chinese there are rooms set apart for Booddhistic worship. An Episcopal bishop and a Roman Catholic archbishop have their residences in San Francisco.

History.—The first white settlement was made in Oct., 1776, by the establishment of a Spanish military post and

a mission of Franciscan friars to convert the Indians. The latter was maintained till 1835. The next year a town called *Yerba Buena* was laid out, and the first house in it was built by an American. The name was changed to *San Francisco* in 1847, when it had 450 inhabitants; in June of the next year it lost most of its male residents on account of the attraction of the gold-diggings, and in 1849 it had become a world famous seaport city. The harbor was filled with ships deserted by their crews, a large part of the population lived in tents, and the prices of many of the comforts of life were enormous. Within fourteen months after Dec. 24, 1849, the town was devastated by five great fires, which swept away every building in the business district and destroyed property worth $16,000,000 in the aggregate. Every fire was immediately followed by the erection of much better buildings, but for years the merchants stored many of their goods in ships anchored beyond the reach of any extensive conflagration. The increase of $10,000,000 annually in the gold production for the first five years after the mines were opened led the people to suppose that the same ratio would continue; but in 1854 the gold yield began to decline, wages fell, the importations decreased, and many dwellings and business houses were left vacant. After the lapse of five years more the development of the agricultural resources of the State, the discovery of the Comstock Lode, and various other favorable circumstances brought in new elements of prosperity, upon the flood tide of which the city rode till 1869, when land speculation, overcalculating the benefits to be derived from the completion of the Transcontinental R. R., led to a panic, the pernicious effects of which were felt for several years. Notwithstanding seasons of depression in certain occupations, general business has always been active and wages high. In 1851 and 1856 vigilant committees, or extra-constitutional organizations of the people, took control of the city to purge it of scoundrels, and most of their proceedings were governed by prudence and justice. During the greater part of the time from 1856 to 1876 the city government was in the hands of independent political parties, which excluded the national political parties, as far as possible, from influence over the nominations for office, and the administration was exceptionally good. The city has been visited by many earthquakes, most of them so slight that inquiry was necessary to determine whether the shaking was not imaginary or due to some other cause. No wooden building and no brick house well built on a solid foundation has ever been seriously injured, nor has any person been hurt in a house, though on Oct. 21, 1868, five persons were killed in the street by loose bricks falling from the tops of houses or chimneys. Tall brick houses are now tied by iron rods as security against such shocks. The population, according to the Federal census, was 34,000 in 1850, 56,000 in 1860, and 149,473 in 1870, in the last-named year including 12,000 Chinese and 48,000 persons of European birth. The estimated population in 1875 was 230,000. (For additional information see *The Annals of San Francisco*, by Frank Soulé; *The Colonial History of San Francisco*, by J. W. Dwinelle; *The History of California*, by F. Tuthill; *The Resources of California*, by J. S. Hittell; and the *City Directories*, by H. G. Langley.) JOHN S. HITTELL.

San Francisco, tp., Carver co., Minn. P. 754.

San Francisco Bay. See SAN FRANCISCO and CALIFORNIA.

San Fratel'lo, town of Sicily, province of Messina, on a hill about 4 miles from the Tyrrhene Sea, and commanding fine inland and marine views. The fruits and wines of the vicinity are of the best quality, and game is most abundant. P. 7489.

San Ga'briel, p.-v. and tp., Los Angeles co., Cal., on San Gabriel River, is an ancient Jesuit mission, celebrated for beauty and fertility, and especially for its fruits. P. 456.

San'gamon, county of Central Illinois, intersected by Sangamon River and numerous tributaries, and traversed by Springfield and South-eastern, Gilman Clinton and Springfield, Springfield and North-western, Chicago and Alton, and Toledo Wabash and Western R. Rs., consists of level prairies dotted with timber, and has some deposits of bituminous coal; has numerous manufactories of carriages and saddlery, as well as flouring and saw mills. Staples, Indian corn, wheat, oats, hay, potatoes, honey, wool, and butter. Cattle, sheep, and swine are numerous. Cap. Springfield, which is also the State capital. Area, 936 sq. m. P. 46,352.

Sangamon, tp., Piatt co., Ill. P. 1380.

San'gerfield, p.-v. and tp., Oneida co., N. Y., on Utica division of Delaware Lackawanna and Western R. R., includes v. of Waterville. P. 2513.

Sang'erhausen, town of Prussia, province of Saxony, on the Grenau, at the foot of the Harz Mountains, has copper works and manufactures of vitriol, saltpetre, and linens. P. 7571.

San German', town of Porto Rico, West Indies, is about 10 miles from the sea, and has 9000 inhabitants.

San'gerville, p.-v. and tp., Piscataquis co., Me. P. 1140.

San Gil, or **Saint Giles,** town of New Granada, South America, in lat. 6° 25′ N., lon. 73° 40′ W., has about 10,000 inhabitants, mostly engaged in the cultivation of sugar and tobacco.

San Gimignano, Italy. See APPENDIX.

San Ginesio, Italy. See APPENDIX.

San Giorgio Morgeto, Italy. See APPENDIX.

San Giovanni a Teduccio, Italy. See APPENDIX.

San Giovanni in Fiore, Italy. See APPENDIX.

San Giovanni in Persiceto, Italy. See APPENDIX.

San Giovanni Rotondo, Italy. See APPENDIX.

Sangir' Islands, a group of 50 islands, most of which are inhabited, between Celebes and Mindanao, in lat. 3° 28′ N., lon. 125° 44′ E. They are high, volcanic, and produce maize, rice, sago, cocoa, sugar, tobacco, and timber. They are inhabited by about 30,000 Christian Malays, who live in different kingdoms subject to the Netherlands.

San Giuseppe Jato, Sicily. See APPENDIX.

Sangkoi, Songca, or **Tonquin,** river of Farther India, rises in Yunnan, a province of China, and falls, after a course of about 600 miles, into the Gulf of Tonquin, in lat. 20° N. and lon. 106° E.

Sangor, town of British India, presidency of Agra, near the Nerbudda, in lat. 23° 50′ N., lon. 78° 29′ E., at an elevation of 1458 feet above the level of the sea. It is a military station, and a large, lively, but somewhat unhealthy place. P. estimated at 50,000.

San'greal (*i. e.* the *Holy Grail*, or "cup," or, according to others, the *Sang Réal*, the "real blood" of Christ), according to mediæval legends, the cup of emerald which held the wine at the first celebration of the Lord's Supper. St. Joseph of Arimathea, it is related, received some of the blood of the Lord in this cup at the crucifixion. Finally, when the Holy Grail was carried away and hidden by the angels, a quest for it was instituted, it being revealed that no one who was not perfectly pure in thought, word, and act could ever find it. King Arthur's knights of the Round Table were prominent participants in the quest.

Sanguinaria. See BLOOD-ROOT.

San'hedrim, correctly **Sanhedrin** (סַנְהֶדְרִין), a corruption of Greek συνέδριον, "assembly;" also called בֵּית דִּין, "court." There are two classes to be distinguished.

A. *The Great Sanhedrim.*—The Jewish tradition traces its origin to the seventy councillors appointed by Moses (Num. xi. 16–25; comp. Ex. xviii. 13–26), and asserts its existence at all periods of the nation's history until after the destruction of Jerusalem by the Romans. But the council appointed by Moses was merely temporary in character, and there is not the slightest evidence of the existence of any such body during the times of the judges and kings. Most probably it was formed at some period subsequent to the Captivity, on the model of the old council of Moses. Strongly confirmatory of this is the Greek name, which points to the period of the Seleucidæ. The earliest reliable trace of its existence is under the Maccabees (2 Macc. i. 10; iv. 44; xi. 27; 1 Macc. xii. 6). It was in full activity at the time of Herod (Joseph., *Ant.*, xiv. 9–4). And we find constant mention of it in the New Testament (Matt. xxvi. 59; Mark xiv. 5, xv. 1; Luke xxii. 66; John xi. 47; Acts iv. 15, v. 21, 27, 34, vi. 12, 15, xxii. 30, xxiii. 1, 6, 15, 20, 28).

Jurisdiction.—It was the supreme "privy council" of the Jews; not only their court of final appeal and last resort, but also an executive and legislative assembly, shaping the general polity of the nation. Its power in matters civil and religious was practically unlimited. It decided all cases brought upon appeal from the lower courts; it had authority over kings and high priests; in it was vested the trial of heresy, idolatry, false prophets (hence the active part they took against our Lord); and it alone had power to pronounce sentence of death. Its active jurisdiction was confined to Judæa, but the Jews in all parts of the world seem in some degree to have recognized its authority. Owing to the inability to check the constant disorders during the last years of the Jewish commonwealth, its power was greatly curtailed by the Romans, and three years before the death of Christ the right of executing sentence of death was denied, save when confirmed by the Roman authorities (John xviii. 34). In the unsettled condition of

affairs attending the fall of Jerusalem it found itself unable to execute civil authority, and from that time until its extinction in the third century its power was merely nominal.

Constitution.—It had seventy-one members (some say seventy or seventy-two), chosen from those who were distinguished in birth, learning, or position. In the New Testament are mentioned—(1) Priests (ἀρχιερεῖς), chiefs of different orders of priests; (2) elders (πρεσβυτεροι), those venerable from age or position; (3) scribes (γραμματεῖς), those learned in the law and tradition. Its officers were—president (נָשִׂיא, "chief"); first vice-president (אַב בֵּית דִּין, "father of the court"); second vice (חָכָם, "judge"); besides a force of secretaries and court officers (Luke xxii. 52).

Place of meeting, in Jerusalem, in a room immediately adjoining the temple, called לִשְׁכַּת הַגָּזִית ("hall of squares"). Their meeting in the house of the high priest for the trial of our Lord does not seem to have been legal. After the fall of Jerusalem they removed to Tabneh, and finally to Tiberias, where the Sanhedrim became extinct A. D. 425.

B. *The Lesser Sanhedrim.*—A court of twenty-three members appointed by the Great Sanhedrim, sitting in all towns of over 120 households, with jurisdiction over local civil and criminal matters. (See Matt. v. 22, x. 17; Mark xiii. 9.)

Literature.—Selden, *De Synedriis et Præfecturis Juridicis Veterum Ebræorum* (1650), a mine of learning and the great source from which all knowledge of this subject is drawn, but containing a mass of irrelevant matter; Ugolini, *Thesaurus*, vol. xxv.; Lightfoot gives much valuable information, derived from the Talmud and Mishna (see *Works*); Ginsburg, in Kitto's *Bible Lexicon*, and Leyrer in Herzog's *Encyklopädie* (art. *Synedrium*), give valuable résumés of the subject, with lists of literature. T. C. Murray.

San'ilac, county of E. Michigan, bordering on Lake Huron, watered by Black and Cass rivers, has a rolling surface well covered with timber. Staples, wheat, oats, potatoes, hay, maple-sugar, wool, and butter. Cap. Lexington. Area, 920 sq. m. P. 16,292.

Sanilac, tp., Sanilac co., Mich. P. 1988.

San'itary Commis'sion, The U. S. On Apr. 15, 1861, the day on which the President's call appeared for 75,000 men, then deemed sufficient to quell the rebellion, the women of Bridgeport, Conn., organized a society with the somewhat vague idea of affording relief and comfort to the volunteers. In Charlestown, Mass., on the same day, and at Lowell a few days after, the women of those cities formed similar societies. On Apr. 19 the ladies of Cleveland, O., organized an association for the care of the families of volunteers. On Apr. 29 a public meeting, called at the Cooper Union, New York, by 91 of the best-known ladies of New York, and attended by influential women from the city and its neighborhood, formed an association known as the Women's Central Relief Association of New York, in which the principles and ideas that afterward flowered into the U. S. Sanitary Commission were first promulgated. The objects of this association were to systematize the impulsive, disorderly, and uninformed sympathies and efforts of the women of the country, so as to make effective, with the least waste of time, labor, and money, the generous and restless desires to help the young army just gathering with such supplies and protection as it was feared the government could not afford it. It is not perhaps peculiar to this country that the women are as much agitated and engrossed by the dangers and exposures incident to war as the men who are called to face them directly. But under no system of government but our own could women feel so deep a responsibility or see so ample an opportunity for supplementing the defects of the governmental care. Besides, it was felt from the first in our late war that the very life of the country was at stake, and that the homes, the hopes, the honor of the American nation were desperately threatened. This feeling sooner or later drew 2,500,000 different men into the field from all classes and ranks in life, and of these one-eighth of all were in their 19th year, about three-tenths under 21, one-half under 23½, and three-quarters under 29½ years of age. Perhaps the first draft of 75,000 had in it as many or more youth under 20 years as any later drafts. It is easy to understand how anxious and tender were the home-feelings that accompanied these striplings into the field. The Women's Central sent a committee* to Washington to confer with the medical bureau and the war department in order to learn more definitely in what way, with least embarrassment to the government and most help to the army, the women could serve the volunteers. This committee soon discovered, what might have been anticipated, that the regular medical machinery of the government, which had been quite adequate to deal in time of peace or small Indian and other wars with a little standing army, was rusty, valetudinarian, infested with routine prejudices, imperfectly awake to the situation, and very jealous of its powers, without appreciating the difficulties that were soon to overwhelm it. It became plain to the committee that no mere organization of the humane sympathies and helpful hands of the women, or even all the people that stayed at home, could meet the case; that the government, the medical bureau, the army, and the country needed to be aroused to the fact that gun-shots and cannon, wounds and death from battle, were not the enemies most to be feared in the war, but the diseases of the camp, arising from private ignorance, inexperienced officers, neglected or unknown sanitary police, the recklessness of raw soldiers, and the influences of exposure, unaccustomed food, and bad cookery. It was known to the committee that the British government had saved what remained of the frightfully decimated army of the Crimea by overriding the regular medical department with a civil commission with nearly absolute powers, which rapidly restored health and the power to achieve a successful campaign. Could a similar commission be established at the very outset of the war in advance of the necessity anticipated with too well proven fears, instead of after the event of fearful losses by camp-fevers, the committee felt that it would be a great triumph of reason and prudence. They accordingly presented their plan to the government, based very much on the sanitary commission of Great Britain, asking for the appointment of a scientific board, to be commissioned with ample powers for visiting all camps and hospitals, advising, recommending, and, if need be, enforcing, the best-known and most approved sanitary regulations in the army.

The government not unnaturally dreaded the possible collision of such a body with the medical and military authorities, and, although feeling the force of the representations, required that the consent of the medical bureau should be obtained before such a commission was appointed. Conferences fully proved that no such consent could be gained, but that a sanitary commission of inquiry and advice, *without authority* of any kind, might be endured, though it would not be welcomed, as an act of deference toward a respectable body of supposed fanatics or philanthropists, backed by a large class of anxious and sympathetic women. And in fact, after great difficulties, this was all the committee gained—the appointment of a doubtful semi-official commission, with the privilege of advising with the medical bureau, of visiting the army in the field, and of recommending to the war department such sanitary regulations and reforms as it might deem useful. The commission, as compared with the British, might be said to have been born paralytic—to have promised nothing but a paper existence, and a speedy death after ignominious failure to fulfil any of its hopes. If it had depended on the government or the medical bureau, as it proposed to do—not for pecuniary support, but for hearty sympathy and co-operation—it would have died in its infancy. But, happily, although it did not realize it at the time, and was nearly discouraged and hopeless of the usefulness it had dared to plan out, there is a dependence in a country accustomed to self-government on public opinion and the better instincts and sympathies of the nation which in times of danger and war may be trusted, and which the U. S. Sanitary Commission soon found more than an offset to the loss of official encouragement and official powers which they had reckoned on. Without powers, without pecuniary support, without any immediate sympathy even from the people in their main object, which was scientific and preventive, they flung themselves upon the merits of their cause, and upon the secondary purpose, which was intelligible and popular, the relief of suffering and want, and went to work in faith that somehow they should effect at least a moderate amount of good, if not what they could have hoped had they been armed with governmental powers to enforce sanitary laws.

A few things became soon obvious, and guided their course:

1. The great object of the Commission must be to develop, strengthen, and support the regular medical and military authorities and methods—to stimulate the departments having the supply of food, transportation, camp equipage, drainage, and incite them by kind and wholesome criticism and counsel, and by the force of public opinion, to do their utmost for the prevention of pestilence and the spread of scurvy, and the lessening of needless exposures of every kind. Any plan for taking the place of the regular authorities, or supplanting instead of

* The committee consisted of Dr. W. T. Van Buren, Dr. Harsen, Dr. Harris, and the writer.

supplementing their efforts, would have been as injurious to the prospects of the soldiers as offensive to the military and medical officers. The government had money, transportation, force, and final responsibility. It was the soldiers' natural, best, and most constant friend. To make the government feel this to the utmost, and the soldiers to recognize and lean upon it, was the true policy of the Commission, never lost sight of from the beginning to the end of the war. But this was the last thing the people at home would perceive. They appreciated neither the importance of strict military discipline, the indispensable value of what is so foolishly stigmatized as *red tape*—meaning order and method—nor the utter folly of any outside or philanthropic association attempting to step in between the army and the government to meet the daily and ordinary wants of a million of men. The service the Sanitary Commission—which early understood all this—rendered the country was by standing between the army, as cared for by the government, and the country, which expected impossibilities, and proposed to take care of the army by countless State, county, and town committees, and, while defending military discipline and strictly conforming to it, pacifying the fears and representing the solicitudes of home by doing all that could be done to supplement governmental shortcomings, while prompting, sustaining, and leading, if needs be, such reforms in the medical and sanitary care of the army as would make the governmental administration efficient.

2. The Sanitary Commission became very early in its history thoroughly convinced that to *prevent* evils to the health of the army was greatly more important and serviceable than to attempt to cure them after they appeared. It accordingly gave its attention chiefly, from first to last, to *prevention*, by a system of camp inspection and the promulgation of counsels touching the choice of camp sites, the importance of drainage and police, and the character and cooking of food. By the appointment of skilled medical inspectors it established at once an advisory and tolerably friendly relation with the surgeons of all the regiments in the field, and by supplying them with short medical and sanitary essays, and engaging them by direct personal appeal and co-inspection in the practical enforcement of hygienic and sanitary regulations, it aroused and maintained, or else supported and elevated, a general zeal in this all-important principle and plan of prevention. The surgeons of the volunteers were not seldom among the best practical physicians of the country, but they were generally of a less valuable and accomplished class of doctors. But they were usually found willing to learn, and were persistently urged and warned of the duty to prevent sickness by the medical inspectors of the Sanitary Commission, until the intelligence and experience of the medical bureau had acquired the power of maintaining its own authority and enforcing its own enlightened policy. It is not too much to say that coaxing, instructing, and urging the regimental surgeons were for a long time more efficient in promoting the preventive service than any orders from head-quarters. But as it was the rule for the Sanitary Commission to seek admission into every department, corps, camp, or regiment from the officers in command, and to do nothing without their consent and approval, it ought to be added that by deference, patience, modesty, and tact its agents gradually overcame to a large degree the natural jealousy and distrust of the generals and officers, both military and medical, and had in most cases, if not their personal support and sympathy, their forbearing sufferance and official furtherance. There never was, there never could be, a wholly cordial relationship between a body of unofficial meddlers, who were charged with representing the sentimental feelings of the women at home, and the officers of the army, particularly the under officers. And probably it was just as well that they did not wholly coalesce. Had the military and medical officers been without jealousy or dislike of the Sanitary Commission and its agents, they might have been less active and willing to notice the defects in the service. They would have been friends, and not critics. The coldness and caution with which the government from first to last treated the Commission, from the cabinet and the medical bureau to the generals and surgeons in the field, was a salutary restraint upon what might easily have become an ill-judged, unmilitary, and intermeddling exercise of merely domestic and popular wishes and sympathies, enervating, demoralizing, and worse than useless. It was in this attitude of suspicion, jealousy, and check that the Commission began, continued, and ended. It acquired its caution, its knowledge of war, and how to deal with army wants, its etiquette and subordination, its pains-taking fore-sight and watchfulness of legitimate opportunities, in this chilling atmosphere, which hardened its own muscles and cooled its brain, while perhaps it only made its heart beat with a deeper and warmer pulse.

Among the *preventive* policies of the Sanitary Commission was the prevention of incompetency, inefficiency, and contracted ideas in the medical bureau. It soon took a sufficiently modest view of its own usefulness to discover that all it could render in the way of actual comforts and supplies was a miserable offset to what the army must be steadily losing by any needless ignorance, incompetency, or want of energy in the medical bureau. Doubtless in due time the government, which earlier discovered the necessity of setting aside the rule of regular succession in all the other bureaus in favor of qualifications and vigor, would have seen the necessity of putting younger blood and firmer hands and more inventive minds in charge of the medical bureau. But from its technical nature the medical department would be the last the government would either understand or criticise. The Sanitary Commission soon concluded that the greatest service it could render the army would be to direct the attention of the government and of Congress to the necessity of reforming the *personnel* and the spirit of the medical bureau, and it had the satisfaction, at the risk of its own existence, of accomplishing this vital object.

Another *preventive* measure which it inaugurated was the suggestion, and finally the erection, of pavilion hospitals from its own models, designed to make contagion and pestilence less easy and fatal. Its plans, improved upon and enlarged, became the type of the great general hospitals which were erected at the base of our armies, and became such wonderful sources of relief to our sick and wounded men.

Among the earliest services of the Commission was the establishment of soldiers' homes at the chief places where new regiments were concentrating, to take care of the sick and supply the defects in the expanding but unperfected arrangements of the quartermaster's bureau for receiving them. Thousands of men arrived at Washington and Louisville hungry, sleepless, half sick, who had to wait perhaps twelve hours after leaving the cars before their quarters in camp were ready or their officers knew how to draw their rations. Temporary homes, where the sick could be sheltered and nursed, and from which whole regiments could be supplied with coffee and food, were extemporized by the Commission at or near the railroad dépôts, and later developed into a complete system of soldiers' homes, in which the estrays, the men passing from the hospitals to their regiments, the convalescents, and men who had lost their papers were, through the whole war, received and tenderly cared for—to an extent which averaged about 2000 soldiers daily for the whole four years of the war.

As soon as the capture of Fort Donelson the Commission, finding the government transportation of the sick to hospitals very rude, inadequate, and cruel, began to organize a system of hospital steamers. The several States were already doing something in the way of transporting more carefully in steamers supplied by themselves, each its own wounded men. But this discrimination was felt to be not only impolitic, but dangerous to the Federal feeling, which forbade the soldiers from bearing any less patriotic title than the common name of "national." The Commission therefore set its face against State distinctions, either in the distribution of supplies or the care of the sick and wounded. Its hospital transports were the earliest form in which it came into collision with State and local partialities, but it had a long and painful controversy with this natural but unwise and injurious prejudice through the whole war; and it always considered that one of its chief objects was to discountenance and abolish the treatment and aid of any soldiers otherwise considered than as national soldiers, each and all possessing equal claims on the care of the country and the Commission. The hospital steamers of the Commission, supplied with every comfort, with surgeons and nurses, plied between the ports nearest to the seats of war and the nearest general hospitals, and transported in comparative comfort tens of thousands of sick and wounded men to the places where their cure was to be attempted or their sufferings made tolerable to the end.

But it was not all or most of the wounded who could enjoy the privilege of water-carriage. The cars in which the largest portion were transported were places of torture to wounded men, who were jolted over the rough roads, sitting up in their faintness or lying about the floor of freight cars. The Commission devised a sort of hospital car, in which the common stretcher upon which the wounded man was carried from the field could be converted into a hanging bed in the car. The car was so hung on gutta-percha springs as to obviate all jolting. Food, medicine, hot drinks, and surgical attendance were provided in each car, and trains of these cars were regularly run by the Commission until the system was adopted by the medical bureau and the duty transferred to the government. Dr. Elisha Harris was the inventor of the hospital car.

Supplemental Hospital Supplies.—It was a popular error through the war, and remains such since, that the main object and chief service of the Sanitary Commission was to supply the army with food, dainties, flannels, stockings, and handkerchiefs over and above what the government could or would supply. Doubtless this was the original impulse in the early days when all the women of the country were excited about the "lint and bandage question;" and certainly it was the desire to meet these supposed wants that induced the framers of the Commission to go to Washington and study the question. But the very name the committee chose for the new Commission proves that they had put the *preventive* service before the relief service in their plan, and designed to keep the supply of food and clothing and comforts quite secondary to the object of preventing sickness and suffering by teaching, urging, and enforcing, so far as their influence went, sanitary regulations. The people at home could, however, know little of, and do nothing for, the preventive service except give their money to support it; and this they could never have been induced to do directly. The relief of actual suffering from want of food, clothing, niceties, medicine, stimulants, anybody could appreciate. Accordingly, the Commission in its home field had to organize a system of supplies, which at length became so vast and so nearly universal that the collection and distribution of these supplies stood for the whole work of the Commission in the popular judgment. The wants of the hospitals and camps very early in 1861 had exhausted 60,000 articles which the spontaneous sympathy of the homes of the country had forwarded to the Commission. By September of that year it became plain that a demand for extra food and extra clothing was going to exceed anything that the unorganized and intermittent beneficence of the people would furnish. The Commission was reluctantly forced to acknowledge that the government could not provide for the humane treatment of all its sick soldiers in a measure likely to satisfy the homes of the land. And it was felt that the furnishing of extra supplies, if left to the impulse of different neighborhoods by different agents of their own, would become so annoying to the government and so subversive of discipline that a terrible conflict of ill-feeling would grow up, in case of a long war, between the government and the homes of the country out of the inevitable necessity the government would feel to preserve order and exclude a rabble of well-meaning camp-followers, and the equally inevitable necessity the homes of the land would feel to make sure that no avoidable wants or suffering were allowed to fall upon the husbands, sons, and brothers who were fighting the country's battles. Moreover, the Commission saw in the lively sympathy and desire for co-operative work among the women of the country not only an opportunity for securing all the supplies required, but a means of relieving the distress, impatience, and suspense which in a long war rends the hearts of the people at home, and tends to make them unjust critics of the policy of the war or hasty in their wishes to bring it to a premature and barren end. The success the Commission had in organizing over 7000 aid societies, which offered opportunities to millions of American women to take some active share in the war, to do something personally for the comfort of the men in the field, and to feel themselves part and parcel of the national struggle, was one of its best services. It united the women in a common array, helped to federalize and nationalize public sentiment, made the war popular at home, beguiled the impatience of mothers, wives, and sisters to recall their husbands and brothers and sons, and filled up the weary years and months with active duty instead of idle tears—with vigorous helpfulness instead of futile murmurs and longings.

The waste, the loss, the misdirection of a vast quantity of supplies for special regiments or individuals, which were entrusted to public channels of conveyance and to the care of regimental officers that could not be found, gradually made the homes of the land willing to look favorably upon a general agency like the Commission, which received no supplies having any particular designation, but held all for the general use of the national soldier. When the system of the Commission was fully explained and its pretensions and plans verified by many witnesses sent forward by local fears and jealousies to examine its work, the various aid societies began to fall in with its plan. Women's councils were convened at Washington from time to time, composed of representative women from the various centres of supplies, to agree upon plans for collecting, and to explain and make acceptable plans for distributing, supplies. A large body of associate members, selected men of weight and influence, was added to the Commission from the home fields to give the women the aid of their counsel, to collect money for the purchase of materials for hospital clothing, etc., and to explain and support the policy of the Commission. These associates were afterward not only the chief instigators of money contributions, but the inaugurators of the great fairs which so generously and magnificently fed the treasury of the Commission.

On Sept. 5, 1861, dépôts of supplies were established at New York, Boston, Philadelphia, Washington, Cincinnati, and Wheeling. Already central aid associations existed at Boston for New England, at New York for the State and part of New Jersey, at Philadelphia for Pennsylvania, Delaware, and Western New Jersey; in Cincinnati, Columbus, Cleveland, in Chicago, in Iowa, and Wisconsin, for the great Western States, which throughout the war were animated by the greatest zeal and liberality. These and other centres had each hundreds of town and village tributaries steadily pouring into their dépôts supplies of food and clothing. They arrived at the central dépôts in boxes containing often a most promiscuous assortment of old clothes and new, stockings, handkerchiefs, dried fruits, jams and jellies, cordials and wines, carpet slippers, books, combs and brushes, the combined gifts of the richer and poorer homes, the work of women's hands or the purchase of their difficult and ill-spared savings. Often they contained every blanket in a poor home which the immediate wants of the family could spare. They were most touching collections to open and behold, and often drew tears from eyes long accustomed to read the secrets of sacrifice and love which every one of them more or less vividly betrayed. These boxes were all emptied, sorted on a system, each article marked, their sorted contents repacked, and held subject to orders from Washington. They were shipped to any point where supplies were needed or likely to be needed, to the care of agencies established at all commanding points along the lines of active war. Agents appointed by the Commission moved about the country encouraging and forming aid societies; the *Sanitary Reporter* in the West, the *Sanitary Bulletin* in the East, kept the people freshly informed of the wants of the army and the disposition made of the stores and supplies the aid societies gave. Circulars, now from Washington to the central auxiliaries, and then from the auxiliaries to their supporting aid societies, kept each village society on the alert. The immense result of this admirably-organized system secured a steady, persistent, and copious flow of supplies all through the war, which redounded to the praise of the women, who soon became as business-like, orderly, and systematic in their administration of their own societies as the best shopkeepers. At Washington in the East, and at Louisville, Ky., in the West, were seated the great distributing offices, Washington being the office from which the administrative orders and regulations proceeded. But these offices were so remote that the Louisville office had to assume great responsibilities, and often to act without any other orders than those of its own energetic chief, Dr. John S. Newberry. Vast dépôts existed in both these cities of received supplies, kept against the wants of great battle-fields, besides those which daily went forward to the order of regimental and general hospitals or to the supply of the homes, rests, and field agencies that accompanied the various corps of the army in the field. At the call of its circulars immense quantities of potatoes, onions, and other antiscorbutics were poured into the transports and dépôts of the Commission from time to time as the army was threatened with scurvy, and frequently the Commission was able to stamp out the seeds of pestilence by its supplies of fresh vegetables. It established vast kitchen-gardens at several points, and raised by the aid of volunteer labor thousands of bushels of vegetables after the supplies of the farmers had given out and the government could obtain no potatoes or onions.

It remains to show how these supplies were distributed. The word "relief," as used by the Sanitary Commission, was a technical term and embraced several distinct modes. Thus, the work of relief was *general* and *special*. *General* relief concerned the wants of the inmates of general, field, and regimental hospitals, and of men in the camp and on the march; *special* relief, the care of sick and needy soldiers in or near military dépôts, discharged men, paroled prisoners, and that vast class of sufferers known as "soldiers in irregular circumstances"—*i. e.* having no legal claim upon the ordinary provisions of the government. Another distinct form of relief was *battle-field relief*. In administering this relief the Commission was studious not to weaken the efficiency of the regular sources of relief by any gratuitous superfluity. First, the need must be plain; second, some satisfactory explanation must be given of the cause of the

* Among the numerous devoted women who labored in the forming and directing of these auxiliaries it may be allowed without invidiousness to name Miss May and Miss Stevenson at Boston, Miss Collins and Miss Schuyler at New York, Mrs Grier and Mrs. Moore at Philadelphia, Mrs Rouse and Miss Brayton at Cleveland, Miss Campbell at Detroit, and Mrs. Hoge and Mrs. Livermore at Chicago.

need; and third, a voucher from the surgeon showing that he had called for aid. These rules seem strict, but any looser ones would have made the Commission a curse to the army and not a blessing, as it proved.

The principles of distribution being settled, the machinery by which the gifts of the people reached the soldier, and the means adopted for estimating his needs, may be described. To each army sent on a distant expedition, and generally to each column of the main armies operating in Virginia and in the South-west, was assigned an inspector with a competent staff known as relief agents. This corps was permanently attached to, and accompanied, the army as an integral part of its organization. It had its own dépôt of supplies. The Commission owned wagons and horses, and had steamboats under its orders; and one or the other accompanied each corps loaded with supplies. The inspector, always a medical man, had it for his business to visit constantly the hospitals within his field of duty, to notice and advise with the surgeon in charge touching all wants, dangers, and defects in the government service, and to furnish such supplies as the surgeons were willing to ask in due form. The Commission, thanks to the generosity of the country, was never wanting in the means of meeting these demands. Whether it were hospital clothing and diet for the Army of the Potomac, or antiscorbutics for Gen. Rosecrans's army before Chattanooga, or Gen. Grant's before Vicksburg, or Gen. Gillmore's army on Morris Island requiring 400 tons of ice to make its unwholesome water drinkable, the Commission did not fail to meet the occasion. Relief on this vast scale in all departments of the army was the regular daily business of the Commission, and it was reduced to such a system, and the machinery so perfected, that it became at last as easy to deal with troops in Texas as with those in Northern Virginia. Of course, it was easier to deal with hospitals at the base of military operations than with the wants of remote field and regimental hospitals; but with six relief agents in the Army of the Potomac alone, with wagons and horses and men to carry out their orders and purposes, with a base of supplies to meet their calls central to their several posts, and with a great dépôt at Washington with means of communication of its own with the field-base, the system worked with wonderful success.

Of course, the character of the agents was of primary importance. The Commission would not receive any agents who would not pledge themselves for a lengthened, definite period of service, nor put any one in a responsible place until disciplined and prepared by a subordinate service. The agents were all instructed and drilled in the principles and requirements of the Commission, and were brought as nearly under military discipline as this special service would allow. They were promoted or degraded as they won or lost the confidence of their superiors. After trying the volunteer plan for a brief season, the Commission found it dearer than the plan of wages, and it was fortunate in possessing the means of hiring a choice body of agents, at a moderate compensation each, whom it could command and treat with the discipline to which unpaid agents would not submit. These men had their badges of office, and were known and respected in the army as no masters of their own time and ways could possibly have been. Whenever peculiar circumstances compelled the Commission to accept temporarily the volunteer services of men who worked for love only, they found that after a brief spurt of service under fearful pressure of battles and wounds they could not rely upon any patient continuance in the exhausting, often dreary, routine work required from their agents. By its system of giving about the pay of army surgeons to its inspectors it secured the best services of the best men. In battle-field emergencies it accepted any volunteer aid that offered, and it was often most effective.

Battle-field Relief.—The unexpected circumstances of place, time, and preparation under which great battles take place necessarily expose the wounded to sufferings which no foresight of the regular authorities of the army and government can fully provide against. It was one of the main purposes and constant efforts of the Sanitary Commission, by studying the situation of our armies and the probabilities of their collision with the enemy, to place their own stores and relief corps where in case of change of strategy or accident they might be ready to supply the wants of the wounded or supplement the deficient or baffled preparations of the medical and the quartermaster's bureaus. The medical department, having no independent transportation, often suffered from the inevitable preoccupation of the quartermaster's department with the more urgent duty of forwarding military stores. The Sanitary Commission, as one of its chief means of usefulness, had wagons and horses of its own—often forty 4-horse teams at a time—and this enabled it at periods when transportation of medical stores was most embarrassed to forward medical and sanitary supplies to the seats of immediate battle far in advance of the medical department. After Antietam (Sept. 17, 1862) nearly 10,000 of our own wounded, besides many of the enemy's, were left, an immense proportion of the whole, shelterless in the woods and fields, without any adequate supply of surgeons, and with not a tenth part of needed medical stores, which were locked up in the block of the railroad between Baltimore, the base of supply, and the battle-field. A wagon-train loaded with medical stores had, however, been sent forward from the Sanitary Commission daily for some time to meet this anticipated difficulty. For four days the medical director received no government supplies, and the wounded were mainly dependent meanwhile on the stores of the Commission. Within one week after the battle the Sanitary Commission had distributed by its agents on the field "28,763 pieces of dry goods—shirts, towels, bed-ticks, pillows, etc.—30 barrels of old linen bandages and lint, 3128 pounds of farina, 2620 pounds of condensed milk, 5000 pounds of beef-stock and canned meats, 3000 bottles of wine and cordials, several tons of lemons and other fruit, crackers, tea, sugar, rubber cloth, tin cups, and other conveniences." It had succeeded in transporting from the purveyor's office in New York to the dépôt at Frederick 4000 sets of hospital clothing and 120 bales of blankets. This must serve as a sample. At Perryville, Ky., the same services were rendered; at Gettysburg, on a vastly larger scale. An auxiliary relief corps, supplementary to the field relief corps (always continued), was organized in May, 1864, to look after the wounded left behind in hospitals as the army moved on. It was designed to secure personal ministrations to the wounded by chosen men responsible to a superintendent; to meet the wounded as they were carried in ambulances with proper food and stimulants, and secure them tender carriage; to assist in carrying them to the hospitals, and there look after their comfort; to meet both their physical and moral wants; to write letters home; to provide them with reading and consolation. This corps, sometimes over 150 in number, was composed usually of educated men, and sometimes of refined women, frequently of ministers of religion, and always of humane and self-consecrated persons. This corps established "feeding-stations" to meet the long trains of ambulances, full of famishing wounded, *en route* to hospitals. At Belle Plain and Fredericksburg, after the battles of the Wilderness, they rendered great services to humanity and performed all the duties of skilled nurses. This corps had its martyrs; *e. g.* William Wilson, treacherously shot by guerillas during his efforts to promote this humane service; Charles H. Stanley; Prof. Hadley (of the Union Theological Seminary); Mrs. Barlow, wife of Maj.-Gen. Barlow; and Miss Gibson, perhaps the flower of female heroism and devotion in the whole service.

It may be stated, as an evidence of the sagacity, enterprise, and comprehensiveness of the plans for battle-field relief, that of nearly or about 700 battles or bloody skirmishes in the whole war, it is estimated that the Sanitary Commission was present by its agents and stores at about 600.

Special Relief Service.—Besides an elaborate machinery of hospital visitors, field relief corps, and auxiliary relief corps, there was required, as experience revealed, a very large ministration to men, without any fault of their own, in what may be called "irregular circumstances," put beyond the reach of ordinary government or army care. Early in the war new regiments, often under incompetent officers, arrived at Washington and other centres with sick men and exhausted soldiers, compelled to walk many miles to their camps, with no government provision of food for them at the dépôts. The Sanitary Commission at once established near the principal dépôts "soldiers' homes," where weak and sick men could be temporarily received, restored to health, and forwarded to camp. This was the beginning of what became a great and costly service of *special relief*. Its several objects were—(1) to supply the sick men of arriving regiments with medicines, food, and care at periods of confusion and under circumstances when they could not be obtained "regularly;" (2) to furnish lodgings, food, and furtherance to soldiers honorably discharged from service or dismissed from general hospitals or from their regiments, but delayed on their way by inability to procure their papers and pay; (3) to communicate with distant regiments in behalf of discharged men and obtain their corrected papers and pay when too sick or weak to go in person; (4) to act as unpaid attorneys for soldiers too feeble to present their own claims at the paymaster's; (5) to aid discharged men without means, if worthy, to reach their homes; (6) to protect disabled soldiers from swindlers in the shape of ticket-agents and sharpers on their way home, procuring them railroad tickets at reduced rates, etc.; (7) to see that discharged and paid men started

for home before being seduced into squandering their pay; (8) to make reasonably clean and comfortable before leaving for home discharged soldiers reduced by misfortune and sickness to self-neglect; (9) to meet at once with food and other aid the necessities of sick men forwarded in large numbers from battle-fields or distant hospitals; (10) to keep a watchful eye upon all soldiers out of hospital, but not yet in service, and prevent desertion and avoidance of duty. Important soldiers' homes and lodges were established at Boston, Hartford, New York, Philadelphia, Cleveland, Cincinnati, Cairo, Chicago, Louisville, Nashville, Memphis, and New Orleans. Forty homes and lodges, in short, were sustained by the Sanitary Commission in its broad field, reaching from Washington to Brownsville, Tex., and from Louisville, Ky., to Port Royal, S. C. Over 4,500,000 meals and over 1,000,000 nights' lodgings were thus supplied, and $2,500,000 of soldiers' wages were collected by the Sanitary Commission. The care of wounded men *en route* was one of the most valuable services of this special relief department; at one time 8000 men were fed for two days by this department.

Convalescent camps — immense establishments found necessary by government—were one of the chief spheres into which the special relief corps penetrated. 200,000 men passed through the one in the rear of Alexandria. The Commission placed a wonderful *woman*, Miss Amy Bradley, at the head of its volunteer labors in this camp, where for two and a half years she and her assistants rendered incalculable service—(1) in distributing clothing among the needy; (2) procuring dainties for the sick; (3) accompanying discharged soldiers to Washington and assisting them in obtaining their papers and pay; (4) furnishing paper and postage and writing letters home for the sick; (5) forwarding money home by drafts that cost nothing to the soldier; (6) answering letters of inquiry to hospital directors; (7) securing certificates of arrears of pay and getting erroneous charges of desertion removed (the Commission saved several innocent soldiers from being shot as condemned deserters); (8) distributing reading matter; (9) telegraphing the friends of very ill soldiers; (10) furnishing meals to feeble soldiers in barracks who could not eat the regulation food. Miss Bradley assisted 2200 men to secure arrears of pay amounting to $200,000. Prisoners of war, while in prison and when released by general exchange, were largely and promptly relieved and comforted by this department. Rev. Frederick N. Knapp was the leading spirit in this whole special relief service, and organized and controlled it with masterly zeal, humanity, and success.

The Hospital Directory.—This was an organized effort to tabulate and keep the run of the names of all private soldiers who passed through the general hospitals, so that the soldier's friends could follow him, know where he lay, if he lived or died, and what became of him when out of hospital. The central office at Washington was opened to the public Nov. 27, 1862; branches were soon established at Philadelphia, Louisville, and New York. Returns were constantly received at the central office from 233 general hospitals, with the names of their shifting occupants and such hints about their condition and changes of place as were most important. The hospital directory contained in its four offices the names of over 600,000 men, with the latest information procurable in regard to the condition of each one of them. Agents of the directory accompanied the supply agents to the battle-field the moment battle had ceased to find out the names of the wounded, and to assure them that information should at once be sent to their friends. The method of the hospital directory was simple but efficient. Applicants for missing men or men not heard from at home communicated the name, rank, and regiment of the person inquired for, and the place he had been last heard from. With this clue he was followed through the book and hospitals by the agents, and 70 per cent. of all such inquiries were successfully answered. This service was unspeakably grateful to the people at home; none received higher praise. An immense row of great ledgers, still preserved in the archives of the Commission, attests the extent of this work.

Pension Bureau and War-Claim Agency.—This agency, free of all cost to soldiers, was designed to obviate the ignorance or inefficiency, or want of strength to win their own way or to secure correct papers, among thousands of soliers passing through the homes and lodges of the Commission. Delay and exposure often increased the illness of feeble applicants. The Sanitary Commission established a lodge just opposite the paymaster's office, and spread a table at which 50 invalid soldiers were sometimes seen seated together, comfortably waiting their turn at the paymaster's. After the war closed this bureau expanded into a claim-agency for soldiers, widows, and orphans, by which about 57,000 claims were put in proper shape, missing testimony secured, and $7,500,000 collected at a saving of half a million of cost to the soldiers—claims which could probably never have been carried through the government offices if not thus assisted, or at only too late a period to be serviceable.

War against Scurvy.—The first appearance of symptoms of scurvy in the armies of the Tennessee and the Cumberland led the Sanitary Commission to make an urgent call on the farmers of the North-west for a gratuitous supply of vegetables. Within a month 15,000 bushels were gathered without cost from a region where the government had been unable to purchase any, and were sent forward to the army, largely meeting the exigency and driving out the disease. Eight barrels of potatoes a day were furnished by the Sanitary Commission to each field hospital, besides other vegetables, pickles, sauer-kraut, etc. To keep up the supply after the farmers' stores had given out, the Commission established *hospital gardens* at Murfreesboro', Nashville, Chattanooga, Knoxville, and Newberne, from which abundant fresh vegetables were drawn for the sick and convalescent and for many other soldiers. At Vicksburg, where the soldiers were depressed by the long delay, the climate, and the crowded condition of boats and barracks, Dr. Newberry, the distinguished representative of the Commission at Louisville and head of the Western department, pushed constant supplies, by the hearty co-operation of Gen. Grant, into the camp, and furnished a large part of the comforts and luxuries that reached the sick and the desponding. His services, and those of Dr. Warriner, were of the highest value in fighting off the symptoms of scurvy and typhoid by extra supplies of sanitary food and antiscorbutics. After the fall of Vicksburg the Pittsburg, Cleveland, and Cincinnati branches of the Sanitary Commission, Davenport, Ia., Quincy and Alton, Ill., New Albany, Ind., Louisville, Ky., Chicago, all vied with each other in supplying the agents of the Commission with boatloads of stores for the heroes who had achieved so difficult a victory. The following list will show the nature and amount of the articles issued from the Sanitary Commission dépôt at or near Vicksburg to the Army of the Tennessee during the four months ending Sept. 1, 1863: Groceries, 2360 pounds; wines and liquors, 2833 bottles; butter, 5839 pounds; apple-butter, 30 gallons; eggs, 2476 dozen; pickles, 5409 gallons; molasses, 85 gallons; potatoes, 7596 bushels; ale and cider, 3139 gallons; ice, 47,367 pounds; crackers, 26,517 pounds; codfish, 13,593 pounds; corn meal, 2485 pounds; tea, 1589 pounds; relishes, 662 bottles; lemons, 25,200; hospital furniture, 2162 articles; fans, 4700; crutches, 65 pairs; mattresses, 199; spices, 2690 papers; comforts, 2429; pillows, 4357; sheets, 9029; drawers, 13,230 pairs; farina, 2125 pounds; sago, etc., 2125 pounds; bed-sacks, 1121; pillow-cases, 6511; shirts, 7909; dressing-gowns, 746; socks, 4218 pairs; slippers, 1504 pairs; bandages, 50 bands; fruit, 7330 cans; dried fruit, 45,208 pounds; dried beef, 1496 pounds; condensed milk, 11,282 cans. The hospitals at Memphis, Vicksburg, Natchez, Helena, Duval's Bluff, Little Rock, Pine Bluff, Brownsville, and Fort Smith were supplied from the steamer Dunleith in the hands of the Sanitary Commission, which constantly refilled at the storehouse at Cairo, from the stores furnished by the branches in the North-west, distributed its cargo to the naval vessels on the White and Arkansas rivers, and relieved the ports they visited, if not always adequately, yet to a most serviceable degree.

In June, 1863, the Army of the Cumberland set out to take Chattanooga over a barren region, mountainous and ill-inhabited, a poor railroad, held by the enemy, the only communication between Murfreesboro' and Chattanooga except by dangerous wagon-roads. Gen. Rosecrans had about 80,000 effective men, 22,000 artillery horses, 3000 private horses, 36,000 mules, requiring immense supplies of forage. All the food for men and horses had to be brought from Louisville, 300 miles away, and 3000 freight-cars were required to do this business. Of course, the medical supplies had to be greatly limited. Rosecrans's lines of communication with his base were several times interrupted by the enemy's temporary successes. By the course of events the Army of the Cumberland became blockaded at Chattanooga, and it is easy to see how limited its means became of relieving the 10,000 wounded men left on its hands after the battle of Chickamauga. For a month, and until the enemy were driven by Gens. Hooker and W. J. Smith from Lookout Mountain, the whole army lived on the scanty wagon-supply accompanying its march and intended only for a few days' use; 10,000 mules died of starvation; starvation was imminent for the men, and retreat for a time seemed the only safety. The medical department was greatly embarrassed in its service. A portion of the Sanitary train (of which 17 wagon-loads had been intercepted and destroyed by the enemy in the Sequatchie Valley) managed to get through—seven wagons loaded with

condensed milk, beef-stock, rags, bandages, and hospital clothing—and entered Chattanooga with the first army-train which arrived there. Three more wagons afterward got through. These ten wagon-loads constituted almost the whole supply of the hospitals until the Tuesday and Wednesday succeeding the battle. To provide for the necessities of the wounded in crossing the mountains from Chattanooga to Stevenson, where the depôt of the Sanitary Commission was, the Commission established a feeding-station midway on the route of the ambulances, which administered much needed relief to the many wounded wayfarers. The following winter in this army was one of necessary privation, chiefly from lack of means of transportation. The chief peril of the waiting troops was from scurvy and chronic diarrhœa, due to the character of their food. To combat this enemy the Commission made desperate efforts to improve the diet of the whole army. During the month of Jan., 1864, there were distributed from the single dépôt at Nashville 3423 bushels of potatoes, 157 bushels of onions, 8742 gallons of sauer kraut, 1964 gallons of pickles, 13,662 pounds of dried fruit, etc.—all antiscorbutics. The hospital gardens established at Chattanooga by the Commission aided materially in the following months in improving the diet of the army. The estimated value of the vegetables thus furnished from Apr. 15 to Nov. 14, 1864, was (at Chattanooga) $66,375.70. The beleaguered forces of Gen. Burnside at Knoxville had the same close attention of the Sanitary Commission.

In the rear of the active campaigners was a large force requiring hardly less attention; and feeding stations and ministrations to the great hospitals, and aid in easing the transportation of the wounded, sometimes for hundreds of miles, from field or regimental hospitals to a general hospital, were the ordinary forms of service. The hospital car on india-rubber springs, which one of the commissioners, Dr. Elisha Harris, had invented and perfected, was multiplied and put to constant use in transporting the wounded long distances, and gave an aggregate of immense relief to the agonies of thousands of wounded men. In the great hospitals at Nashville, where Rev. Mr. Ingraham and Judge Root were the visitors of the Commission (100,000 men in six months passed through them), immense personal services were rendered, material and moral, to the sick and wounded from the store-rooms of the Commission; from supplies of delicacies for the use of the "light-diet kitchens," where ladies cooked and distributed them; from supply-hospital visitors to hospitals and camps, seeking out cases requiring special care; in supplying State agents and agents of the Christian Commission with the means of meeting the calls of their clients; and in supplying soldiers' homes and hospital trains with what they lacked after the government had furnished what it could. This lasted until good and sufficient stores and care from the regular authorities were rendered possible by full communication and a more complete order and system.

The Commission then resolved to throw its energies into preparations for Sherman's army in its campaign for the capture of Atlanta. Before it began, 3000 barrels of vegetables and large supplies of condensed milk, beef, stimulants, under-clothing, and bandages were sent to Chattanooga, and from early in May to the close of July about 100 tons a week of additional stores were forwarded. Our army established over 300 hospitals of a rude kind in the woods on its devious and protracted way. Each one of these hospitals was visited by agents of the Commission, and no less than twenty-four wagon-loads of sanitary stores were distributed close to the line of battle during the ten days before the railroad at Ackworth was reached by the army. At feeding stations in the rear more than 17,000 meals were furnished up to July 14.

Throughout the whole West the affairs of the Sanitary Commission had been managed so prudently that the generals in the field, from Gens. Grant and Sherman down to their lowest subordinates, were on the most friendly and confidential relations with its agents, and did their utmost by army orders and personal labor to aid and advance their humane work. This was seldom as true in the East.

It would be only to repeat the same story, with variations to suit other circumstances, if we went to the Army of the Potomac and followed it to the heights opposite Fredericksburg, and saw the work of the Commission there. This army was much better supplied, it is true. Still, the medical officers welcomed, in the distress caused by an unexpected snowstorm early in December, the supply which could not elsewhere be had of 1800 blankets, 900 quilts, 5270 woollen shirts, 4439 pairs of woollen drawers, and 4270 pairs of woollen stockings. The wounded after the battle of Fredericksburg were swiftly removed by rail to Aequia Creek, where the Sanitary Commissioners at once established at the landing "a feeding and relief station," where on the first night of its existence over 600 men were fed and cared for. After the defeat at Chancellorsville the wounded probably suffered more than on any occasion in the war, as not only the regular medical service, but the supplementary service of the Sanitary Commission, was baffled by the fortunes of war. The Sanitary Commission agents accompanied the army on its forced marches to Gettysburg, its wagons continually replenished from Washington, and its supplies freely given to surgeons' orders during all the skirmishes, fatigues, and privations of that midsummer march. The most extensive preparations were made by the Commission to meet the wants of the impending crisis, the inevitable and perhaps final conflict of two equal armies—100,000 men on either side. Experienced officers were sent to Frederick, Baltimore, Philadelphia, and Harrisburg, and a systematic daily communication kept up between them and the agents with the army, while supplies were accumulated and concealed at different points near to the expected field of battle. In the early conflicts of the two armies, on July 1 and 2, many of our men were wounded, and the surgeons received prompt assistance from two wagon-loads of sanitary supplies which had reached Cemetery Hill the night before. The hospitals of the 1st, 2d, 3d, 5th, 11th, and 12th corps were very materially aided from these stores on this first day of a general engagement. The empty wagons were at once sent back to Fredericksburg and reloaded—one to return *viâ* Westminster, the other by the direct route. Dr. McDonald, in charge, and Rev. Mr. Scandlin, one of the most earnest and effective Sanitary Commission agents, with two laboring-men in the service, were captured by the cavalry of the retreating rebels, marched to Richmond, and confined for months in Libby Prison. At this very hour the Sanitary Commission was taking care of men from the rebel side with just as much tenderness as of its own troops; and this it did always when the enemy's wounded fell into our hands. Before railroad communication between Gettysburg and the North was restored, the first and most pressing wants of the wounded had been materially relieved by the energy with which the Sanitary Commission forced its supplies forward by its independent transportation. When communication by rail was fully established, the Commission poured its stores into Gettysburg in immense amounts. Large quantities of fresh provisions were sent every day from Philadelphia in "refrigerating cars." The following table will give some notion of the relief the people sent to Gettysburg during the ten days succeeding the battle through the hands of the Sanitary Commission. Each morning the supply-wagons of the division and corps hospitals were at the doors of the Sanitary Commission storehouse, and went away laden with what was needed. If the stores asked for were not on hand they were telegraphed for, and by the next train arrived and were delivered. The personal services rendered in the hospitals to sick and dying men, to men waiting amputation, to men forwarded by rail and fed on the way by its agents, were enormous and indispensable.

Table of Supplies distributed by the Sanitary Commission at Gettysburg in the ten days succeeding the Battle.

Articles of Sustenance.		Canned fruit, cans	582
Fresh poultry and mutton, pounds	11,000	Canned oysters, cans	72
Fresh butter, pounds	6,430	Brandy peaches, jars	302
Eggs, dozen	8,500	Catsup, jars	42
Fresh garden vegetables, bushels	675	*Articles of Sustenance.*	
Fresh berries, bushels	48	Vinegar, bottles	24
Fresh bread, loaves	12,900	Jamaica ginger, jars	43
Ice, pounds	20,000	*Articles of Clothing.*	
Concentrated beef-soup, pounds	3,800	Drawers (woollen), No.	5,310
Concentrated milk, pounds	12,500	" (cotton), "	1,833
Prepared farinaceous food, pounds	7,000	Shirts (woollen) "	7,158
Dried fruit, pounds	3,500	" (cotton) "	3,266
Jellies and conserves, jars	2,000	Pillows, "	2,114
Tamarinds, gallons	750	Pillow-cases, "	264
Lemons, boxes	116	Bed-sacks, "	1,630
Oranges, "	46	Blankets, "	1,007
Coffee, pounds	850	Sheets, "	274
Chocolate, "	831	Wrappers, "	508
Tea, "	426	Handkerchiefs, "	2,659
White sugar, "	6,800	Stockings (woollen), pairs	3,560
Syrups, bottles	785	" (cotton), "	2,258
Brandy, "	1,250	Bed-pans, No.	728
Whisky, "	1,168	Towels and napkins, "	10,000
Wine, "	1,148	Sponges, "	2,300
Ale, gallons	600	Combs, "	1,500
Biscuits, crackers, and rusks, barrels	134	Buckets, "	200
Preserved meats, pounds	500	Soap (castile), pounds	250
Preserved fish, pounds	3,600	Oil silk, yards	300
Pickles, gallons	400	Tin basins and cups, No.	7,000
Tobacco, pounds	100	Old linen, barrels	110
Indian meal, "	1,621	Water-tanks, No.	7
Starch, "	1,074	Water-coolers, "	46
Codfish, "	3,848	Bay rum and cologne, bottles	225
		Fans, No.	3,500
		Chloride of lime, barrels	11
		Shoes and slippers, pairs	4,000
		Crutches, pairs	1,200

Lanterns, No.	180	Paper, quires	237
Candles, pounds	350	Pants, coats, and hats, pieces	189
Canvas, square yards	300		
Mosquito-netting, pieces	648	Plaster, rolls	16

Want of space compels us to pass rapidly over the work of the Commission in the battles of the Wilderness, never perhaps so laborious and effective. By two steamboats, two barges, and forty-four 4-horse wagons of its own it conveyed 200 tons of stores to advantageous points, while it employed 200 relief agents in personal services to the wounded. From May 3 to 12 the Union army suffered a loss of 3300 killed and 30,000 wounded, and the Sanitary Commission was busy in aiding the humane and efficient Dr. Cuyler, medical director, in the work of assuaging their sufferings. At Port Royal, White House, and City Point their work went on equally efficiently. The money required by the Sanitary Commission during the months of May and June to supplement the supply for the wants of the army in Virginia alone amounted to $515,000. Morris Island, Olustee, and Newberne, owing to the marshy character of the soil, required and received special attention from the Commission in seeking to drive off the effects of malarious poisons; and Gen. Gillmore would willingly testify to the efficient service of Dr. Marsh and his assistants of the Sanitary Commission in sustaining the health of his troops before Charleston, S. C. At and after the terrible siege of Fort Wagner the Commission rendered immense help by its antiscorbutics, ice, and other comforts, so that its flag was saluted by the grateful regiments as they passed its station. Its agents were specially fortunate in supplying the wants of the troops after the unexpected battle of Olustee in Florida, where a terrible deficiency existed in the medical supplies of the government. Gen. Burnside's army in North Carolina, from the character of the soil and climate there, suffered from scurvy, and was attacked at Newberne and Beaufort with yellow fever. Every one of the Sanitary Commission agents, except Dr. Page, was prostrated with the fever. Dr. Hand, the medical director, showed himself a hero in the danger, but he was most zealously supported by the Sanitary Commission inspector, Dr. Page, and together they conquered the pestilence at the risk of their lives, and principally by means of a reorganization of the board of health, with 300 negroes set to work to purify the town. In the department of the Gulf the work of the Sanitary Commission was admirably administered by Dr. Crane and Dr. G. A. Blake, who continued at New Orleans until the close of the war, doing most efficient service. Dr. Newberry sent down cargo after cargo of vegetable food to Dr. Blake, who distributed it among the garrisons at isolated points on the Gulf, the Red River, and to posts in Texas.

Special inspection of hospitals was one of the duties undertaken by the Sanitary Commission. It organized a corps of sixty physicians and surgeons of assured position, under Dr. Henry G. Clark of Boston as inspector-in-chief, who visited all the general hospitals in the country, and reported in a thorough and exhaustive manner (in 2500 folio pages) by the month of May, 1863, to the medical committee of the Sanitary Commission, consisting of Dr. W. H. Van Buren, Dr. C. R. Agnew, and Dr. Wolcott Gibbs, who prepared the instructions under which Dr. Clark and his corps acted. The object was to obtain such information in regard to the practical management of the hospitals as might furnish suggestions to the surgeon-general for improvements in the system. What effective aid the Commission offered it might be invidious to the excellent government administrators of the hospitals to state. But it is certain that our army hospital system attained an excellence never reached in any country before; and it is lamentable that the lessons it learned and taught have been since so generally disregarded in the hospital buildings erected by civilians, which are, almost without exception, discreditable to the medical science and art of the country. It is almost impossible to find now in civil use what is known abroad with honor and admiration as "the American hospital;" and this is a disgrace to our intelligence and humanity.

Bureau of Vital Statistics.—The most scientific and permanently valuable part of the work of the Sanitary Commission was its early-begun and persistently-continued effort to collect, tabulate, and turn to account such returns as a system of careful inspection could supply touching the effects of applied or neglected hygiene, of diet, of long marching and heavy equipment, of tent and fixed hospitals; the mortality of young recruits; the influence of climate, age, drill, nationality, of previous occupations, or state of education upon soldiers; the height, weight, strength, and force of the enlisted men. Of camp inspections, 1482 were received, representing about 870 regiments. These, conducted according to very careful forms prepared in the bureau, were, after being filled by the inspectors, all tabulated and grouped in a way to convey very valuable information to the Commission in its effort to correct abuses and soften hardships and dangers. But a vast amount of facts of not immediate practical use, but of great scientific value, were collected by the bureau in matters of profound interest to students of anthropology, to life insurance, and to the whole science of vital statistics: which are either already available in Dr. B. A. Gould's really precious report, or can be examined in the archives of the Commission, arranged for preservation in the Astor Library. Mr. Frederick Olmsted, the fertile, thorough, and accurate first general secretary of the Sanitary Commission, to whom the executive management was for two years so judiciously confided by the board, did few things greater in his term of office than the inauguration of the bureau of vital statistics; his report of the statistics of the battle of Bull Run was the first scientific attempt to generalize the causes of our disaster; it began the work which was enlarged under Mr. E. B. Elliott, Mr. T. J. O'Connell, and finally still more effectively under Dr. Gould, until the bureau of vital statistics became one of the most creditable and one of the most fruitful portions of the work of the Sanitary Commission. Its reports have made it known to the whole scientific world, and probably it has added more new and valuable facts to the science of vital statistics than any one contribution at any time.

Financial History of the Commission.—The earliest call for aid published by the Commission was June 21, 1861, in two brief papers—one addressed to the people at large, the other to life insurance companies. It received from all sources up to Sept. 1, $13,630, a sum soon exhausted, and with grave uncertainty whether it could be renewed. Up to Mar. 28, 1862, the commission had received only $53,720, while its expenses were continually increasing, and, if it went on, must evidently increase rapidly and in a greater ratio. In Mar., 1862, it looked as if the Sanitary Commission must disband for want of funds, but its board were resolute to try the experiment to the last gasp of their strength. The services of the Commission in its hospital transport system, which cost it $20,000 per month (although the hire of its steamers was paid by the government), began to tell upon the public, and at the darkest moment money came flowing in, in comparatively small sums, but from a wide number of contributors, almost all convinced by their own observation or experience of the services the Commission was rendering. The financial infancy of the Commission ended in Sept., 1862. Till that time it had lived from hand to mouth, never sure of a month's continued solvency. The treasurer reported at the ninth session of the board that its receipts to Sept. 10, 1862, had been $158,501. Thus far, its receipts had been chiefly from New York, Philadelphia, and Boston, but now they began to come in from all parts of the country: and either in money or valuable supplies they became considerable. But it was the munificence of California, and the Pacific States following her lead, that first made a great impression on the public of the needs and possibilities of the Commission. California, and her sisters, remotest from the war and least able to contribute men, indulged their patriotism and gave relief to their pent-up sympathies with the national cause by pouring out their money like water. And, fortunately for the Commission and the country, they adopted the Sanitary Commission as their almoner. The first glorious contribution from California of $100,000, by telegraph dated San Francisco Sept. 19, 1862, was the making and saving of the Sanitary Commission. Supplies had been coming in out of all proportion to the money necessary to move and distribute them. The more the Commission received of goods to aid the soldier, the more embarrassed it was for money to forward and apply them. But this splendid thing done for the soldiers by distant California, the first in magnitude and in power of surprise, awoke a general enthusiasm. Only fourteen days later California sent another donation of equal amount, and from that date its donations to the Sanitary Commission became systematic, and averaged probably $30,000 per month while the war lasted! From that date, after every great battle, money and supplies came pouring in from other quarters, but with each of them came a still greater drain on the stores and the treasury. About this time (the beginning of 1864) a series of great fairs was inaugurated, either by officers of the Commission or by its friends, in aid of its treasury or of the independent treasuries of its branches. They occurred at Chicago, Cincinnati, Cleveland, Pittsburg, Albany, Baltimore, Boston, Brooklyn, L. I., New York, Philadelphia, and many other towns and cities. The net product reached the enormous sum of $2,736,868.84. The total amount in money received from the people by the Sanitary Commission up to May 1, 1866, was $4,962,014.26. But at least $2,000,000 more were raised in its interest by its branches, which they

expended themselves, and which, though equally serviceable, never came into its treasury. Gratuitous transportation by railroad and express companies and free communication by telegraph lines saved the Commission at least two thirds of the cost in these necessary departments of its work. The aggregate value of the services rendered by the public to the Commission has been estimated at $2,000,000. No officer or member of the Commission, excepting its secretaries, who left other occupations to devote their whole time to the work, ever received a dollar for his services. But it had at some periods 500 persons, from physicians and surgeons to cooks and teamsters, upon its roster, who were receiving its support at army rates, according to grade of service, and its other expenses were enormous. The finances of the Commission received a punctilious care under the lead of George Templeton Strong, a lawyer and man of the highest character, its only treasurer through the war, who gave the most scrupulous attention to vouchers and accounts, and under the direction of the Commission submitted his books to three auditors, Messrs. A. A. Low, Jonathan Sturgis, J. J. Astor, Jr., who employed an expert to examine them from time to time and report their audit, without finding a single flaw, through the whole life of the Commission. Mr. Strong's great services were held in the strongest respect and gratitude by his fellow-commissioners and the public acquainted with his solid devotion: and his recent death has not diminished the sense of them among his old fellow-workers. The sources of the money contributions, and their amount, will be found in the following table, taken from the official report of the Commission:

Receipts of the U. S. Sanitary Commission from June 27, 1861, to Jan. 1, 1866.

Maine	$24,938 43	Italy	$50.00
New Hampshire	21,926.84	Turkey	50.00
Vermont	3,521.17	China	2,989.90
Massachusetts	15,532.00	Japan	5,000.00
Mass (through Boston		U. S. army	1,738.30
branch)	106,396.60	U. S. navy	199.00
Rhode Island	11,823 96	Boston and New	
Connecticut	8,418.55	England Fair	50,000 00
New Engl'd (States		Yonkers, N. Y	12,000 00
not designated)	6,683.75	Flushing, L. I., Fair	3,934.32
New York	229,328.71	Brooklyn and Long	
New Jersey	20,741.25	Island Fair	305,513.83
Pennsylvania	12,736 77	Schuyler co. (N. Y.)	
Delaware	775.00	Fair	1,287.43
Maryland	5,913.95	Albany (N. Y.) Fair	80,000.00
Dist'ct of Columbia.	12,124.53	Metropolitan (New	
Virginia	703.60	York) Fair	1,184,487.72
Ohio	16,049 50	Warwick, Orange	
Indiana	1,264.15	co. (N. Y.) Fair	1,432.73
Illinois	4,342.50	Po'keepsie (N. Y.)	
Michigan	691.30	Fair	16,192.27
Wisconsin	916.00	Hornellsville (N.Y.)	
Iowa	13.50	Fair	800.00
Minnesota	67.85	South Adams (Mass.)	
Kentucky	6,608 05	Fair	3,087.04
Lousiana	3,177.25	Maryland State	
North Carolina	8.00	(Baltimore) Fair	40,234.54
California	1,233,977.81	Wheeling (Va.) Fair	2,500.00
Nevada	107,642.96	Great Central Fair,	
Oregon	79,406.94	Philadelphia.	1,035,398.96
Wash Territory	20,918.92	Unknown sources	3,952.26
Idaho Territory	5,301.31	Interest on U. S. cer-	
Colorado Territory.	1,025.00	tificates	37,771.71
Nebraska Territory	10.50	Interest on deposits	
Vancouver's Island.	2,195.61	in Nassau Bank,	
Sandwich Islands	17,955 51	Brooklyn	1,923.63
Chili.	5,376.79	Interest on deposits	
Peru	2,002.00	in Fourth Nation-	
Buenos Ayres	18,412.85	al Bank, N. Y	3,154.15
Cuba.	23.00	Receipts from ad-	
Costa Rica	84 00	vertisements in	
Canada.	441 48	*Sanitary Bulletin*	2,160.00
Newfoundland	150.00	Receipts from sub-	
England	11,145 33	scriptions for *San-*	
Scotland	74 75	*itary Bulletin*	191 80
France	3,550.00	Contributions to	
European branch		medical fund	197.00
(Paris)	13 372 72	Proceeds from sales	
London branch	36,790 12	of furniture, sur-	
Belgium	100 00	plus stores, etc	72,298 07
Germany	843.22	Total amount	$4,924,480.99

NOTES.—(1) For a table of disbursements we must refer to the official *History*, by C. J. Stillé, where an audited account will be found on p. 547, Appendix.—(2) The estimated value of supplies sent the Commission, in various kinds of dry goods, raw material and made up, vegetables, fruits, wines and cordials, and all else, is roughly estimated at $15,000,000.

Internal Organization.—The original board, named by the medical bureau and the secretary of war after advising with the originators of the plan, consisted of nine persons—Rev. Dr. H. W. Bellows, Prof. A. D. Bache, Prof. Wolcott Gibbs, Dr. Jeffries Wyman, Dr. W. H. Van Buren, Dr. Samuel G. Howe, R. C. Wood, surgeon U. S. A., G. W. Cullum, U. S. A., A. E. Shiras, U. S. A., with power to add as many more associates as they deemed necessary. The order of the secretary of war creating the Commission is dated June 9, 1861. Immediately after, Elisha Harris, M. D., G. T. Strong, Esq., J. S. Newberry, M. D., F. L. Olmsted, Esq., Bishop T. M. Clark, Horace Binney, Jr., Esq., were added, and later Hon. R. W. Burnett, Hon. Mark Skinner, Hon. Joseph Holt, Rev. J. W. Heywood, Fairman Rogers, Esq., J. Huntington Wolcott, Esq., C. J. Stillé, Esq., Ezra B. McCagg. During the early months of the war the board met in Washington (where excellent quarters were provided by the government) once in every six weeks, but after the first year its sessions were held quarterly. The board had a general supervision of the work, the defining of its policy and measures, which were committed to secretaries, heads of bureaus, and agents for execution. The board held twenty-three sessions, usually four or five days each. To them was presented by the general secretary a sketch of the work founded on the reports of the heads of the various bureaus—of Inspection, Statistics, Special Relief, War-Claim Agency, Hospital Record, the Treasury, and the Branches in the Home-field. The pressure and complexity of the business soon compelled the board to appoint from its members a standing committee charged with all the responsibility of the Commission during the intervals of its sessions. This committee consisted of Rev. Dr. Bellows, Dr. W. H. Van Buren, Prof. Wolcott Gibbs, Mr. E. T. Strong, and Dr. C. R. Agnew, to whom Mr. C. J. Stillé was afterward added. It was necessary that this standing committee should be constituted of gentlemen living near each other, as their meetings were held necessarily daily, and the city of New York thus became their head-quarters. For four years their daily meeting was scarcely intermitted, except on Sundays. The care, anxiety, and labor thrown upon them in explaining, defending, and maintaining the deliberate policy of the Commission, anticipating its wants, arranging and addressing public meetings, planning financial schemes, meeting the exigencies of the field-work by summoning supplies and forwarding them to distant dépôts, settling delicate questions with the government, the army, and its own agents, was something which only the immense excitement of the times, and the growing interest and success of their humane work, could have enabled professional men—every one of them with numerous public duties besides—to bear.

But the burden of the labor fell upon the general secretary at the head of the central office at Washington. Mr. F. L. Olmsted occupied this post for the first two years; and it is not too much to say that he impressed his genius upon the Commission, which had originated with others, in such a way as to make it doubtful whether without his fine power of organization, his influence with subordinates, his experience in great undertakings, and his extraordinary powers of concentrated attention upon what he undertakes, it would have survived its youth. He was succeeded by Dr. J. Foster Jenkins, who was promoted for his prudence, faithfulness, and high medical and general intelligence from a lower office in the Commission to this important post, and labored effectively for two years in it until his health broke down. He was succeeded by Mr. John S. Blatchford, who brought rare power of order, industry, and zeal to the work, and specially distinguished himself by his success in organizing the war-claim and historical bureau, and finally by closing up the long-protracted business of this involved and widely-related enterprise. The office at Washington, with its several bureaus, presented all the extension, activity, order, subordination, and checks and balances of a great commercial house. Dr. John S. Newberry at Louisville, the Western secretary, had a large force of clerks, inspectors, and agents under him admirably managed. The office of the standing committee in New York was the scene of constant hard work under Mr. Benjamin Collins, assisted by Mr. C. G. Lathrop and Mr. S. H. Stebbins, accomplished accountants. Considering the fiduciary nature, the extent and growth of this—probably the largest work of volunteer benevolence ever carried on in the same space of time or under similar circumstances—it is gratifying to remember how generous the trust of the public was in the integrity and wisdom of its administrators, and how little friction of a harmful kind, notwithstanding its constant difficulties, it suffered in its anomalous relations to the government and the army and navy.

This long yet imperfect digest of the work of the U. S. Sanitary Commission is mainly taken (though with the help of a full personal knowledge of the general facts and internal policy here set forth) from the official *History of the Sanitary Commission*, so ably written by one of its members, Mr. Charles J. Stillé, now provost of the University of Pennsylvania, and with his concluding words, we end this article: "However opinions may differ in regard to the policy of the government or the strategy of the generals during the late war, the organized sympathy and care of the American people for those who suffered in their cause stands out alone in its ever-fresh beauty from the dark

background of civil strife, and must always and everywhere call forth the homage and admiration of mankind. It is the true glory of our age and our country, one of the most shining monuments of its civilization. May it ever prove a beacon to warn, to guide, and to encourage those who in future ages and other countries may be afflicted with the dire calamity of war!"

List of the Members of the U. S. Sanitary Commission and its Officers.—Henry W. Bellows, D. D., New York, president; Alexander Dallas Bache, LL.D., Washington, D. C., vice-president; George T. Strong, Esq., New York, treasurer; W. H. Van Buren, M. D., New York, C. R. Agnew, M. D., New York, Prof. Wolcott Gibbs, M. D., New York, medical committee; Fred. Law Olmsted, Esq., New York, general secretary; Prof. John S. Newberry, M. D., Louisville, Ky., Western secretary; Elisha Harris, M. D., New York; Charles J. Stillé, Esq., Philadelphia, official historian; S. G. Howe, M. D., Boston; Rt. Rev. T. M. Clark, Providence, R. I.; Horace Binney, Jr., Esq., Philadelphia, Pa.; Rev. J. H. Heywood, Louisville, Ky.; * Hon. R. W. Burnett, Cincinnati, O.; Hon. Mark Skinner, Chicago, Ill.; * Hon. Joseph Holt, Washington, D. C.; J. Huntington Wolcott, Esq., Boston, Mass.; Ezra B. McCagg, Esq., Chicago, Ill.; † Fairman Rogers, Esq., Philadelphia, Pa.; ‡ Robert C. Wood, M. D., U. S. A.; § G. W. Cullum, U. S. A.; ‖ Alexander E. Shiras, U. S. A.

HENRY W. BELLOWS.

Sanitary Science, a term of recent origin, defined by a high authority, Dr. Mapother, as "an application of the laws of physiology and general pathology to the maintenance of the health and life of communities by means of those agencies which are common and in constant use." It is therefore nearly a synonym of "preventive medicine" and "state medicine," and in many of its practical aspects has been treated under the head of HYGIENE (which see). Recent commentators have shown the probability that many, if not all, the minute directions for daily life contained in the Mosaic code were based upon the views then prevalent in regard to hygiene, and a similar origin may be ascribed to the Spartan code attributed to Lycurgus, while the vast public works for drainage and sewerage in Rome, and the appointment of *archiatri populares* or state physicians, testify that sanitary science was not unknown to the rulers of that empire. During the Middle Ages, however, the widespread contempt of the body and of all material things which was inculcated by the ascetics of the Church of Rome effectually prevented the adoption of any public sanitary measures; and it was not until an advanced period of the nineteenth century that public hygiene was recognized as a science of vast intrinsic importance. To the labors of Dr. Southwood Smith (1788–1861), Edwin Chadwick (b. 1801), Dr. Edwin Lankester (1814–74), Dr. William Farr (b. 1807), Dr. Lyon Playfair (b. 1819), and Dr. Edmund A. Parkes may be chiefly ascribed the beneficent movement in England which has resulted in the establishment of sanitary science upon a firm basis—the appointment of boards of health in all the cities of Great Britain and Ireland, and even in most of the smaller towns, the division of that kingdom into health-districts, and the passage by Parliament of very numerous measures directly inspired by those energetic reformers. To their labors, again, is largely due the somewhat later development in the U. S. of similar administrative reforms, which received an incalculable impetus from the medical department of the military service during the civil war—a school in which nearly all the American sanitary reformers of the present day were trained.

Among the more important antecedents to sanitary science may be mentioned the establishment of quarantines in the fourteenth century, the discovery of vaccination in the eighteenth century, and its enforcement by government, and the appearance of the Asiatic cholera in Europe in 1832, the latter being a phenomenon which in England, France, Germany, and the U. S. had the result of directly leading to searching investigations of the conditions of public health and disease, especially in crowded cities. In England a poor-law was enacted in 1834, embracing a provision for the appointment of a medical commission to supervise its execution, and its first elaborate *Report on the Sanitary Condition of the Laboring Population of Great Britain* (1842) has been characterized as "the true starting point of modern sanitary legislation." The "health-of-towns commission," the first fruits of the preceding publication, issued valuable *Reports* in 1844 and 1845, which in turn gave rise to the "metropolitan sanitary commission," in both of which the organizing genius was Mr. Edwin Chadwick, while the eminent physicians above named imparted "determinate method and an approach to scientific exactness" to the vast accumulations of data presented in the *Reports* of the years 1847 and 1848. The public health department in the privy council was organized in 1858. At the present day sanitary science in England may truly be said to have sensibly lengthened the average duration of human life, to have contributed in no slight degree to the health and comfort of all classes of the nation, and by the numerous associations which have been formed for its promotion to have become a recognized power of the highest order in the state. Its influence is also highly beneficial in an incidental manner as conducting to the scientific treatment of many economic subjects which have heretofore been abandoned to the crude speculations of political theorists or regulated in accordance with ill-understood class interests.

In the U. S. boards of health have been constituted in all the larger cities, most of them dating from a period subsequent to the close of the civil war (1865). The "metropolitan board of health of the State of New York," instituted in 1866, was in 1870 transformed into the "board of health of the health department of the city of New York," and under both names has published valuable *Annual Reports*. Those of 1866, 1867, and 1868 were from the pen of the sanitary superintendent, Dr. Edward B. Dalton (b. 1834, d. 1872), who also wrote an article on the history and management of the metropolitan board of health in the *North American Review* (Apr., 1868). Under the management of Dr. Moreau Morris, assisted by Prof. Charles F. Chandler, Ph. D., as analytical chemist (the latter in 1873 appointed president of the board, which position he still retains), and by 10 district inspectors, much has been done toward rendering the city of New York habitable, but the field for the labors of that board is so vast, and the discretionary powers confided to it so limited, that further legislation is urgently required, as well as the establishment of sanitary instruction in every public school.

The literature of the subject, though recent, is of considerable bulk, and rapidly increasing; it will here be sufficient to direct attention to Dr. Edmund A. Parkes' *Manual of Practical Hygiene* (1864), Dr. Gairdner's *Public Health in Relation to Air and Water* (1862), Dr. A. P. Stewart's *Medical and Legal Aspects of Sanitary Reform* (1867), Dr. E. D. Mapother's *Lectures on Public Health* (1869). Fuller bibliographical references will be found under the title HYGIENE. (See also the articles FERMENTATION, GERM-THEORY OF DISEASE, DISINFECTION, FOOD, GYMNASTICS, RESPIRATION, SEWER, VENTILATION, and VITAL STATISTICS.)

PORTER C. BLISS.

San Jacin'to, new county of S. E. Texas, on Trinity and San Jacinto rivers, has a rolling surface and a fertile soil. Cap. Cold Spring. Area, 500 sq. m.

San Jacinto, p.-v. and tp., San Diego co., Cal. P. 92.

San Jacinto, v., Harris co., Tex., on Buffalo Bayou. P. 172.

San Jacinto, a river of Texas, rises in Walker co., and flows S. E. 120 miles to San Jacinto Bay, an arm of Galveston Bay, is navigable 45 miles, and gives name to the famous battle fought on its banks in 1836. (See SAN JACINTO, BATTLE OF, by C. G. FORSHEY.)

San Jacinto, Battle of. This closing battle of the war of Texan independence was fought Apr. 21, 1836, in S. E. Texas, 2 miles S. W. of the junction of San Jacinto River and Buffalo Bayou, near the bay of the same name. Gen. Houston, in command of the Texan forces, had been gradually falling back eastward, toward San Jacinto River and Bay, before the advance of the Mexican army under Gen. Antonio Lopez de Santa Anna from the W. The whole sparse population was fleeing in the same direction. Harrisburg, the seat of government, was abandoned on the 18th, and on the same evening was burnt by the pursuing army. The armies were marching on parallel lines, Houston's object being to reach the river and hold command of the ferry at its mouth; Santa Anna's, to cut off his retreat and capture him. They reached the bay boundary almost simultaneously, and took position within a mile of each other. Houston's better knowledge of the country had enabled him to strike the exact point desired; and here they determined to fight. On the 20th some pretty severe skirmishing took place, with but little result. On the 21st the battle was fought, sudden, desperate, and decisive. With the cry, "Remember the Alamo!" the Texans made their charge, and at the expiration of a single hour Santa Anna had fled, and the whole of his army not slaughtered in the action had surrendered. The force of the Mexicans was 1536; that of the Texans, about 700. Their loss was 8 men killed and 25 wounded; among the latter was Gen. Houston, slightly wounded in the ankle. When Gen. Santa Anna was brought in prisoner, the soldiers, burning for revenge for his atrocities committed on the prisoners of the Alamo and Fannin's command, clamored for his

* These gentlemen never took their seats.
† Resigned 1864. ‡ Resigned Dec., 1864.
§ Resigned Feb., 1864. ‖ Resigned Dec. 17, 1864.

life. Milder and more politic measures prevailed, however; and upon his promise to use his best influence to secure the recognition of Texan independence his parole was accepted by Pres. Burnet. How well it was kept history has recorded. This battle, however, ended the struggle for Texan independence. C. G. FORSHEY.

Sanjio Saneyoshi, b. in Kioto (now called Saikio), Japan, about the year 1836, of a high Kûgé family; educated by private instructors with great care, both in Japanese and Chinese literature. Before the late revolution he and six others of similar high rank took a decided stand against the policy of the late tycoon, when they were all suspended from the offices they held and consigned to the care of certain daimios for confinement; after his release, and in 1864, he became a court officer to the tenno, and was noted for his continued opposition to the tycoon and for his zeal in the progressive affairs of the empire; early in 1868, and immediately after the change of government, he was made vice prime minister, and in July, 1871, elevated to the rank of dajio dai zin. He is by nature a true conservative, and has ever been popular with the people. F. A. P. BARNARD.

San Joaquin', county of Central California, intersected by San Joaquin River, and watered by its tributaries, the Mokelumne, Calaveras, and Stanislaus rivers; lies between some outlying spurs of the Coast Range on the S. W. and the Sierra Nevada on the N. E.; is traversed by Central Pacific, Stockton and Copperopolis, and Stockton and Visalia R. Rs.; has a nearly level surface, well adapted for agriculture, and contains considerable tracts of "tule" or unreclaimed swamp-land. Important manufactures are being rapidly introduced. Wheat and barley are produced in vast quantities; wine, hay, butter, cheese, and wool are important staples, and domestic animals abound. Cap. Stockton. Area, 1452 sq. m. P. 21,050.

San Joaquin, tp., Sacramento co., Cal. P. 1073.

San Joaquin, tp., Stanislaus co., Cal. P. 1015.

San Joaquin River, rises in Fresno co., Cal., and after a S. W. course to the Tulare Slough it turns N. W., traverses the magnificent valley which bears its name, and at last, joining with the Sacramento, falls into Suisun Bay. At high water the outflow of the Tulare system of lakes is discharged by the San Joaquin, which is navigable to Stockton for large steamers for a good part of the year, and small steamers can ascend 275 miles higher. The river is some 350 miles long.

San José, city, cap. of the republic of Costa Rica, in the province of the same name, in lat. 10° 56′ N., lon. 83° 45′ W., about midway between the Pacific and the Caribbean Sea, 15 miles N. W. from Cartago, the ancient capital, with which it is connected by a railway, now in course of construction between Puerto Limon and Punta Arenas, is in a picturesque and fertile valley at the base of the Barba and Cartago volcanoes, 4500 feet above the sea; is regularly laid out, but ill built, having no edifices of architectural merit. It has several educational institutions, including a university, to which are attached a medical department, a museum, and a chemical laboratory; has 2 banks, the National and the Anglo-Costarican; is connected with Punta Arenas, its seaport, by the only tolerable carriage-road in the country, and exports large and increasingly valuable quantities of coffee by way of the steamers of the Panamá and San Francisco lines. P. 26,000.

San José, tp., Los Angeles co., Cal. P. 474.

San José, p.-v. and tp., cap. of Santa Clara co., Cal., in the heart of the beautiful Santa Clara Valley, 50 miles due S. from San Francisco, and 30 miles from the Pacific Ocean, is connected with San Francisco by railroad on the W. side of the northern arm of San Francisco Bay, and

State Normal School, San José, Cal.

with the overland railroad by a branch road on the E. side of the bay. It is also connected by rail with the southern portion of the State. The city contains a public library, 9 churches, the college of Notre Dame for young ladies, with buildings and grounds valued at $500,000, the San Jose Institute and Business College, 7 fine public-school buildings, the State normal school, the finest court-house in the State, costing $200,000, a theatre, 3 large public halls, and many other excellent public buildings and elegant private residences. The city owns a beautiful park of 400 acres, 6 miles distant, containing numerous mineral springs, with which it is connected by a magnificent avenue lined with four rows of trees, the avenue alone costing over $30,000. The city is embowered in flowers, trees, and shrubbery, and with a most equable and delightful climate throughout the year is regarded by tourists as one of the most beautiful inland towns on the continent. It has 4 banks, 2 daily and 4 weekly newspapers, and 1 monthly agricultural journal. Staple products of the city and valley, wheat, wine, dried and canned fruits, tobacco, etc. P. of v. 9089; of tp. 3420.

J. J. OWEN, ED. DAILY AND WEEKLY "MERCURY."

San José, p.-v., Allen's Grove tp., Mason co., Ill., on Jacksonville division of Chicago and Alton R. R.

San Juan', town of the Argentine Republic, province of San Juan de la Frontera, is tolerably well built and in a fertile and well-cultivated district on the river San Juan. P. 8353.

San Juan, county of Washington Territory, embracing the islands of San Juan, Orcas, Lopez, Blakely, Decatur, Shaw, Waldron, Henry, Spiedan, Stuart, and Sucia, and several islets, all lying in Puget's Sound between the mainland and Vancouver Island. They were formerly included in Whatcom co., and the possession of several was disputed between Great Britain and the U. S. (see SAN JUAN

BOUNDARY QUESTION); but after the award of the emperor of Germany (Oct., 1872) they were in 1873 erected into a county. The islands of San Juan and Orcas have each an area of about 60 sq. m., Lopez about 30 sq. m., the aggregate of the county being 200 sq. m. The population of San Juan was in 1870, 376, exclusive of an English garrison; that of Orcas, 108, and of Lopez, 48; of the county (including 72 Indians), 554. The islands are mostly mountainous and well wooded, but have some fertile prairie-lands. Deposits of coal and limestone have been found. Cap. Friday Harbor.

San Juan, tp., Los Angeles co., Cal. P. 445.

San Juan, tp., Monterey co., Cal. P. 2638.

San Juan, a river of Central America, 120 miles in length, forming the outlet of Lake Nicaragua into the Caribbean Sea, and in the lower half of its course the boundary between the republics of Nicaragua and Costa Rica. Its depth varies from 2 to 20 feet, and navigation is rendered difficult by five rapids; but small steamers have ascended through its whole course, which forms a part of the contemplated Nicaraguan interoceanic ship-canal, for which purpose extensive improvements in the channel or the construction of lateral canals will be necessary. The mouth of the river has more than once changed, and the best entrance is now in the territory of Costa Rica.

San Juan Boundary Question. The island of San Juan, in the Gulf of Georgia, on the Pacific coast of North America, lying midway between lat. 48° and 49° N., and in lon. 128° W., is the largest of the group of islands between the Straits of Fuca and the continent. It is bounded N. by the Gulf of Georgia, E. by the Straits of San Juan, and S. and W. by the Straits of Fuca. This island owes its celebrity to the fact that it was seized and occupied by the British government in 1859, and immediately afterward by an American force under the orders of Gen. Harney, the U. S. claim to the island being deemed indisputable. To prevent a collision between the English and U. S. forces, the late Lieut.-Gen. Scott, then at the head of the army, was sent to San Juan and to the local English authorities at Vancouver, who ultimately arranged for a joint occupancy of the island until its ownership could be settled by diplomacy between the U. S. and Great Britain. From that period until the negotiation of the Treaty of Washington in 1871 the two governments labored in vain to arrange this question, but without success. Six different times the British government proposed arbitration, but in every instance the U. S. rejected the offer, on the ground that our right to the island was as perfect as it is to any part of the N. W. coast S. of lat. 49°; that the treaty of June, 1846, did not give to Great Britain the shadow of a claim to one square foot of land or water S. or W. of the Straits of Fuca and the Canal de Haro; that the U. S. had an indisputable right to continue the line of 49° N. from the Lake of the Woods and the Rocky Mountains due W. to the Pacific Ocean, cutting off the southern portion of the island of Vancouver; and that we only waived that right as an act of grace and comity to a friendly power, and consented that the line of boundary, after reaching the middle of the Gulf of Georgia, should deflect to the southward and pass through the Straits of Fuca, so as to leave untouched the island of Vancouver; *and for no other purposes whatever.*

When (in 1848) the claim of Great Britain, that "the channel which separates the continent from Vancouver's Island," as set forth in the treaty, did not mean the Canal de Haro, but a smaller passage far to the eastward, and which, for the purposes of the claim thus set up, was named *Rosario Straits*, nearly all the parties who were connected with the treaty of 1846 were still living, and of course the impudent claim that under that treaty Great Britain was entitled to nearly all the islands in the Gulf of Georgia S. of lat. 49° was treated almost with contempt. Whenever urged, we refused to listen to it; and finally Great Britain proposed arbitration. This was promptly rejected, on the ground that there was nothing about which to arbitrate, the words of the treaty of 1846, drawn by the English minister of foreign affairs, having definitively fixed and settled the line of boundary; and to each and every subsequent proposal to arbitrate, five in number, the U. S. invariably returned the same reply, until finally, in 1871, when the joint high commission for the settlement of the Alabama claims was in session in Washington, our government, in the interests of peace and to accomplish the settlement of the Alabama question by arbitration, did consent that the "San Juan question," as it was called, should be referred to the king of Prussia, simply to determine whether the words of the treaty of 1846 constituted the "Canal de Haro and the Straits of Fuca" the boundary intended by that treaty, or whether these words were intended to convey to Great Britain all the islands in the Gulf of Georgia S. of 49° N., instead of simply the southern point of the island of Vancouver.

The king of Prussia had no alternative but to decide as he did—viz. that the line of boundary fixed by the treaty with the full knowledge of all those concerned in negotiating it, and which was drawn by Lord Aberdeen and accepted by the U. S. without any alteration whatever, was to pass from the centre of the Gulf of Georgia, on the parallel of 49° N., through "the Canal de Haro and Straits of Fuca" to the Pacific Ocean, and that the divergence from the parallel of 49° was made for no other purpose but to leave to Great Britain *the whole of Vancouver's Island*, instead of giving the southern end of it to the U. S., which would have been the effect of extending the line of 49° N. across the island. This decision, following immediately upon the heels of the Geneva award of £3,000,000 sterling in the settlement of the Alabama question, gave great dissatisfaction in England, where the absurdity of their claim under the treaty of 1846 had never been pointed out, and the merits of the question were not at all understood by the present generation. Under these circumstances Gen. J. Watson Webb, who had been more mixed up with the settlement of the North-western boundary question than any man living, was invited to write and publish a brief history of the treaty of 1846. He did so, and its very general republication by the English press not only satisfied the intelligent people of England that no injustice had been done them, but prevented the threatened arraignment of the English ministry in the House of Commons for having submitted the San Juan question to arbitration. (See *Papers relating to the Treaty of Washington*, vol. v., Washington, 1872.) J. WATSON WEBB.

San Juan' de Fu'ca, Strait of, the entrance to Puget Sound and the Gulf of Georgia, lies S. of Vancouver's Island and N. of Washington Territory. Its entrance is in lat. 48° 23′ 30″ N., lon. 124° 43′ 48″ W.

San Juan de la Fronte'ra, town of the Argentine Republic, capital of a province of the same name which forms the westernmost part of the country, on the river San Juan, which rises in the Andes and falls into the salt lake of Guanacache. It is indifferently built, and its 17,000 inhabitants are mostly scattered in straggling suburbs and engaged in the cultivation of wine, fruit, and maize.

San Juan de los Reme'dios, town on the northern coast of Cuba, in a low and marshy district, but in 1867 exported 544,426 cwts. of sugar and 187,752 cwts. of molasses. P. 6000.

San Juan del Ri'o, town of the Mexican confederation, state of Querétaro, at an elevation of 6300 feet above the sea, on the Rio Paté, and surrounded by orchards and gardens. P. about 5000.

San Juan de Nicaragua. See GREYTOWN.

San Juan de Puer'to Ri'co, capital of the Spanish island of Porto Rico, West Indies, on a small island off the northern coast of the main island, with which it is connected by a bridge. It has a good harbor, a fine cathedral, a handsome theatre, and is strongly fortified by walls, bastions, and a detached fort. It is generally well built, and is one of the healthiest and pleasantest cities of the West Indies, though it lacks good drinking-water. P. 20,000.

Sankey (IRA DAVID), b. at Edinburgh, Lawrence co., Pa., Aug. 28, 1840; in business at New Castle, Pa., 1855–71, when he joined Mr. Moody in evangelistic work in Chicago, Ill. They labored together in Great Britain 1873–75, when they returned to the U. S. to inaugurate a new era of preaching to the masses. Mr. Sankey is the author of several popular sacred tunes, which he sings with remarkable effect. (See MOODY, D. L.) R. D. HITCHCOCK.

Sankhya, the name of the chief system of philosophy in India. The word signifies "numerical" or "rational," referring to its twenty-five principles, and not, as some have supposed, to a system of numerical symbolism like that of Pythagoras. Its doctrines are attributed to the venerable sage Kapila, who delivered them in the form of memorial verses (*Káriká*). They owe their preservation to Ishwara Krishna, who reduced them to writing. The *Sankhya Káriká* was translated into English by Colebrooke, and published in 1837, accompanied with the commentary of Gaurapáda (Latin translation by Lassen (Bonn, 1832); German translation by Windischmann (Bonn, 1852); French translations by G. Pauthier (Paris, 1833), by B. St. Hilaire (Paris, 1852).) Besides the *Sankhya Káriká*, there is the *Sankhya Pravachana*, a work of 499 memorial verses (printed at Serampore in 1821). This school of philosophy, which has furnished the underlying thought of all the other Indian systems, seeks to solve the problem of life without recourse to revelation as contained in the *Vedas* and other Hindoo scriptures. It is therefore reactionary in its character, and stands opposed to

religious authority. It may be described as having an atheistical left wing, a theistical centre, and an ethical right wing (the two *Yoga* systems). The atheistical *Sankhya* [illegible] as the essence of matter and the origin whence all emanates. The theistical *Sankhya* identifies [illegible] with the Supreme Being. The *Yoga* systems are theistical, but their chief tendency is ethical. The *Yoga* of Patanjali enjoins avoidance of temptation, and tends to contemplation and quietism; while the other, the [illegible] *Yoga*, enjoins the combating of temptation, and trains its devotees for the active contest with evil. The latter is the doctrine of the *Bhagavad Gita* (translated into English by Charles Wilkins in 1785, and the chief source of the current ideas regarding Indian philosophy). The Indian view makes the world an emanation. Individuality is regarded as having arisen from limitation of the abstract essence or being of the Deity. Hence the individuality of material things, and also of souls, is a negation of true being, and must perish. That which distinguishes one being from another is an addition from without, involves externality, and is a fetter or hinderance preventing the attainment of the divine. Emancipation, "liberation of the soul," is accordingly the great object of the Indian philosophy. The *Sankhya Karika* begins: "Our inquiry is into the means of avoiding the three sorts of pain; for pain is embarrassment"—*i. e.* external limitation. Its solution is thus stated: "Through the study of (the twenty five) principles the conclusive, incontrovertible, one only knowledge is attained, that neither I am, nor is aught mine, nor do I exist." This passage is interpreted by some to mean the annihilation of the soul and its absorption into the nothingness of the absolute; by others it is understood as the escape from error and illusion to the clear knowledge of universal truth. One can see in this system a revolt against the irksome and galling limitations of the system of caste. The theoretical mind seeks relief from the rigid distinctions of particularity (tedious ceremonial observances) by a flight to the indefinite, vague, and empty ground and substance of all things, and finds solid satisfaction in contemplating the pure identity wherein neither caste differences nor the bewildering luxuriance of tropical nature, nor even the prolific creations of its teeming fancy, can any longer find subsistence to vex and weary it.

The *Sankhya* philosophy is supposed to date from a period anterior to the eighth century B. C., and its reaction against Brahmanism became a popular movement in the sixth century in the Boodhistic reformation of Sakyamuni, who taught the *Yoga* system with little change, and named its "deliverance of the soul from pain and illusion" the *Nirvâna*. WILLIAM T. HARRIS.

San Lazzaro, Island of, Italy. See APPENDIX.

San Lean'dro, p.-v., Alameda co., Cal., on Central Pacific R. R. P. 426.

San Lu'car de Barrame'da, town of Spain, province of Cadiz, on the left bank of the Guadalquivir, near its mouth. It is well built, carries on an active trade, and exports large quantities of wine and fruits. P. 18,130.

San Lu'is, p.-v., cap. of Costilla co., Col.

San Lu'is de la Pun'ta, town of the Argentine Republic, capital of a province of the same name, is beautifully situated, but indifferently built, and has no manufactures and very little trade. Its 5000 inhabitants are mostly engaged in agricultural pursuits.

San Lu'is Obis'po, county of S. W. California, extending from the Pacific Ocean to the Coast Range, watered by Guaymas and Salinas rivers, is mountainous, has important mines of gold, silver, and coal; also bituminous and warm sulphur springs. The valleys are exceedingly fertile. Staples, barley, wool, butter, and cheese. Sheep-raising is the chief industry. Cap. San Luis Obispo. Area, 2400 sq. m. P. 4772.

San Luis Obispo, p.-v. and tp., cap. of San Luis Obispo co., Cal., 9 miles inland from the bay of the same name, contains 5 churches, a female college and 2 schools, 1 bank, 1 newspaper, and railroad connection with one of the best harbors from San Francisco to San Diego. P. 1579 (1870—1871) 3000. O. F. THORNTON, ED. "SAN LUIS OBISPO TRIBUNE."

San Luis Park is partly in Colorado and partly in New Mexico. It is the largest of the great Rocky Mountain parks, and has the San Juan Mountains on the W. and the main chain of mountains on the E. It is traversed by the Rio Grande. Gold, silver, iron, and copper abound. The valley is inhabited by people of Mexican descent.

San Luis Potosi', state of the Mexican confederation, bounded by New Leon, Tamaulipas, Vera Cruz, Querétaro, Guanajuato, and Zacatecas, and comprising an area of 29,486 sq. m., with 476,500 inhabitants. It is traversed by several mountain-ranges, which to the N. W. enclose large plateaus, while to the S. E. they gradually slope down into low plains. The mountains are rich in precious metals, and are generally covered with beautiful forests of oak, pine, and cedar. The plateaus are treeless, but afford excellent pastures. The soil is everywhere fertile, and the climate is agreeable and healthy, except on the low and marshy coast. Agriculture and the rearing of sheep and cattle are the principal occupations; mining and manufacturing industry have declined.

San Luis Potosi, town of the Mexican confederation, capital of the state of the same name, on an elevated plain 6350 feet above the level of the sea, near the sources of the river Tampico. It is well built, contains many fine buildings and handsome public squares, and carries on a lively trade in wines and manufactured goods imported through Tampico, and in the rich products of its own surroundings. P. 33,581.

San Luis Rey, p.-v. and tp., San Diego co., Cal., on San Luis Rey River, near the Pacific coast. P. 335.

San Marcello Pistojese, Italy. See APPENDIX.

San Marco in Lamis, Italy. See APPENDIX.

San Mar'cos, p.-v., San Luis Obispo co., Cal.

San Marcos, p.-v., cap. of Hays co., Tex., on the great thoroughfare and stage-route from Austin *viâ* San Antonio to Mexico, and on the line of International R. R., 25 miles S. of Austin City, has several churches, excellent schools, and 1 newspaper. A series of boiling springs forming a great natural curiosity and affording fine water-power are located here. P. 742.

ISAAC H. JULIAN, ED. "WEST TEXAS FREE PRESS."

San Mari'no, the oldest and smallest republic in the world, is situated in Eastern Central Italy, and is governed by a legislative senate of 60 members elected for life, an executive council of 12, two-thirds of whom go out every year, and two presidents elected for six months. This has been the form of government since 1847, when the constitution was considerably changed. The territory of the republic is 22 sq. m. in extent, and embraces five small villages, with a pop. (in 1874) of 7816. The capital, of the same name, is perched on the crest of a mountain 2635 feet above the sea, and commands a splendid view of the Apennines on one side, and, at sunrise, of the Dalmatian coast, across the Adriatic, on the other. It is said to have been founded early in the fourth century by St. Marinus, a converted stone-mason, who fled from Rimini (13 miles N.) during the Diocletian persecution. Borgo, 500 feet lower down, is the residence of the principal inhabitants. The other three villages are Serravalle, Faetano, and Monte Giardino. There is a standing army of 131 officers and 819 men, and it has an annual revenue of about $22,000, the expenditures being a trifle less. The principal products are fruit, silk-worms, and wine, and there is some good pasturage. Gunpowder is manufactured. This little republic exists, of course, by the sufferance of its powerful neighbors, but owes much also to the good sense and energy of its citizens, the most distinguished of whom has been Antonio Onofri, a contemporary of the First Napoleon. There is a history of the republic by Melchiorre Delfico, a Neapolitan (1804). (See Augustus J. C. Hare's *Cities of Northern and Central Italy*, 1876.) R. D. HITCHCOCK.

San Martin, de (JOSÉ), b. Feb. 25, 1778, at Yapeyú, on Uruguay River, then capital of the province of Misiones, of which his father was governor; educated in the College of Nobles at Madrid; became aide-de-camp to the military governor of Cadiz; distinguished himself against the French at Baylen and subsequent battles, gaining the rank of colonel; returned to the La Plata 1811; entered the military service of the insurgents; was soon made a general and given command of a division; gained several victories in Upper Peru; became governor of the province of Tucuman 1813, and of that of Cuyo (now divided into Mendoza and San Juan) 1815; organized there an expedition for the liberation of Chili from the Spanish yoke; crossed the mountains early in 1817; gained a brilliant victory at Chacabuco Feb. 12 of the same year, and a still more decisive one at Maypú Apr. 5, 1818; organized the government of Chili, which he left in the hands of O'Higgins; sailed for Peru with the squadron commanded by Lord Cochrane Aug. 21, 1820; captured Lima, drove the Spaniards from the coast, and assumed the title of "protector" of Peru, 1821, but resigned that post in a mysterious manner the following year after an interview with Bolivar at Guayaquil, and sailed secretly for Europe, where he passed the remaining twenty-eight years of his life in absolute seclusion near Paris. D. at Boulogne, France, Aug. 17, 1850.

San Marti'no di Lupa'ri, town of Italy, province of Padua, with a fine church. P. 5296.

San Mate'o, county of W. California, occupying most of the peninsula between the Pacific Ocean and the Bay of

San Francisco, is traversed by Southern Pacific R. R., has several ranges of hills containing deposits of coal, rich plains, and fertile valleys in a high state of cultivation, yielding chiefly fruits, vegetables, butter, and cheese for the San Francisco market. There are mineral springs impregnated with sulphur and iron. Cap. Redwood City. Area, 432 sq. m. P. 6635.

San Mateo, p.-v. and tp., San Mateo co., Cal., on Southern Pacific R. R. P. 977.

San Mau'ro Castelver'de, town of Sicily, province of Palermo, about 19 miles from Cefalù and 12 miles from the sea. The pasturage of the district is excellent, and it exports cheese and manna. P. 5168.

San Miguel', town of San Salvador, Central America, on a navigable river of the same name, 20 miles from its mouth in the Pacific Ocean, in the Bay of Fonseca. Its surroundings, though very fertile, are thinly peopled, as the district is not healthful, yet the annual fair of the city is attended by many people and large sales are made. P. about 12,000.

San Miguel, county of E. New Mexico, adjoining Texas, on Rio Pecos and Canadian rivers, is mountainous, and chiefly devoted to sheep-raising. Cap. Las Vegas. Area, 10,800 sq. m. P. 16,058.

San Miguel, de (Evaristo), b. at Gijon, Spain, in 1780; served in the Spanish army and in the Cortes during the war of independence; afterward edited a liberal paper which drew on him the persecution of King Ferdinand VII.; took a prominent part, along with Riego, in the constitutional revolution of 1820; wrote the "Hymn of Riego," now the national hymn of Spain; became minister of foreign affairs 1822; was taken prisoner by the French "army of intervention" during the war of 1823–26; resided in England until 1834, after which he was for several years very prominent in the Cortes and in the government of Isabella II. as captain-general of Aragon and of the Basque provinces; took an active part in the revolution of 1854, at which time he was made president of the revolutionary junta and of the Cortes, minister of war and field-marshal, and in 1856 a grandee of the first class. D. at Madrid May 29, 1862. Author of a *History of Philip II.* (1847) and several other historical and political works.

San Miniato, Italy. See Appendix.

Sannaza'ro (Jacopo), b. at Naples July 28, 1458; educated at the academy of Pontano; travelled much, and began to write poetry to free himself from the overwhelming passion with which Carmosina Bonifacia inspired him; received great favor from King Frederick III. of Naples as a reward for his poems; followed him into exile in 1501, when he was driven from the throne by the Spaniards, and did not return until after his death. D. at Naples Apr. 27, 1530. The most remarkable of his Italian poems, of which a collected edition appeared at Padua in 1723, is *Arcadia*, a series of idyls partly in prose, partly in verse. His Latin poems comprise a long poem, *De Partu Virginis*, of which an edition was given by Becker (Leipsic, 1826), *Eclogæ*, and epigrams, among which is the famous poem in praise of Venice, which the senate rewarded with 600 ducats.

San Nican'dro Gargani'co, town of Italy, province of Capitanata, on the Gargano, at the western foot of Monte Origoni, about 4½ miles from the Adriatic. P. 7895.

San Pab'lo, p.-v., Contra Costa co., Cal., on San Pablo Creek and San Francisco Bay. P. 1075.

San Pas'qual, p.-v., San Diego co., Cal. P. 275.

San Pasqual Valley, an Indian reservation in San Diego co., Cal. P. 117.

San Patri'cio, county of S. Texas, on the Gulf of Mexico, between Aransas and Nueces rivers, is largely covered with mezquite bushes and other small trees, and is subject to summer droughts. Pasturage is the chief industry. Cap. San Patricio. Area, 550 sq. m. P. 602.

San Patricio, p.-v., cap. of San Patricio co., Tex., on Nueces River.

San Pete, county of Central Utah, adjoining Colorado, intersected by Green River and the Wahsatch Mountains, watered by Sevier River, has considerable timber, and is well adapted to agriculture. Staples, wheat, potatoes, hay, wool, and butter. Cap. Manti. Area, about 7000 sq. m. P. 6786.

San Pier d'Arena, Italy. See Appendix.

San Pierre', p.-v. and tp., Starke co., Ind., on Louisville New Albany and Chicago R. R. P. 105.

San Pie'tro in Casa'le, town of Italy, province of Bologna, well built and the centre of a very active traffic in agricultural products. P. 8480.

San Quen'tin, p.-v., Marin co., Cal., on San Francisco Bay.

San Ra'fael, p.-v. and tp., cap. of Marin co., Cal., 15 miles N. of San Francisco by ferry and cars, has 4 churches, 3 academies and 1 public school, a handsome county building, a fire company, 2 carriage manufactories, 2 newspapers, 2 lines of railroad, and 3 of stages. It is a favorite resort for consumptives and asthmatics. P. of v. 841; of tp. 2695. S. F. Barstow, Ed. "Journal."

San Remo, Italy. See Appendix.

San Ro'que, town of Spain, province of Cadiz, on the Bay of Gibraltar, was built by the Spaniards after the loss of Gibraltar. It is celebrated for the salubrity of its climate, the cheapness of living, and the beauty of its women. It produces great quantities of fruit and vegetables, in which it carries on a considerable trade with Gibraltar. P. 7619.

San Sa'ba, county of W. Texas, bounded N. and E. by Colorado and traversed by San Saba River, consists of rolling prairies with a few hills. Staples, wheat, sweet potatoes, molasses, honey, and wool. Cap. San Saba. Area, 700 sq. m. P. 1425.

San Saba, p.-v., cap. of San Saba co., Tex. P. 168.

San Salvador', or **Banza Congo,** the capital of the territory of Congo, Western Africa, on the river Lelunda, 50 miles from its mouth, was in the sixteenth and the beginning of the seventeenth century a large and flourishing place, but is now only a heap of ruins.

San Salvador, city of Brazil. See Bahia.

San Salvador, the smallest of the Central American republics, is bounded W. by Guatemala, from which it is separated by the river Paza; N. by Honduras; E. by the Bay of Conchagua or Fonseca; and S. by the Pacific Ocean. Area, 7230 sq. m. P. 600,000, of whom 9000 are white, of Spanish descent, 1000 negroes, 290,000 mestizoes, and 300,000 Indians, who speak Spanish and profess the Christian religion. Between the coast land, which consists of a belt of low, level ground of an average breadth of 15 miles, and the lofty Cordilleras on the frontier of Honduras, there runs through the whole length of the country, and forming with the Cordilleras a broad inland valley, a range of volcanic mountains, whose highest points are San Vicente and San Salvador, each more than 9000 feet high, and in which sixteen peaks are still active. The valley and the coast-land are exceedingly fertile, well watered by a number of short but copious streams, generally navigable and well adapted to irrigation. Although the climate is hot, the heat seldom becomes oppressive, and only a few districts are unhealthy. Agriculture is the chief occupation. The mineral wealth of the country, which at one time was considered immense, seems to be nearly exhausted. Cattle-rearing and dairy-farming are only pursued to a limited extent, though the country possesses a good breed of cattle; fishing is also of subordinate importance. The whole energy of the population seems to be concentrated on agriculture, and the result is by no means small. The total value of the exports for the year 1870 amounted to $3,810,916—namely, indigo, $2,447,550; coffee, $507,793; and sugar, $250,232. Indigo is the staple crop, being extensively cultivated and of superior quality. The extensive forests yield excellent timber, especially cedar, and yearly from 17,000 to 22,000 pounds of balsam of Peru. The total revenue of the state in 1869 was $830,371; expenses, $802,802. Every village of 50 inhabitants is compelled by law to maintain a school. Cap. San Salvador.

San Salvador, capital of the republic of San Salvador, Central America, in an elevated valley 2100 feet above the level of the sea, 5 miles from its port, La Libertad, at the foot of the volcano San Salvador, which rises 7100 feet. On Apr. 16, 1854, the city was entirely destroyed by a fearful earthquake, but it has been rebuilt on the same site, its commerce has revived, and it has nearly as many inhabitants. The climate is healthy, the situation beautiful, and the surroundings very fertile. P. about 16,000.

San Salvador, p.-v. and tp., San Bernardino co., Cal. P. 560.

San Salvador' de Baya'mo, town of Cuba, on an elevated plain near the Canto. P. 7100.

San Salvador Island. See Bahama Islands.

San Salvato're Monferra'to, town of Italy, province of Alessandria, 7 miles N. of Alexandria. There are mineral springs here of some reputation for the cure of scrofulous and cutaneous affections. This town belonged for many centuries to the marquisate of Monferrato. P. 7000.

Sansanding', town of Central Africa, state of Bambara, on the Joliba, has large markets, and is the entrepôt of an important trade in salt and gold-dust. P. 11,000.

Sanscrit Language and Literature. See Appendix.

Sans Culottes' [Fr., "without breeches"], a name bestowed early in the first French Revolution by the royalists

upon the [illegible] of the populace. The latter for a time accepted the name with much pride, but it was finally dropped.

San Sebastian. See Saint Sebastian.

San Secondo Parmese, Italy. See Appendix.

Sansepolero, Italy. See Appendix.

San Severino Marche, Italy. See Appendix.

San Severo, Italy. See Appendix.

Sanson′ (Nicolas), b. at Abbeville, France, Dec. 20, 1600, was teacher of geography to Louis XIII., afterward royal geographer, and prepared a great number of maps of the Roman empire, etc. D. at Paris in 1667. His two sons succeeded him as royal geographers, and after them followed his grand nephew, Robert de Vaugondy.

San′ta An′a, town of Central America, in the republic of San Salvador, is well built and contains several fine public buildings of the time of the Spaniards. Sugar and coffee are extensively cultivated in the vicinity. P. 10,000.

Santa Ana, county of N. W. New Mexico, adjoining Arizona, intersected by Rio Grande, San Juan, and Colorado Chiquito rivers, has a mountainous surface and a wide valley containing good farming lands, which, however, require irrigation. Cap. Jemez. Area, about 7000 sq. m. P. 2599.

Santa Ana, p. v. and tp., Los Angeles co., Cal. P. 1445.

Santa Anna, tp., De Witt co., Ill., on Indianapolis Bloomington and Western and Gilman Clinton and Springfield R. Rs., includes the v. of Farmer City. P. 1276.

San′ta An′na, de (Antonio Lopez), b. at Jalapa, Mexico, Feb. 21, 1798; served as a subaltern in the Spanish ranks against the insurgents during the first war of independence, attaining the rank of colonel; placed himself in 1821 at the head of the movement in Vera Cruz which seconded the "plan of Iguala," proclaimed by Iturbide for the achievement of Mexican independence under a monarch of the house of Bourbon; succeeded in expelling the Spaniards from Vera Cruz; was made a general by Iturbide, whom he recognized as emperor in June, 1822, but, having quarrelled with him, proclaimed the republic at Vera Cruz Dec. 2, 1822, initiating a movement which resulted in May, 1823, in the fall of the short-lived monarchy, the establishment first of a junta, and soon afterward in the election of Guadalupe Victoria to the presidency; lived several years in comparative retirement on his estate near Jalapa until 1828, when, in the bitter struggle between the rival presidential candidates, Gomez Pedraza and Guerrero, he *pronounced* in favor of the latter at the castle of Perote, marched upon Oaxaca, and there sustained a memorable siege, terminated only by the triumph of Guerrero in Mexico (1829); was appointed by the latter to a high command in the army; was sent against the expedition of Gen. Barradas, the last effort of Spain for the reconquest of Mexico, and succeeded in forcing that officer to capitulate with his whole army at Tampico Sept. 11, 1829—an event which obtained for the victor an immense popularity; acquiesced at first in the revolution by which Pres. Guerrero was overthrown by Vice Pres. Bustamante (Jan., 1830), but in 1832 took up arms against the latter, and after many sanguinary battles negotiated at Puebla terms of peace involving the resignation of Bustamante, the return of the legally-elected president, Gomez Pedraza, from the U. S. to serve out the balance of his unexpired term (Jan. to Apr., 1833), and the holding of a new presidential election. Santa Anna presented himself as the candidate of the liberal party, the first organization of the kind which has existed in Mexico; was elected president for four years, and inaugurated Apr., 1833, but soon retired on plea of ill-health to Jalapa, leaving to the vice-president, the distinguished statesman Dr. Valentin Gomez Farias, the task of attempting the ecclesiastical reforms which had been promised, and which soon led to a revolution headed by the Church party, to which Santa Anna gave in his adhesion, banishing the vice president and governing thenceforth in the interest of the reactionary spirit of the Church and the army, which found means to establish a practical dictatorship by the overthrow of the constitution of 1824 and the substitution of a clumsy and anomalous system known as the "organic bases" of 1835. The numerous insurrections which attended this change of system afforded a pretext to the Texan colonists to declare their independence, and Santa Anna, having marched against them, won the victory (or massacre) of the Alamo, Mar. 6, but was taken prisoner at the battle of San Jacinto, Apr. 21–22, 1836; negotiated during his imprisonment a treaty recognizing the independence of Texas, which was of course disregarded at the capital and covered his name with obloquy; was set at liberty and sent to the U. S. 1837; ascended the Mississippi and the Ohio; visited Pres. Jackson at Washington; returned to Mexico, and relapsed into obscurity at Jalapa until the French attack upon the fortress of San Juan de Ulloa in Dec., 1838, brought him again into prominence as the heroic defender of Vera Cruz, where he lost a leg, but continued to animate his troops with stirring words; which, combined with the fact that his injuries were for some weeks supposed to be of a mortal character, made him again a popular hero and martyr. In consequence, he was made acting president for some months in 1839, was placed at the head of a successful revolution which in 1841 overthrew the existing system of government, and was dictator until Dec., 1844, when a new uprising of the liberal party against his arbitrary acts made Gen. Herrera president; and, being taken prisoner while attempting to escape from the country, he was tried for treason (Jan., 1845), banished for ten years, and took up his residence at Havana. The war with the U. S. again directed attention to him, and returning secretly to Mexico, he was again made president by a popular movement which restored the liberal constitution of 1824. Defeated by Gen. Taylor at Buena Vista, Feb. 22, and by Gen. Scott in the battles from Vera Cruz to the Valley of Mexico Mar.–Sept., 1847, he was forced to flee from the country (1848), and resided quietly at St. Thomas and at Turbaco, New Granada, until 1853, when a conservative revolution once more placed him at the head of the government as dictator with almost unlimited powers. His despotic instincts now took free range, and he arrogated the title of "serene highness" as president for life, with power to name his successor, and sold the Mesilla Valley to the U. S. for $10,000,000. The impending triumph of the "plan of Ayutla" under Alvarez and Comonfort led to his flight from the country Aug., 1855, when he proceeded to St. Thomas, and was in his absence again tried for treason, and his vast landed property confiscated. During the war of reform he remained quiet, but during the existence of the French intervention he proceeded to Vera Cruz (May, 1864) and offered his services to Gen. Bazaine, but was immediately expelled from the country. Soon afterward he recognized the so-called "empire" of Maximilian, and was created a "grand marshal" by that prince, but was not allowed to return, and consequently began a series of intrigues with the government of the U. S., taking up his residence at Elizabethtown, N. J., whence he corresponded with Secretary Seward and Pres. Juarez to no purpose. After the fall of Maximilian he once more proceeded to Mexico with revolutionary intentions, but was taken prisoner at Sisal, Yucatan, tried at Vera Cruz, and condemned to death, but his sentence was commuted by Pres. Juarez to banishment for eight years. At the beginning of 1874 he took advantage of the amnesty to return to the City of Mexico, where he resided for a time in poverty and obscurity, having been unsuccessful in his appeals to congress and to the executive for the restoration of his confiscated estates. He was destitute of a regular education, but possessed great political shrewdness, and published a vast number of pamphlets and manifestoes. In 1874–75 he was engaged in the preparation of an *Autobiography*. D. at Vera Cruz June 20, 1876.

Porter C. Bliss.

San′ta Bar′bara, county of S. W. California, on the Pacific Ocean, bounded N. by Guaymas or Santa Maria River, watered by Santa Inez and other rivers, traversed by the sierras of San Rafael and Santa Inez, is mountainous in the eastern part, has fertile valleys along the coast noted for their luxuriant variety of subtropical fruits and vegetation. Gold, iron, copper, and petroleum are found. Sheep-farming and fruit-raising are the leading industries, grapes, oranges, and almonds being very abundant, and mulberry trees having recently been introduced with success. Cap. Santa Barbara. Area in 1870, 2800 sq. m. P. 7784. Since that time a portion of the county has been formed into a new county named Ventura.

Santa Barbara, p.-v., cap. of Santa Barbara co., Cal., about 260 miles S. of San Francisco, with which it is connected by steamboat, stage, and railroad, contains 6 churches, including an old mission cathedral of ancient build, the Santa Barbara and Franciscan colleges, St. Vincent's Institute, and a graded public school, 1 bank, 2 daily and 3 weekly newspapers, a circulating library, Masonic and Odd Fellows' lodges, and temperance and Patrons of Husbandry societies, several vineyards, and 2 excellent hotels. The town has water and gas, and its hot springs are becoming very popular with invalids. P. 4255.

J. A. Johnson, Ed. "Weekly Press."

Santa Caterina Villarmosa, town of Sicily. See Appendix.

San′ta Cathari′na, province of Brazil, bounded by the provinces of São Paulo, Paraná, and Rio Grande do Sul, and the Atlantic, comprises an area of 25,000 sq. m., with 140,000 inhabitants. On account of its mild and equable climate, the beauty of its scenery, and the inex-

haustible fertility of its soil this province has received the name of "the paradise of Brazil." Of the many islands which lie along the coast of this province, Santa Catharina, the largest, forms a bay which affords safe anchorage for the largest vessels.

San'ta Cla'ra, county of W. California, on San Francisco Bay, watered by Coyote and Guadalupe rivers, and lying between the Monte Diablo and Santa Cruz ranges of mountains, which are heavily wooded with fine timber, is traversed by the Southern Pacific R. R. and by San José branch of Central Pacific R. R., consists largely of a wide valley of surprising fertility, noted for its enormous crops of wheat, while the hillsides are equally favorable to the vine, has mineral and hot springs, and includes the New Almaden and Guadalupe quicksilver-mines, the richest in the world. Manufactures are rapidly being introduced. Cheese, butter, barley, hay, and hops are staples. Cap. San José. Area, 1332 sq. m. P. 26,246.

Santa Clara, p.-v., Santa Clara co., Cal., on Southern Pacific R. R., in the centre of the rich agricultural valley from which the town derives its name, 48 miles S. E. of San Francisco, contains 1 college (Santa Clara) and St. Mary's Academy, 1 bank, 1 newspaper, a tannery, a flour-mill, and hotel. P. 3469. EDS. "THE OWL."

Santa Croce sull' Arno, Italy. See APPENDIX.

Santa Cruz, an island of the West Indies, the largest and southernmost of the Virgin group, in lat. 17° 45′ N., lon. 64° 34′ W., comprises an area of 84 sq. m., with 22,760 inhabitants, and belongs to the Danes. The northern coast is hilly; the rest of the surface is flat. The soil is exceedingly fertile, and the climate not unhealthy, but hurricanes and earthquakes are frequent. Nearly the whole island is under cultivation; sugar and rum, both of excellent quality, are the principal products. The island was discovered by Columbus on his second voyage, and belonged successively to Holland, England, Spain, and France, which latter in 1733 ceded it to Denmark. The language is English. Cap. Christiansted.

Santa Cruz, county of W. California, lying between the Pacific Ocean and Monterey Bay, bounded E. by the Santa Cruz Mountains and S. by Pájaro River, consists chiefly of heavily-timbered mountains, is well watered, produces copper, coal, and some gold, and has several fertile valleys yielding fine crops of grain and vegetables. Butter, cheese, and swine are also produced in abundance. There are numerous saw-mills and several manufactories. Cap. Santa Cruz. Area, 432 sq. m. P. 8743.

Santa Cruz, p.-v. and tp., cap. of Santa Cruz co., Cal., 75 miles S. of San Francisco, on Monterey Bay, at the mouth of Lorenzo River, has 6 churches, 1 college, and a seminary, 1 savings and loan bank, 2 newspapers, 1 orphan asylum, 3 tanneries, 2 foundries, gasworks, 1 basket manufactory, 1 flour and 2 planing mills, 5 hotels, and repair-shops. P. of v. 2561; of tp. 4436. W. W. BROWNING, ED. "SENTINEL."

Santa Cruz (ANDRÉS), b. in Upper Peru (now Bolivia) in 1794; took part in the war of independence, rising to the rank of field-marshal; became Peruvian minister to Chili 1828; was elected president of Bolivia after the overthrow of Gen. Sucre 1829; placed himself at the head of the "Unitarian" movement in Bolivia and Peru, which countries he succeeded, partly by force, in uniting as the "Peru-Bolivian Confederation" (1836), consisting of the three republics of North Peru, South Peru, and Bolivia, each with a separate president and constitution, but subordinate for some purposes to Santa Cruz, who fixed his government at Lima in the double capacity of president of Bolivia and "supreme protector of the Peru-Bolivian Confederation." In 1837-39 he carried on a disastrous war with Chili, probably with the ulterior design of annexing that republic to the confederation, but that anomalous system of government was overthrown in 1839 by the combined efforts of Gens. Velasco and Ballivian, and Santa Cruz took refuge in Europe, never returning to South America. As a safeguard against any attempts at a revolution, he was kept constantly employed by successive administrations, both of Bolivia and of Peru, as minister to the courts of London, Paris, Rome, and Madrid. D. at Saint Nazaire, France, in Sept., 1865.

Santa Cruz de la Pal'ma, town of the Canary Islands, on the E. coast of Palma, at the head of a spacious bay, has some shipbuilding and trade. P. 5600.

Santa Cruz de Santia'go, cap. of the Canary Islands, on the N. E. coast of Teneriffe, in a somewhat unfertile and even unhealthy district. But it has an excellent harbor, making the city the chief commercial port of the islands. Wine, brandy, and cochineal are exported. The town and harbor are strongly fortified. P. about 11,000.

Santa Eufemia d'Aspromonte, Italy. See APPENDIX.

Santa Fé, town of the Argentine Republic, capital of a province of the same name, in a fertile and well-cultivated plain on the river Salado. It is well built, has a college, and carries on some trade. P. 10,670.

Santa Fé, county of Central New Mexico, drained by the Rio Grande and Rio Pecos and their affluents, and traversed by the principal chain of the Rocky Mountains, has several fertile valleys producing fruit and wine of superior quality. Sheep raising is the leading industry. Cap. Santa Fé, which is also the capital of the Territory. Area, about 1800 sq. m. P. 9699.

Santa Fe, p.-v. and tp., Alexander co., Ill., on Mississippi River. P. 600.

Santa Fe, p.-v., Butler tp., Miami co., Ind. P. 115.

Santa Fé, city and capital of the Territory of New Mexico and county-seat of Santa Fé co., the commercial centre, an archiepiscopal see of the Roman Catholic Church, and head-quarters of the military district, is 20 miles E. of the Rio Grande del Norte, on Santa Fé Creek; altitude 7044 feet; lat. 35° 41′ 6″, lon. 105° 46′ 30″. The soil is productive under irrigation for all the fruits and products of the 40th meridian; climate dry and moderate in temperature the year round. It is distant per odometer measurement, *viâ* stage-road, 430 miles S. from Denver, 210 miles S. W. of the railroad terminus at Trinidad in Colorado, 598 miles N. E. of Tucson, 280 miles N. of Mesilla, and has mail-coaches daily to railroad, and semi-weekly S. to El Paso and Silver City, and W. to Fort Wingate, and direct telegraphic communication N., E., and S. P. 5000, made up principally of natives of the country, except as represented in the Federal officers, the professions, and commercial classes. It had long been occupied as an Indian pueblo at the discovery and occupation by the Spaniards in the latter part of the sixteenth century; fragments of gold and silver ores are found, among other fragments of slag and pottery, in the edge of the foot-hills, indicating the existence of reduction works in days gone by, of which neither history nor tradition gives account. Mines of the precious and grosser metals in varying quantities, and extensive quarries of fine marble, gypsum, and limestone, are known in the surrounding mountains. The Pueblo (or Village) Indians, having been subjected to slavery, arose in 1680 and drove the Spaniards out of Santa Fé and the territory; they then erected in the plaza a stone enclosure, into which the public records and fixtures and decorations of the churches were cast and burned, and also filled up and obliterated all traces of mines developed. According to public records in the office of the secretary of the Territory, the Indians held possession of the country for fourteen years to a day, when they were finally reconquered by the Spaniards, who with their descendants continued successively, under the authorities of Spain and Mexico, to occupy and govern the country until the American occupation by Gen. S. W. Kearny, Aug. 18, 1846. On the authority of ex-Gov. Donaciano Vigil we give the following items of history: A custom house was first established here in 1821; in 1822 the first train of merchandise from the U. S. was brought into Fernandez de Taos by the five Robidoux brothers; two years later the first train of merchandise arrived at Santa Fé from the same source; in 1826 the first American mercantile house was established by Henry Clews & Bro.; there were about 20 American traders and trappers resident when taken possession of by the U. S. army. The Territorial government under the organic act was established in 1851; in 1862 the rebel forces under Gen. Sibley occupied the city for a few days, until


Cathedral of Santa Fé.

obliged to flee in consequence of defeat by the Union forces under Col. Slough, 1st Colorado Vols., at the battles of Pigeon's Ranch and Apache Cañon on Mar. 28; a substantial monument of granite and marble stands in the plaza, erected by the Territory in commemoration of the event. Among the local objects of special interest is the adobe palace erected previous to 1680, having been the quarters of the civil and military authorities up to 1851, and since occupied by the legislative assemblies and governors of the Territory; the San Miguel church, S. of the river, built, according to tradition, shortly after the Spanish occupation, and being the oldest church standing, if not the first church erected in the U. S.; and Fort Marcy, on the foot hills immediately adjacent to the town, built and occupied by Gen. Kearny in 1846. The city has 6 principal jobbing-houses, whose annual sales reach $2,000,000, 2 national banks, 1 daily and 1 weekly newspaper, an orphan asylum under the Sisters of Charity, 4 Roman Catholic and 2 Protestant churches, and 1 Presbyterian and 2 Roman Catholic academic schools. Archbishop Lamy has in course of erection a very substantial and imposing cathedral of stone, Roman Byzantine in design, cruciform in plan, with 270 feet length of nave and choir, and proportional otherwise, the corner-stone of which was laid in Oct., 1870.

WILLIAM G. RITCH, FOR THE "NEW MEXICAN."

Santa Fe de Bogota. See BOGOTÁ.

Santa Fiora, Italy. See APPENDIX.

Sant' Agata dei Goti, Italy. See APPENDIX.

Sant' Agata di Puglia, Italy. See APPENDIX.

Sant' Agostino, Italy. See APPENDIX.

San'ta Inez', tp., Santa Barbara co., Cal. P. 1038.

Santal. See SANDAL WOOD and SANTAL WOOD.

Santa'laceæ [from the principal genus, *Santalum*, sandal-wood], a small order of apetalous dicotyledonous plants widely distributed over the world, most nearly related to Loranthaceæ, but incompletely, if at all, parasitic, according with that order in having its ovules and seeds destitute of integuments. The sandal-woods are far the most important representatives of the order. The European are all herbs, as is *Comandra*, the commonest North American representative; but the Alleghanies have two shrubby genera; one of them, *Pyrularia*, oil-nut, has a large kernel abounding with acrid oil. The quandang-nut of Australia, however, is bland and edible. The "Australian cherry" (so called, "with the stone on the outside," is the nut of *Exocarpus*, supported on an apparent succulent red berry, which is formed by an enlargement of the tip of the flower-stalk. ASA GRAY.

Santaline. See SANTAL WOOD.

Santa Lucia del Mela, Sicily. See APPENDIX.

San'tal-Wood, Sanders, or **Saunders,** etc., from the *Pterocarpus santalinus*, imported from the East Indies, Ceylon, Madagascar, and the coasts of Coromandel and Malabar. It occurs in large billets, compact, hard, and of a dull murky-red color. Its coloring-matter is supposed to be similar to, if not identical with, that of bar and cam wood. It is only developed by age, and, while it is abundant in the trunks, is not found in the young branches. Wiedel (*Zeit. Chem.* [2], vi. 83) isolated two peculiar bodies from santal-wood: (1) *santal* ($2C_8H_6O_3.3H_2O$), colorless crystals, tasteless, odorless, insoluble in water, bisulphide of carbon, benzol, and chloroform, and only slightly soluble in alcohol and ether. Its alkaline solution is yellow, but becomes rapidly red in the air, and gives red precipitates with lime and baryta. Its alcoholic solution assumes a dark red color with ferric chloride. He obtained 3 parts from 1000 of wood. (2) *Santaline* ($C_{14}H_{12}O_4$), which differs from alizarine by only H_4. It has a magnificent scarlet color, with a green metallic iridescence, is insoluble in water, slightly soluble in alcohol and ether, and imparts a reddish purple color to alkaline solutions. Sandal wood is used chiefly on the Continent, to give a bottom to woollen cloth to be subsequently dyed with indigo, yielding by this combination a fine blue (*bleu de Nemours*), which is purple blue by reflected light. It also imparts a dark red to woollen and cotton goods, which assumes a rich brown on passing through a bath of bichromate of potash. With sumac it gives a dark brown, with fustic a light brown. See also SANDAL WOOD. C. F. CHANDLER.

Santa Margherita di Belice, Sicily. See APPENDIX.

Santa Margherita Ligure, Italy. See APPENDIX.

Santa Maria. See PUERTO DE SANTA MARIA.

Santa Maria Capua Vetere, Italy. See APPENDIX.

Santa Maria in Monte, Italy. See APPENDIX.

San'ta Mar'ta, city of Colombia, cap. of the state of Magdalena, on the Bay of Santa Marta, in the Caribbean Sea, near the mouth of Magdalena River, has monthly communication by steamer with New York and the West India ports, and maintains a considerable coasting-trade. The port is commodious, and defended by three fortresses. The Santa Marta mountain range rises in some peaks to 17,000 feet, and is not connected with the Andes.

San'ta Mar'tha, an ill-built and decaying town of Venezuela, South America, on an inlet of the Caribbean Sea, among fertile surroundings. P. about 5000.

Santa Mau'ra, or **Leucadia,** one of the Ionian Islands, about a mile off the western coast of Greece, with which it was formerly connected by an isthmus, comprises an area of 180 sq. m., with 20,327 inhabitants. The range of hills which traverses it from N. to S. ends at the southern extremity in some high white cliffs, which are called "Sappho's Leap," and from which the island received its name.

Santa'na (PEDRO), b. in Santo Domingo about 1810; headed the revolt of the eastern portion of the island, securing its independence from Hayti, 1844; was president 1844–48; repulsed a new Haytian invasion Apr. 22, 1849, acquiring thereby the title of "liberator;" was again president 1853–56 and 1858–61, but, becoming wearied of the efforts to preserve peace, negotiated in the latter year the reannexation of Santo Domingo to Spain. D. at Santo Domingo June 14, 1864.

Sant' Anastasia, Italy. See APPENDIX.

Santan'der, town of Spain, capital of the province of the same name, on a promontory in an inlet of the Bay of Biscay, where a spacious and perfectly safe harbor is formed by two moles and provided with convenient quays and docks. The surrounding hills are beautiful, covered with vineyards and forests, and rich in mineral springs and iron and copper ores. The rivers and the sea teem with fine fish. The city has several good manufacturing establishments. Wheat and ores are the principal items of exportation. P. about 35,000.

Santander', one of the nine confederate states of the United States of Colombia into which that country was divided by the constitution of 1858, is bounded N. E. by Venezuela, S. E. by Boyaca, and W. by the river Magdalena; includes the cities of Pamplona, Ocaña, and Rosario de Cucuta, the inhabitants of which are industrious and well educated. Area, 16,293 sq. m. P. 425,427. Cap. Socorro, a city of 12,000 inhabitants.

Santander (FRANCISCO DE PAULA), b. at Rosario de Cucuta, New Granada, Apr. 2, 1792; educated at the College of Bogota; served under Bolivar in the war of independence as colonel; became provisional vice-president of Cundinamarca; was chiefly instrumental in assembling at his native place, Rosario de Cucuta, in Jan., 1821, the constituent congress of delegates from Venezuela and New Granada, by which the two countries were united as the republic of Colombia, of which Bolivar was chosen president and Santander vice president (Oct., 1821); was in charge of the executive power from Dec., 1821, to Sept., 1827, while Bolivar was absent in Peru or engaged in campaigns; was re-elected vice-president 1827, but soon came into collision with the "liberator," to whom monarchical projects were attributed, and was soon banished from the country upon a charge of being concerned in a plot for the assassination of the former; resided several years in England, France, and Germany; was recalled after the dissolution of the centralized republic of Colombia, and chosen first constitutional president of the republic of New Granada, which office he filled 1833–37. D. at Cartagena May 6, 1840.

Sant' Angelo dei Lombardi, Italy. See APPENDIX.

Sant' Angelo di Brolo, Sicily. See APPENDIX.

Sant' Angelo Lodigiano, Italy. See APPENDIX.

Santa Ninfa, Sicily. See APPENDIX.

Sant' Antimo, Italy. See APPENDIX.

Santaquin', p.-v., Utah co., Ut.

Sant' Arcangelo di Romagna, Italy. See APPENDIX.

Santarem', town of Spain, province of Estremadura, on the Tagus, is in a very fertile district. P. 9000.

Santaro'sa (SANTORRE), COUNT OF, b. at Savigliano in 1783. While still very young he entered the Piedmontese army; in 1821 was minister of war during the brief revolutionary period. On the complete failure of the new Subalpine government he first retired to Switzerland, and thence to France, where he formed a close friendship with Victor Cousin, who afterward wrote his life; then went to London, and there became attached to Ugo Foscolo, but finally left England for Greece, where he d. in 1825, fighting for her independence. Author of a *History of the French Revolution*.—His son, COUNT PIETRO SANTAROSA, the friend of Silvio Pellico, wrote an admirable history of the Ciompi, and was constitutional minister of the

king of Sardinia. As it was during his ministry that the law Siccardi was passed, abolishing the special ecclesiastical tribunals, the archbishop of Turin, Luigi Fransoni, refused him the last sacraments of the Church.

San'ta Ro'sa, county of W. Florida, lying between Alabama and the Gulf of Mexico, bounded S. W. by Pensacola Bay and Escambia River, and traversed by Yellow and Blackwater rivers, has a level surface and a sterile soil. Santa Rosa Island lies off the S. coast. The western extremity of the island, on which is FORT PICKENS (which see), forms the sea-barrier of Pensacola harbor. Staples, rice and molasses. Cap. Milton. Area, 700 sq. m. P. 3312.

Santa Rosa, tp., San Luis Obispo co., Cal. P. 1111.

Santa Rosa, p.-v., cap. of Sonoma co., Cal., on North Pacific R. R., 60 miles N. W. of San Francisco, has 7 churches, 2 colleges, 1 private, high, and public schools, several flouring mills, a tannery, 5 hotels, 2 banks, 1 newspaper, and a fine water-supply. The manufacture of wine is extensively carried on, and the largest vineyard under one management in the world is located in this county. P. 2898. THOMAS L. THOMPSON, ED. "SONOMA DEMOCRAT."

Santee', tp., Clarendon co., S. C. P. 977.

Santee, tp., Georgetown co., S. C. P. 2571.

Santee Agency, p.-v. and tp., Knox co., Neb. P. 27.

Santee River is formed in South Carolina by the union of Wateree and Congaree rivers. It is navigable throughout for steamboats, and its length is 150 miles. Its lower course is through pine forests and low rice-lands. It reaches the Atlantic through the North and the South Santee.

Sant' Elia Fiumerapido, Italy. See APPENDIX.

Sant' Elpidio a Mare, Italy. See APPENDIX.

Santeramo in Colle, Italy. See APPENDIX.

Santerre' (ANTOINE JOSEPH), b. at Paris Mar. 16, 1752; led the mob against the Bastile July 14, 1789; was elected commander of a battalion of the national guard; played a conspicuous part in the riots of the Champ de Mars, the attack on the Tuileries (June 20, 1792), and the insurrection of Aug. 10; was appointed commander-in-chief of the national guard of Paris with the rank of general of division, and governor of the Temple during the imprisonment of the king, whom he escorted to the scaffold; was sent to the Vendée at the head of an army of 20,000 men, but was beaten at Coron Sept. 18, 1793; recalled, arrested as an Orleanist, but liberated after the fall of Robespierre; lost his influence and his fortune. D. Feb. 6, 1809.

Santhià, Italy. See APPENDIX.

Santia'go, central province of Chili, stretching from the Pacific Ocean to the frontier of the Argentine Republic, consists chiefly of ranges of mountains, embracing some of the highest peaks of the Andes, but with numerous broad, fertile, and picturesque valleys in a high state of cultivation; is traversed by the river Maypú; has productive mines, especially of silver and copper, and affords pasturage to immense herds of cattle. It is subdivided into the departments of Santiago, Melipilla, Rancagua, and Victoria. Area, 7800 sq. m. P. in 1872, 380,419. Cap. Santiago, which is also the capital of the republic.

Santiago, city, cap. of the republic of Chili and of the province of the same name, in a beautiful valley on both sides of Mapocho River, which is crossed by several fine bridges, near the W. base of the Andes, at a height of about 1800 feet above the level of the sea, is regularly laid out with wide and well-shaded streets, has several creditable public edifices, including the cathedral, the mint, the treasury and post-office, the archbishop's palace, the hall of congress, and the theatre, considered the finest in South America; is defended by two fortresses, which crown the hill of Santa Lucia in the centre of the city; has a university with 1200 students, a military academy, an academy of science, 2 normal colleges, a large public library, and numerous other educational, religious, and benevolent institutions, public and private, of high rank; has a magnificent *paseo* or drive extending along the banks of the Mapocho for 2 miles, decorated with good statues of San Martin, O'Higgins, Abraham Lincoln, and other patriots; has a considerable internal commerce; maintains 3 banks, 2 insurance companies, and a number of manufactures; is connected by railways with Valparaiso and Talca, and will be placed in communication with Buenos Ayres by the Transandine Railway, now (1876) in course of construction. Santiago was founded in 1541 by Pedro de Valdivia, and has suffered severely from earthquakes and inundations. An international exposition was held here in 1875. P. in 1865, 115,377; estimated in 1876 at 150,000.

Santiago, p.-v. and tp., Sherburne co., Minn. P. 156.

Santia'go de Composte'la, town of Spain, province of Galicia, at the confluence of the Sar and the Sarela, is the see of an archbishop, and has a magnificent cathedral, a university, and several educational and religious establishments, from which it chiefly derives its importance. The cathedral, said to contain the bones of the patron of Spain, the apostle James, was built in the eleventh century, is in the form of a cross 270 feet long and 204 feet broad, and contains six naves formed by beautiful Gothic pillars. Before the Reformation this church was annually visited by great crowds of pilgrims, but since that time the number of visitors has decreased and the city decayed. Some manufactures of linen, silk, leather, and paper are carried on, and the vicinity is very rich in cereals, vegetables, fruit, and wine. P. about 29,000.

Santia'go de Cu'ba, town and formerly capital of the island of Cuba, on the southern coast, near the mouth of the river Santiago. It has a spacious, safe, and strongly-defended harbor, is well built, and contains a fine cathedral and many other handsome public buildings, but its climate is hot and unhealthy. Its commerce is nevertheless very large: in 1867 the total value of its exports amounted to $8,250,000, and 537,994 cwts. of sugar, 4714 cwts. of molasses, 79,728 cwts. of coffee, 6199 tons of copper ore, and 14,470 sacks of cacao were exported, besides large quantities of rum, tobacco, cotton, etc. P. of city and district, 96,000—viz. 27,729 white and 68,271 colored.

Santiago del Este'ro, central province of the Argentine Republic, lying S. W. of the Rio Salado, which separates it from the Gran Chaco, is mountainous in the W., but elsewhere level or greatly undulating; has a hot climate and a poor soil covered with stunted vegetation. Agriculture is little practised, stock raising being the almost exclusive industry. The people are largely of Indian blood, and in a part of the state the Quichua language, introduced by a colony from Peru during the empire of the Incas, is still spoken. Education is little cared for, and there are no public institutions of any importance. Ponchos, lace, and woollen articles of considerable artistic merit are manufactured by hand. Area, about 35,000 sq. m. P. in 1869, 132,763. Cap. Santiago, which has a pop. of 7775.

Santia'go de los Caballe'ros, town of Santo Domingo, capital of a province of the same name, on the right bank of Yaqui River, is well built and has about 8000 inhabitants, mostly engaged in agriculture and cattle breeding, the manufacture of leather and tiles, and commerce. The old city of the same name, founded by the Spaniards in 1504 and destroyed by Dessalines in 1805, stood several miles farther to the N. W., on a less salubrious site.

Santillana (IÑIGO **Lopez de Mendoza**), MARQUIS OF, b. at Carrion de los Condes in 1398, son of the grand admiral of Castile, from whom he inherited great wealth; served with distinction in wars against Aragon and against the Moors and in the civil wars of Castile; enjoyed great influence at court, and was an eminent patron of letters, being himself the author of the *Comedieta de Ponza*, of a *Canto Funebre* on the death of Enrique de Villena, of a volume of proverbs in rhyme, *Refranes*, and of various other works. D. at Guadalajara Mar. 26, 1458.

San'to Domin'go, or the **Dominican Republic,** comprises the eastern and larger part of the island of Hayti in the West Indies, separated from the republic of Hayti by the river Pedernales, which flows to the S., and the river Daxabon or Massacre, which falls into the Bay of Manzanillo on the northern coast. Its physical geography and its history are given in the articles on HAYTI and DOMINGO, SANTO, PROJECTS OF ANNEXATION TO THE U. S. Its area is estimated at 18,000 sq. m.; its pop. at from 150,000 to 200,000, of which one tenth are white, Spaniards of unmixed descent, and the rest a mixture of Spaniards, Indians, and negroes, with a small number of pure negroes. The prevailing religion is the Roman Catholic, and the archbishop of Santo Domingo bears the title of primate of the Indies. Other denominations are tolerated, and the Methodists and Baptists have churches and schools, mainly supported by the colony of negroes which emigrated in 1824 from the U. S. and settled in the island. The republic is divided into five provinces—Santo Domingo, Azua de Compostela, Concepcion de la Vega, Santiago de los Caballeros, and Santa Cruz del Seybo. The government consists of a president, who is elected for six years and holds the executive power, and a senate, which has the legislative power and is composed of nine members, elected also for six years. The present president, elected Dec. 20, 1873, is Ignacio Gonzales. The finances are in bad order. In 1870 the receipts were reported to be $772,684, and the expenses $728,605, with a debt of $1,565,831 internal, and $757,700 foreign. The receipts are chiefly derived from customs duties. The rich natural resources of the country are very little developed. The gold and silver mines, which in the sixteenth century yielded an enormous profit, are

not now worked, even their location has in many cases been forgotten. The fine timber and cabinet-woods of the forests are often unavailable on account of the entire lack of roads. The coffee is in many places left to grow wild, and very little care is bestowed on the cultivation of tobacco and the cotton plant, which latter grows luxuriantly and yields a product of excellent quality. In 1863 the total value of the imports amounted to $1,500,000, of the exports to $2,000,000; but in 1870 the figures had decreased respectively to $560,000 and $700,000. The principal articles of export are tobacco, coffee, cotton, sugar, cocoa, ginger, hides, wax, mahogany, and dyewoods. The principal ports are Puerto Plata and Santo Domingo.

Santo Domingo, capital of the republic of Santo Domingo, at the mouth of the river Ozama, in lat. 18° 28′ N. and lon. 69° 55′ W., is surrounded with a wall 10 feet high, and has a good harbor. It was founded in 1494 by Bartolomew Columbus, under the name of Nueva Isabella, and was the first city built by white men in the New World. Several of the old buildings, among which is the cathedral, 1512–40, are still standing. The city has a college and some trade in cabinet and dyewoods. P. from 6000 to 10,000.

San'tonine, or **Santoninic Acid,** a crystallizable principle obtained from the drug *Santonica* or "Levant wormseed." Santonine occurs in flat, quadrilateral, colorless prisms, is inodorous and nearly tasteless, and practically insoluble in water. It is poisonous in overdose to the animal system, producing convulsive tremblings, dilatation of the pupils, and enfeebling of the functions of the heart and lungs. It also causes the urine to acquire an unnatural yellow color, and, what is very singular and as yet unexplained, it produces *yellow vision*, the field of view appearing as if seen through a yellow tinted medium. Santonine is exceedingly poisonous to the *Ascaris lumbricoides*, or round worm, a parasite infesting the intestines in man, and is consequently used in medicine as an anthelmintic or vermifuge. From its poisonous properties it must be given with care. EDWARD CURTIS.

Santorin. See THERA.

San'tos, town of Brazil, province of São Paulo, on the northern coast of the island of Enguá-Guaçú, in lat. 23° 55′ S., lon. 46° 19′ W. It has a good harbor and a steadily increasing trade. P. about 12,000.

Santo Stefano Quisquena, Sicily. See APPENDIX.

Santuck, p.-v. and tp., Union co., S. C. P. 1879.

San Vicen'te, town of Central America, in San Salvador, at the foot of the now extinct volcano of the same name, is regularly built and carries on some trade. The vicinity contains plantations of indigo and tobacco. P. 6000.

Sanvito al Tagliamento, Italy. See APPENDIX.

San Vito dei Normanni, Italy. See APPENDIX.

São Francis'co, or **San Francisco,** river of Brazil, rises in the province of Minas Geraes, in lat. 20° S., lon. 45° W., flows first N., then E., forming the boundary between the provinces of Pernambuco and Bahia, and falls into the Atlantic in lat. 10° 24′ S., after a course of 1652 miles. At 140 miles from its mouth the falls of Paulo Affonzo render it innavigable, but above these falls it becomes navigable once more, and continues so for upward of 900 miles.

Saône', river of France, rises in the department of Vosges at an elevation of 1476 feet above the level of the sea, flows S., and joins the Rhone at Lyons. Its entire length is 316 miles; it is navigable for a distance of 170 miles below the city of Gray, department of Haute Saône. It receives from the left side the Doubs.

Saône-et-Loire, department of France, between the two rivers Saône and Loire, and mostly occupied by the mountains of Côte d'Or. The mountains are low and rich in coal and iron, and on their gentle slopes is produced the celebrated Macon wine. On the excellent pastures along the rivers large herds of cattle and horses are reared. Area, 3270 sq. m. P. 598,344. Of 72,374 children of school age, 14,187 received no school education in 1857.

Saône, Haute. See HAUTE SAÔNE.

São Pau'lo, province of Brazil, bordering on the Atlantic and situated between the provinces of Paraná and Minas Geraes, comprises an area of 131,705 sq. m., with 835,000 inhabitants. The coast land is mostly low, and separated from the more elevated inland plateau by a chain of mountains which in some places extend to the sea. The province is exceedingly rich. Gold, silver, and sulphur are found, besides a number of gems. All S. European fruits are grown, together with those of the tropics, and forests abound. The climate in the low coast land is hot, moist, and often unhealthy; in the inland plateau cooler and more healthy. But the natural resources of the province are very little developed.

São Paulo, town of Brazil, capital of the province of São Paulo, on a tributary of the Tiete. It has an ecclesiastical seminary, a law-school, a school of medicine, and several other educational institutions. It is rather indifferently built, but beautifully situated, and carries on some trade and manufactures. P. 22,032.

São Pedro do Rio Grande do Sul. See RIO GRANDE DO SUL.

São Salvador, or **San Salvador,** city of Brazil. See BAHIA.

Sap [Lat. *sapa*, "must," or "new wine boiled thick"], the juice of plants. It is probable that the water of the sap and its ash constituents are taken up only by the roots. This dilute solution of inorganic matter is carried to the green tissue of the plant, where it is exposed to the air and concentrated by evaporation. From the atmosphere carbonic acid is taken up. Under the influence of sunlight the dissolved matters are assimilated, and the *crude sap* becomes *elaborated sap*. The prepared sap is fit to be used in growth or any kind of work in the plant, and it is carried to all points where it is needed. The transmission of crude and elaborated sap, and the laws which govern their transfer, will be treated of under VEGETABLE PHYSIOLOGY. Pres. W. S. Clark of the Massachusetts Agricultural College has recently conducted an extensive and valuable series of experiments upon the pressure of sap in our woody plants. (See *Reports of Massachusetts Agricultural College*, 1873 and 1874.)

Sap'ajou, a name corrupted from a South American term, and applied to New-World monkeys of the family Cebidæ, having a prehensile tail whose under surface is naked and callous toward the tip; the throat is not dilated. They are better known under the name *Ateles*, and constitute one of the most characteristic forms of American monkeys. THEODORE GILL.

Sapan'-Wood, from the *Cæsalpinia sappan*, a variety of BRAZIL-WOOD (which see), imported from Siam, Japan, the East Indies, etc.

Sapelo Island, one of the "sea-islands" of McIntosh co., Ga., in Atlantic Ocean, famous for its fine quality of cotton. P. 336.

Sap-Green, a coloring-matter obtained by boiling down the juice of the berries of the buckthorn (*Rhamnus catharticus*), after adding lime to prevent change by acid fermentation, which would turn the color red. The buckthorn is a native of Europe, but has made its way to the U. S., and grows wild in some parts. It is a shrub six or eight feet high, with branches that terminate with thorns. The berries contain four seeds, are about the size of a pea, black and shining, with green pulp, of disagreeable odor and nauseous bitter taste. They constitute an active purgative medicine, seldom used, as it causes griping pains. Sap-green is used chiefly as a water-color pigment.
HENRY WURTZ.

Sapinda'ceæ [from *Sapindus*, one of the genera], a large and important natural order of polypetalous exogenous trees and shrubs. As at present constituted, it includes the Staphyléaceæ, or bladder-nuts; the true Sapindaceæ, mostly tropical, but embracing the horse-chestnuts; and the Acerineæ, or maples. Some of the plants are poisonous, others medicinal, and some afford useful fruits.

Sapodil'la, the fruit of *Achras sapota*, a West Indian tree of the order Sapotaceæ. It is highly valued as a dessert fruit.

Saponification. See SOAP, by PROF. B. SILLIMAN, M. D., M. N. A. S.

Sap'onine, also called **Struthiine** [Lat. *sapo*, "soap"], a singular uncrystallizable substance obtained from the plant called soapwort or bouncing bet (*Saponaria officinalis*). It is also contained in *Gypsophila struthium* and many other plants. Bley discovered it; Bussy first obtained it pure; and Bucholz found 34 per cent. in the dry soapwort root, which makes with water a lather like soap. By first extracting the root with water and evaporating, then treating the extract with alcohol, a solution of saponine is obtained nearly pure. On evaporation the saponine appears brown, though white when pure, hard, brittle, sweetish in taste, followed by persistent acrimony. When inhaled in powder it produces violent sneezing. It is said to be poisonous, and, when injected into the cellular tissue of animals, to produce an extraordinary *local* paralysis of the muscles, without acting through the general nervous system. For its composition the following is assigned, but deemed questionable: $C_{12}H_{24}O_8$. H. WURTZ.

Sapony, tp., Dinwiddie co., Va. P. 2086.

Sapor. See PERSIA, by CLEMENS PETERSEN, A. M.

Sapota'ceæ [from *Sapota*, one of the genera], a natural order of gamopetalous exogenous trees and shrubs,

mainly tropical, but the Southern U. S. have a few species, chiefly of the genus *Bumelia*, none industrially important. But the tropical Sapotaceæ include many useful trees. The order is characterized by a tendency to milky juice and to rusty pubescence, especially on the lower face of the simple and alternate entire leaves; small and regular perfect flowers, fertile stamens as many as the lobes of the corolla, and opposite them, their anthers turned outward, alternating with a sterile series or set of petaloid scales, a several-celled ovary and fruit, ovules and seeds solitary in each cell, the latter large and nut-like, having a thick and bony coat. Sapodilla plums (see SAPODILLA), star-apples (from *Chrysophyllum Cainito*), marmalade (*Achras mammosa*), and the bully-tree fruit of Surinam (*Mimusops*) are among the prized tropical fruits of the order. The butter trees—so called from the bland thick oil they yield—are species of *Bassia*, and the milky juice of several species, notably of *Isonandra gutta*, is the source of gutta-percha. The wood is generally very hard and durable (iron-wood, etc.). ASA GRAY.

Sap'pers, Miners, and Pontoniers. Among the great improvements in the attack and defence of fortifications introduced by Vauban, not the least was the establishment of regularly-organized companies of sappers and of miners. The duties of these troops had previously been performed in a desultory manner by soldiers detailed from the artillery and infantry. The first company of sappers was organized about 1690 as a free company, under the command of Vauban himself. It was armed and drilled as infantry, and was instructed in all the works appertaining to sieges. The men were taught to make gabions, fascines, hurdles, etc., to trace lines and trenches, to drive the various kinds of saps (see SIEGE), to descend into and pass the ditch, to destroy the enemy's obstacles, to drain the trenches, to take care of the tools, to put up the various kinds of revetments, to post and superintend working-parties, and were expected also to serve in the mines when required. In the defence they were taught to adjust and sod the slopes, to place the various obstacles, such as palisades, fraises, etc., and to repair the defences when injured by the enemy's artillery. All of these duties are still performed by sappers. Three engineers, Goulon, Esprit, and Mesgrigny, organized in 1679, 1695, and 1705, respectively, each a company of miners, whose duties were the construction and service of mines and countermines. (See MINES, MILITARY.)

By the year 1705 these companies, as well as the sappers, had been attached to the artillery. They naturally belonged to the engineer service, but convenience of transportation and personal influence kept them with the artillery until 1759, when they were placed under the engineers. In the following year, however, they were returned to the artillery, where they remained until 1793, when they were finally attached to the engineers. The duties of pontoniers, or constructing temporary military bridges, had up to this time (1793) been performed by "artillery-workmen." The necessity of a better organization was evident, and companies of pontoniers were organized, continuing, however, to form part of the artillery.

The numbers of these troops were increased from time to time as the necessities of the service demanded; the present force in France is about 8000.

In England the corps of Royal Sappers and Miners was established in 1812. It performed the duties of pontoniers, as well as those indicated by its title. It was composed entirely of enlisted men, the officers being detailed from the Royal Engineers. In 1856 the two corps were consolidated under the name of the corps of Royal Engineers. The present force is about 4500 men.

In Prussia a company of pontoniers was created in 1715, and placed under the orders of the artillery. In 1742, Frederick the Great organized two companies of miners, which were at first attached to a regiment of pioneers, and afterward formed an independent corps. Previously to 1810 there were no regular sappers in the Prussian army, but in that year the pontoniers and miners were placed under the engineers and took the name of pioneers, a part of their duties being those of sappers. The present force is 10,800 men.

In the U. S. a company of "bombardiers, sappers, and miners" was attached to the corps of engineers (see ENGINEERS, CORPS OF) by the act of Congress of Apr. 29, 1812, but was discontinued in the reorganization of 1821. In 1846 a company of "sappers, miners, and pontoniers" was organized as part of the corps of engineers, and was sent to Mexico with the army of invasion. It took part in the siege of Vera Cruz, in the attack at Cerro Gordo, and formed part of the storming-parties at Contreras, Churubusco, and Molino del Rey. At Chapultepec it was engaged in the construction of batteries, occasionally fighting with muskets, and at the Garita San Cosmo it did excellent service as infantry. After the war it was stationed at West Point to assist in the instruction of cadets at the U. S. Military Academy. In 1853 a detachment accompanied Stevens's survey of the Northern Pacific R. R. In 1858 the company formed part of the Utah expedition, returning to West Point in the fall of the same year. In the fall of 1858 a detachment was sent to the Pacific coast, where it was engaged until 1861 in opening and repairing roads, constructing bridges, and in fortifying San Juan Island at the time of the boundary dispute. In 1861 this detachment proceeded to Washington, where it was engaged upon the defences and in the instruction of volunteer troops in the preparation of siege material. The main portion of the company was engaged during the summer of 1861 in the defence of Fort Pickens. In the fall of 1861 it joined the Army of the Potomac. An act of Congress of Aug. 6, 1861, added three companies, of 150 men each, to the engineer troops, and authorized one company of topographical engineers. In 1863 the corps of engineers and of topographical engineers were merged into one, and the strength of the battalion of engineers thus became five companies. One of these was not organized, however, until 1865. From the fall of 1861 until the end of the civil war the battalion formed part of the Army of the Potomac. The limits of this paper will not permit a detailed history of its services during that war. These were simply invaluable. Under Capt. Duane (now lieutenant-colonel of engineers and brevet brigadier-general) the original company had been thoroughly instructed in pontoniering, sapping, and mining. This instruction quickly pervaded the battalion, and it was thus enabled to give lessons to the volunteers which could be obtained from no other source. The battalion bears upon its colors, in addition to the names mentioned above in connection with the war with Mexico, the following: Yorktown, Fair Oaks, Mechanicsville, Gaines's Mill, White Oak Swamp, Malvern Hill, Antietam, Fredericksburg, Chancellorsville, Franklin Crossing, Kelly's Ford, Rappahannock Station, Wilderness, Po River, North Anna, Cold Harbor, Siege of Petersburg.

The following volunteer regiments were organized as engineer troops during the war: The 1st New York Engineers, in service from Sept. 10, 1861, to June 30, 1865, served as sappers in the siege of Fort Wagner and as pioneers and pontoniers with the armies of the Potomac and of the James; the 15th New York, in service from June, 1861, to June, 1863, served as sappers, pioneers, and pontoniers with the Army of the Potomac (another regiment, with the same title, raised between June, 1863, and Jan., 1865, performed similar duties with the armies of the James and of the Ohio); the 50th New York, in service from Sept., 1861, to June, 1865, performed similar duties with the armies of the Potomac and of the James; the 1st Michigan Engineers, in service from Dec., 1861, to Sept., 1865, served in the Army of the Cumberland, repairing and destroying railroads, building fortifications, etc.; the 1st Missouri Engineers, in service from Oct., 1861, to July 22, 1865, served in the Army of the Cumberland, repairing railroads and building bridges, and afterward had charge of the ponton-trains of the Army of the Tennessee during Sherman's march to the sea; the 1st U. S. Veteran Volunteer Engineers, in service from July 8, 1864, to Sept. 6, 1865, served in the department of the Cumberland. In addition to these, many infantry and artillery troops served as engineer soldiers when occasion required, the high character and intelligence of the volunteers rendering it an easy matter to find men capable of being quickly instructed in these duties. For example, the 48th Pennsylvania Infantry, composed largely of Pennsylvania miners, were readily transformed into military miners, and in that capacity executed the Petersburg mine (July, 1864), which as an engineering operation was a perfect success. In the Army of the James a company of the 1st Massachusetts Heavy Artillery, and one of the 9th Maine Infantry, acted as pontoniers. The 58th Indiana Infantry served as pontoniers in the armies of the Cumberland and of Georgia, and accompanied Sherman on his march to the sea. For mining at Vicksburg and Port Hudson practical miners were selected from the different regiments, and temporarily organized as military miners. The sapping at these sieges was done by details from the infantry, as it had been in the seventeenth century, before the time of Vauban. In all cases these troops served under the engineers when on engineer duty.

The most remarkable feats of the war in this branch of the service were, in mining, the Petersburg mine, above referred to; in sapping, the siege of Fort Wagner before Charleston, July to Sept., 1863; and in pontoniering, the bridge across the James River just above Fort Powhatan. The latter was over 2000 feet long in pontons, besides 200 feet of trestle-work. It was built by the regular battalion of engineers, two companies of the 15th New York, and part of a company of the 50th New York, in all about 450 men, in about five hours on the evening of June 15, 1864, the approaches having previously been prepared by the 1st

New York Engineers. The stream was rapid and deep, in [illegible] places [illegible] feet. This was the longest floating bridge [illegible] constructed by an army in the field. (See BRIDGES, MILITARY.) Another long bridge was built by the same [illegible] the Chickahominy in 1862. That stream was [illegible] different one, and a large portion of the bridge was built on trestles and cribwork. (See BRIDGES, MILITARY.) Though not falling strictly within the scope of this article, mention may here be made of the extraordinary feats of bridge-building executed by the construction corps—civilians—under the direction of a volunteer engineer—attached to Sherman's army during the Atlanta campaign. The railroad bridge across Etowah River, Ga., which had been destroyed by the enemy, was rebuilt by 600 men in six days. It was 625 feet long and 75 feet high. The railroad bridge across the Chattahoochee, near Atlanta, 740 feet long and 90 feet high, was rebuilt in 4½ days.

Upon the reduction of the army in 1870 the number of enlisted men in the battalion of engineers was limited to [illegible], one company being reduced to a skeleton of 10 sergeants and 10 privates; and in 1875 the number was further reduced to 200. One company of [illegible] men is stationed at the Military Academy at West Point, engaged in the instruction of cadets in practical military engineering. Small detachments are employed in surveying and exploration in the Western territory. The others are stationed at the engineer school of practice at Willett's Point, New York harbor. They are kept thoroughly drilled as infantry, and are well instructed in field fortification, sapping, mining, pontoniering, field sketching, and the service of torpedoes. The officers of the battalion are temporarily detailed from the corps of engineers, usually serving with it four or five years.

Napoleon I. considered the proper proportion of engineer troops to infantry to be 1 : 40. Since his day the advances in the art of war have somewhat increased this proportion. It should be especially large in a country like the U. S., where the army is rather a magazine of military knowledge than a force capable of resisting a powerful enemy. In France the proportion is 1 : 33; in England, 1 : 34; in Prussia, 1 : 36; and in the U. S., 1 : 60. O. H. ERNST.

Sap'phire [Gr. σάπφειρος; Lat. *sapphirus*], a gem, among the purest forms of the mineral species CORUNDUM (which see), which is crystallized alumina or sesquioxide of the metal aluminium. These, however, are not usually called sapphires by dealers in gems unless blue in color, the red stones being called *rubies*, the yellow ones often *topaz*, and the green *emeralds*, though the latter two names belong to entirely distinct minerals. (See EMERALD, TOPAZ, and PRECIOUS STONES.) H. WURTZ.

Sap'pho [Σαπφώ], b. in the island of Lesbos, at Mytilene or Eresos, a contemporary of Alcæus, Stesichorus, and Pittacus, founded a school of poetesses at Mytilene about 600 B. C., and enjoyed a great reputation herself among her countrymen for her poems. The details of her life and character are uncertain. She is said to have lived for some time in Sicily in exile. The comic dramatists of Athens introduced her often in their plays as a courtesan, but this conception seems to have originated from mere misunderstanding, if it were not simple slander. The story of the leap from the Leucadian rock on account of an unhappy passion for a young man, Phaon, is a fable. Her poems, comprising nine books, were mostly erotic; some, however, were satirical. They were written in the Æolic dialect, and in a great variety of metres, of which one, the Sapphic strophe, is said to have been invented by her. But only one poem, an ode to Aphrodite, has come down to us entire; the rest consist of fragments only. The best editions are by Neue (Berlin, 1827), and in the collections of Schneidewin (Göttingen, 1839) and Bergk (Leipsic, 1866). (For her life and character see Welcker, *Sappho von einem herrschenden Vorurtheil befreit* (Göttingen, 1816), and Schöne, *Untersuchungen über das Leben der Sappho* (Leipsic, 1867).)

Sar'aband [Pers. *serband*], a slow dance in ¾ time and of a peculiar rhythm. It is now out of fashion. In character it resembled the minuet. It was of Oriental origin.

Sar'acens, a name which with classical writers denotes a particular Arabian tribe, though the location of this tribe is not clearly indicated, but which afterward was applied to the followers of Mohammed or to those Mohammedan nations which invaded Europe. The etymology of the word is uncertain. It is sometimes derived from one Arabic root signifying "to plunder;" sometimes from another signifying "to rise," hence meaning *eastern*.

Saragos'sa, town of Spain, capital of the province of Saragossa, on the Ebro, was founded by the Phœnicians. Under the Romans it became a flourishing city, rose still higher under the Moors, and reached the culmination of its prosperity when (in 1118) it became the capital of the kingdom of Aragon. After the union of Aragon and Castile, when Madrid became the royal residence, Saragossa lost some of its splendor, and in 1809 it was nearly destroyed by the French, by whom it was twice besieged during the Peninsular war. The place was first invested June 15, 1808; after 49 days' stubborn resistance the siege was raised Aug. 4, but recommenced Dec. 20, and bombarded until Jan. 27, 1809, when the city was entered by general assault. The inhabitants defended the place house by house and street by street, and it was not until Feb. 22 that the place capitulated. By disease and war some 60,000 lives were lost during the siege, mainly by disease. It is still a splendid city, however, well built, containing many excellent edifices and establishments, and situated in a fertile, densely-peopled, and carefully-cultivated district. Of its two cathedrals, the one is an old building in Gothic style, the other a perfectly modern, rather singular, but rich and highly-ornamented edifice of the seventeenth century. Its university was founded in the fifteenth century, and enjoys still a high reputation, being generally attended by more than 1000 students. It has also an ecclesiastical seminary, a school of law, a medical school, 5 hospitals, and many other educational and benevolent institutions. Its former flourishing manufactures have declined, yet linen, cloth, silk, soap, hat, and saltpetre factories are in operation, and quite a lively trade is carried on. P. about 65,000.

Saragossa, Maid of. See AGUSTINA.

Sarahsville, p.-v., Centre tp., Noble co., O. P. 256.

Saraisk', town of Russia, government of Riasan, on the Oster, trades extensively in timber and cattle. P. 6029.

Saranac, p.-v., Boston tp., Ionia co., Mich., on Detroit and Milwaukee R. R. P. 724.

Saranac, p.-v. and tp., Clinton co., N. Y., on Saranac River, which here has several falls and affords abundant water-power. P. 3802.

Saransk', town of Russia, government of Pensa, at the confluence of the Saranka and Insara, manufactures leather, soap, and all kinds of wooden implements. P. 10,109.

Sarapool', town of Russia, government of Viatka, on the Kama, has manufactures of leather and a trade in timber. P. 5427.

Sarato'ga, county of E. New York, bounded N. E. by Hudson and S. by Mohawk River, intersected by Sacondaga River and other streams, is occupied in its N. W. part by the Adirondack Mountains, which contain deposits of iron ore; has many celebrated mineral springs in its central part, and is traversed by several railroads. Agriculture and stock-raising are the leading industries. Staples, potatoes, hay, Indian corn, oats, buckwheat, hops, honey, wool, butter, and cheese. There are numerous saw and flour mills and manufactories of carriages, saddlery, and machinery. Cap. Ballston Spa. Area, 780 sq. m. P. 51,529.

Saratoga, tp., Grundy co., Ill. P. 1233.

Saratoga, tp., Marshall co., Ill. P. 1163.

Saratoga, p.-v. and tp., Howard co., Ia. P. 104.

Saratoga, p.-v. and tp., Winona co., Min. P. 1058.

Saratoga, tp., Saratoga co., N. Y., on Hudson River and Saratoga Lake, has several mineral springs. P. 4052.

Saratoga, tp., Wilson co., N. C. P. 1108.

Saratoga, tp., Wood co., Wis. P. 300.

Saratoga, Battle of. The forced abandonment of Fort Ticonderoga by St. Clair in July, 1777, and the attendant disasters, involving the loss of vast quantities of supplies and ammunition, and the retreat of Schuyler from Fort Edward to Saratoga, thence to the mouth of the Mohawk, where he fortified himself, had produced a profound feeling throughout the country. Schuyler was unjustly held responsible, and early in September was superseded in command of the northern department by Gen. Gates. But before the latter's arrival great changes had taken place. Stark had gained a splendid victory at Bennington, Arnold had forced St. Leger to raise the siege of Fort Schuyler, the militia were rapidly assembling, and Morgan with his riflemen, 500 strong, had arrived when Gen. Gates assumed command, and the depression of a few weeks ago was now succeeded by a feeling of confidence and enthusiasm among the troops. Burgoyne, in command of the British forces, pressing on, crossed the Hudson Sept. 13 and 14, and encamped his army on the heights and plains of Saratoga. Gates meantime had moved his army up to Stillwater, and taken possession of Bemis's Heights, to the S. of Saratoga, near the river—a strong position—which he fortified. On Sept. 19, Burgoyne moved out, and was soon engaged with the left wing of the American army under Benedict Arnold, who had with him Morgan's riflemen. The battle, which began about 4 P. M., was continued until dark, each side repeatedly gaining possession of the

disputed ground; but at night the British held the field, having sustained a loss of over 500, that of the Americans falling below 300. Burgoyne now discovered that he had a dangerous foe in his front. He also learned of the capture of his fleet of boats laden with supplies by Lincoln's militia in his rear, and the destruction of his communications with Canada; but, receiving promise of aid from Sir Henry Clinton from below by way of the Hudson, he fortified his position and awaited the latter's coming. Clinton not arriving, and Burgoyne finding himself in danger of being cut off from retreat, and his supplies being nearly exhausted, determined to risk a battle, and on Oct. 7 advanced at the head of 1500 men, with 6 pieces of artillery. His right was at once attacked by a New Hampshire brigade and Morgan's riflemen. Arnold, who had been relieved from command after the battle of Bemis's Heights owing to some misunderstanding with Gen. Gates, and now acting without orders, placed himself at the head of the troops, and with great daring and recklessness led them into action. The British lines were repeatedly broken, and Burgoyne with difficulty regained his camp, but with the loss of his able second, Gen. Frazer. Gen. Arnold was also severely wounded in the leg. Renewing the assault, the Americans gained a lodgment in the camp, when darkness put an end to the conflict. During the night Burgoyne retreated and took possession of the heights in his rear. Fearful of being surrounded, however, he continued his retreat next day to Saratoga. Not receiving aid from Clinton, and every line of retreat being closed to him, it was decided in council to propose a cessation of hostilities while terms of capitulation were being negotiated. Gates at first demanded an unconditional surrender, which Burgoyne refused, and on the 17th terms were agreed upon—the British to march out with the honors of war, and be permitted to embark for England, on condition of not serving against the U. S. again during the war. The number of prisoners surrendered was 5752. Gates's army numbered upward of 10,000. The terms of the surrender were not ratified by Congress, Burgoyne's army being retained as prisoners until the close of the war. Burgoyne and several other officers, however, were permitted to depart: 42 guns, between 4000 and 5000 muskets, and a large supply of ammunition were among the valuable captures.

Saratoga Springs, p.-v. and tp., Saratoga co., N. Y., 36 miles N. of Albany and 186 from New York City, on the great trunk-line of railroads from New York to Montreal, is the leading and fashionable watering-place of America, celebrated for its numerous mineral springs, some of which have been bottled and exported to all parts of the world for over fifty years. The principal springs are the Congress, Hathorn, Empire, Geyser, High Rock, Excelsior, Star, Columbian, Washington, and White Sulphur. To accommodate the crowd of travelers who annually visit the place, numerous large hotels have been erected, finished, and furnished in a style equal to the best in the country, with accommodations for from 10,000 to 15,000 persons at one time. Of these, the principal are the United States, Grand Union, Congress Hall, Clarendon, Windsor, Columbian, American, Marion, and Holden House. At the first four named first-class orchestras are sustained in the season, and during the winter of 1875–76, Congress Park was laid out in walks, lakes, etc., with a large orchestra to play during the season. Large sums are spent annually in laying out and keeping up roads for rides and drives, the principal ones leading to Saratoga Lake, a beautiful sheet of water 4 miles from the village, where the college boating crews held their regattas in 1874 and 1875, the lake affording a straight-away course 3 miles or more in length, where fourteen boats can row side by side. Hotels at the lake accommodate numerous dinner-parties in the season. The great battle-ground, where Burgoyne was beaten by Gates in 1777, is 12 miles E. of the place, on Hudson River, and is accessible by good roads. The Saratoga Racing Association has one of the best mile tracks for running adjacent to the village, and two meetings are held in July and August each year, where the most celebrated thoroughbreds of the country meet. There are 8 churches—2 Presbyterian, 2 Baptist, and 2 Methodist, and 1 Episcopal and 1 Roman Catholic. A town hall costing $110,000 is used for conventions, concerts, and public entertainments. There are 1 daily and 3 weekly newspapers. P. of v. 7516; of tp. 8537. E. J. Huling, Publisher "Sentinel."

Saratov', government of Russia, on both sides of the Volga, comprises an area of 74,730 sq. m., with 1,725,178 inhabitants, among whom are about 100,000 Protestant Germans and 50,000 Mohammedan Tartars, Kalmucks, and Kirghees. Although a large portion of the government consists of desert steppes, much rye, wheat, and oats is exported, bees and silkworms are extensively reared, and many kinds of manufactures, fisheries, and distilleries are in operation.

Saratov, a large and rich city of Russia, capital of the government of Saratov, on the Volga, is for the greater part built of wood, but has many fine public buildings of stone, several hospitals, large bazaars, churches, schools, etc. It manufactures cloth, linen, tobacco, leather, earthen ware, rope, etc., has large breweries, distilleries, vinegar-factories, and foundries, and carries on an extensive trade in corn, cattle, and fish. P. 93,218.

Sarawak', kingdom of Borneo, East Indies, on the north-western coast of that island, on both sides of the navigable river Sarawak, is between lat. 0° 30' and 3° 20' N., and lon. 109° 40' and 111° 40' E., and was granted in 1841 to Sir James Brooke, with the title of rajah, by the sultan of Borneo. The capital, Sarawak, has about 25,000 inhabitants, and carries on a large and steadily increasing trade in timber, teak, sandal, iron, and camphor wood; in edible birds' nests, gutta-percha, sago, antimony ore, and rice, in exchange for which articles it imports European manufactures and tobacco.

Sar'ber, new county of Central Arkansas, bounded N. by Arkansas River, and watered by its affluents, has a broken surface, generally well timbered, but with some prairies and fertile river-bottoms. Staples, cotton, hay, Indian corn, and tobacco. Area, 625 sq. m. Name since changed to Logan co.

Sarcocol'la [Gr. σαρκοκόλλα, "flesh-glue," from its usefulness as a vulnerary], a nauseous gum resin produced by *Penæa sarcocolla*, *P. mucronata*, *Sarcocolla vulgaris*, etc., evergreen shrubs of the order Penæaceæ, ranging from the Euphrates to the Cape of Good Hope. It is now seldom used in civilized regions.

Sarcolac'tic Acid, or **Paralactic Acid,** a metamere of Lactic Acid (which see).

Sarcoph'agus [Gr. σαρκοφάγος, "flesh-eating"], a kind of stone formerly obtained at Assos in Lycia. It was much used for making stone coffins, which were believed to have the property of destroying the corpse within forty days. The powdered stone was also thrown upon dead bodies for the same purpose. In later times, as at present, all stone coffins are called sarcophagi.

Sar'cosine [Gr. σάρξ, "flesh"], an alkaloid product of the decomposition of Creatine (which see), the crystalline constituent of juice of flesh, discovered by Chevreul. Sarcosine is $C_3H_7NO_2$, and results, together with *urea*, on boiling creatine with baryta-water. Sarcosine forms colorless crystals, soluble in water with ease, but insoluble in ether and with difficulty in alcohol. It is neutral in reaction, though it forms salts with acids, which react acid. Sarcosine is obtainable from other sources than from creatine, as by the action of methylamine on chloracetate of ethyl. H. Wurtz.

Sarcoxie, tp., Jefferson co., Kan. P. 1876.

Sarcoxie, p.-v. and tp., Jasper co., Mo., on Memphis Carthage and North-western R. R. P. 1983.

Sard [Lat. *sarda*; Gr. σάρδιον, from *Sardis*, in Lydia], a rich and rare variety of carnelian, deep red, and, when seen by transmitted light, of a fine blood-red. (See Precious Stones.) It commands a high price.

Sardanapa'lus, a voluptuous and effeminate king of Assyria, whose name has become a byword, but whose exact place in Assyrian history is still undetermined. According to Ctesias (about 398 B. C.), followed by Diodorus Siculus (about 8 B. C.), he was the last of thirty kings who succeeded Ninus and Semiramis, all of whom were sunk in luxury and sloth. A formidable rebellion, headed by the Median Arbaces and the Chaldean priest Belesys, roused Sardanapalus to prodigies of valor, but he was at last shut up in Nineveh, and, after enduring a two years' siege, made a funeral pile of his richest furniture and burnt himself in his palace, with his concubines and eunuchs. This is not now generally believed to be veritable history. Ninus appears to be a fabricated name, and Semiramis to have been borrowed from Sammuramat, wife of Bin lik his III. (857–828 B. C.), later by 500 years than the legendary date of Ninus and Semiramis. Nor would any nation probably survive an unbroken succession of thirty dissolute kings. But most likely there was at some time a Sardanapalus, such as is described by Ctesias. Lenormant, Oppert, and Hincks identify him with the Asshur lik hish of the monuments, assigning 800 B. C. as the date of his accession, and 789 as the date of his death and of what may be called the first destruction of Nineveh. This first destruction of Nineveh is denied by the Rawlinsons, who identify Sardanapalus with the Asshur bani pal of the monuments, who died 626 B. C., after a reign of forty two years, and was succeeded by his son Saracus, whose name on the monuments is Asshur-emid-ilin. Saracus, perhaps, burned himself in his palace when Nineveh fell (625 B. C.).
R. D. Hitchcock.

Sar'dine [Gr. σαρδίνη, the "Sardinian fish"], a name applied to a number of fishes belonging to the family Clupeidæ, and especially to those preserved in oils and enclosed in tin boxes. The true sardine of the Mediterranean and neighboring waters is the *Pomolobus* or *Clupea pilchardus*, and a very near relative of this species (*Pomolobus sagax*) is found on the California coast. The sardine of the Mediterranean is dressed, salted, and partly dried, then scalded in hot oil, and finally hermetically sealed in tin boxes with hot salted oil or oil and butter. A few are preserved in red wine. The menhaden (*Brevoortia menhaden*) of the U. S. has within the last few years been extensively put up in the form of sardines, after its bones have first been softened by steam and the body trimmed to a proper size.

Sardin'ia, an island in the Mediterranean Sea, nearly midway between Spain and Italy, and between Europe and Africa, just S. of Corsica, from which it is separated by a channel 7 miles wide, called the Strait of Bonifacio. Area, 9205 sq. m. P. 636,660. The surface is mountainous. A range of mountains—whose highest peak, Genargentu, situated nearly in the centre of the island, rises 5276 feet—traverses the island from N. to S., and sends out branches to both sides. These mountains are in some places completely naked and barren, but in others they are covered with forests or with fine pastures, and almost everywhere they contain marble, alabaster, lead, copper, iron, rock-crystal, etc., though mines and quarries are not very much worked. Between the offshoots of the central range lie large table-lands or slightly sloping valleys, in which sandy and stony districts, perfectly sterile and unproductive, alternate with large tracts of very fertile soil. Along the coasts, which are in most places steep and rugged, are found extensive salt marshes and lagoons, to which the remarkable insalubrity of these places is generally ascribed. To inhale the gases with which in autumn the atmosphere is impregnated during night is death; the inhabitants move away or try to shut themselves up hermetically in their huts before sunset, and they never come forth until after sunrise. Agriculture is the main occupation of the inhabitants, though it is still in a backward state. Wheat, maize, and beans, wine, olives, figs, and oranges, tobacco, linseed, cotton, and madder, are raised in larger quantities than demanded by home consumption, and the production could easily be doubled by better implements and better methods. The fisheries along the coasts, especially of tunny, anchovies, and sardines, are very valuable, but are mostly in the hands of foreigners. Salt and gunpowder are the only manufactures of any importance, and both of them are monopolies of the government. The island has been in the possession of the house of Savoy since 1720, but until recently it has been shamefully neglected, old baronial and ecclesiastical forms of society being allowed to keep nine-tenths of the population in ignorance and indolence.

Sardinia, p.-v. and tp., Erie co., N. Y. P. 1704.

Sardinia, p.-v., Washington tp., Brown co., O. P. 164.

Sardinia, Kingdom of, was formed Aug. 24, 1720, by a treaty between Austria and Victor Amadeus II., duke of Savoy. The house of Savoy began to make itself felt in the history of Europe as early as the eleventh century, partly by the fidelity and vigor with which its members supported the emperors against the popes, partly by the shrewdness with which they steered through and profited by the wars between Germany and France, in which they could not help being implicated. In 1111, Amadeus III. was created count of Savoy by the emperor Henry V., and in 1416, Amadeus VIII. was created duke of Savoy by the emperor Sigismund. In the war of the Spanish succession (1700–13) Duke Victor Amadeus II. (1675–1730) was a claimant for the Spanish throne, and by the treaty of peace at Utrecht (1713) he received the island of Sicily and the title of king. Sicily he was compelled to yield to Austria in 1720, but as a compensation he received the island of Sardinia, from which he took his title of king, and thus was formed the kingdom of Sardinia, consisting of Savoy, Piedmont, and Sardinia, and comprising an area of 28,769 sq. m., with 5,167,542 inhabitants (1857). In 1831 the elder line of the house of Savoy failed, and the younger line ascended the throne with Charles Albert (1831–49). In his foreign policy Charles Albert was rather unsuccessful, but his interior administration was prudent and vigorous. The material resources of the country were developed with great sagacity, and the state was brought to a most prosperous condition. In 1848 he gave a free constitution, and the whole of Italy looked naturally to Sardinia and Charles Albert as the leaders in a war for liberty and independence. Charles Albert tried, and declared war against Austria, but on Mar. 13, 1849, was thoroughly defeated at Novara, and compelled to resign the crown to his son, Victor Emmanuel II., who succeeded in fulfilling the task of uniting the scattered Italian nation into one free state, for a history which see the article on ITALY.

Sar'dis, or **Sardes,** an ancient city of Asia Minor, the capital of Lydia, was at the foot of Mount Tmolus, on the river Pactolus, near its influx in the Hermus. Under Crœsus it was one of the wealthiest, most magnificent, and most luxurious cities of the East. Under the Romans it declined, and in the time of Tiberius it was entirely destroyed by an earthquake. It was rebuilt, but it never acquired its former splendor and importance. Now only a few ruins of its theatre and of a temple of Cybele are left in the vicinity of the village *Sarti*.

Sardis, tp., Bullock co., Ala. P. 1218.

Sardis, p.-v., Mason co., Ky. P. 149.

Sardis, p.-v., cap. of Panola co., Miss., on Mississippi and Tennessee R. R., 50 miles S. of Memphis, has 7 churches, an academy for males and females, 1 newspaper, 1 hotel, and a handsome court-house. P. about 1300.

L. C. BALCH, ED. "PANOLA STAR."

Sardis, p.-v., Lee tp., Monroe co., O., on Ohio River. P. 170.

Sardis, p.-v. and tp., Harrison co., West Va. P. 1599.

Sardou' (VICTORIEN), b. at Paris Sept. 7, 1831; studied medicine, afterward history; gained his livelihood as a teacher and by writing for papers, magazines, cyclopædias, etc.; tried his fortune as a dramatist in 1854 with the *Taverne des Étudiants*, which failed; tried again in 1860 with *Candide* and *Monsieur Garat*, which succeeded; and burst then upon the public with a productiveness almost unparalleled: *Les Pattes de Mouche*, *Piccolino*, *Les Femmes fortes*, and *Nos Intimes* in 1861; *Les Ganaches*, *La Papillonne*, and *Les Premières Armes de Figaro*, in 1862; *Bataille d'Amour* and *Les Diables noirs* in 1863; *Don Quichotte* and *Les Pommes du Voisin* in 1864; *Les Vieux Garçons*, *La Famille Benoiton*, *Nos Bons Villageois*, and *Maison neuve* in 1865, etc. Most of these plays made a great and decided success, and none failed, and about this time the author took rank by general consent as the first dramatist of his age, ruling the stage wherever there is one. The most prominent of his later works are *Séraphine* (1868), *La Patrie* (1869), and *Fernande* (1870).

Saree, town of Persia, province of Mazanderan, on the Tejend, 18 miles from its mouth in the Caspian Sea, is an old place, mentioned by Firdousi, but which long ago has lost its importance. In 1834 cholera destroyed nearly the whole population, and since that time it has been rising very slowly. P. between 20,000 and 30,000.

Sargas'so Sea, a name applied to certain great areas in the ocean which are often found almost covered with floating Gulf-weed (*Sargassum vulgare* and *bacciferum*) and other algæ. This principal sargasso sea is to the W. and S. W. of the Azore Islands, reaching to the Bahamas westward. Its area, according to Maury, is equal to that of the Mississippi Valley. The weed impedes the passage of ships and abounds in animal life. Its N. and S. boundaries are 36° and 19° N. lat. In the Pacific there is a sargasso sea some 500 miles E. S. E. of New Zealand, and another about 1000 miles W. of San Francisco; and still others exist. The weed is believed to grow from shallow banks at the sea-bottom, and to become detached.

Sar'gent, tp., Douglas co., Ill. P. 1035.

Sargent (AARON A.), b. in Newburyport, Mass., Sept. 28, 1827; was in early life a printer and editor; emigrated to California in 1849; studied law; was admitted to the bar 1854; was district attorney of Nevada co. 1855–56; vice-president of the Republican national convention at Chicago 1860; member of Congress 1861–63 and 1869–73, and U. S. Senator for the term 1873–79.

Sargent (EPES), b. at Gloucester, Mass., Sept. 27, 1812; spent several months with his father at St. Petersburg, Russia, in childhood; wrote some sketches of European travel for the *Literary Journal*, a paper conducted by himself and several other boys of the Boston Latin School, where he was educated; was two or three years a student at Harvard, and wrote for his brother's paper, the *Collegian*, but did not graduate; was for a short time on the editorial staff of the *Daily Advertiser*; assisted Samuel G. Goodrich ("Peter Parley") in several of his publications; wrote for Miss Josephine Clifton *The Bride of Genoa*, a five-act play successfully produced at the Tremont Theatre (1836), and for Miss Ellen Tree a tragedy, *Velasco*, brought out with equal success at Boston, New York, and Washington, and elsewhere throughout the country (1837), and some years later (1850–51) at Marylebone Theatre, London; became one of the editors of the Boston *Atlas* (1837), and was for some time its Washington correspondent; re-

moved to New York 1839, where he assisted Gen. Morris in conducting the *Mirror*; was afterward one of the editors of the *New Monthly Magazine* (1843); wrote a comedy, *Change makes Change*, produced at Niblo's Theatre; two juvenile tales, *Wealth and Worth* (1840) and *What's to be Done? or The Will and the Way* (1841), both of which passed through many editions; a *Life of Henry Clay* (1842), preferred by Mr. Clay to his numerous other biographies; a novel, *Fleetwood, or Stain of Birth* (1845), *The Mariner's Library*, and *American Adventure by Land and Sea*; and commenced editing the series of the *Modern Standard Drama* (7 vols., 1846–56); settled at Roxbury, near Boston, about 1847, in which year he published *Songs of the Sea and other Poems*; edited for several years the Boston *Transcript*; prepared a successful *Standard Speaker* (1852), which was followed by several other works on elocution and a series of readers (1855); edited the *Select Works of Benjamin Franklin, with Memoir and Notes* (1852); wrote brief biographies of Campbell, Rogers, Collins, Gray, Hood, and Horace and James Smith, prefixed to editions of their poems (1854–57); produced a tragedy, *The Priestess* (Mar., 1855), at the new Boston Theatre; wrote *Arctic Adventure by Sea and Land* (1857), a new volume of Poems (1858), *Original Dialogues* (1861), *Peculiar, a Tale of the Great Transition* (1863), *Planchette, or the Despair of Science, an Account of Modern Spiritualism* (1869), *The Woman who Dared, a Poem* (1869), *School Manual of English Etymology* (1873); has published several novels and other books anonymously; contributed largely to the *Knickerbocker*, the *Atlantic*, and other magazines; has been a favorite lecturer before lyceums, and is now (1876) preparing an elaborate work upon Spiritualism. Among his poems, several have been set to music and become popular favorites, especially the well-known song, *A Life on the Ocean Wave.* PORTER C. BLISS.

Sargent (HENRY), brother of Lucius M., b. at Gloucester, Mass., Nov. 25, 1770; studied art for several years at London under Benjamin West; became a distinguished painter at Boston; was adjutant-general of Massachusetts 1811, and afterward aide to Govs. Brooks and Strong, and invented an elevated railway. D. at Boston Feb. 21, 1845. His best known painting is *The Landing of the Pilgrims*, which he gave to the Pilgrim Society, and is widely known through engravings.

Sargent (JOHN OSBORNE), brother of Epes, b. at Gloucester, Mass., in 1810; educated at the Boston Latin School and at Harvard College, where he established a literary periodical, *The Collegian*, in which he was aided by his brother Epes, O. W. Holmes, and other students; graduated 1830; aided S. G. Goodrich in the preparation of his *Pictorial Geography of the World* (1831) and series of school histories (1832–33); studied law with William Sullivan; practised several years at Boston; sat in the Massachusetts legislature 1835–36; was an editorial writer for the Boston *Atlas* 1834–37; assisted Col. J. Watson Webb in the editorship of the New York *Courier and Enquirer*, contributing also as an efficient public speaker to the success of Gen. Harrison in 1840; practised law in New York 1840–48; took part in the political contest of 1848 by conducting the *Battery*, a Whig campaign paper; established with Alexander C. Bullitt, at Washington (1849), the *Republic*, a successful Whig newspaper; translated several books from the German; author of several legal and political pamphlets; published in 1844 an essay on modern *Improvements in Steam Navigation and the Arts of Naval Warfare*, with a biographical sketch of John Ericsson.

Sargent (LUCIUS MANLIUS), b. at Boston, Mass., June 25, 1786; entered Harvard College 1804, but did not graduate; studied law, but never practised; translated some minor Latin poems; published *Hubert and Ellen, with other Poems* (1813); took an active part in many philanthropic organizations, and particularly in the temperance cause, frequently appearing as a lecturer and writing a series of twenty one *Temperance Tales* (1833 *seq.*), which were translated into many languages; was for many years a contributor ("Sigma") to the Boston *Transcript*, in which paper he published *Dealings with the Dead, by a Sexton of the Old School* (republished in a volume 1856), *Reminiscences of Samuel Dexter* (1858), and *The Irrepressible Conflict* (1861), a review of Congressional discussions on slavery. He wrote a number of poems, never collected into a volume. D. at West Roxbury June 2, 1867. By his first wife, Mary, sister of Hon. Horace Binney of Philadelphia, he had three children, one of whom, HORACE BINNEY, b. June 30, 1821, graduated at Harvard 1843, became a distinguished cavalry officer during the war of the rebellion, and was brevetted brigadier general Mar. 21, 1864. (See *Reminiscences of L. M. Sargent*, by J. H. Sheppard.)

Sargent (LUCIUS MANLIUS, JR.), M. D., son of Lucius M., b. at Boston, Mass., Sept. 15, 1826; graduated at Harvard 1848; studied medicine; became house surgeon and dispensary physician at the Massachusetts General Hospital; was commissioned surgeon to the 2d Massachusetts Volunteers May 28, 1861, but soon exchanged that post for active service in the 1st Massachusetts Cavalry, rising to be lieutenant-colonel Sept. 30, 1864, and was killed in an engagement on Meherrin River, near Bellefield, Va., Dec. 9, 1864, while in command of his regiment.

Sargent (NATHAN), b. at Putney, Vt., May 5, 1794; received a good education; studied law; settled at Cahawba, Ala., 1816, where he became county and probate judge; resided at Buffalo, N. Y., 1826–30; established a Whig newspaper at Philadelphia 1830; was afterward Washington correspondent of the *United States Gazette*, becoming widely known under his *nom de plume* of "Oliver Oldschool;" was sergeant at arms of the U. S. House of Representatives 1849–51; register of the treasury 1851–53; commissioner of customs 1861–71; and was for some years president of the Washington Reform School. D. at Washington, D. C., Feb. 2, 1875. Author of a *Life of Henry Clay* (1844) and *Public Men and Events* (2 vols., 1875), issued but a few days before his death. It contains many interesting reminiscences of the days of Jackson, Clay, and Calhoun.

Sargent (PAUL DUDLEY), b. at Gloucester, Mass., in 1745; was wounded at Bunker Hill; commanded a regiment at the siege of Boston 1775–76, and a brigade in the summer of 1776; took part in the battles of Harlem, White Plains, Trenton, and Princeton; removed to Maine after the war, and was for many years judge of the court of common pleas in Hancock co. D. at Sullivan, Me., Sept. 15, 1828.

Sargent (WINTHROP), b. at Gloucester, Mass., May 1, 1753; graduated at Harvard 1771; became captain of one of his father's ships 1775; became navy agent at Gloucester Jan. 1, 1776; served at the siege of Boston as captain of artillery, and subsequently in the Long Island, New Jersey, and Pennsylvania campaigns, attaining the rank of major; was connected with Gen. Rufus Putnam's Ohio Company; was made by Congress surveyor-general of the North-west Territory 1786; became its secretary 1787; was adjutant-general of St. Clair's expedition against the Miami Indians 1791, and in Wayne's expedition 1794–95, being wounded in the former; was a member of the American Academy of Arts and Sciences and of the Philosophical Society, and an original member of the Society of Cincinnati as delegate from Massachusetts; aided Dr. B. S. Smith in preparing his *Papers Relative to certain American Antiquities* (1796); wrote some poems; was governor of Mississippi Territory 1790, and again 1801. D. on a voyage from Natchez to Philadelphia June 3, 1820.

Sargent (WINTHROP), grandson of Major Winthrop, b. at Philadelphia, Pa., Sept. 23, 1825; graduated at the University of Pennsylvania 1845, and at Cambridge Law School 1849; practised his profession at Philadelphia, and subsequently at New York; edited from original MSS., with a valuable introductory memoir, *The History of Braddock's Expedition against Fort Duquesne* (1855); edited *The Loyalist Poetry of the Revolution* (1857) and several reprints of curious Revolutionary tracts, and was author of *The Life and Career of Major John André, Adjutant-General of the British Army in America* (Boston, 75 copies only, 1861), a work of extraordinary research. He wrote largely for the *North American Review* and other magazines; was an accomplished bibliographer; was for many years engaged in preparing a *catalogue raisonné* of books relating to America (unfinished). D. at Paris, France, May 18, 1870.

Sargon. See ASSYRIA, by W. JACOBS, A. M.

Sarlat′, town of France, department of Dordogne, on the Sarlat, trades in walnut oil, liqueurs, wine, truffles, and cattle. P. 6586.

Sarma′tia, the ancient name for the vast region extending from the Baltic to the Black Sea, and from the Vistula to the Volga. The Romans, however, knew very little about this country.

Sarmien′to (DOMINGO FAUSTINO), b. at San Juan de la Frontera in the viceroyalty of Buenos Ayres Feb. 15, 1811; received a liberal education; became a teacher at San Luis; took part in politics as an opponent of Rosas; was consequently exiled to Chili in 1831; returned to San Juan in 1836; established there a ladies' seminary and edited a literary journal, but the province having fallen under the power of Rosas, he again went to Chili in 1840 and devoted himself to the cause of popular education, publishing a number of textbooks, editing several periodicals, and establishing many schools of different grades, including a normal college at Santiago. In 1845 the Chilian government sent him on an educational tour of inspection to Europe and the U. S., where he made the

acquaintance of Horace Mann and carefully studied his methods of instruction. In 1851 he returned to the La Plata, served as personal and military secretary to Urquiza in the campaign against Rosas, after whose fall he aided in framing the constitution of 1853; held several important ministries in the government of Buenos Ayres; became superintendent of public instruction, governor of the province of San Juan, and minister to the U. S. 1864–68. While holding the latter position he was chosen president of the Argentine Republic, a post which he filled with eminent ability and success from Oct. 12, 1868, to Oct. 12, 1874, when, being ineligible for re-election, he was succeeded by a distinguished member of his cabinet, Dr. Avellaneda. During his term of office the Paraguayan war was successfully terminated, two formidable insurrections were quelled, and an imminent danger of rupture with Brazil was more than once averted without any sacrifice of the national honor. Educational institutions of various kinds were founded in all the provinces, some of them being placed in the hands of American teachers; an astronomical observatory was created at Córdova under the management of Dr. Benjamin A. Gould; railroads and telegraphs were built with great rapidity; a vast European immigration was fostered; commerce was rapidly multiplied, lawlessness was sternly repressed, justice effectively administered, and the national finances managed with strict integrity. Pres. Sarmiento is recognized as one of the most enlightened of modern rulers. He has written largely for the press, being, like many other South Americans, at once a poet, a novelist, an essayist, an historian, and a political writer; but his chief laurels have been won as an educator. The best known of his books are *Viages por Europa, Africa y America*, *Civilizacion y Barbarie*, and *Vida de Lincoln*. PORTER C. BLISS.

Sar'nia, a port of entry, capital of Lambton co., Ont., Canada, at the head of Lake St. Clair. Here the Sarnia branch of Great Western Railway terminates, while at Point Edward, a northern suburb of the town, is the W. terminus of Grand Trunk Railway. Sarnia is connected with Port Huron, Mich., by a steam-ferry which plies throughout the year, while from Point Edward to Fort Gratiot, Mich., are ferry-boats by which railroad cars are carried across. Sarnia has 2 weekly newspapers, a large trade, a custom-house, thriving manufactures, and extensive commerce by rail and steamers. P. of town, 2929; of tp. 3458.

Sarno, Italy. See APPENDIX.

Saronno, Italy. See APPENDIX.

Sar'pi (PIETRO), commonly known under his monastic name, FRA PAOLO, b. at Venice Aug. 14, 1552; entered the order of the Servites in 1565, and became provincial in 1579 and procurator general in 1585. As such he resided at Rome, and enjoyed at first great favor at the papal court, but his studies of mathematics, physics, astronomy, and medicine, in which he acquired great learning, and is said to have made, or at least anticipated, several great discoveries—as, for instance, that of the circulation of the blood—and his liberal and independent views, made him soon suspected. In 1589 he returned to Venice, the republic having chosen him her councillor and theologian in the controversies with Pope Paul V. concerning the relation between Church and State. Sarpi opposed the papal claims with great energy, and exercised considerable influence on the attitude which the Venetian republic assumed toward the pope. He was consequently excommunicated as a heretic, and, as this had no effect, pursued by assassins, on account of which he was compelled to spend the later years of his life in his cell in the monastery, where he d. Jan. 14, 1623. In 1619 he published at London, under the pseudonym "Pietro Soave Polano," his *Istoria del Concilio Tridentino*, which was soon after translated into several other languages—into English in 1629 and 1676—and now forms the foundation of his fame. A collected edition of his works, among which his letters especially have great interest, appeared at Venice in 6 vols. in 1677. His *Life* was written by Bianchigovini in 1836, and by A. G. Campbell in 1875. (See also T. Adolphus Trollope, *Paul the Pope and Paul the Friar*, London, 1860.)

Sar'py, county of E. Nebraska, lying between Missouri River on the E. and the Platte on the S. W., is traversed by Union Pacific and Omaha and South-western R. Rs., has an undulating surface and a very fertile soil. Staples, Indian corn, wheat, hay, and butter. Cap. Papillion. Area, 235 sq. m. P. 2913.

Sarpy Centre, p.-v., Sarpy co., Neb., 16 miles S. W. of Omaha, has 2 churches, a free seminary, a public park, 1 newspaper, and 1 wagon and agricultural implement manufactory. The soil is very fertile, and gold bearing quartz has been found, assaying 20 ounces to the ton. P. including co., 3800. ALLEN GERRISH, ED. "SENTINEL."

Sarrace'nia [named in honor of Dr. Sarrazin of Quebec], a remarkable genus of E. North American herbs of the natural order Sarraceniaceæ, remarkable for the expanded petal-like style, and especially for the hollow pitcher-shaped leaves, usually half full of water, and containing many drowned insects. Of the six species, *S. purpurea* is the commonest. Its roots, and those of *S. variolaris*, recently had a great but transient reputation as a remedy in smallpox.

Sarracenia'ceæ, the natural order of pitcher-plants, of which the above is the principal genus and the type. (See PITCHER-PLANTS.)

Sarreguemines', town of the German empire, province of Alsace, on the Sarre, has celebrated manufactures of pottery, hemp, silk, satin, velvet, leather, paper, gloves, etc. P. 6075.

Sarsaparil'la, the roots of certain species of smilax, indigenous in the northern part of South America and in Central America. Exactly what are the species that afford the sarsaparillas used in medicine is not yet definitely known, although the history of the drug dates back to the sixteenth century; but *S. officinalis* and *S. medica* are doubtless two genuine sources. The medicinal species of smilax are climbing plants, growing from a large woody root-stock, from which long fleshy roots grow horizontally in all directions. It is these roots that constitute the drug sarsaparilla. They vary in thickness from that of a quill to that of the little finger, and consist of a thick cortical portion covered with a thin epidermis of various colors, a thin ligneous layer, and a central medulla, which often abounds in starch. The roots have scarcely any smell, but when chewed produce a disagreeable acrid impression in the mouth, which persists for some time. Sarsaparilla contains a crystallizable principle called *parilline*, upon which such medicinal virtues as the drug possesses most probably depend. There are various sorts of sarsaparilla, obtained from different localities, which are most easily grouped into the *mealy* and *non-mealy*, according to the proportion of starch they contain. Of the mealy are Honduras, Guatemala, and Brazilian or Lisbon sarsaparilla, and of the non-mealy, Jamaica, Mexican, and Guayaquil. Sarsaparilla was at one time held in high esteem as a medicine, principally as a remedy for syphilis, but it is now accorded but feeble power, and where used is prescribed simply to assist the action of more potent drugs. EDWARD CURTIS.

Sars'field (PATRICK), earl of Lucan, b. in Ireland about 1645; served on the Continent in the English life-guards under the duke of Monmouth, and against him at Sedgmoor 1685; was at the Revolution a member of the Irish Parliament and one of the wealthiest and most influential Irish Roman Catholics; adhered to the cause of King James, to whom he offered his services in 1689; fought at the battle of the Boyne, July 1, 1690; surprised the English artillery before Limerick, and compelled William III. to raise the siege Aug., 1690; commanded the Irish reserve at the battle of Aughrim, July 12, 1691; exhibited great gallantry in the second defence of Limerick; obtained honorable conditions of surrender Oct., 1691; retired to France with a corps of Irish volunteers; distinguished himself at Steenkirke, Aug., 1692, and was killed at the battle of Landen, July 19, 1693.

Sartain' (JOHN), b. in London, England, in 1808; became an engraver; came to the U. S. 1830; settled in Philadelphia; introduced mezzotint engraving into America; also practised oil-painting; was editor and proprietor of the *Foreign Semi-monthly Magazine*; founder of *Sartain's Union Magazine*; published *Poetical and Prose Illustrations of Celebrated American Painters* (4to, 1852), and was the designer of several meritorious public monuments, among which is that to Washington and Lafayette in Monument Cemetery, Philadelphia.

Sarthe, department of France, extending on both sides of the Sarthe, comprises an area of 2371 sq. m., with 446,603 inhabitants. The surface is mostly level, and the soil often light and sandy. Wheat and wine are produced, but the rearing of cattle, poultry, and bees is the chief occupation. The manufactures comprise iron, glass, porcelain, and faïence. Of 51,584 children of school age, 12,556 received no school education in 1857. Cap. Le Mans.

Sar'ti (GIUSEPPE), b. at Faenza, Papal States, Dec. 28, 1729; received his musical education in Bologna; composed his first opera in 1752, *Pompeo in Armenia*, which had success; was director of the opera at Copenhagen 1756–65; visited London in 1769–70; was chapel-master at the cathedral of Milan 1779–84; went in that year to St. Petersburg as director of the opera. D. at Berlin July 28, 1802. He composed over thirty operas, of which

none, however, made any great impression, but of his church music his terzetto, *Amplius Lava Me*, is still remembered. He was the teacher of Cherubini.

Sar'to, del (Andrea), (real name, according to the best authority, Andrea Vannuchi; called Del Sarto from his father's trade, that of a tailor), b. in Florence in 1487; was from the beauty of his early works called "the faultless painter." He studied wood and metal engraving, and became a disciple of Pietro di Cosimo, but gained his best instruction from the works of Ghirlandaio, Leonardo da Vinci, Michael Angelo, and Raphael. His genius was of the sweet, gracious type; his works are pervaded by a sentiment of harmonious beauty. Had he himself been entirely free from the evil influences that corrupted his nature and vitiated his art, he would have stood even higher than he did. As it is, his best pieces, the *Madonna del Sacco*, the *Madonna del Trono*, the frescoes of the Nunziata and the Scalzo, have a singular charm of grace and color. But his unfortunate and miserable marriage with a beautiful but unprincipled woman was the cause of his demoralization as a man and artist. He became careless, mannered, and affected, repeated himself, worked for money and feverishly, and lost whatever of sincerity and earnestness he had. D. in Florence in 1530. The easel pictures of Andrea—*Madonnas*, *Holy Families*, altar-pieces, and such-like—are familiar to the visitors at foreign galleries. But it is only in Florence that he can be fairly judged. The story of his private life is one of the tragedies of biography. O. B. Frothingham.

Sarto'rius (Sir George Rose), b. Aug. 9, 1790; entered the navy at an early age; was present at the battle of Trafalgar; commanded a gunboat at the siege of Cadiz; in command of the Portuguese fleet 1830–31; knighted in 1841, and made K. C. B. in 1865. Author of several papers on naval warfare and engineering.

Sart'well (Henry Parker), M. D., Ph. D., b. at Pittsfield, Mass., Apr. 18, 1792; began the practice of medicine when nineteen years of age; served as surgeon during the war of 1812–15; settled at Bethel, Ontario co., N. Y., 1821, and at Penn Yan 1832; kept records of the weather for more than forty years, and for the same length of time was known as an enthusiastic and intelligent botanical collector, forming an herbarium of 80,000 species, now possessed by Hamilton College, Clinton, N. Y. About 1846 he devoted his whole time to the study of the genus *Carex*, and brought out *Carices Americanæ Septentrionalis Exsiccatæ* (2 parts, 1848; part iii. unfinished). D. at Penn Yan Nov. 15, 1867.

Sarzana, Italy. See Appendix.

Sarzeau', town of France, department of Morbihan, on a peninsula in the Atlantic, is much frequented as a watering-place, and has a trade in wine and silk. P. 6788.

Saskatch'ewan (or **Nelson**) **River,** one of the chief rivers of North America. The basin it drains is about 482,000 sq. m. in area, and is 1300 miles in extreme length from the most westerly source of the N. branch of the Saskatchewan, about lon. 117° 35′ W. (from Greenwich) and lat. 52° N., in the heart of the Rocky Mountains, to the source of the Winnipeg, lon. 90° W., lat. 48° 45′ N., 60 miles N. from Lake Superior, at the boundary of the province of Ontario, with an extreme width of 790 miles from the most southern source of Red River in Minnesota to the mouth of Nelson River, lat. 57° 06′ N., lon. 93° 35′ W., on Hudson's Bay. Length of the Saskatchewan by S. branch from source to sea, in straight courses of 10 miles, 1545 miles; with the requisite addition for sinuosities, 1732 miles at least by its channel. It slightly exceeds the Ganges and the Yukon of Alaska, similarly measured, in length, and is one-eighth greater in area of basin than the Ganges, but less than either in volume discharged. For 300 miles N. N. W. from lat. 49° N. (the U. S. boundary) the summit watershed of the Rocky Mountains is the western boundary of the valley of the Saskatchewan, which at the base of the mountains has an elevation of about 4000 feet above the sea. Its southern boundary, the watershed between it and the Missouri, declines from that elevation to 1500 and 1700 feet above the sea. The watershed between it and the river Athabasca on the N. W. rises in steps to 2500 feet. That between it and the river Churchhill or Beaver, on the N., is much lower and less continuous, their waters nearly connecting in some parts when high. On the S. E. and N. E. it is bounded by the summit-ridges of the Laurentian ranges that divide it from Lake Superior and from the other rivers falling into Hudson's Bay, varying from 1800 to 1500 feet above the sea. From these elevations it descends gradually, but unevenly, to Lake Winnipeg, which by latest observations is 710 feet above the sea, lying in the axis of greatest depression of surface, the mean elevation of which, from the Lake of the Woods to Great Slave Lake on the river Mackenzie, is under 1000 feet. The vast sloping plateau from this axis of depression to the base of the Rocky Mountains presents occasional eminences and ranges like the Riding Mountains W. of Lake Manitoba, and more westward the Touchwood, Thunder-breeding, Cypress, and Hand Hills, rising from 500 to 1000 feet over the adjoining plains, which are furrowed with deep and generally narrow valleys, in which nearly all the rivers flow. E. of the axis of depression the country is rugged and hilly. The sources of the N. and E. branches of the Saskatchewan are stated by Dr. Hector to be but a few miles apart, in a grand nucleus of lofty summit-glaciers about lat. 51° 40′ N., lon. 117° W., near Mount Hooker, 15,700, and Mount Brown, 1600 feet, in height, where the Rocky Mountains are 200 miles in breadth. Thence diverging 200 miles apart midway, they unite at 550 miles in direct distance eastward, the course of the N. branch being about 856 miles, the S. branch about 903 miles. At 260 miles up the latter it receives Red Deer River, about 115 miles long, on the left. About 177 miles up the N. branch it receives on the right Battle River, nearly 400 miles long. Measured in August, the volume of water passing in the N. branch was 25,261, and in the S. branch 34,285, cubic feet per second, or very little more than the mean of the Rhine. A little below their junction it measured 59,667 cubic feet per second. At 333 miles farther it enters Cedar Lake, 30 miles long; at 20 miles from which it enters Lake Winnipeg, descending 60 feet, 43½ of which is in the Grand Rapid, 2¾ miles long, commencing 5 miles from the mouth. The last 2 miles are swift waters. The Saskatchewan is narrow, varying from 220 to 660 yards in width below the forks. In the N. or lesser branch the navigation is obstructed at low water by shoals and shifting sandbars. There are two steamboats already on it. It is found, by warping up two rapids, that they can easily ascend from the head of the Grand Rapid, 5 miles from the mouth, up to Fort Edmonton on the N. branch, 850 miles, and probably very nearly to Rocky Mountain House, 160 miles higher. The average ascent in the 894 miles is 15 inches per mile. About 116 miles from its entrance to Lake Winnipeg, traversing the N. end of it for 50 miles, and Play Green Lake adjoining, 30 miles, with its volume of water more than doubled by the large tributary of Lake Winnipeg, obstructed in its course by many rapids and falls, with 710 feet of descent, it enters Hudson's Bay at York Factory, lat. 57° 06′ N., lon. 93° 35′ W.

Of the area drained by the Saskatchewan or Nelson River, that part of it E. of the Lake of the Woods and Lake Winnipeg is a rugged country of Laurentian formation, excepting 100 miles of the lower course of the river, which is in the Silurian plain of Hudson's Bay. W. of these lakes a parallel belt of Silurian formation extends to and over Red River, excepting from the mouth of the Assiniboine upward, where a belt of Devonian intervenes, increasing in breadth southward. The Silurian belt extends to about halfway between Lake Winnipeg and Lake Manitoba, above which it sweeps, with increasing breadth, more abruptly westward. A parallel belt of Devonian of irregular but nearly similar width extends westward of the Silurian, sweeping directly W. along the northern watershed. Then all westward to the Crystalline and Laurentian region of the Rocky Mountains, excepting where a belt of Carboniferous formation crops up along their base, is Tertiary, Cretaceous throughout. Of the Laurentian region E. of Lake Winnipeg, one-fourth may perhaps be arable, and of that one-half along the watershed will be found too cold for cultivation, the remainder, say 70,000 sq. m., being valueless except for timber, to which add 15,000, probably, in the Rocky Mountains equally valueless, with 20,000 on the lower course too cold for cultivation, and three fourths of the arid region on the S. Saskatchewan and Qu' Apelle, say 60,000; making together 165,000 sq. m. of the total area unserviceable, leaving 317,000 sq. m. of the basin of the Saskatchewan as arable land fit for cultivation. Excellent wheat, weighing 68 pounds to the bushel, was raised at Lake Athabasca in 1875, 340 miles N. of the Saskatchewan. A. J. Russell.

Sas'nett (William Jeremiah), D. D., b. in Georgia Apr. 29, 1820; graduated at Oglethorpe University in 1839; studied law, but abandoned it for the ministry, in which he speedily rose to eminence; paid great attention to the subject of education; wrote much in favor of the paramount importance of developing and cultivating the sensibilities in female education; filled the chair of English literature in Emory College, Ga., with great ability; also the presidential chair of Lagrange Female College, and also that of the East Alabama Male College at Auburn, Ala.; besides writing largely for periodicals, published two volumes, entitled, respectively, *Progress* and *Discussions in Literature and Religion*. He was a powerful preacher, a great debater, and a devout Christian; belonged to the Montgomery conference of the M. E. Church, South, at the time of his death, Nov. 3, 1865. T. O. Summers.

Sas'safras [from the Spanish *salsafras*], the *Sassafras officinale*, a shrub of the order Lauraceæ, becoming a tree in the Southern States. Its leaves are aromatic and highly mucilaginous, and the bark of the root is a powerful stimulant, with a pleasant taste and smell. It has considerable use in medicine, but is employed principally at present for flavoring purposes. Confectioners use it in the same way. The volatile oil is more frequently employed than the bark in substance. The wood is soft and brittle, but is sometimes employed for making boxes and drawers on account of its pleasant smell. Farther India and China produce the *Sassafras parthenoxylon*. The Brazilian sassafras is *Nectandra cymbarum*.

Sassafras, p.-v., Millington tp., Kent co., Md., on Sassafras River. P. 281.

Sassafras Fork, p.-v. and tp., Granville co., N. C. P. 1859.

Sassafras, Oil of, a highly fragrant essential oil, obtained from the root of the sassafras tree, which contains from 1 to 2 per cent. of it. It is heavier than water; boils at 430° F. St. Evre gives as its composition $C_{20}H_{20}O_4$.

Sassan'idæ, the name of a celebrated dynasty which reigned in Persia from 226 A. D. to 651. It ascended the throne with Ardshir, a son of Sassan, and was overthrown with Yesdigerd III. (632–651), who was murdered in that year, having previously been defeated at Cadesia (639) and Nahavend (641) by the caliph Omar. The reign of the Sassanidæ was an epoch of great prosperity. The boundaries of the empire were extended, and time after time the Roman legions retired, defeated and humiliated, from the frontiers. They were thoroughly beaten by Sapor I. (240–273) at Edessa, where the emperor Valerian was taken prisoner; again by Narsi (294–303) under Galerius; and most completely by Sapor II. (310–381) under Constantius; and again under Julian, who fell at Ctesiphon in 363. Bahram V. Gour (420–448) compelled the Byzantine emperor to pay a tribute to Persia, and this tribute was still paid to Chosroes II. (591–628). Internally, the state of the country was very flourishing. The reign of the Sassanidæ was the blossom of the Persian nationality in religion and in poetry. Magnificent cities, of which only the names and some ruins are left, were built and flourished, and by the aid of costly and ingenious aqueducts, canals, and other means of irrigation large tracts were covered with fields and orchards which a few years after the invasion of the Arabs were transformed into arid wastes. Thus, it cannot be wondered at that up to this very day the traditions of the family of the Sassanidæ are very vivid and much cherished among the Persians.

Sassari, Sardinia. See APPENDIX.

Sassoferrato, Italy. See APPENDIX.

Sassuolo, Italy. See APPENDIX.

Sas'sy Bark, one of the ordeal drugs of Western Africa, is the bark of *Fillæa suaveolens*, a large tree of the order Leguminosæ. Like the Calabar bean, it is a very poisonous narcotic, administered in Africa to supposed witches. Its properties are not well understood.

Sa'tan [Heb. שָׂטָן, "the fiend"]. The idea of Satan as the origin of all evil and the ruler of a realm of evil does not occur in those books of the Old Testament which were written before the Exile. It was introduced among the Jews during the Babylonian captivity through their acquaintance with the religion of Zoroaster. The Persian dualism, however, was absolutely irreconcilable with the monotheism of the old Judaism, and in the book of Job Satan is still the servant of God and dependent on him. In the period between the close of the Apocrypha and the appearance of Jesus the idea of Satan developed into a comprehensive demonology, supported by the Pharisees, though rejected by the Sadducees. This demonology passed directly into Christianity, and was still more strengthened and developed during the contest between Christianity and the heathen world. To many of the early Fathers the universe seemed to be divided between God and Satan, and history to consist of a struggle between them for the sole rule. The Middle Ages still clung to this view; and although in modern times it has faded away before the purer and more energetic conception of God as the One, the idea of Satan as the personal representative of evil still forms a part of the creeds of most Christian denominations.

Satellites. See ASTRONOMY, EARTH, MOON, JUPITER, SATURN, URANUS, NEPTUNE, and SOLAR SYSTEM.

Sat'in, a smooth and lustrous fabric of silk, of Chinese invention. Of the warp threads only one in every five or ten is raised to allow the shuttle to be passed, but each thread is raised in regular succession as the shuttle is thrown. It is woven with the right side uppermost.

Satin Bower-Bird. See BOWER-BIRD.

Satinet', a coarse fabric, of which the warp is cotton and the weft woollen. It was originally the name of an inferior variety of satin.

Satin Spar, a fibrous variety of carbonate of lime, found of snowy whiteness in England, Scotland, and elsewhere, which when polished has a lustre resembling that of satin. A fibrous kind of GYPSUM (which see) is also called satin spar, is softer than the above, and is frequently made into ornaments resembling cat's-eye.

Satin-Wood, a name given to several kinds of ornamental wood. The best is from Guiana, and is the wood of *Ferolia Guianensis*. Florida satin-wood is from *Xanthoxylum Floridanum*, a kind of prickly-ash tree. The West India satin-wood is from different trees, some of it of the very best, and others of the poorest quality. The rich and fragrant satin-wood of India is usually of good quality. It comes from *Chloroxylon Swietenia*, a cedrelaceous tree which yields a sort of wood-oil. Satin-wood is used in making workboxes, hair-brushes, and cabinet-work.

Sat'ire is the name of a peculiar species of poetry which originated with the Romans, and in this, its Roman form, died out with the Latin literature. The name *satira* was originally written *satura*, which, derived from the root *sat*, "enough," denoted a dish of different kinds of fruit mixed together, then a stew; with the satyr of the Greek mythology and the satyric drama of the Greek theatre it had nothing to do. In its primitive period, when it first arose out of popular life, the artistic form of the *satura* was dramatic, a scenic improvisation in various metres; but afterward, when under the hands of Lucilius the *satira* became a fixed and well-defined literary *genre*, it adopted the epic form, modifying the tone only of the hexameter, not its construction. As developed by Horace, Persius, and Juvenal, the æsthetic character of the *satira* was a blending of epic and lyric elements. Descriptions of men and manners characteristic of the age formed the epic materials which entered into the composition. But these descriptions were not given by the *satira* in the same manner as by the epopee; that is, in pure objectivity, merely for the sake of artistic representation. On the contrary, they had here another function—namely, to convey to the reader the sentiment with which the poet looked at them, the judgment which he passed on them, his indignation, his scorn; and this formed the lyric element of the composition. From the different manner in which these two elements were combined arose the difference between the satire and the didactic poem. The latter gave its propositions, its theses, directly in abstract form, and added the descriptions as illustrations, as persuasive arguments; while the former gave its verdicts only indirectly, seen through the descriptions, revealed in the picture by illuminating it; that is, the *satira* was humorous.

But although, as above mentioned, this species of poetry, this literary *genre*, died out with the Latin literature, it was only the form, the *satira* (properly speaking), which vanished; the substance, that which we call the satirical, or simply satire, and which was by no means invented by the Romans, continued to live. It flourished among the Greeks long before there existed any Roman literature, and two phases of it, parody and irony, the modern persiflage and sarcasm, were powerfully developed by them. But in Greece its form was principally dramatic. Aristophanes' comedies are dramatic satires, not comedies in the common use of the word, and large passages of Plato's dialogues, especially where Socrates is cornering some Sophist in his argument, are of a most brilliant satirical effect. And it continued to flourish in the Christian era in innumerable shades and under innumerable forms, and often burst forth in specimens compared with which the *satiræ* of Horace, Persius, and Juvenal are very insignificant; such as *Reineke Vos*, *Epistolæ Obscurorum Virorum*, *Don Quixote*, *Gulliver's Travels*, etc. In a volume or two of *Kladderadatsch*, *Charivari*, or *Punch* satire may be studied in all its phases and in all its forms. CLEMENS PETERSEN.

Satisfac'tion [Lat. *satisfactio*], in law, denotes, when used in a general sense, the acquittance of a legal claim, the legal compensation and settlement for injuries done, or the discharge of a debt or demand, as by the payment of the money due upon any obligation. As a generic term, it thus includes all the particular modes by which a pecuniary liability on the one side and right on the other are ended, so that they entirely cease to exist. In a more special and restricted sense the term is applied to the discharge of an obligation which is a matter of record—a judgment or a mortgage—where the discharge itself is also of record. At the common law an entry was made on the roll by an at-

torney of the judgment creditor which admitted that the judgment had been paid and satisfied. In the U. S. a written instrument, often called a "satisfaction-piece," is executed by the judgment creditor, or in certain contingencies by his attorney, acknowledging that the judgment therein described is satisfied. Upon filing this writing in the office where the judgment is entered and docketed, the clerk records a minute of that fact in the proper book and upon the docket. A similar entry is made by the clerk upon the filing of an execution by which the judgment has been satisfied. Recorded mortgages are discharged in a somewhat similar manner. In many of the States the mortgagee himself is required by statute to write a satisfaction upon the margin of the record, and a refusal on his part renders him liable to an action for damages. In other States the mortgagee executes and acknowledges before a proper officer an instrument in which he recites that the obligation has been paid, and delivers the same to the mortgagor or other party liable for the debt. On filing this writing in the office of the clerk, recorder, or register, it is itself thereupon recorded, and the mortgage is satisfied of record by an appropriate indorsement. The several means above described are intended to convey a public notice that the lien of the judgment or mortgage is destroyed, of the same nature as the original notice that their lien was in existence. JOHN NORTON POMEROY.

Sa'toralja Ujhely', town of Hungary, celebrated for its excellent wine and the granite-quarries in its vicinity. P. 6500.

Sa'trap [Gr. σατράπης; anc. Pers. *khshatrapâvan*; mod. Pers. *sitrab*], the ruler of a satrapy or province of ancient Persia. The old satraps imitated the absolutism and the tyranny of their royal masters, and on the decline of the old kingdom some of the satrapies became independent monarchies.

Satta'ra, town of British India, capital of a district of the same name, in lat. 17° 41′ N., lon. 74° 1′ E., has a fort, and is noted as one of the most salubrious and pleasant stations of Deccan, otherwise it is insignificant. The district of Sattara, comprising an area of about 11,000 sq. m., with 1,028,520 inhabitants, was incorporated in the British empire in 1848, the rajah who had reigned under British authority dying without heirs.

Sat'terthwaite (THOMAS EDWARD), M. D., b. at Spuyten Duyvel, N. Y., Mar. 26, 1843; graduated at Yale College 1864, at the College of Physicians and Surgeons, N. Y., 1867; served as a commissioned surgeon in the Franco-German war; is surgeon to Demilt Dispensary, microscopist to St. Luke's Hospital, and pathologist to the Presbyterian Hospital, N. Y., and has published a number of professional papers, among which are *Bacteria, their Nature and Relation to Disease* (in New York *Medical Record*, Dec., 1875), and an essay *On the Structure and Development of Connective Substances*, to which was awarded in 1876 the alumni prize of the College of Physicians and Surgeons.

Satura'tion, in chemistry [Lat. *saturare*, to "fill," "glut," "cram," "sate," or "cloy"]. The term *saturation* is used by chemists in *five* distinct senses: *First*, in the sense of saturation of *solvent* powers of liquids. There are here two cases—solutions of solids in liquids, and solutions of gases in liquids. (The subject is treated under the head of SOLUTION, SOLVENTS, AND SOLUBILITY, by HENRY WURTZ.) *Second*, in the sense of saturation of *absorbent* powers of solids for gases. The absorption of *liquids* by porous solids is scarcely to be classed among *chemical* phenomena, unless when accompanied by thermic changes indicating formation of chemical compounds, although in common parlance the term "saturation" is applied to this also. *Third*, in the sense of the saturation of *acidity* and *basicity*, and the formation of *neutral* salts, by the combination of acids and bases, or of electro-positive metals or radicals with halogens. (See SALTS, CHEMISTRY AND CLASSIFICATION OF, by HENRY WURTZ; also SALT-RADICALS, by the same.) *Fourth*, in a sense possibly somewhat akin to the last, referring to the limit of chemical combination of water with other compounds to form *hydrates*. This sense is distinct from *solutions in water*, which generally pass much beyond this limit, but it will also be treated under the head of SOLUTION, SOLVENTS, etc. *Fifth*, in the sense of saturation of the *equivalence*, or so-called "atomicity," of an element or radical by other elements or radicals (for which see VOLUMES, MOLECULAR). HENRY WURTZ.

Sat'urday [with the Romans *Dies Saturni*, "Saturn's day"], the seventh and last day of the week, is the Jewish Sabbath, and is called *Dies Sabbati* in the Roman Catholic breviary.

Sat'urn. The planet Saturn is the sixth in order of distance from the sun, and the third of the superior planets. It travels at a mean distance of 872,137,000 miles from the sun, but the greatest and least distances of Saturn from the sun differ from the mean distance by nearly 49,000,000 miles, being respectively 920,973,000 miles and 823,301,000 miles. The eccentricity of the orbit is 1.055996. The earth's mean distance being about 91,500,000 miles, and the variation of the earth's distance insignificant in comparison with the enormous distance of Saturn, the greatest, mean, and least distances of the planet from us when in opposition may be conveniently taken as 826,500,000, 777,500,000, and 729,000,000 miles respectively. An account being taken (as in the case of MARS, which see) of the varying degree to which the planet is illuminated, it appears that when Saturn is at his nearest, in opposition, he can be more favorably examined than when at his remotest opposition distance in the proportion of about 8 to 5—a noteworthy difference, which has not been sufficiently taken into account in our books of astronomy. Saturn circuits his orbit in a period of 10,759.2198 days, or 29 years 167.2 days. His synodical period, or the interval between successive oppositions, exceeds a year by about $12\frac{3}{4}$ days on the average. His volume exceeds the earth's about 700 times, but his mean density is so small that his mass only exceeds hers about 90 times. In fact, his mean density is less than that of any known member of the solar system (except, of course, the comets), being only 0.13 when the earth's is taken as unity, or, if the density of water be taken as the unit, that of Saturn is about .73, or less than the density of mahogany. His mean diameter is about 70,000 miles, his compression about $\frac{1}{10}$, so that the polar diameter is about 3500 miles less, and the equatorial diameter about 3500 miles greater.—Saturn is distinguished among all the planets by the remarkable complexity of his structure and the number of subordinate bodies over which he bears sway. His gigantic orb is girt about by a mighty system of flat rings, the span of which from outside to outside amounts to 167,000 miles, or more than six times the circumference of the earth. There are two chief bright rings, the outermost nearly 10,000 miles in width, the innermost about 17,500 miles in width, while between them there is a gap about 1500 miles across. Thus, the entire breadth of the system of bright rings amounts to nearly 28,910 miles. It is probable that each bright ring is subdivided into several others. Inside the system of bright rings there is a dark ring (discovered by the elder Bond of Harvard Observatory, Cambridge, U. S.), also probably multiple, which has a breadth of about 8700 miles. Between this ring and the planet intervenes a space more than 10,000 miles in breadth. This wonderful appendage has been the object not only of very careful scrutiny, but of much discussion. After a careful investigation of the difficult problems suggested by its motion and at least relative stability—an investigation in which Laplace, Peirce, Bond, and Clerk Maxwell have taken part—astronomers have been led to the conclusion that the rings are not continuous bodies, but consist of multitudes of small satellites, mixed probably with vaporous matter, travelling in flat flights around the central orb. This is, in fact, the only possible interpretation of the actual existence and continuance of the rings: for no system of continuous rings could continue to travel in dynamical equilibrium around Saturn, or bear the strains to which the tremendous attractive power of Saturn would subject them. The planet is attended by eight satellites, travelling at distances ranging from 3.36 to 64.359 radii of Saturn, so that the actual span of the orbit traversed by the outermost satellite amounts to more than 4,500,000 miles. This is the largest subordinate scheme within the planetary system. The sixth satellite, in order of distance from Saturn, is judged to be about 3000 miles in diameter, so that it is an orb nearly as large as the planet Mercury. The outermost is about as large as the least of Jupiter's satellites; the rest are smaller; and, somewhat singularly, the satellite which travels between the sixth and the outermost is the least of all, and can scarcely be discerned save in the most powerful telescopes. It was discovered by the elder Bond of Harvard; the sixth or largest by Huyghens; the two innermost by Sir W. Herschel; and the rest by J. D. Cassini. The globe of Saturn is marked, like that of Jupiter, by belts, but they are less distinct. The tint of the planet as a whole is yellowish, but the belts show considerable variety of color. An equatorial belt, nearly always seen, has a creamy-white color: the dark belts on either side are commonly cinnamon colored; while the polar regions show a faint tinge of azure. As in the case of Jupiter, the conclusion to which we are led by the careful study of these belts and of the probable condition of Saturn's globe is, that we do not see a solid or liquid orb, but only the outer parts of a deep and cloud laden atmosphere. In fact, while the general evidence in Saturn's case is identical with that already considered in dealing with Jupiter, there are some points of detail which are different, and afford even more convincing evidence as to the condition

of these giant planets. The belts of Saturn show a marked curvature when the planet is near those parts of the orbit where the summer or winter of Saturn is in progress (so far as the sun's elevation viewed from Saturn is concerned). Now, this curvature enables the astronomer on earth to determine whether the varying position of the Saturnian sun exercises any influence on the belts, which, if sun raised, would naturally exhibit the effects of the solar action. But, instead of any change corresponding to varying solar action, the belts, though not altogether unchanging, exhibit one markedly constant feature in the permanence of the great equatorial bright zone. This, if sun-raised, and therefore sun ruled, would travel northward and southward (as the Saturnian sun passed N. and S. of the celestial equator) through a range of fully 30,000 miles on the globe of the planet. Since, on the contrary, the belt remains persistently equatorial, the conclusion to which we are led is that it is due to some cause inherent in Saturn's globe. Doubtless, the actual cause is the intense heat still pervading that globe. It is worthy of notice that Prof. Peirce, in discussing the condition of the major planets of the solar system, has been led to the conclusion that they must still be intensely heated, deducing this result from the nebular theory of planetary genesis. Saturn, according to the observations of Sir W. Herschel, the Bonds, Airy, Coolidge, and others, exhibits at times strange changes of figure, his globe bulging out in the regions corresponding to our temperate zones, and being depressed at the poles and equator, or sometimes bulging out toward one polar region and being depressed at the other. The shadow of the globe on the rings also shows at times a very marked departure from the figure to be expected if a perfect oblate sphere cast a shadow on a plane ring. These peculiarities, perfectly inexplicable on the ordinary theory of the planet, are easily explained if the globe we see be regarded as bounded by cloud-masses in an exceedingly deep atmosphere, so that the actual figure of the disk may vary according as higher or lower cloud-strata form its boundary. The whole subject of the condition of the giant planets of the solar system is well worth careful study, carried out independently of notions which, though they have long prevailed, have never had any real basis in observation, or even any justification from analogy, since surely it can no more be regarded as reasonable to assume without evidence that Jupiter and Saturn resemble the earth, which they exceed hundreds of times in volume, than it would be to assume without evidence that they resemble the sun, which exceeds them hundreds of times in volume. R. A. Proctor.

Sat'urn, a mythical king of Italy, settled on the Capitoline Hill, which was also called the Saturnian Hill; introduced agriculture and social order among the aboriginal inhabitants, and instituted the Golden Age. After his death he was removed to the abodes of the gods, and a temple was raised for him at the foot of the Capitoline Hill. In the later Roman mythology he was identified with Cronos.

Saturna'lia [Lat.], the old Italian festival of the god Saturn, celebrated in ancient Rome with feasting and mirth. Slaves were permitted freedom of speech and act, and all classes threw off care and toil. During the republic it was celebrated on the 19th of December; Augustus made it embrace the 17th, 18th, and 19th; and later it included five or even seven days. Of these seven days, the first two were the true Saturnalia, and the three following were the Opalia in honor of Ops, while the last two were called Sigillaria, from the *sigilla* or clay toys then sold. The festivities of the old Christmas, of Twelfth Night, and of the Carnival seem to have borrowed much from the Roman Saturnalia.

Saturni'nus (Lucius Appuleius), one of the most violent and unscrupulous demagogues which ancient Rome produced, was quæstor in 101 B. C., and stationed at Ostia to superintend the provision of Rome with corn, but filled the position so badly that he was superseded by the senate. He immediately joined the party of Marius. In 100 B. C. he was tribune for the second time, but secured his election only by murdering his competitor. In order to ingratiate himself with the masses, he made the most extravagant propositions of distribution of lands in Gaul, of the establishment of colonies, of a fixed price for corn, etc. In the election campaign of the following year new murders and frauds were committed by him and his party, but suddenly the masses themselves turned against him. After a short fight in the Forum and the Capitol he was compelled to surrender, and was stoned to death by a mob, though Marius, who was consul, attempted to save him.

Sat'yr [Gr. *Σάτυρος*], one of a class of imaginary beings in the Greek mythology, rough and rude woodland divinities, much dreaded by the simple rustics. They were bristly and uncouth, and, according to Liddell and Scott, they differed from the fauns by the want of horns. They were lustful and drunken beings, and are stigmatized by Hesiod as "the race of worthless satyrs." The Romans identified them with the fauni and sylvani. Silenus was the leader of the satyrs, themselves often called Sileni.

Saucelito, p.-v. and tp., Marin co., Cal., on N. side of entrance to Bay of San Francisco, has 1 newspaper. P. 731.

Sau'erkraut [Ger., "sour cabbage"], an article of food prepared by shredding cabbages, adding some salt, pepper corns, cloves, caraway, etc., and allowing the whole to ferment under pressure. The juice is poured off from time to time, and strong brine is added. It is freshened before it is cooked, and may be boiled, fried, or otherwise prepared for the table.

Saugatuck', p.-v. and tp., Allegan co., Mich., at the mouth of Kalamazoo River, on Michigan and Erie ship-canal (proposed), contains several churches, excellent schools, 1 newspaper, and a few manufactories. Is in the centre of the famous Michigan fruit-region. P. of v. 1026; of tp. 2538. C. M. Winslow, Ed. "Commercial."

Saugeen, Canada. See Southampton.

Sau'gerties, p.-v. and tp., Ulster co., N. Y., extending from the Catskill Mountains to Hudson River at the mouth of Esopus Creek, has 1 weekly newspaper, 2 national banks, several churches and schools, extensive manufactories of quicklime, cement, and bricks, and a considerable shipping business for agricultural products. P. of v. 3731; of tp. 10,455.

Sau'gus, p.-v. and tp., Essex co., Mass., on Saugus branch of Eastern R. R., has important manufactures, and includes p.-v. of Saugus Centre. P. 2247.

Sauk, county of S. W. Wisconsin, on Wisconsin and Baraboo rivers, traversed in the S. W. corner by Chicago and North-western R. R., has a broken surface, well timbered and productive, with several saw-mills and iron-foundries, and rapidly-increasing manufactures. Cattle, horses, sheep, and swine are numerous. Staples, wheat, Indian corn, oats, potatoes, hay, hops, wool, and butter. Cap. Baraboo. Area, 850 sq. m. P. 23,860.

Sauk Centre, p.-v., Stearns co., Minn., on Sauk Lake, 45 miles W. of Mississippi River, has 4 churches, a public library, a graded school, 2 flouring-mills, 1 newspaper, and repair-shops. P. 1155. J. H. Simonton, Ed. "Herald."

Sauk City, p.-v., Sauk co., Wis., on Wisconsin River, 25 miles W. of Madison, is a German settlement; has 3 churches, 2 hotels, and a German paper, established 1852. Principal business, farming. It is situated in the hop-centre of Wisconsin, and the completion of the Fox and Wisconsin River improvement, which is now in process by the U. S. government, is expected to add largely to the future of Sauk City. A mile farther N. on the river is the village of Prairie du Sac, with about 600 inhabitants. At each of these two places a bridge crosses the Wisconsin; the bridge at Sauk City is 900 feet long. The lumber-trade is very extensive at Sauk City; the lumber comes down the river in rafts from the pineries. P. about 1000.
H. Kleinpell, Ed. "Pioneer-am-Wisconsin."

Sauk Rapids, p.-v. and tp., cap. of Benton co., Minn., on St. Paul and Pacific R. R., 75 miles N. W. of St. Paul, contains 1 graded school, 1 newspaper, excellent water-power, 2 hotels, and shops. The finest granite-quarries in the North-west are here, and dairying is extensively carried on. P. of v. 412; of tp. 444.
G. W. Benedict, Ed. "Sentinel."

Saukville, p.-v. and tp., Ozaukee co., Wis. P. 1930.

Saul, the first king of Israel, a son of Kish, of the tribe of Benjamin; was anointed by Samuel; fought with great success against the Philistines, Moabites, Ammonites, Edomites, and Amalekites, and governed well in the earlier part of his reign, but afterward became possessed of "an evil spirit from the Lord," committed great cruelties, and fell, together with three of his sons, in the battles of Mount Gilboa against the Philistines, about 1055 B. C. One of his sons, Ishbosheth, maintained himself for two years against David as king of all the tribes with the exception of that of Judah. (For further details concerning Saul see the articles on David, Samuel, and the Jews.)

Saulcy', de (Louis Félicien Joseph Caignart), b. at Lille, France, Mar. 19, 1807; studied at the École Polytechnique; was appointed professor of mechanics at the military school of Paris in 1838, and shortly after keeper of the museum of artillery; gained celebrity first as a numismatist by his *Essai de Classification des Suites monétaires byzantines*, which received a prize from the Academy in 1836; studied Assyrian and Celtic inscriptions, and wrote *Les Campagnes de Jules César dans les Gaules* (1860) but concentrated himself more especially on Hebrew antiquities; visited the Holy Land in 1850, and wrote *Voyage autour de la Mer morte et dans les Terres bibliques* (2 vols.,

1852–54), *Études sur la Numismatique judaïque* and *Histoire de l'Art judaïque* (1858), *Voyage en Terre-Sainte* (1865), *Les Derniers Jours de Jérusalem* (1866), *Histoire de Hérode* (1867), *Étude chronologique des Livres d'Esdras et de Néhémie* (1868), *Sept Siècles de l'Histoire judaïque* (1874), and *Numismatique de Terre-Sainte* (1874).

Sauls'bury, tp., Hardeman co., Tenn., on Memphis and Charleston R. R. P. 400.

Saulsbury (Willard), b. in Kent co., Del., June 2, 1820; educated at Delaware and Dickinson colleges; was admitted to the bar 1845; was attorney-general of Delaware 1850–55, and U. S. Senator 1859 to 1871, when he was succeeded by his brother Eli (b. Dec. 29, 1817). Another brother, Gove, was governor of Delaware 1865–71.

Saulston, tp., Wayne co., N. C. P. 1119.

Sault de Sainte Marie, p.-v. and tp., cap. of Chippewa co., Mich., at the foot of the rapids or falls from which it derives its name, on St. Mary's River, near the outlet of Lake Superior, and on the ship-canal constructed around those rapids to facilitate navigation between Lakes Superior and Huron, has a picturesque location on the site of an early French fort, mission, and trading-post, famous in the seventeenth century as one of the head-quarters of Jesuit explorations; has 3 hotels, 2 churches, and is chiefly inhabited by French Canadians and Chippewa Indians, who are engaged in hunting, trapping, fishing, making maple-sugar, and in trafficking with the summer visitors who make this a place of resort. P. 1213.

Saulte Sainte Marie, p.-v., Algoma district, Ont., Canada, directly opposite the town of the same name in Michigan, and at the foot of the rapids of St. Mary's River. The inhabitants are mostly engaged in fur-trading and fishing. (See Saint Mary's River.) P. of v. about 400; of sub-district, 879.

Saumaise. See Salmasius.

Saumur', town of France, department of Maine-et-Loire, on the Loire, is famous for its rosaries made of cocoanut shells, has manufactures of linens and cambrics, and trades in wine, corn, hemp, and spirits. P. 14,079.

Saunders. See Sandal-Wood and Santal-Wood.

Saun'ders, county of E. Nebraska, bounded N. E. by the Platte and drained by Cottonwood and other rivers, consists chiefly of fertile rolling prairies, and is traversed in its S. E. corner by Burlington and Missouri River R. R. Staples, wheat, Indian corn, hay, and butter. Cap. Wahoo. Area, 750 sq. m. P. in 1870, 4547; in 1875, 10,382.

Saunders, tp., Henry co., Ala. P. 1143.

Saunders (Ephraim Dod), D. D., b. in Morris co., N. J., Oct. 31, 1809; graduated at Yale College 1831, in theology at Princeton; was pastor of a Presbyterian church in Goochland co., Va., for sixteen years, and afterward for a short time at Pottstown, Pa; travelled in Europe, and founded at West Philadelphia, Pa., about 1857, the Saunders Institute, a highly efficient classical school for boys. Among the teachers was his only son, Courtland, b. in Virginia in 1841, a young man of extraordinary attainments, author of *A New System of Latin Paradigms, with a Synopsis of Declensions,* published 1860, when not twenty years of age; entered the Union service as captain in the Corn Exchange Regiment, and was killed at Antietam 1862. Dr. Saunders gave in 1870 the large building and extensive grounds of the institute to found the Presbyterian Hospital of Philadelphia as a memorial of his son, and by personal solicitation raised $100,000 for the erection of other buildings. D. at West Philadelphia Sept. 13, 1872. The late John A. Brown, a retired banker of Philadelphia, gave $300,000 for the endowment of the memorial hospital, which was thus enabled to start with about $500,000.

Saunders (Prince), b. at Thetford, Vt., about 1775, a negro, who received an excellent education; taught school at Colchester, Conn., and at Boston; went to Hayti 1807; was employed by Christophe as superintendent of education; was the author of the criminal code of Hayti; visited England in an official capacity, and was there received into the society of the most eminent men, partly owing, it is said, to the supposition that his first name, "Prince," implied a member of the reigning family of Hayti. Returning to the U. S., he studied theology, became minister of a colored church in Philadelphia, and published *Documents relative to Hayti* (1816), *A Memoir on Slavery* and *Haytian Papers* (1818). He ultimately went back to Hayti, where he obtained high offices, and was attorney-general at the time of his death, Feb. 12, 1839 (or 1840).

Saunders (Romulus M.), b. in Caswell co., N. C., in Mar., 1791; studied at the University of North Carolina, but did not graduate; resided some years in Tennessee, where he was admitted to the bar 1812; returned to North Carolina; was a member of the legislature 1815–20, and Speaker of that body two years; member of Congress 1821–27 and 1841–45; attorney-general of North Carolina 1828; president of the board of commissioners on claims against France 1833; judge of the supreme court of the State 1835; minister to Spain 1846–50; was subsequently again a member of the legislature, and took a leading part in promoting the construction of railways in North Carolina. D. at Raleigh Apr. 21, 1867.

Saun'derson (Nicholas), LL.D., F. R. S., b. at Thurlestone, Yorkshire, England, in 1682; lost his sight by an attack of smallpox in infancy, but was carefully instructed by his father; learned Latin and Greek at academies; was taught the higher mathematics by private tutors, and displayed such mastery of all the allied sciences, including optics, that in 1707 he lectured upon them with great applause at the University of Cambridge, and on the recommendation of Sir Isaac Newton was in 1711 chosen to succeed Whiston as Lucasian professor of mathematics at Christ's College. D. Apr. 19, 1739. After his death appeared his *Elements of Algebra* (1740), to which was prefixed a biographical sketch by his son John. His *Method of Fluxions* appeared in 1756.

Saunemin, tp., Livingston co., Ill. P. 974.

Saup'pe (Hermann), b. at Wesenstein, near Dohna, Saxony, Dec. 9, 1809; studied philology at Leipsic, and was appointed professor at the University of Zurich in 1838, director of the gymnasium at Weimar in 1845, and professor at the University of Göttingen in 1856. Together with Haupt, he has edited since 1848 a collection of Greek and Roman authors with German notes, which immediately became very popular.

Sauquoit, p.-v., Paris tp., Oneida co., N. Y., on Utica division of Delaware Lackawanna and Western R.R. P. 459.

Saurians. See Reptilia.

Saurin' (Jacques), b. at Nîmes, France, Jan. 6, 1677; removed to Geneva after the Revocation of the Edict of Nantes; studied theology; was chosen pastor of the Walloon church in London in 1701, and in 1705 of the Walloon church at the Hague, where he d. Dec. 30, 1730. He was a powerful preacher, and several collections of his sermons have been often reprinted and translated into German and English. His *Discours sur les Événements les plus mémorables du Vieux et Nouveaux Testaments* (1720) also became very popular under the name of "Saurin's Bible."

Saurop'sida [σαῦρος, a "lizard," and ὄψις, "resemblance"], a group established by Prof. Huxley for the reception of the birds and reptiles in contradistinction to the mammals or Theropsida, on the one hand, and on the other the amphibians, fishes, and inferior types which constitute the type of Ichthyopsida. These agree with the mammals in having an amnion and allantois, the latter being developed at the expense of the enlarged vitellus of the egg, and with the Ichthyopsida, or at least the higher forms of the group, by the development of a quadrate bone or corresponding elements intervening between the lower jaw and the skull. The skeleton is well ossified; the skull has no separate parasphenoid bone, at least in the adult; "the proötic is always ossified, and either remains distinct from the epiotic and opisthotic throughout life, or unites with them only after they have ankylosed with adjacent bones;" the occipital condyle is always single; the heart is either quadrilocular, as in the birds, or trilocular, as in the reptiles. Specialized kidneys are developed, and succeed the Wolffian bodies of the embryo. All the species are either oviparous or viviparous. The gap now existing between the representatives of the contained classes, birds and reptiles, was much less in former types, and many intermediate forms lived in the Mesozoic period. Theo. Gill.

Saussure', de (Horace Bénédict), b. at Conches, near Geneva, Feb. 17, 1740; studied under his uncle, Charles Bonnet, and under Haller, and was appointed professor of physics and philosophy at the University of Geneva in 1762. After careful and comprehensive preparations, improving his instruments, especially the hygrometer, and inventing new instruments, such as the cyanometer and diaphanometer, he commenced a series of scientific mountain excursions, crossing the Alps fourteen times by eight different routes, ascending Mont Blanc in 1787 and Monte Rosa in 1789, encamping for seventeen days on the Col du Géant, and visiting the Jura, Vosges, and Auvergne mountains, Germany, England, Sicily, and Italy. The result of these voyages was a multitude of the most valuable observations, which exercised a great influence on the development of the science of geology when communicated in *Voyages dans les Alpes* (4 vols., 1779–96). The most remarkable of his minor works are—*Sur l'Hygrométrie* (1783) and *De Aqua* (1771). In 1786 he resigned his chair, but after the annexation of Geneva to France was appointed professor of natural history at the central school of the department of Léman. D. at Geneva Jan. 23, 1799.

Sav'age (CHARLES C.), b. at Middletown (now Cromwell), Conn., in 1820, engaged in the stereotyping business in New York City; wrote for religious and agricultural papers, and was author of *Illustrated Biography* (1852) and *The World, Geographical, Historical, and Statistical* (18[illegible]).

Savage (EDWARD), b. at Princeton, Mass., in 1761; was at first a goldsmith; studied painting under West in London; afterward resided some time in Italy; founded a museum in New York; removed it to Boston, where it formed a part of the old New England Museum. He was established as a portrait painter in New York as early as 1789; made and engraved a group of the Washington family, and executed a profile portrait of Pres. Washington on wood.

Savage (JOHN), b. at Dublin, Ireland, Dec. 13, 1828; studied at the art school of the Royal Dublin Society; took part in the revolutionary movements of 1848, editing two journals and placing himself at the head of an armed band of peasants; escaped to New York; became a proof-reader for the New York *Tribune*; was afterward editorially connected with several newspapers at New York, Washington, and New Orleans; was active in organizing Irish volunteers for the suppression of the rebellion of the Confederate States; wrote several popular war-songs, including *The Starry Flag*, and published several volumes of poems, dramas, and biographies.

Savage (JAMES), LL.D., b. at Boston, Mass., July 13, 1784, descended from Thomas Savage, an early Massachusetts settler, and also from Rev. William Wheelwright, noted for his religious and political controversies in the seventeenth century; graduated at Harvard 1803; commenced the practice of law 1807; sat in both houses of the Massachusetts legislature, in the executive council, and in the constitutional convention of 1820; filled several municipal posts at Boston; was official orator July 4, 1811; contributed to the *North American Review* and the *New England Magazine*; conducted for five years the *Monthly Anthology*; edited Paley's *Works* (Cambridge, 5 vols., 1828; new ed. 1830), several volumes of *American State Papers* and of the *Collections* of the Massachusetts Historical Society, of which he was for some years the president; issued several genealogical, historical, political, and controversial pamphlets, and published from the original manuscripts Gov. John Winthrop's important *History of New England* (Boston, 2 vols., 1825–26; new ed. 1853), "with notes to illustrate the civil and ecclesiastical concerns, the geography, settlement, and institutions of the country, and the lives and manners of the principal planters;" was influential in procuring the publication of Gov. Hutchinson's *History of Massachusetts*, and compiled, on the basis of Farmer's *Register*, a *Genealogical Dictionary of the First Settlers of New England, showing Three Generations of those who came before May, 1692* (Boston, 4 vols., 1862-64), a work of great value and displaying extraordinary industry and research, but confused in plan, unequal in execution, and disfigured by the exhibition of spleen against many of the parties to the colonial controversies of the seventeenth century, especially against Cotton Mather and the opponents of his ancestor, Wheelwright. Mr. Savage was long connected with the first savings bank at Boston, and a member of the principal historical, literary, and scientific societies. D. at Boston Mar. 8, 1873.

Savage (RICHARD), an English poet, claimed to be the illegitimate son of Anne, countess of Macclesfield, by Richard Savage, Earl Rivers, alleging that he was born at London Jan. 10, 1698; was reared in poverty. By the alleged intervention of his grandmother, Lady Mason, he was enabled to obtain a tolerable education in a grammar school at St. Alban's, and was afterward apprenticed to a shoemaker; but having displayed literary tastes, he went to London about 1716, where he obtained the patronage of Steele, and of Wilks and Mrs. Oldfield, the actors, and assumed the name of his father on being informed in a mysterious manner of the circumstances of his birth. In 1717 he translated from the Spanish a play, *Woman's a Riddle*, which had a run of twelve nights; produced in 1723 a successful tragedy, *Sir Thomas Overbury*; in 1726 a volume of *Miscellaneous Poems and Translations*; in 1728 *The Bastard, a Poem*, which speedily ran through five editions; and in 1729 his best work, *The Wanderer, a Moral Poem*. In 1727 he was condemned to death for killing a man in a tavern brawl, but pardoned in opposition to the wishes of his mother; was then taken into the house of Lord Tyrconnel, a relative of his mother, and allowed a pension of £200, but soon quarrelled with his protector; subsisted thereafter upon money subscribed by Pope and his literary circle; obtained from Queen Caroline an annual stipend of £50 in consequence of some verses he had written on her birthday; resided several years at Bristol, where he was thrown into prison for debt Jan., 1743. D. there Aug. 1, 1743. He is now best remembered by the pathetic *Life* written by his friend Johnson.

Savan'na [Sp. *sabana*, a "sheet"], a grassy plain in a tropical region, yielding pasturage in the wet season, and often having a growth of under-shrubs. It corresponds to the *prairie* of more northern latitudes. The word is chiefly used in tropical America.

Savanna, p.-v. and tp., Carroll co., Ill., on Mississippi River and on Western Union R. R. P. of v. 971; of tp. 1236.

Savan'nah, cap. of Chatham co., Ga., a seaport, the largest and principal city in the State, is on a level plain on the southern bank of Savannah River, 50 feet above the sea and 18 miles from it by the river. Savannah does an immense foreign and domestic export business in cotton, the staple commodity, rice, timber, lumber, and naval stores. The latter articles—*i. e.* rosin and turpentine—have just begun to assume a prominent place, and promise to become vigorous rivals of King Cotton. In receipts Savannah ranks as the second cotton-port in the U. S.; from Sept. 1, 1874, to Dec. 1, 1874, the receipts exceeded those of New Orleans. Below is a condensed table of exports, foreign and domestic, for the year ending Dec. 31, 1873: Foreign—cotton, 377,697 bales, valued at $29,316,264; lumber and timber, valued at $381,993; staves and headings, $75,512; and miscellaneous merchandise. Domestic—cotton, 243,993 bales, valued at $18,373,980; timber and lumber, valued at $1,198,007; naval stores, $81,944.50; rice, 22,294 tierces, valued at $1,035,488; and other merchandise.

Summary of Value of Exports for the year 1873.

Foreign	$29,850,275.00
Coastwise	22,793,778.75
Total	$52,644,053.75

The depth of water on Savannah bar is 26 feet at mean high water, 19 feet at mean low water; in Tybee Roads anchorage, 38 feet at mean high water, 31 feet at mean low water. The marine railway has 260 feet length of cradle, with improved appliances; length of graving dock, 345 feet; breadth of base, 45 feet; breadth of top, 80 feet; floating capacity, 16½ feet. Three separate lines of steamships ply between Savannah and New York, and one line to each connects with Boston, Philadelphia, Baltimore, and Providence; 3 daily and 2 weekly newspapers are published here, 1 of the latter being German. Of manufactories there are 1 cotton-factory, 1 paper-mill, 6 iron and brass foundries, 5 wagon and carriage factories, 1 flour-mill; also, 5 cotton-presses, 1 express company, 3 telegraph companies, 1 waterworks, 1 gas company, and a park. Three railroads have their *termini* here—the Central, which feeds the interior of the State, the Atlantic and Gulf, feeding the South-west and Florida, and the Savannah and Charleston. Of horse-car lines, 2 flourish here. Lines of steamboats circulate between the coast-towns of Georgia, Florida, South Carolina, and Savannah. Of public buildings the most prominent are the custom-house and post-office, exchange, police barracks, theatre, Oglethorpe Barracks (U. S.), and market; private buildings of rare and beautiful architectural proportions are prominent. Of these are 4 banks, one of which is national; besides, there are 5 private banking institutions. There are a volunteer fire department and electric fire-alarm telegraph, 11 military organizations, 30 churches, 5 loan associations, 16 benevolent societies, 7 Masonic and 7 Odd Fellows lodges, 6 of temperance, 5 of Knights of Pythias, 4 trades unions, a jockey club, Y. M. L. A., Y. M. C. A., a sportsman's club, choral association, regatta association, cotton exchange, 8 school buildings, 1 infirmary, 3 hospitals, and 1 medical society. Savannah has also three noteworthy and attractive monuments—one in memory of Count Pulaski, who fell in the American assault on the British works in that city on Oct. 9, 1779; another in memory of Gen. Nathaniel Greene; and the third in honor of the Confederate dead—erected in the magnificent park on the southern limits of the city. P. 28,235.

J. A. DOYLE, ASSOCIATE ED. "DAILY ADVERTISER."

Savannah, p.-v., cap. of Andrew co., Mo., on the Hopkins branch of Kansas City St. Joseph and Council Bluffs R. R., 14 miles N. of St. Joseph, has 6 churches, good schools, 2 banks, 2 newspapers, a large flouring mill, and 2 hotels. Principal business, farming and stock-raising. P. 1257. O. E. PAUL, ED. "ANDREW CO. REPUBLICAN."

Savannah, p.-v. and tp., Butler co., Neb., on Platte River.

Savannah, p.-v. and tp., Wayne co., N. Y., on New York Central R. R. P. 1933.

Savannah, tp., Jackson co., N. C. P. 515.

Savannah, p.-v., Clear Creek tp., Ashland co., O. P. 394.

Savannah, tp., Anderson co., S. C. P. 1067.

Savannah, p.-v. and tp., cap. of Hardin co., Tenn., on a river of the same name, 200 miles above its mouth, has several churches, 2 colleges, and 1 newspaper. Business, cotton, corn, and lumber dealing. P. of v. 328; of tp. 1336.
W. L. Oury, Ed. "Transcript."

Savannah River forms the boundary-line between Georgia and South Carolina. From its source, at the junction of the Tugalo and Keowee rivers, to its mouth on Tybee Roads it has a channel length of 450 miles, while the distance in a direct line is only 250 miles. With its tributaries it drains an area of over 8000 sq. m. The Savannah is a turbid stream, and the current in the upper portion of the river and its tributaries is rapid and carries a great deal of silt, particularly during the season of freshets. Bars are therefore formed in the broader portions of the stream where the current is less rapid, and the stream becomes sluggish. At Savannah the mean rise and fall of tide is 6½ feet. The tidal-wave ordinarily ascends to a point about 28 miles above Savannah city, or 45 miles from Tybee Roads. The river is now navigable to Savannah for vessels drawing 18 feet of water, and by small vessels to Augusta, 231 miles, and even far beyond the latter place for small craft. Under appropriations of Congress improvements in the river and harbor of Savannah are in progress, having in view the securing of a 22-foot channel to Savannah.

Savary' (Anne Jean Marie René), duke of Rovigo, b. at Marcq, department of Ardennes, Apr. 26, 1774; entered the army in 1789; fought under Custine and Pichegru on the Rhine, and under Dessaix in Egypt; became aide-de-camp to Napoleon after the battle of Marengo, and was used by him as much in diplomatic as in military affairs, evincing an equally brilliant talent in both directions. In 1802 he was placed at the head of the secret police to watch even Fouché, and the discovery of the conspiracy of Cadoudal was chiefly his work. In 1804 he presided, as commander of the troops of Vincennes, over the execution of the duke of Enghien. His greatest military exploit was the victory at Ostrolenka (Feb. 16, 1807) over the Russians, for which the emperor gave him a great dotation and made him duke of Rovigo. His greatest diplomatic success was the negotiation in 1808 with Charles IV. of Spain, which ended with the king's journey to Bayonne. From 1810 to 1814 he was minister of police. After the fall of Napoleon he wished to accompany him to St. Helena, but was arrested on board the Bellerophon and kept in captivity at Malta. He escaped, went to Smyrna, returned in 1819 to Paris, and was finally reinstated in his titles and honors. In 1823 he again left France, and took up his residence in Rome, having fallen out with the French court on account of his *Sur la Catastrophe de Msgr. le Duc d'Enghien*, in which he made Talleyrand accountable for the execution of the duke. Louis Philippe recalled him, and made him commander-in-chief of Algeria Dec. 1, 1831, where he developed great activity. D. at Paris June 2, 1833. His *Mémoires* (8 vols., 1828) give a history of the First Empire.

Sa've, a river of Austria, rises in the province of Carniola, flows through Croatia, forms the boundary between Slavonia and Turkey, and joins the Danube at Belgrade after a course of 550 miles; navigable 200 miles from mouth.

Saverne', town of the German empire, province of Alsace, manufactures woollen cloth and hosiery and trades in timber and wood. P. 6407.

Saverton, p.-v. and tp., Ralls co., Mo. P. 1599.

Saviglia'no, town of Italy, province of Cuneo, on a plain 1050 feet above sea-level, and 20 miles S. of Turin. The district produces wheat, maize, fruits, vegetables, hemp, silk, etc., very abundantly. Sant' Andrea, the principal church, dates as early as the eleventh century, and there are other mediæval churches, convents, etc., of some interest. P. 16,150.

Savigny', von (Karl Friedrich), b. at Frankfort Feb. 21, 1779; studied jurisprudence at Marburg, Göttingen, Leipsic, Halle, and Jena; was appointed professor at Marburg in 1800, at Landshut in 1808, at Berlin in 1810; minister of justice in 1840; retired in 1848. D. at Berlin Oct. 25, 1861. He was the leader of the historical school in jurisprudence, and exercised a great influence, both on the study of law and on legislation in Germany. His lectures on Roman law, its principles, institutions, and historical development, attracted large audiences, although his views of the Roman law-system as the highest standard and most consummate model, and of our time as utterly incapable of developing the idea of right in adequate forms, were generally considered extravagant. His principal writings are—*Treatise on Possession* (1803; translated into English in 1848), *Vom Beruf unserer Zeit für Gesetzgebung und Rechtswissenschaft* (1814), *Geschichte des römischen Rechts im Mittelalter* (6 vols., 1815–31), *System des heutigen römischen Rechts* (8 vols., 1840–49), *Das Obligationenrecht* (2 vols., 1851–53), besides a number of minor essays, mostly of historical contents, collected in his *Vermischte Schriften* (5 vols., 1850). His biography was written by Rudorff (Berlin, 1863).

Sav'ile (Sir Henry), b. at Over Bradley, near Halifax, England, Nov. 30, 1549; educated at Brasenose and Merton colleges, Oxford, becoming fellow of the latter and lecturer on mathematics; travelled on the Continent; became Greek and mathematical tutor to Queen Elizabeth 1578, warden of Merton 1585, provost of Eton 1596; was knighted by James I. 1604, and founded at Oxford the Savilian professorships of geometry and astronomy 1619, giving his library for their use. D. Feb. 19, 1622. He translated the *History* and the *Agricola* of Tacitus (1581), edited the *Latin Chronicles* of English history (1596), brought out a magnificent edition of the complete works of Chrysostom (8 vols., 1610–13), and is regarded by Hallam as the most learned Englishman in profane literature in the reign of Elizabeth.

Saville, tp., Perry co., Pa. P. 1693.

Saville (George). See Halifax, Marquis of.

Sav'in, the *Juniperus sabina*, a berry-bearing, almost prostrate shrub of the order Coniferæ, growing on rough lands of Europe and Asia, and found also in Canada, but scarcely so in the U. S. It has a strong, almost fœtid scent, which frequently causes headache. Its leaves abound in an acrid essential oil isomeric with turpentine oil. Savin oil and tops are sometimes used by abortionists, but if effectual, it is only so at the utmost peril of the patient's life. It is sometimes useful in chronic rheumatism, amenorrhœa, and other diseases.

Sav'ings Banks, institutions devised by philanthropists for receiving and securely investing the moderate savings of industry, under provisions for their repayment on demand or at short notice, managed by persons having no interest in the profits of the business, which are divided at stated intervals among the depositors. Savings banks were conceived and instituted as a means to an end. Their ultimate purpose in the social economy was to abate the evils of extreme poverty. Devices to this end, in the form of measures for the care and maintenance of the poor, had served little more than to aggravate the evils they were ordained to mitigate. The means provided and expended for the relief of pauperism had proved fruitful in promoting pauperism. Appropriations for the support of the destitute showed in the results as bounties offered to idleness and improvidence. Statesmen were baffled by this ever-recurring problem of human want, whose magnitude increased and whose difficulties multiplied with every attempt at its solution. They could not stop, they dared not go on. To stop was to decree starvation to thousands—to go on was to invite the idle and dissolute to unite with the destitute in crying for bread. In this strait to the aid of statesmanship came philanthropy, with the suggestion, novel at the time, that incentives to industry might be more effective than gratuities to idleness in diminishing the evils and the burdens of pauperism. These incentives philanthropy proposed to supply by offering to the smallest savings of frugal industry what they had never before enjoyed—a place of secure deposit, whence in time of need they could be withdrawn, together with such moderate interest as they had earned meanwhile. In contrast with the vast monetary interests controlled and nearly or remotely affected by savings banks in our day, their humble origin in the abodes of poverty and toil, which it was their mission to brighten with the hope of gain, is difficult to realize. Yet in conditions such as we have outlined, and with the single purpose which we have noted, did savings banks, both in Europe and America, have their inception.

Origin and Early History.—Savings banks, as above defined and characterized, had their origin in England about the close of the last century. The monetary institutions in Berne and Hamburg, which are sometimes cited as instances of an earlier origin, received moneys and granted annuities; they did not undertake to return deposits. The earliest exposition of a practicable scheme, embracing the distinctive features of the modern savings bank, was made by the celebrated Jeremy Bentham, who in 1797 proposed a well-devised system of "frugality banks," to constitute a branch of the pauper system of the government. His plan failed to receive favorable consideration from Parliament or pronounced acceptance by the public, though it doubtless helped to give direction and form to the practical efforts soon afterward inaugurated. Malthus in 1803 advocated a system of county banks to facilitate, and thereby to encourage, the saving of small sums. A later and more pronounced movement for the establishment of savings banks was made in Parliament in 1807 by Mr. Samuel Whitbread.

His bill provided for a "fund and assurance office for investing the savings of the poor." This was to be, in fact, a national savings bank, under the direction of government officers, to which small sums of money might be transmitted free through the post office from any part of the kingdom. These were to be invested in government securities, and repayment by the sale of securities when required was provided for. While Mr. Whitbread is entitled to the highest credit for the intelligence and zeal displayed by him in the advocacy of this bill, it is due to the "truth of history" to record that the measure was devised and formulated by Patrick Colquhoun, a local police magistrate of London. While his official duties brought him into daily intercourse with the indigent and degraded poor, his philosophical mind was occupied with the study of the causes and conditions of pauperism, and his active sympathy in devising measures for its relief. He became prominently identified with the system of savings banks as finally established, and in letters to his friend, Thomas Eddy of New York, commending these to his favorable consideration, he refers to a more comprehensive plan devised by himself in 1806 as having failed upon its introduction into Parliament, the time not being ripe for it. He was the intimate friend of Bentham, and doubtless his plan of a national savings bank was the subject, if it was not indeed the result, of many conferences between them. In the mean time, and while these discussions were in progress, an active and practical philanthropy had given form to the distinctive savings-bank idea—a place of secure deposit and sure return for the scant savings of poverty. As early as 1798 the Rev. Joseph Smith of Wendover proposed to the poor of his parish to receive from them during the summer sums as small as twopence, which he would return to them in the winter season with an addition of one-third as a reward for their providence. Of course this was more benevolence than banking. The scheme of Mrs. Priscilla Wakefield of Tottenham, inaugurated in 1799, embraced the deposit of moneys by women and children only, to whom pensions were to be granted when they reached a certain age. Moneys were allowed to be withdrawn only in exceptional cases. In 1801 the scheme was somewhat expanded, and a savings bank incorporated as a feature. A more practical organization of this effort was effected in 1804. An undertaking was organized at Bath in 1808, under the patronage of Lady Isabella Douglas, for the benefit of domestic servants only, which approached more nearly the ideal of savings banks, as subsequently defined and understood, than those previously considered.

In each of these several schemes of purely local beneficence, as also in others that might be noted, we discern the germ of the savings-bank principle as subsequently wrought out; but neither of them, in its general scope, in its plan of organization or methods of procedure, presented a model after which a system adapted to the needs of the country at large could be constructed. For the suggestion and practical inception of such a plan and of such methods the credit unquestionably belongs to the Rev. Henry Duncan of Ruthwell, Scotland. He thus organized a savings bank in his own parish of Ruthwell in 1810. Its success, as compared with previous efforts, was marked and decisive, and the notoriety given to it through the writings and labors of Dr. Duncan directly promoted the organization of savings banks upon a similar plan in various parts of the kingdom. Dr. Duncan has been called the "father of savings banks;" and as the founder of a plan of organization and procedure without which the idea of savings banks as originally promulgated could have gained no permanent hold upon the country, the title is not misapplied. The Edinburgh savings bank, though claiming an earlier origin, appears to have been established in 1814. It adopted a less complex and more popular form of organization and procedure than that of Dr. Duncan, and this became the model upon which savings banks were organized thereafter.

Inception and Course of Legislation.—The period of exclusively voluntary or unincorporated organization in the establishment of savings banks in Great Britain terminated in 1817, when two acts were passed by Parliament designed to encourage, protect, and regulate these institutions in Ireland and England. There was no legislation affecting this interest in Scotland until 1835. These acts were virtually, if not in terms, repealed in 1828 by a new act, which was thereafter recognized as the "governing statute" concerning savings banks. This statute was modified and amended from time to time until 1863, when an entire revision and consolidation of the laws relating to savings banks was effected. The course and character of the legislation affecting this interest may be briefly but sufficiently outlined as follows: Trustees have at all times been prohibited from deriving any profit from the transactions. The moneys received were to be deposited in the Bank of England or of Ireland to the credit of the commissioners for the reduction of the national debt, and by them were to be invested in 3 per cent. bank annuities. The government guarantied to the trustees a specific rate of interest on the moneys deposited by them to the credit of the commissioners. This rate, under the acts of 1817, was £4 11s. 3*d.* per cent., but was subsequently reduced to £3 16s. $\frac{1}{2}$*d.*, and finally to £3 5s. per cent. per annum. The rate of interest to be paid to depositors was at first left to the discretion of the trustees, but was afterward limited at not exceeding £3 0s. 10*d.* per cent. The rate paid has varied in different institutions, and still varies from the limit fixed by law to as low as £2 10s. per cent. Deposits were limited originally to £100 the first year, and £50 in any year thereafter; this was afterward changed, and the limit fixed at £30 in any year and £150 in all, or £200 including interest. Depositors were also prohibited from keeping an account in more than one savings bank, but might transfer an account from one bank to another. The significance of these restrictive provisions will be seen in the fact that in the fifty-five years from 1817 to 1872 the interest paid by the government to savings banks exceeded that which it had received from investments on their account by the sum of £4,169,427 10s. 5*d.* As an incentive to industry and economy, and a check to pauperism, the government could afford to bestow this bounty upon savings banks, but only upon terms that would tend to exclude from any considerable share in it the opulent classes, whom the liberal interest allowed and the security afforded by savings banks would naturally attract. Trustees in England are made liable only for their own personal malfeasance, but in Ireland they are made liable for losses, unless by their rules they limit their liability to a fixed sum, which is not to be less than £100. The government has never conceded its liability to make good the losses sustained by savings banks, though in one instance of exceptional hardship Parliament appropriated £30,000 as a partial restitution to depositors.

The internal administration of savings banks in Great Britain in respect to methods of business and the facilities afforded to depositors in their dealings is far from uniform. Out of 638 savings banks doing business in 1861, only 20 were open daily, and some of these allowed moneys to be withdrawn on only two days in the week; others open new accounts only on certain days. More than half the savings banks were open but one day in each week, and many of these but for one hour, while some, with deposits of from £200,000 to nearly £300,000, are open but two days in a week. A leading savings bank in London closes its doors for a week in each year while preparing its annual balance. In nearly all savings banks outside of Scotland notice is invariably required before any part of a deposit can be withdrawn.

Savings Banks and Poor Relief.—The following facts, bearing upon the ministry of savings banks in relieving the poor, are pertinent and suggestive: From 1811 to 1821 there was expended in England for poor relief the sum of £68,000,000. From 1821 to 1831 less than £63,000,000 was expended, a reduction during the decade of over £5,000,000, while during the same period the deposits of savings banks in the United Kingdom increased from £4,740,188 to £11,698,635. Again, the sum expended in England for poor relief in 1834 was £5,989,411, while in 1841, seven year later, it was but £4,492,329, a reduction of £1,497,082, or 25 per cent. During the same period the deposits in savings banks increased from £16,386,035 to £24,536,971. The agency of savings banks in contributing to these results very clearly appears from other and more detailed statistics which the limits of this article compel us to omit.

Statistics of Growth and Progress.—In the following table we give the number of depositors and the balance to the credit of savings banks, including interest, on the books of the national debt commisioners in quinquennial periods from 1817 to 1872. We also include the year 1861, as marking the highest limit reached by savings banks before their decadence commenced under competition with post-office savings banks, and the return for 1874, showing the number of depositors and the amount due at that time:

Year ending Nov. 20.	Number of depositors.	Amount to credit of savings banks.	Year ending Nov. 20.	Number of depositors.	Amount to credit of savings banks.
1817	9,291*	£231,028	1852	1,209,934	£31,912,413
1822	204,784*	6,546,690	1857	1,366,560	35,255,722
1827	325,000*	14,188,708	1861	1,609,103	41,790,783
1832	410,861	14,416,885	1862	1,558,189	40,809,578
1837	636,339	19,711,797	1867	1,385,782	36,792,912
1842	875,086	25,406,642	1872	1,425,147	40,000,462
1847	1,096,086	30,236,632	1874	1,463,569	41,467,171

The whole amount credited to the savings banks by the commissioners from 1817 to 1872 was £104,015,502; amount repaid, £64,015,040; balance, £40,000,462, as above. From

* Partly estimated.

statistics which we have not space to introduce it appears that only about 15 per cent. of the moneys deposited in savings banks ever reached the debt commissioners, the 85 per cent. being used in making current payments. Applying this ratio to the foregoing, we have as the whole amount deposited to 1872, £693,436,680; withdrawn, £653,436,218.

Post-Office Savings Banks.—The favorable record made by savings banks did not preserve the system from criticism and complaint. These related chiefly to the high rate of government interest, whereby savings banks were made in a measure a public charge; to their insufficiency in numbers; to the indifferent facilities afforded by those in operation; and to their insecurity, as shown by disastrous failures from frauds of officers, for which neither the trustees nor the government could be held responsible. The efforts to reform the system resulted in 1861 in the establishment of a system of post-office savings banks, which, however, was little more than an expansion and adaptation to existing conditions of the scheme of Patrick Colquhoun, made prominent by Mr. Whitbread in 1807. Amongst the distinguished names identified with the effort to establish postal savings banks, that of Charles William Sikes of Huddersfield is deserving of special record. No arbitrary interference with the existing system of savings banks was attempted, but these were left to hold their own in competition with the new system as best they could. The practical operation of the latter may be briefly stated: Certain post-offices throughout the United Kingdom are designated at which sums of not less than one shilling or some multiple thereof will be received for transmission to the central office in London. Not exceeding £30 in one year, or £150 in all, or £200 including interest, is received from any one person. The depositor receives a book in which his deposits are entered, and a receipt for each deposit is also forwarded to him in due course from the central office. The moneys are invested in the public funds, and deposits of not less than £1 or multiples thereof receive interest at the rate of 2½ per cent. per annum. The government is responsible for the repayment of all moneys received, thus affording to depositors perfect security. A depositor may apply at any post-office savings bank in the kingdom for the purpose of withdrawing money, and may direct payment of the same to be made to him at that or at any other post-office savings bank. His order is forwarded to the postmaster-general, by whom a warrant for the designated amount is drawn upon the postmaster where payment is to be made, which is forwarded to the depositor, who presents the same, together with his book, and receives his money.

Progress of Post-Office Savings Banks.—On Sept. 16, 1861, the system was inaugurated by opening in England and Wales 301 postal savings banks, which number was increased before the close of the year to 1629. The system was extended in the following year to Ireland and Scotland. In 1866 the number of postal savings banks in the United Kingdom was 3369, or more than five times the highest number under the old system; and Dec. 31, 1874, the number was 5068. They extend to nearly or quite every township, to every large village, and are amply distributed for the convenience of large cities, London being provided with 576. In the ten years from Sept., 1861, to Sept., 1871, there had been deposited, including interest, £44,198,743, withdrawn £28,044,539, leaving due depositors £16,154,204. During the calendar year 1874 there was deposited £8,341,256; interest credited, £524,559; withdrawn, £6,876,095; balance due depositors Dec. 31, £23,157,469. Of the whole amount deposited in postal savings banks up to the last above date, £2,287,872 had been transferred by the old savings banks, of which 179 had closed, while only 474 were in operation against 638 in 1861. Amongst those remaining there appears to have been but little improvement in the facilities extended to the public, only 26 being open daily as late as 1874. At the close of 1874 there had been deposited in postal savings banks £72,042,032; withdrawn, £48,884,563; accounts opened, 4,006,888, closed, 2,388,155; remaining open, 1,618,733.

Penny savings banks, military savings banks, and savings banks for seamen have been established as auxiliaries of the general system, for the purpose of meeting the special needs of classes for which the ordinary savings banks did not hold out adequate inducements or facilities. The penny savings banks have quite commonly been tributary to the larger institutions, making them the depositories of their aggregate accumulations. The military and seamen's savings banks have been conducted independently. Their statistics are unimportant, and fail to exhibit any distinctive features concerning the thrift of the classes they represent, for large numbers of these prefer to deposit in the regular institutions.

Savings Banks in the United States.—Our statements in the opening of this article concerning the conditions under which savings banks had their inception finds confirmation in the following extract from the message of Gov. De Witt Clinton to the legislature of New York in 1818. He says: "Our statutes relating to the poor are borrowed from the English system, and the experience of that country, as well as our own, shows that pauperism increases with the augmentation of the funds applied to its relief. The evil has proceeded to such an alarming extent in the city of New York that the burdens of heavy taxation which it has imposed menace a diminution of the population of that city and a depreciation of its real property." Very shortly after the successful inauguration of savings banks in Great Britain upon a popular and practical plan these institutions began to attract attention in the U. S., where, through explanatory pamphlets and correspondence upon the subject, their operation became known. The first organization of which we have record was effected in the city of New York Nov. 29, 1816. The first to go into practical operation was in Philadelphia, which as a purely voluntary association commenced receiving deposits Dec. 2, 1816, which would indicate an organization effected prior to that in New York. The first to become incorporated was in Boston Dec. 13, 1816, and it organized and commenced business in the spring of 1817. Thus, the U. S. anticipated Great Britain in giving to this interest the sanction and protection of law. The savings bank of Salem, Mass., was next incorporated Jan., 1818, and commenced business in April following. The savings bank of Baltimore opened as a voluntary association for receiving deposits on Mar. 16, 1818, and was duly incorporated in December of that year. The Philadelphia Saving Fund Society, whose voluntary action we have noticed, was incorporated Feb. 25, 1819, and the Bank for Savings in New York, which never received deposits under its voluntary organization, was incorporated Mar. 26, 1819, and commenced business on the 3d of July following. The following were also incorporated in 1819: Society for Savings, Hartford, Conn.; Savings Bank of Newport, Providence Institution for Savings, Bristol Institution for Savings, all in Rhode Island; and the Savings Bank of Portland, Me. The subject was also considered in the legislature of New Hampshire in this year, but no result was reached until 1823, when the Portsmouth Savings Bank was chartered. The foregoing are all in existence at the present time except the Bristol, which did not organize, and the Portland, which failed in 1838. The solid basis of financial security upon which these institutions were planned, and the ability and fidelity which have characterized their management, will appear from the following statement of their condition on or near Jan. 1, 1876:

Name.	Opening.	Open accounts.	Due depositors.	Surplus.
Philadelphia Saving Fund Society, Pa.	1816	44,700	$11,290,127	$1,079,428
Boston Provident Savings Institution, Mass.	1817	34,883	14,761,081	797,178
Savings Bank of Baltimore, Md	1818	32,429	12,512,209	1,250,000
Salem Savings Bank, Mass.	1818	16,004	6,090,583	400,000
Bank for Savings, New York, N. Y.	1819	66,129	21,695,401	1,150,067
Society for Savings, Hartford, Conn	1819	23,876	8,100,097	299,820
Savings Bank of Newport, R. I.	1819	5,203	4,058,092	Unknown.
Providence Institution for Savings, R. I.	1819	20,465	8,508,380	170,895
Portsmouth Savings Bank N. H.	1823	7,204	2,440,043	55,031

The facilities afforded to depositors are greatly superior to those of English savings banks under the old system. With rare exceptions, savings banks in this country are open four or five hours daily, and very many of them on one or more evenings in each week. When open it is for the transaction of any kind of business. Deposits are practically payable on demand, though the right to require notice is reserved. There is little danger that this right will be too rigidly enforced. The tendency is in the opposite direction, of an over solicitude to answer the demands of depositors at once, when the interests of all would be best promoted by delay.

The plan of organization of savings banks is not altogether uniform. In some States there is a large body of corporators, empowered to enlarge their number indefinitely, who elect from their number annually a board of trustees or directors, to whom the management of the institution is committed. In others the corporators are a defined and limited number, who are themselves the trustees and responsible for the management. These are commonly empowered to fill vacancies that occur, though in some cases this is done by designated authority outside of the board.

In the States outside of New England, New York, and New Jersey savings banks are commonly organized with a capital stock. In Maryland and Pennsylvania both the mutual and stock systems prevail, but the estimates for these States found in the following table embrace only those of the former class. The latter adapt themselves to conditions which savings banks were not originally designed to provide for. In whatever else they have differed, savings banks in the U. S. have been alike in being organized and conducted upon a plan of independent self-support. They have not been the recipients of private nor of government bounty. The interest they have received and disbursed has been earned, not awarded. They have conferred great and lasting benefits, and have neither asked nor received favors in return.

Development of the Savings-Bank System.—The following table exhibits the growth of savings banks in the U. S. from 1830, with such an approximation to accuracy as the defective records of their early condition in all of the States, and the absence of all public record concerning them in many of the States, even at the present time, enables us to reach:

States.	Deposits at close of 1830.	Deposits at close of 1840.	Deposits at close of 1850.	Deposits at close of 1860.	Deposits at close of 1870.	Deposits at close of 1874.
	$	$	$	$	$	$
Maine	No data.	150,000*	500,000*	1,539,257	16,597,888	31,051,963
New Hampshire	250,000*	750,000*	1,776,768	5,590,652	21,472,120	30,214,585
Vermont	None.	None.	199,376	1,111,532	2,301,940	5,011,831
Massachusetts	2,500,000*	5,819,554	13,660,024	45,054,236	135,745,097	217,452,120
Connecticut	350,000*	1,500,000*	5,466,444	19,377,670	55,297,705	73,783,802
Rhode Island	200,000*	500,000*	1,495,545	9,163,760	30,708,501	48,771,501
New York	2,623,504	5,431,966	20,852,972	67,440,397	230,749,408	303,935,649
New Jersey	None.	None.	2,000,000*	4,500,000*	20,001,951	32,044,840
Pennsylvania	500,000*	1,200,000*	5,000,000*	8,000,000*	15,000,000*	20,000,000*
Maryland	No data.	No data.	3,000,000*	6,000,000*	12,000,000*	16,000,000*
Indiana	None.	None.	None.	None.	None.	1,000,000*
California	None.	None.	None.	1,000,000*	36,555,909	69,026,603
Totals	6,423,504	15,351,520	53,931,129	168,777,504	576,430,519	848,292,894

The number of open accounts in the States enumerated above at the close of 1874 may be stated at 2,390,664, and a fair estimate of the deposits in savings banks not enumerated would increase the amount to a total of $1,000,000,000, and the open accounts would be increased in like manner to nearly or quite 2,850,000. The annual interest or dividends paid by savings banks in the above States exceeds $45,000,000. In the State of New York alone it is over $16,000,000.

The aggregate work accomplished by savings banks in the U. S. since their establishment in 1816 can only be approximated. In the State of New York we are able to reach very nearly a correct statement, as follows: accounts opened, 3,492,256; amount of deposits received, including interest credited thereon, $1,969,347,200; interest credited, $154,561,584. With these data as a basis of calculation, applied only to the States named in the above table, we obtain the following as the nearest rational approximation: accounts opened, 7,533,684; amount deposited, including interest, $4,241,464,470; interest credited, $241,497,868.

Investments.—While there is much diversity among the several States in their policy concerning investments, the favorite and best-approved securities are the stocks of the U. S. or of States in undoubted credit, the bonded obligations of cities and counties, and mortgages of real estate. As a rule, the management of savings banks has been more conservative in the matter of investments than the law. But it is a rule with unfortunate exceptions.

Restrictions upon Amount of Deposits.—Legislation in this country has followed the English precedent of imposing restrictions upon the amount which might be deposited by one person in any savings bank, but the occasion which made such restriction necessary in England has never existed here. To this may be attributed the fact that the effort has never been attended by marked success, savings banks having seldom regarded these restrictions whenever they have deemed it desirable to evade or to defy the law imposing them. The only really effective restriction of this nature is that imposed by those savings banks which, for reasons of their own, have preferred to deal only with small individual accounts, and have refused to accept those above the prescribed limit. But with every savings bank in the country open to any depositor the restrictions of the law, if rigidly enforced, would be the occasion of inconvenience rather than of hardship.

Interest or Dividends.—The original theory of savings banks was that their earnings, after paying expenses, were to be ratably divided amongst the depositors. To this was afterward supplemented the idea of reserving a small sum from these earnings for the purpose of meeting any losses which might occur. In this way a surplus is formed, the purpose of which is to promote security. Upon this theory the interest would be regulated exclusively by the earnings. In late years a practice has grown up of agreeing to pay a given rate of interest. This is a departure from true savings-bank principles. The disasters that in late years have fallen upon savings banks are in nearly every instance traceable to the attempt to fulfil promises concerning interest which should never have been made. Subject to such general restraints as the law may impose, each savings bank regulates the dividends or interest allowed according to its own discretion. In the early history of savings banks 4 per cent. was a common rate, with extra dividends once in three or five years; and many of the older institutions still adhere to this rate. The prevailing rate during the last fifteen years has been 6 per cent. on all sums. In some of the New England States even higher rates have obtained, while in California 8 and 9 per cent. is common, and on deposits for a fixed term 10 and even 12 per cent. is allowed.

Savings-bank failures, in the U. S., have in but few instances been the result of fraud or embezzlement on the part of officers: in Great Britain they have been caused by nothing else. In this country bad or reckless management, sometimes within the law, sometimes in disregard of the law, is what has commonly wrought the ruin of those which have failed.

Savings banks in France had their inception in the philanthropic efforts of M. Benjamin Delessert of Paris, who obtained from London an account of their operations in Great Britain. He with nineteen associates organized the first savings bank in France on May 22, 1818. They are under the close and direct supervision of the government. No account is allowed to exceed 1000 francs, and when by credits of interest any account is about to exceed that sum, a portion is arbitrarily withdrawn and invested for the depositor in *rentes*. The interest on these investments is collected by the bank and credited to the depositor's account. At the close of 1873 the number of savings banks and branches was 1209, the number of accounts 2,020,623, and the amount of deposits about 535,000,000 francs, or nearly $107,000,000. Measures of legislation designed to enlarge the facilities and increase the usefulness of savings banks have recently been under consideration, with what results we are not advised.

Savings banks in other countries of Europe have had a varying success. In Switzerland they have attained much prominence. In Germany they are prosperous, but not numerous, and are frequently combined with life insurance offices. In Sweden they have attained a fair degree of success. Even in Italy they have been more successful than the condition of the people would lead us to expect. In Spain, Austria, and Russia there are savings banks, but so few as hardly to constitute a system. In Ghent, Belgium, a system of deposits in the public schools has been in operation for a number of years with gratifying success, and the system is rapidly extending itself to other countries in Europe.

EMERSON W. KEYES.

* Estimated.

Savoie′, a department of France. (See SAVOY.)

Savoie, Haute. See SAVOY.

Savo′na [anc. *Sabatium*], town of Italy, province of Genoa, on the sea-shore, connected by rail with Nice and Genoa, has a large inland and maritime trade, extensive manufactures, metallurgic foundries, and shipbuilding. The old majolica of Savona is still prized. Savona is of ancient origin. Its mediæval history is intimately connected with that of Genoa. P., including suburbs, 24,851.

Savona, p.-v., Bath tp., Steuben co., N. Y., on Rochester division of Erie R. R.

Savonaro′la (GIROLAMO), b. at Ferrara Sept. 21, 1452, son of Niccolò Savonarola and his wife, Elena dei Buonaccorsi of Mantua. He was intended for the medical profession, and his early studies were directed accordingly. Aristotle, St. Thomas Aquinas, and the Bible were the favorite read-

ing of his boyhood, but he also delighted in music and poetry. Before the age of twenty he had become so shocked and saddened by the vices of the brilliant court of Ferrara, and by the degraded state of morals and religion around him, that he resolved to retire to a monastery. But respect for his father's wishes and the tenderest love for his gifted mother delayed his purpose for some years. In 1475, however, he entered the Dominican convent in Bologna, where he passed seven years in the exercise of every virtue possible in a cloister. In 1482 he was sent to preach in Tuscany, where the magnificent Lorenzo de' Medici was then at the height of his power. It was not likely that a conscience too sensitive to endure the immorality of Ferrara would be more tolerant of the state of things then existing in Florence; and the voice of Fra Girolamo was soon heard in strong condemnation of her vices and those of her rulers. His reputation as a popular preacher rose rapidly. Though the unpolished eloquence of the zealous *frate*, whose every utterance breathed the profoundest conviction of the truth of revelation, could have small attraction for an aristocracy distinguished for its classical culture and its cynical incredulity, yet he was soon listened to with admiring respect by many of the greatest men of that great age, such as Michel Angelo Buonarroti, Pico della Mirandola, etc., as well as by the thousands of humbler citizens who thronged the churches where he preached. In 1491 he was elected prior of San Marco, and at the same time he proudly refused the largess sent to his convent by Lorenzo, who had vainly hoped to buy his silence. His unsparing rebukes, hurled alike at the highest and the lowliest wrongdoer, did not fail to rouse a deadly hostility against him. He asserted both the right and the obligation of the Christian teacher to instruct his hearers in their civic as well as other duties, and his bold exercise of this right drew upon him the increased ill-will of Lorenzo. In his last hours, however, the offended prince turned to him for consolation, and in 1492 took place that awful interview between Fra Girolamo and the dying Lorenzo. Nor was the heroic reformer more indulgent to tyranny and vice in the Church than in the State. He launched the most scathing denunciations against the shameful corruption then scarcely less conspicuous in the higher ecclesiastics than in their infamous head, Pope Alexander VI. With the prophet's "Thus saith the Lord," he threatened Church and State with the speedy vengeance of Heaven if they did not repent, and evil princes, temporal and spiritual, out of Italy as well as in it, trembled before the terrible *frate*. His followers in Florence (known as *Piagnoni*) multiplied; he pressed his reforms more vigorously (the "burning of the vanities" took place in 1494); his enemies (the *Arrabbiati*) grew bitterer and fiercer. The pope remonstrated, a cardinal's hat was offered, *on conditions*, but the bold, disinterested prior was not to be moved. In 1495 he was summoned to Rome, but, knowing what awaited him there, evaded the summons. Finally, an order from the Vatican forbade him to preach. He submitted at first, then disobeyed, declaring himself unable to resist the prophetic spirit which compelled him to speak his Master's words. The sentence of excommunication followed. The *Arrabbiati* got possession of Florence. Fra Girolamo's letters to foreign sovereigns, urging them to call a council to dethrone the Borgia and elect a new pope, fell into the hands of his enemies. On Apr. 7, 1498, occurred the famous attempt at a "trial by fire," and on the night of the following day the convent of San Marco was attacked by an infuriated mob. The signoria sent thither officers to demand the surrender of the prior, who, with two of his brethren, was conveyed to the dungeons of the Bargello, and brutally tortured the same night. These barbarities were continued for weeks, suspended only when the life of their victim was in danger. In the delirium of agony he sometimes gave confused answers as to his prophetic gifts, but no confession of guilt could be extorted from him. His destruction, however, was inevitable. He had been the chief instrument of driving the weak and wicked Pietro de' Medici out of Florence, he had braved Alexander VI.; and these were crimes not to be pardoned when they against whom they were committed had the power to punish. The enraged pope threatened Florence with an interdict and with every other form of vengeance if she spared the hated friar. Sentence of death was pronounced on May 22, 1498, and the next day he and his two friends were publicly hanged and burned in the Piazza della Signoria and their ashes thrown into the Arno. The judgment of history has acquitted Savonarola of the charges brought against him in his own day, and the sincerity of his faith, the disinterestedness of his aims, are now as unquestioned as the purity of his life and the power of his intellect. Even the Roman Catholic Church itself, through Popes Paul V. and Benedict XIV., has declared his works irreproachable, and placed him among the servants of God. In the convent of San Marco are preserved various objects of interest once belonging to the martyred prior, such as his Bible filled with annotations by his own hand, etc., and a portrait, probably by his friend Fra Bartolommeo. He was of middle stature, dark complexion, plain in feature, pallid and worn with abstinence; his expression severely noble, but benevolent, and when animated his keen dark eyes glowed like flames. Among the many works of Savonarola, the best known is his *Triumphus Crucis de Veritate Fidei* (Florence, 1497). The reader is referred to a most interesting *Life* of Savonarola by Prof. Pasquale Villari (2 vols. 8vo, Florence, 1860; translated into English by Horner, London, 1863), where he will find full references to authorities and a list of Fra Girolamo's works, both published and unpublished; also to Mr. J. Perrens' *Savonarola, sa Vie, ses Écrits* (3d ed., Paris, 1859). C. C. Marsh.

Sa'vory, the name of *Satureja hortensis* (summer savory) and of *Satureja montana* (winter savory), labiate garden-herbs of Old-World origin, much employed in domestic cookery in flavoring forcemeats and other dishes.

Sav'oy, formerly a political division of the kingdom of Sardinia, and originally the family possession of the dynasty now reigning in Italy. In 1860 it was ceded to France, and is now divided into the two departments of Savoie and Haute Savoie. Savoy is the loftiest mountain-region of Europe, containing the highest peak, Mont Blanc. Bounded N. by the Lake of Geneva and E. by Piedmont, it is covered by the Graiian Alps, and entirely broken up into mountains and valleys. It contains very little cultivable land, but that which it contains is most carefully cultivated, planted with vines and mulberry trees, and generally produces wheat enough for home consumption. The mineral wealth of Savoy is not great, though coal, lead, iron, etc. are found, and to some extent worked. But the pastures which cover the mountains are very important, and feed large herds of cattle and sheep; dairy farming is the principal occupation. The area of the two departments is—Savoie, 2282 sq. m., with 267,958 inhabitants; Haute-Savoie, 1319 sq. m., with 273,027 inhabitants. The Savoyards are an honest, industrious, intelligent, and hospitable race, deeply attached to their native country. They emigrate in large numbers to France, Germany, and other places, but when they have amassed sufficient wealth return to live in their fatherland. Cap. of Savoie, Chambéry; of Haute-Savoie, Annecy.

Savoy, p.-v. and tp., Berkshire co., Mass. P. 861.

Savoy, The, in the Strand, London, is a spot remarkable for its ancient buildings and its historical associations. The Palace of the Savoy, on the side of the river Thames, was built in the year 1245 by Peter, earl of Savoy and Richmond, uncle to Eleanor, queen of Henry III., who on visiting his niece was solemnly knighted in Westminster Abbey, and afterward made this building his place of residence. According to Knighton, it surpassed other English mansions in beauty and magnificence. It came into the possession of the "time-honored" John of Gaunt, duke of Lancaster, and within its walls John, king of France, after the battle of Poitiers (1356), was confined a prisoner. "Thither," says Froissart, "came oftentimes the king and queen of England to see him and make great feast and cheer." John was released in 1360 upon conditions which could not afterward be fulfilled, and therefore the French monarch, with chivalrous honor, returned to his former prison, and there died in 1364. Disturbances arose in London respecting the duke of Lancaster, who took Wycliffe under his protection, and the citizens threatened the palace; but it escaped for a time, only to be burnt in Wat Tyler's Insurrection (which see). It is curious in connection with this outrage that the insurrectionists would not permit the place to be pillaged, and one of them was thrown into the fire "because he minded to have reserved one goodly piece of plate." The building remained a heap of ruins until the close of the reign of Henry VII., who determined to erect on the site a house "to harbor 100 poor people, sick, or lame, or travellers to be furnished with lodging, food, firing, and attendance for a certain time." It was made, in fact, a sort of casual ward, and, as might be expected, it became a refuge for all sorts of vagabonds and vagrants. This circumstance led to the suppression of the establishment in the reign of Edward VI., but it was restored under Queen Mary. "The court-ladies and maids of honor," says Strype's *Stowe*, "in imitation of the queen's charity, contributed their parts and shares toward it by sending sufficient store of beds and bedding and other things necessary for furniture of the rooms where the poor were to be harbored." The chapel of the palace became a church in the reign of Queen Elizabeth, and the district of the Savoy was constituted a distinct parish. The hospital suffered great abuse at that period—first, through the embezzlement of its funds by the master, one Thomas Thurland, and next through its be-

coming again the resort of abandoned characters, who, under pretence of calamity, sought shelter from the consequences of their crimes or irregularities. The hospital, however, continued to exist until the commencement of the reign of Queen Anne, when it was finally dissolved and the offices of master and chaplains extinguished. The buildings, which had been used in the time of Charles II. for the accommodation of disabled soldiers and sailors, were then left to fall into decay, and a view of the remains in 1761 shows them to have been then in a condition of hopeless ruin. Upon the erection of Waterloo bridge, the first stone of which was laid in 1811, the shattered walls of the palatial edifice were swept away, and the chapel remained the only but a very interesting relic of the ancient pile of buildings.

The chapel of the Savoy was burnt down in 1860, and beautifully restored at the cost of Queen Victoria. It consists of a nave without aisles or chancel. As a specimen of the state of society at a former period we may mention one use for which this building was employed in 1754, as appears from a newspaper. The *Public Advertiser* of the 2d of June of that year announced that marriages might be performed there with "the utmost privacy, decency, and regularity." It is added, "The expense not more than one guinea, the five shilling stamp included. There are five private ways by land to this chapel, and two by water." In the Savoy chapel many distinguished personages are buried. JOHN STOUGHTON.

Savoy Con'ference, The, was held soon after the Restoration, and arose out of the state of parties after the dissolution of the Commonwealth. The Episcopalians were determined to restore the Church of England to what it was before the civil war, but the Presbyterians, who mainly had been in possession of church benefices and church power for many years, contended for some modification of the former system. A royal commission was issued on Mar. 25, 1661, appointing certain divines to confer together. The representatives of Presbyterianism were Edward Reynolds, bishop of Norwich; Dr. Tuckney, master of St. John's College, Cambridge; Dr. Conant, reg. prof. div., Oxford; Dr. Spurstow; Dr. Wallis, Sav. prof. geom., Oxford; Dr. Manton, Mr. Calamy, Mr. Baxter, Mr. Jackson, Mr. Case, Mr. Clarke, Mr. Newcomen. *Coadjutors.*—Dr. Horton, Dr. Jacomb, Dr. Bates, Dr. Cooper, Dr. Lightfoot, Dr. Collins, Mr. Woodbridge, Mr. Rawlinson, Mr. Drake. The Episcopal divines were—Accepted Frewen, archbishop of York; Gilbert Sheldon, bishop of London, master of the Savoy; John Cosin, bishop of Durham; John Warner, bishop of Rochester; Henry King, bishop of Chichester; Humphrey Henchman, bishop of Sarum; George Morley, bishop of Worcester; Robert Sanderson, bishop of Lincoln; Benjamin Laney, bishop of Peterborough; Bryan Walton, bishop of Chester; Richard Sterne, bishop of Carlisle; John Gauden, bishop of Exeter; with the following coadjutors: Dr. Earle, dean of Westminster; Dr. Heylyn, Dr. Hacket, Dr. Barwick, Dr. Gunning, Dr. Pearson, Dr. Pierce, Dr. Sparrow, Mr. Thorndike. The commission gave authority to review the Book of Common Prayer, to compare it with ancient liturgies, to consult respecting exceptions made to it, and by agreement to make alterations such as would satisfy tender consciences and restore unity to the Church. The instrument appointed "the master's lodgings in the Savoy" as the place of meeting. Gilbert Sheldon, the master, perhaps procured this arrangement for his own convenience. As the terms of the commission specified advice and consultation as purposes of the meeting, friendly conference seemed necessary; but the Episcopal party manifested no disposition for anything of that kind. They were determined, as men of business, not to speak freely, but sternly to preserve the old restrictions of the Establishment. They required written communications from their opponents, to which Baxter, the most active of the Presbyterians, agreed. At length exceptions to the Liturgy were presented in form, and emendations of different kinds recommended. They may be seen at length in Baxter's *Life and Times*, the chief authority we have for the history of the proceedings. The answers of the bishops were uncourteous and captious, not indicating any disposition to conciliate, but foreclosing the possibility of removing Presbyterian objections. They said: The alterations asked, if allowed, would be a virtual confession that the Liturgy was an intolerable burden, a cause of schism, and would justify past non-conformity. Taking such ground, it mattered not what the objections made might be—none were admissible: and therefore to advise and consult was a thing out of the question. It had been arranged that whilst the rest of the Presbyterian brethren employed themselves in drawing up *exceptions* against the Book of Common Prayer, Baxter should prepare *additions*. In one fortnight he accomplished his task and presented his reformed Liturgy. The author tells us that he compared what he did with the Assembly's Directory, the Book of Common Prayer, and Hammond l'Estrange; but he seems to have borrowed little or nothing from these sources, beyond introducing or allowing the use of the creeds—sometimes the use of the Athanasian Creed—the *Te Deum*, and the Psalms in order for the day. This famous Presbyterian polemic, at the time presenting his reformed formularies, presented with them a petition to the bishops, begging them to yield to such terms of peace and concord as they themselves confessed to be lawful. The contrast between the pacific, conciliatory, and reasonable strain of the petition and the hard, repulsive tone of the prelates' answers to the exceptions is very striking. A rejoinder to the bishops' answers touching exceptions made to the Liturgy followed on the part of the ministers. A preface to it was drawn up by Calamy. The rejoinder itself, composed by Baxter—forming, indeed, a book of 148 pages, and taking up the Episcopal document paragraph by paragraph with a great deal of close reasoning and scholastic subtilty—is too extensive in its range and too minute in its details to admit of any satisfactory synopsis of its contents. All hope of a *pacifying* conference being abandoned, the Presbyterian divines agreed to a debate; many hours being spent in fixing its order. The bishops, according to their policy throughout, maintained that it belonged to those who were accusers to begin: *they* were simply on the defence. No effect was produced by the Presbyterians' rejoinder: "We are the defendants against your impositions; you command us to do certain things under pain of excommunication, imprisonment, and silence. We defend ourselves against this cruelty by asking you to show authority for this." At last it was settled that there should be a formal dispute, to be conducted by three persons on each side. Strangers were allowed to be present, and the room was full of auditors, young Tillotson, the eminent preacher and archbishop of later days, being amongst them. The debate turned upon vague abstractions and upon subtle theological distinctions, occasionally interrupted by outbursts of temper and uncivil personalities. As might be expected, the hall of the Savoy palace became an arena for logical gladiatorship, and the object of the meeting was a strife for victory. Those who are familiar with modern committees, and with what occurs when both parties lose their tempers and the stronger carries the point, can understand how the Savoy Conference terminated. "We are all agreed," says Baxter, "on the ends for the Church's welfare, unity, and peace, and His Majesty's happiness and contentment; but after all our debates were disagreed of the means; and this was the end of that assembly and commission." JOHN STOUGHTON.

Savoy, Declara'tion, The, an ecclesiastical document, so called from its having been framed by a number of ministers who met in the Savoy hospital for the purpose. Before the death of Oliver Cromwell a meeting was convened by notice from the clerk of the council of state, addressed to the Congregational elders resident in London. Cromwell, though not favorable to the proceeding, yet permitted it; but the ministers did not meet until after his decease; then they assembled in the Savoy Sept. 29, 1658, to declare the principles of their faith and polity. The business was disliked by people about the court, who feared it might lead to fresh divisions between the Independents and Presbyterians. There might be political intrigues at the background of the movement, for Cromwell said in reference to some of its projectors, who were republican officers, "They must be satisfied, or we shall all run back into blood again." At all events, when the meeting came to be held nothing was done which the Protector would have disapproved. The declaration did not clash with the sentiments of broad charity so dear to his heart. As to doctrine, the declaration is substantially the same as the Westminster Confession. Its specialty consists in its outline of ecclesiastical order. Whereas the *covenants* or mutual agreements into which Congregationalists had entered at the formation of their churches in the time of the civil wars generally contained some references to further light breaking in upon them from God's word, we discover in the Savoy Declaration no language whatever of that kind; and it seems to be assumed in the document that Congregationalism, as to the knowledge of its principles, had by that period attained to something like completeness. The following were fundamental propositions: "A particular church consists of officers and members, the Lord Christ having given to his called ones—united in church order—liberty and power to choose persons fitted by the Holy Ghost to be over them in the Lord. The officers appointed by Christ to be chosen and set apart by the Church are pastors, teachers, elders, and deacons. The way appointed by Christ for the calling of any person unto the office of pastor, teacher, or elder in a church is that he be chosen thereunto by the common suffrage of the church itself, and solemnly set apart by fasting and prayer, with the imposition of hands of the eldership of that

church, if there be any before constituted therein; and of a deacon, that he be chosen by the like suffrage, and set apart by prayer and the like imposition of hands; and those who are so chosen, though not set apart after that manner, are rightly constituted ministers of Jesus. The work of preaching is not so peculiarly confined to pastors and teachers but that others also, gifted and fitted by the Holy Ghost and approved by the people, may publicly, ordinarily, and constantly perform it. Ordination alone, without election or consent of the church, doth not constitute any person a church officer. A church furnished with officers according to the mind of Christ hath full power to administer all his ordinances; and where there is want of any one or more officers, those that are in the church may administer all the ordinances proper to those officers whom they do not possess; but where there are no teaching-officers at all, none may administer the seals, nor can the church authorize any so to do. Whereas, the Lord Jesus Christ hath appointed and instituted, as a means of edification, that those who walk not according to the rules and laws appointed by him be censured in his name and authority, every church hath power in itself to exercise and execute all those censures appointed by him. The censures appointed by Christ are admonition and excommunication; and whereas some offences may be known only to some, those to whom they are so known must first admonish the offender in private; in public offences, and in case of non-amendment upon private admonition, the offence being related to the church, the offender is to be duly admonished, in the name of Christ, by the whole church through the elders: and if this censure prevail not for his repentance, then he is to be cast out by excommunication, with the consent of the members." JOHN STOUGHTON.

Saw [Ang.-Sax. *sage*], an instrument for evenly dividing wood or other substances by the action of a row of sharp-pointed metallic teeth. It is usually made of a thin blade of steel, the teeth being more highly tempered than the rest of the plate. The use of this implement, so necessary to many dissimilar arts and handicrafts, is naturally traceable to an early period of civilization, the Egyptians having made it of bronze, and the Oriental nations of various other metals. The process of manufacture is quite complex and delicate. The East Indian saw has the teeth pointed toward the handle, instead of away from it as in Europe and America; and this peculiarity gives the former an obvious advantage in respect to the expenditure of force, as well as in the neat execution of delicate work. The teeth are usually notched at an angle of 60°. Saws are naturally manufactured in modern times of many sizes, shapes, and qualities, varying from the minute surgical or dental tool to the large instrument used in common water and steam saw-mills, and the still larger one manufactured for working into lumber the gigantic trees of the Pacific coast. The earliest saw-mills worked by water-power are supposed to have been constructed in France about the twelfth century; the earliest ones in the U. S. are said to have been established by the Dutch in New York about 1633, and by the English at the falls of the Piscataqua River, near Berwick, Me., in 1634. Their use now constitutes an important branch of industry in the Dominion of Canada and in all the heavily-timbered northern regions of the U. S., as well as of Europe.

Sawfish. See PRISTIDÆ and PRISTIOPHORIDÆ.

Saw-Fly. See HYMENOPTERA, by PROF. A. S. PACKARD, JR., M. D., M. N. A. S.

Saw-Mill, an establishment for the cutting of lumber by means of saws driven by machinery. The saw-mill has almost entirely superseded the saw-pit, in which planks were made by hand. In its most improved forms it is the product of American ingenuity. Saw-mills employ straight up-and-down saws, single or in gangs, or circular saws. Steam and water power are extensively employed in running saw-mills, and in the Netherlands windmills are also used. Special forms of the saw-mill have been invented for sawing shingles, clapboards, laths, etc., and also for cutting out mouldings, furniture-stock, veneers, etc. Jig, scroll, and belt saws are among the kinds employed for work of this class.

Saw'yer (FREDERICK A.), b. in Boston, Mass., Dec. 12, 1822; graduated at Harvard 1844; was a professional teacher at Gardner and Wiscasset, Me., 1844-51, afterward in Massachusetts and New Hampshire 1851-59; became principal of the normal school at Charleston, S. C., 1859; returned to New England during the civil war; was appointed collector of internal revenue at Charleston 1865; took an active part in the reconstruction of South Carolina; was U. S. Senator from that State 1867-73, and assistant secretary of the treasury 1873-74.

Sawyer (FREDERICK WILLIAM), b. at Saco, Me., Apr. 22, 1810; removed to Boston 1838; commenced there the practice of law 1840; has been a regular contributor to the *Evening Transcript* since 1847, and was the originator and president of the "Pawners' Bank" at Boston. Author of *The Merchant's and Shipmaster's Guide* (1840), *A Plea for Amusements* (1847), and *Hits at American Whims, and Hints for Home Use* (1860).

Sawyer (HORACE B.), b. at Burlington, Vt., Feb. 22, 1797; entered the U. S. navy as midshipman in 1812, attaining by regular promotion the rank of captain in 1853. In the war of 1812-15 he rendered valuable service, being on the Constitution at the capture of the Cyane and Levant, and subsequently engaged in the West Indies and Mediterranean in ridding those waters of pirates. His native State presented him with a sword in 1856 for his services in the war with Great Britain. D. at Washington, D. C., Feb. 14, 1860.

Sawyer (LEICESTER AMBROSE), b. at Pinckney, N. Y., about 1805; graduated at Hamilton College 1828; studied theology; was ordained as a Presbyterian minister 1831; was for some time president of Central College, O.; became pastor of a Congregational church at Westmoreland, N. Y., 1854; subsequently resided at Whitesboro', Oneida co., N. Y., and was editorially connected with the Utica *Morning Herald*. Author of *Elements of Biblical Interpretation* (New Haven, 1836), *Mental Philosophy* (1839), *Moral Philosophy* (1845), *A Critical Exposition of Baptism* (Cincinnati, 1845), *Organic Christianity, or the Church of God* (1854), and *The Reconstruction of Biblical Theories, or Biblical Science Improved* (1862). In 1838 he began a new translation of the entire Bible, which he completed about 1856. The New Testament was published at Boston Oct., 1858. The prophetical books of the Old Testament were issued Dec., 1860, and the book of Daniel, with the apocryphal additions, was separately issued 1861. The remaining (earlier) portions of the Old Testament were not published.

Sawyer (PHILETUS), b. at Whiting, Vt., Sept. 22, 1816; received an ordinary common-school education; went to Wisconsin 1847; engaged in the lumber-business at Oshkosh on an extensive scale; was a member of the legislature 1857 and 1861; mayor of Oshkosh 1863-64; was a delegate to the "Loyalists' convention" 1866, and sat in Congress as a Republican from 1865 to 1875, when he declined a re-election. He served on several important committees connected with the business interests of the Northwest, and reached the position of chairman of the committee on Pacific railroads.

Sawyer (THOMAS JEFFERSON), D. D., b. at Reading, Vt., Jan. 9, 1804; graduated at Middlebury College 1829; was pastor of a Universalist church in New York City 1830-45, and again 1852-61, having in the interval been principal of the Liberal Institute at Clinton, Oneida co., N. Y.; taught theology in the same institution; resided on a farm at Clinton 1861-69, after which he became professor of theology in Tufts College, Medford, Mass., an institution which he had been instrumental in founding (1852), as he had also been in the establishment of the theological department of the St. Lawrence University (1856). He has defended the doctrines of Universalism in public discussions with several clergymen of other denominations, and some of these polemics have been published, the most important being that with Rev. Isaac Westcott, entitled *The Doctrine of Eternal Salvation* (New York, 1854). In opposition to the views of H. W. Beecher, he published *Who is our God? the Son or the Father?* (1859).—His wife, CAROLINE M. FISHER, b. at Newton, Mass., Dec. 8, 1812, was married 1832; has written much in prose and verse for periodicals, especially the *Christian Messenger*; published several translations from the French and German, and edited the *Ladies' Repository*, a Universalist monthly magazine. She also published the *Poems* of Mrs. Julia H. Scott (1854), preceded by a *Memoir*.

Sawyer's Bar, p.-v., Siskiyou co., Cal., on N. fork of Solomon River. P. 160.

Saxe (JOHN GODFREY), LL.D., b. at Highgate, Vt., June 2, 1816; graduated at Middlebury College 1839; was admitted to the bar at St. Alban's 1843; practised law in Franklin co. 1843-50; was editor and proprietor of the Burlington *Sentinel* 1850-56; was State's attorney of Vermont one year, after which he devoted himself chiefly to literature and to popular lecturing; was Democratic candidate for governor 1859 and 1860; was for some years editor of the Albany *Evening Journal*, and subsequently became a resident of Brooklyn, N. Y. Author of several volumes of humorous poems, the longest of which were delivered at college commencements and other anniversary occasions. More than 40 eds. of his collected poems have been issued in the U. S. and in England.

Saxe (MAURICE). See MAURICE, count of Saxony.

Saxe-Al'tenburg, duchy: area, 1321.5 quad. kiloms.; pop. 142,122 inhabitants; annual budget, 2,223,561 marks; treasury fund, 3,691,279; is situated N. E. of the Thüringian Forest, and consists of two separate parts, called the eastern and the western district. Cap. Altenburg. By the division of 1485 the country fell to the Ernestine line, but in 1547 it was transferred to the Albertine. In 1553, however, it was returned to Duke Friedrich the Magnanimous of the Ernestine line, and was under dukes of its own from 1603 to 1672, when the reigning family became extinct, and it fell to Saxe Gotha. As this line too became extinct, the country fell, according to the convention of Nov. 15, 1826, to the duke of Saxe Hildburghausen, who gave up his own country, Hildburghausen, and became duke of Saxe-Altenburg. His descendants are still reigning. A. NIEMANN.

Saxe-Co'burg-Go'tha, duchies: area, 1967.75 quad. kiloms.; pop. 174,339, of which 561.99 q. k., with 51,709 inhabitants, belong to Coburg, 1405.75 q. k., with 122,630 inhabitants, to Gotha; separated from each other by the Thüringerwald—Coburg to the S. and Gotha to the N. Caps. Coburg and Gotha. Although standing under one government, the administration is separate. Coburg has a budget of 868,993 marks, with a debt of 2,285,011; Gotha, a budget of 2,298,000, and a debt of 874,380. Since the accession of Duke Ernst II. in 1844, these two small duchies have formed the starting-point for much intellectual progress. The union of the two countries dates from 1826. The house of Saxe Coburg, founded in 1680, became extinct in 1699. The contest concerning the heritage ended in 1720. The duke of Saxe-Saalfeld received the country. The dukes of Saxe Saalfeld-Coburg reigned to 1826, when they ceded Saalfeld to Meiningen, and received Gotha, whose own dynasty had died out. AUGUST NIEMANN.

Saxe-Lauenburg. See LAUENBURG.

Saxe-Mei'ningen-Hild'burghausen, duchy: area, 2468.43 quad. kiloms.; pop. 187,957; budget, receipts, 4,223,640 marks; expenses, 3,793,640; treasury fund, 9,151,000; is situated to the S. of the Thüringerwald. Cap. Meiningen. The reigning line was founded by Bernhard, third son of Ernst the Pious. In 1826, Duke Bernhard acquired the duchy of Hildburghausen, with Saalfeld and other estates, but having sided with Austria in 1866, he was compelled to abdicate, and was succeeded by his son Georg, who still reigns. AUGUST NIEMANN.

Sax'enburg, p.-b., Jefferson tp., Butler co., Pa., on Butler extension of Pennsylvania R. R. P. 295.

Saxeville, p.-v. and tp., Waushara co., Wis. P. 746.

Saxe-Wei'mar-Ei'senach, grand duchy; area, 3615 quad. kiloms.; pop. 286,183; budget, receipts, 6,319,970 marks; expenses, 6,283,180; no debt; consists of three districts—Weimar, Neustadt, and Eisenach—situated along the Rhön and the Thüringerwald. Caps. Weimar and Eisenach; university at Jena. The reigning line descends from William, the third son of Johann III., the ancestor of the whole now living Ernestine line. In 1672 the house was divided into the lines of Weimar, Eisenach, and Jena. That of Jena became extinct in 1690, and the countries were again united in 1741 under Ernst August. The congress of Vienna enlarged the country with 31 geographical sq. m. and 77,000 inhabitants, and made it a grand duchy. Since 1853, Carl Alexander has reigned. AUGUST NIEMANN.

Saxifraga'ceæ, a rather large natural order of exogenous herbs and shrubs, comprising the true saxifrages, hydrangeas, gooseberries, currants, grass of Parnassus, *Philadelphus*, and numerous other plants, many of them ornamental and some useful. Not a few are astringent. The order is moderately represented in the U. S. The true Saxifragaceæ are most nearly related to the Rosaceæ, from which they differ in the definite stamens, albuminous seeds, tendency to consolidation of the carpels, also to have opposite leaves and no genuine stipules.

Sax'ifrage [Lat. *saxifraga*, "the stone-breaker," applied to some plants as growing in clefts of rocks; to others as supposed solvents of stone in the bladder], a name popularly applied to a very great number of plants of widely different characters. But the name should now be limited to plants of the genus *Saxifraga* (order Saxifragaceæ). This large genus comprises many alpine and high northern species, some of them highly ornamental in culture. Some of them were once used in medicine, but none have active properties. The U. S. have numerous species, some of the European also. The vernal saxifrage (*S. Virginiana*) is a very common early spring flower. The swamp saxifraga or meadow plantain (*S. Pennsylvanica*) is common in wet grounds, and its radical leaves are gathered and boiled as potherbs in spring.

Sax'o Grammat'icus, the earliest Danish historian, was secretary to Bishop Absalon, and afterward provost at the cathedral of Roeskilde, where he d. in 1204. His *Historia Danica* consists of 16 books, and reaches to the year 1186. The latter part, where he relates what he has seen himself or heard from eye-witnesses, is perfectly reliable, and the narrative has often a great charm; but his representation of the heathenish age is much colored by his monkish views, and the materials which he employed for his narrative—Runic inscriptions, old songs, the writings of the Icelanders, etc.—he did not use critically. His surname he received from the correctness and elegance of his Latin, which excited the admiration even of Erasmus. His work was first printed at Paris in 1514. The best edition is that by P. E. Müller (3 vols., Copenhagen, 1839–58). It was translated into Danish by Vedel in 1575, and by Gruntvig in 1818.

Sax'ons [Lat. *Saxones*; Celtic *Sassenach*, *Saisnaig*, perhaps from *Sachs*, a "battle-knife"], a Low-German tribe first mentioned in history in 287 A. D., when they appear in England under Carausius. Their name survives in Saxony, Prussian Saxony, the minor Saxon states, etc. (On the relations of the Saxons to the Angles of Britain see ANGLO-SAXON.) We find them early colonists of Normandy and France. There is at present a large number of so-called Saxons in Transylvania, descendants of the Low-German colonists introduced in 1143 and 1247 by the Hungarian kings. They are one of the dominant races of that region, and preserve the use of the German language, which, however, is considerably corrupted.

Saxon's, tp., Randolph co., Ala. P. 827.

Saxonville, p.-v., Framingham tp., Middlesex co., Mass., on Saxonville branch of Boston and Albany R. R., has important woollen manufactures.

Sax'ony, province of Prussia, between Hanover and Brandenburg, comprises an area of 9729 sq. m., with 2,103,174 inhabitants. The western portions are occupied by the Hartz Mountains; the rest is low and level, sloping northward and watered by the Elbe and its affluents. The soil is very fertile and very well cultivated, and many branches of manufacture are developed with great energy and success. Cap. Magdeburg.

Saxony, Kingdom of, a part of the German empire, comprising an area of 14,989.55 quad. kiloms., with 2,556,244 inhabitants, lies hemmed in between Prussia and Austria, a position fraught with great political difficulties and the principal cause of most of the historical vicissitudes of the country. It belongs to the North German mountain region, two-fifths of the surface being mountainous (Erzgebirge S., Lausitzergebirge E., with the Saxon Switzerland), two-fifths hilly, and one-fifth lowland. The principal river is the Elbe with its affluents, the Black and the White Elster, the Mulde, and the Pleisse. The population is very dense, 8900 to 1 geographical sq. m.; 52,000 Wends, nearly all settled in the government of Bautzen, live among the Germans, who belong partly to the Franconian and partly to the Thuringian tribes. In administrative respects the country is divided into 4 governments—Bautzen, with 330,945 inhabitants; Dresden, with 676,584; Leipsic, with 591,215; Zwickau, with 957,500. The principal towns are—Dresden, with 177,089 inhabitants; Leipsic, with 106,925; Chemnitz, with 68,229; Zwickau, with 27,322; Plauen, with 23,355; Glauchan, with 22,036; Freiberg, with 21,673; and Meerane, with 19,187. With respect to creed, there live in the country 2,493,556 Protestants, 53,642 Roman Catholics, 554 Greek Catholics, 4339 belonging to other Christian sects, and 3357 Jews. Agriculture is carried on with a high degree of perfection. Wheat, rye, oats, barley, millet, etc. are cultivated; also flax. The vine is grown along the Elbe. Cattle-breeding is important; sheep especially are very numerous. The arboriculture is excellent; $30\frac{6}{10}$ per cent. of the total area is covered with forest. Mining is an old occupation here, especially in the Erzgebirge, and it is still very flourishing. Silver, iron, gold, lead, sulphur, arsenic, zinc, etc. are produced; 52,000,000 cwts. of coal and about 10,000,000 cwts. of brown coal are annually raised. Manufacturing industry is much developed; Chemnitz, Zwickau, Plauen, Zittau, Bautzen, and Leipsic especially are important. Linen, cotton, and woollen goods, paper, chemicals, metal ware and machinery, straw goods, porcelain, musical and mathematical instruments, are manufactured. Leipsic has large type-foundries and printing establishments. The commerce is also very comprehensive; its principal centre is Leipsic, which is also the seat of the highest commercial court of Germany. The most important money institutions are the Bank of Leipsic, the Saxon Bank in Dresden, and the Agricultural Bank of Bautzen. The country is better provided with railways than any other part of Germany; 1448 kils. were in operation Jan. 1, 1875. Public education stands very high; the numerous educational in-

stitutions comprise a university in Leipsic, a mining academy in Freiberg, an academy of arboriculture at Tharand, a polytechnic school in Dresden, an industrial school at Chemnitz, 5 architectural, 5 commercial, 7 schools for the exact sciences, 12 gymnasiums, more than 2000 evangelical, and 40 Roman Catholic public elementary schools. The government is a constitutional monarchy, established in 1831 and modified in 1849, 1851, 1860, 1861, 1868, and 1874. In all foreign affairs and in many important interior questions the authority of the German empire has wholly superseded that of the particular Saxon government, which, however, is still independent with respect to the interior administration. The reigning king is Albert, who ascended the throne Oct. 29, 1873; the representation of the people is composed of two chambers. The finances are in good order; the principal items of the budget for 1875 were as follows: (1) *Receipts.*—Domains, 8,106,957 thalers; droits réguliers, 19,535,592; capitaux productifs, 6,367,509; impôts et droits, 13,482,861; total, 47,492,919. (2) *Expenses.*—Dotations, including the royal appanages, 21,916,290; ministère, 135,540; justice, 3,033,630; interior, 5,685,876; finance, 1,702,551; worship and public education, 4,190,577; foreign affairs, 165,960; matriculation, 4,440,651; pensions, 2,048,958; public works, 3,751,350; fonds de reserve, 421,556; total, 47,492,919. At the end of 1874 the public debt amounted to 324,393,675. The army forms the 12th corps of the German imperial army. The colors of the country are green and silver.

History.—That German tribe which the Romans called Saxones was in ancient time settled between the Eider, Elbe, and Trave. Charlemagne made war upon them 772–803, and subjugated them, and Saxony now became a dukedom, belonging to the Frankish and afterward to the German empire. Under Otto the Magnificent, Thuringia was united to it, and Otto's son, Heinrich, became king of Germany in 919. His successor, the emperor Otto I., gave the dukedom of Saxony to Hermann Billung. Under the house of the Billungs, Saxony made war upon the emperor Henry IV. in 1067, but in 1106 the house became extinct, and under the emperor Lothar, in 1125, the country came into the possession of Duke Henry of Bavaria. His son, Henry the Lion, increased the dukedom, but when he was placed under the imperial ban his dominions were scattered, and, after being reduced to a small piece of land, the dukedom of Saxony was given to Count Bernhard of Ascania. The house of Ascania branched off in 1260 into two lines, of which one, the Wittenberg, became extinct in 1421, while the other, the Lauenberg, reigned until 1680. The title of duke of Saxony followed the Wittenberg branch; it was changed in 1355 to that of elector, and both land and title were bestowed on Friedrich the Valiant, margrave of Meissen, in 1421. Thus, the name of Saxony, which originally designated a tribe, became a princely title, and was transferred to countries with which it had no historical connection. Since 1088 the house of Wettin has reigned in the margraviate of Meissen. In 1485 the grandsons of Friedrich the Valiant, Ernst and Albert, divided the inherited countries, so that Ernst received Thuringia, and Albert, Meissen, and two lines were thus formed, which still flourish, the Ernestine and the Albertine, of which the former now reigns in the four Saxon duchies, Saxe-Weimar-Eisenach, Saxe-Meiningen-Hildburghausen, Saxe-Altenburg, and Saxe-Coburg-Gotha; the latter in the kingdom of Saxony. Many changes, however, took place in the disposition of the property before the present state became settled. After the battle of Muhlberg, by the capitulation of Wittenberg in 1547, the chief of the Ernestine line lost the largest part of his land and the electoral dignity, which were acquired by Duke Moritz of the Albertine line. During the Thirty Years' war this line acquired considerable importance, Johann Georg I. being an ally of Sweden and receiving the two Lausitz from the emperor by the Peace of Prague in 1635. But after the Peace of Westphalia, in 1648, the rise of Brandenburg became an impediment to the further development of the electorate. The elector August embraced Roman Catholicism in 1607, became king of Poland, and involved Saxony in war with Charles XII. of Sweden. His successor, August, sided with Maria Theresa of Austria against Friedrich II. of Prussia, and in the Seven Years' war Saxony lost 90,000 men and 70,000,000 thalers. At the same time the minister of August, Count Brühl, squandered enormous sums. Under Friedrich August III. (1768–1827) the country again began to rise, though it had some very hard years also during this period. As a member of the German empire it took part in the war against France, and concluded an alliance with Prussia in 1806. The defeat at Jena also affected Saxony heavily, but Dec. 11, 1806, it concluded an alliance with Napoleon and entered the Confederation of the Rhine, after which the elector received the title of king. By the Peace of Tilsit the king of Saxony obtained the grand duchy of Warsaw, which had just been established, and portions of Prussia and Austria, but in the battle of Leipsic he was taken prisoner by the allied Russian-Prussian Austrians, and, May 18, 1815, he was compelled to surrender all his acquisitions, even the two Lausitz. In the long period of peace from this moment, and up to 1866, the country became very prosperous, though a narrow and short sighted government presented many obstacles to its development. The revolutionary years of 1848–49 brought many great and beneficial reforms to Saxony. Aug. 9, 1854, King Johann ascended the throne, and both he and his minister, Beust, made a most stubborn opposition to the Prussian policy, and showed a decided partiality for Austria as the leader of the small states. But the war of 1866 brought the independence of Saxony in imminent danger, and the king, Johann, saved his crown only by entering the North German confederacy, over which Prussia presided, by paying 10,000,000 thalers in war indemnity, and by dismissing Beust. The liberal party in Saxony hailed this event with enthusiasm, but the party consisting of the court, the nobility, and the army officers continued hostile to Prussia. In 1870–71 the Saxon soldiers fought under the leadership of the crown prince, afterward King Albert, as true allies by the side of the Prussians, and the interior development of the country has not only kept pace with, but in some respects even advanced beyond, that of the rest of Northern Germany. AUGUST NIEMANN.

Sax'ton, p.-b., Liberty tp., Bedford co., Pa., on Raystown branch of Juniata River and on Huntingdon and Broad Top R. R., at its junction with Shoup's Run branch. P. 318.

Saxton (JOSEPH), b. in Huntingdon co., Pa., Mar. 22, 1799, where he received a common school education. His mechanical ingenuity was early shown by improvements in the machinery in his father's nail-factory. At eighteen he went to Philadelphia, and there invented a machine for cutting the teeth of chronometer wheels, an original escapement with a compensating pendulum, and made the clock which still marks the time from the belfry of Independence Hall. He subsequently went to London, where he resided for nine years. Here he formed the acquaintance of Faraday, which ripened into a lasting friendship. His mechanical genius was fully recognized, and he was placed as chief assistant in the Adelaide Gallery, then the great scientific repository, and while there constructed a magneto electric machine by which the first magnetic spark was produced, and which was permanently placed in the gallery. He also constructed the apparatus used by Mr. Wheatstone in his experiments on the velocity of electricity in its passage through a wire. He next invented a locomotive differential pulley, by means of which high speed may be given to vehicles by horses travelling at a slow rate, and a medal-ruling machine for tracing lines on metal or glass, representing by an engraving the design on the face of the medal. He returned to America to superintend the construction of the machinery and balances for the Philadelphia mint, and subsequently, under the auspices of Prof. Bache, was placed in charge of the construction of the standard weights and measures for the U. S.—a position he filled with marked ability, furnishing the State capitals and the custom-houses with accurate sets of weights and measures. A gold medal was awarded him at the London exhibition of 1851 for a large class balance of extreme precision, and he was at various times the recipient of other medals awarded for his meritorious works. He was one of the original corporators of the National Academy of Sciences. Among his many ingenious devices and inventions, the mirror-comparator for comparing and the tracing-machine for dividing standard measures, his deep sea thermometer, used in the exploration of the Gulf Stream by the U. S. Coast Survey, his self registering tide-gauge, and his immersed hydrometer, deserve especial mention. D. at Washington, D. C., of paralysis, Oct. 26, 1873. G. C. SIMMONS.

Saxton (RUFUS), b. in Deerfield, Mass., Oct. 19, 1824; graduated from the U. S. Military Academy July 1, 1849, as brevet second lieutenant of artillery, his first service being in Florida against the hostile Seminoles; from 1855 to 1859 was on Coast Survey duty, and for a year was assistant instructor of artillery tactics at West Point. On the outbreak of war he was stationed at St. Louis, and participated in dispersing the Confederate force at Camp Jackson, May 10, 1861; appointed assistant quartermaster U. S. army May 13, 1861, he served on the staff of Gen. Lyon as chief quartermaster until transferred in July to the staff of Gen. McClellan in West Virginia. In September he accompanied the expedition to Port Royal, S. C.; appointed brigadier-general U. S. volunteers in Apr., 1862, he commanded at Harper's Ferry when threatened by Jackson; assigned to duty as military governor of the department of the South July, 1862, where he was engaged in

organizing negro soldiers and troops, and as commissioner of the Freedmen's Bureau until Jan., 1866, when he was mustered out of the volunteer service; brevet major, lieutenant colonel, colonel, and brigadier general. In 1872 he became deputy quartermaster-general U. S. army, with rank of lieutenant colonel.

Saxton's River, p.-v., Rockingham tp., Windham co., Vt., on the river of the same name.

Say (JEAN BAPTISTE), b. at Lyons Jan. 5, 1767; was educated for a commercial career, and spent a part of his youth in England; found employment on his return to Paris on Mirabeau's paper, *Courrier de Provence*, and afterward as secretary to Clavière, minister of finance; edited from 1794 to 1800 *La Décade*; became a member of the tribunate in 1799; published his celebrated *Traité d'Économie politique* in 1803, and enjoyed already a great reputation when his thorough disagreement with Napoleon's policy compelled him to retire into private life. He established a large spinning mill, and published in 1812 *De l'Angleterre*, and in 1815 *Catéchisme d'Économie politique*. After the fall of Napoleon he again took an active part in public life, and was appointed professor at the school of Arts et Métiers in 1819, and at the Collége de France in 1831. D. at Paris Nov. 15, 1832. His lectures, which gathered large and appreciative audiences, were published 1828-30 under the title *Cours complet d'Économie politique*, and after his death some minor essays, *Mélanges et Correspondances* (1833).

Say (THOMAS), b. at Philadelphia, Pa., July 27, 1787, son of a druggist and bred to that business, from which he withdrew in consequence of pecuniary losses and devoted himself to natural history; became an intimate friend of William Bartram, the naturalist; was one of the founders of the Philadelphia Academy of Natural Sciences Mar. 21, 1812; was first curator of that body, living for several years in its museum at an average cost for food of not above twelve cents a day; was one of the leading contributors to the *Journal* published by the academy; accompanied Messrs. Maclure, Peale, and Ord in their scientific exploration of the islands and coasts of Georgia and East Florida 1818; was chief zoologist to Major Long's expeditions to the Rocky Mountains 1819-20, and to the sources of St. Peter's River 1823; published *Astronomical and Meteorological Records and Vocabularies of Indian Languages* (Philadelphia, 1822); supplied material for James's and Keating's accounts of Major Long's two expeditions, and wrote the zoology for the latter book (1824); issued his principal work, *American Entomology*, in 3 8vo vols. beautifully illustrated (Philadelphia, 1824-28), describing here and in his other works probably a greater number of new species of insects than were ever discovered by any other single naturalist up to that period; was chosen a member of the Linnaean and Zoological societies of London; contributed numerous articles to the *Transactions* of the Philosophical Society, to the publications of other scientific bodies, and to *Silliman's Journal*; removed with Maclure and Owen to New Harmony, Ind., 1825; remained there after the separation of his associates, acting as agent of the property of that unfortunate socialistic experiment; published at New Harmony 7 numbers of a great work on *American Conchology* (1830-34), with colored plates by Mrs. Say. D. at New Harmony Oct. 10, 1834. His *Complete Writings on the Conchology of the U. S.* were edited by William G. Binney (New York, 8vo, 1858, with 75 colored plates), and his *Complete Writings on the Entomology of the U. S.* were collected and issued by Dr. John L. LeConte (New York, 2 vols. 8vo, 1859, with 54 colored plates), the latter work being preceded by a *Memoir* of the author from the pen of his early associate, George Ord, originally read before the American Philosophical Society Dec. 19, 1834. A *Biographical Sketch of Thomas Say*, delivered before the Academy of Natural Sciences by Dr. Benjamin H. Coates Dec. 16, 1834, was published in Waldie's *Select Circulating Library* (vol. v., 1835), and another memoir may be found in the *National Portrait Gallery*, vol. iv. It was asserted in the obituary notice which appeared in *Silliman's Journal* that Mr. Say had "done more to make known the zoology of his country than any other man." PORTER C. BLISS.

Say'brook, p.-v. and tp., Middlesex co., Conn., on Long Island Sound, at the mouth of Connecticut River, on the Shore Line division of New York New Haven and Hartford R. R., at its junction with Connecticut Valley R. R., has a fine hotel, is a noted place of summer resort, and celebrated as the original seat of Yale College and for the ecclesiastical council which promulgated the "Saybrook Platform." P. 1267.

Saybrook, p.-v., Cheney's Grove tp., McLean co., Ill., on Decatur and State Line R. R. P. 389.

Saybrook, p.-v. and tp., Ashtabula co., O., on Lake Shore and Michigan Southern R. R. P. 1421.

Saylor, tp., Polk co., Ia. P. 1007.

Sayre (LEWIS AUSTEN), M. D., b. in Madison, N. J., Feb. 29, 1820; his grandfather was a deacon, and served as quartermaster under Gen. Washington. At the age of ten young Sayre was taken to Lexington, Ky., where he was adopted by an uncle; entered the University of Transylvania; graduated there in 1837; having selected the medical profession, in 1839 he entered the office of Dr. David Green in New York City; in 1842 took the degree of M. D. in the College of Physicians and Surgeons; his first appointment was prosector to Prof. Willard Parker; appointed resident physician in 1859 by the mayor of New York, and soon after was elected professor of orthopedic surgery in the Bellevue Hospital Medical College, which he still holds, the first chair of the kind created in the U. S.; in 1852 first exsected the head of the os femoris and portion of the acetabulum with success—an operation he has now performed oftener than probably the whole profession besides. Dr. Sayre is the author of several monographs on orthopedic surgery, and stands at the head of the treatment of deformity in this country. PAUL F. EVE.

Sayre (NATHANIEL C.), b. and educated in New Jersey; was admitted to the bar; moved to Sparta, Ga., in 1820; was elected solicitor-general of the northern circuit; for a number of years was elected to the legislature, either to the house or senate; was promoted to the bench in his circuit 1845. D. at Sparta in 1854. As a lawyer and legislator he did much in the legislative halls for the improvement of the judiciary system of the State.

ALEXANDER H. STEPHENS.

Sayre (STEPHEN), b. on Long Island, N. Y., in 1734; graduated at Princeton 1757; became a successful merchant and banker in London, of which city he was chosen sheriff 1774; was intimately connected with Lord Chatham and other friends of the American colonies; was imprisoned in the Tower on a charge of high treason in consequence of unguarded language; was soon released, but had already suffered the ruin of his business interests; was employed by Dr. Franklin and Arthur Lee in their important negotiations with European courts; returned to the U. S. after the peace of 1783, and was an active political opponent of Washington's administration. D. in Virginia Sept. 27, 1818.

Say'ville, p.-v., Islip tp., Suffolk co., N. Y. (Long Island), on South Side R. R. P. 1200.

Scab [Lat. *scabies*], a disease of sheep much resembling the itch which sometimes afflicts the human species. Like that disease, it is caused by the presence of a minute acarus or spider-like mite. Sulphur ointment, arsenical washes, tobacco-water, and mercurial ointments are all useful, and the disease can generally be cured without difficulty. It may be suspected when the sheep rub themselves much or have bare and scurfy patches upon the skin.

Scabaritic Disease. See SCABIES.

Scab'bard-Fish, a name given to the *Lepidopus argyreus*, a species of the family Trichiuridæ, distinguished by the elongated, ribbon-like body, pointed head, formidably-armed mouth, elongated dorsal and anal, and well-developed and forked caudal fin. The species is an open-sea fish, and rather rare on the coasts of Europe. (See also TRICHIURIDÆ.) THEODORE GILL.

Sca'bies [Lat.], or **Itch,** is a parasitic disease of the skin. It affects chiefly the hands, more especially the webs of the fingers, their inner surfaces, and the back of the hand. Less frequently it extends to the arms, and rarely the feet, legs, and abdomen are affected. The scalp may be invaded, but the face is exempt. This disorder infests children, who receive the peculiar insect from person to person by contact in school or play, and its lodgment is facilitated by neglect to wash perspiration and dirt from the hands. Persistent and annoying itching is experienced; careful inspection detects small red elevations, points of irritation, papular at first; soon these become vesicular or watery at the tip, white-capped points, and often from scratching are rendered pustular, and later scaly. Closer inspection discloses small red lines connecting these vesicles or branching from them into adjacent healthy skin. These red lines are subcuticular channels, produced by the burrowing of the itch-insect beneath the cuticle or scurf-skin, and the vesicles are the result of inflammation to which its presence and irritation have given rise. The insect will not be found in the fluid or cavity of the vesicle, but by laying open the diverging canals with a fine needle may often be found at its end. This parasitic insect is known as the *Acarus scabiei*, or *Sarcoptes hominis*. It is a minute, whitish insect, from $\frac{1}{100}$th to $\frac{1}{60}$th of an inch long. The male is least often found, being migratory in his habits, and small. His head is provided with two mandibular organs and four palpi or bristles; the adult

male has eight legs. The female is sedentary in habits, and more easily found, especially at the ends of channels, where she lays her eggs. The acarus makes its progress beneath the epidermis by means of suckers or disks upon its legs, and by aid of bristles upon its back, directed backward. Hahnemann ascribed itch to a supposititious cause, a subtle humor, which he termed *psora*; but the microscope has established the parasitic nature of the disease. The treatment of scabies is to kill the parasites. Remedies producing this end are termed parasiticides. Chief among these is sulphur, in ointment, powder, or vapor. Sulphurous acid is a convenient application. Carbolic acid, kerosene, petroleum, strong alkalies, solution of corrosive sublimate are also efficacious. Even when cured as a specific disease, the redness and vesicles may linger, a chronic condition of irritation. Soothing ointments are then indicated.
E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Scad, a name given in some parts of England to the *Trachurus trachurus* (otherwise called horse mackerel), a fish of the family Carangidæ, distinguished by its elongated, fusiform body, completely plated lateral line, and silvery color. When fresh it is scarcely edible, but it takes salt well, and when pickled is very good. Immense quantities are taken in the British seas. The name has been also extended to congeneric species, as well as to species of like form belonging to the genera *Trachurops* and *Decapterus*.

Scæv'ola, a cognomen common among the members of the plebeian family of the Mucii in ancient Rome, signifying, according to Varro, an "amulet." The two most prominent members of the family were QUINTUS MUCIUS SCÆVOLA, THE AUGUR, and QUINTUS MUCIUS SCÆVOLA, THE PONTIFEX, both celebrated as jurists, and nearly contemporary. The former, the augur, was *tribunus plebis* in 128 B. C., prætor in 121, consul in 117, and d. soon after the outbreak of the war between Marius and Sulla. Cicero, who was born in 106 B. C., states that after putting on the toga virilis he was taken by his father to Scævola to be instructed in law, and that he remained in close attendance upon him until his death. The latter, the pontifex, was *tribunus plebis* in 106 B. C., and consul in 95. He was afterward *pontifex maximus*, and during a riot in Rome in 82 between the parties of Sulla and Marius sought refuge in the temple, but was slain by the Marians before the altar. He did not give direct instruction in law, but allowed young men to be present when he gave his *responsa* to his clients. After the death of the augur, Cicero attached himself as a student to him. —The surname *Scævola* was also given to a legendary hero in the Roman history, CAIUS MUCIUS, a patrician, at the close of the sixth century B. C. When Porsenna besieged Rome, Scævola penetrated his camp and killed one of his attendants, whom he mistook for the king. Seized and brought before Porsenna, he confessed that he was one of 300 young Romans who had sworn to free Rome from its dangerous enemy by killing him; and when Porsenna threatened to burn him alive if he did not mention the names of the other conspirators, he thrust his right hand into the fire and held it there till it was consumed. Hence the surname *Scævola*, "the left-handed."

Scafati, Italy. See APPENDIX.

Scaglio'la [It. dim. of *scaglia*, a "scale"], an imitation of marble, made by mixing ground gypsum with glue, coloring it, applying it to the surface to be marbleized, and setting into the soft mass, if it be desired, bits of various ornamental stones. When hard the surface is smoothed and polished. It is an admirable imitation of the more costly marbles, but is not durable, especially in damp places. *

Sca'la [Lat. *Scaligeri*], the name of a celebrated Italian family which reigned in Verona from 1260 to 1387. The name first occurs in the history of Verona in the middle of the eleventh century, and after a long series of internal disturbances, tyranny alternating with anarchy, MASTINO DELLA SCALA succeeded in 1260 in making himself master of the city. He ruled with firmness and wisdom; the city prospered, and, although he was assassinated in 1279, the power continued in his family for more than a century. Under Cangrande (1311-29) the fortune of the family culminated. He was confirmed in his possessions, to which were added Vicenza, Padua, Treviso, etc. by the emperor Henry VII. At his court lived Dante, and many of the most magnificent architectural monuments of the city were erected during his reign. But most of his successors, Cangrande II., Paolo Alboino, and others, were worthless and infamous tyrants, and in 1387, Galeazzo Visconti of Milan expelled Antonio della Scala. The male line of the family, which flourished in Bavaria under the name of Scaligeri, became extinct in 1598; the female is still flourishing in the families of Dietrichstein and Lamberg.

Sca'la No'va, town of Asiatic Turkey, eyalet of Aïdin, on an inlet of the Ægean Sea, has a good harbor and some trade. P. about 10,000.

Scalars. See QUATERNIONS, by J. M. PEIRCE.

Scald. See BURNS AND SCALDS.

Scale [Lat. *scala*], a mathematical instrument used in plotting and in other branches of applied geometry. It consists of a slip of wood or other material divided into parts in accordance with some mathematical law. The ivory ruler ordinarily furnished by the instrument-maker has a great variety of scales stamped on its faces, of which the *scale of equal parts* and the *scale of chords* are of most frequent use.

Scale of Equal Parts.—This consists of a number of inches, or aliquot parts of an inch, laid off along a line. The first part, counting from the left, is subdivided into ten equal parts, the 0 of the scale being at the beginning of the second part. The *principal divisions* are numbered from the 0 toward the right, and the *subdivisions* toward the left. This scale is used, in connection with a pair of dividers, for laying off and measuring the lines of a drawing.

Scale of Chords.—This scale is used for laying off and for measuring the angles of a drawing. It is constructed by laying off from the left-hand extremity of a given line the chords of all the arcs from 0° up to 90°, corresponding to some assumed radius. The extremity of each chord is marked by a corresponding number; the origin of the scale and the extremity of the chord of 60°, which is equal to the radius, are marked in a more conspicuous manner than the other divisions. To lay off an angle, the vertex and one side being given, take the chord of 60° as a radius, and from the vertex of the angle as a centre describe an arc cutting the given side; then from the point in which this arc cuts the side as a centre, with a radius equal to the chord of the arc corresponding to the given angle, describe a second arc cutting the first; join this point of intersection with the given vertex; the last line will make the required angle with the given side. The method of measuring an angle by means of the scale is obvious. W. G. PECK.

Scale, in music, the name applied to the regular series of sounds, or degrees on the stave, which form the gamut. The scale in its simplest form consists of seven steps or degrees, counted upward in regular order from a root or prime, to which series the eighth is added to complete the octave. By reverse motion the same notes form the descending scale; and by the addition of other notes above or below in a continuous order the scale may be extended to seven, eight, or more octaves. The *diatonic* scale is that which consists of the tones and semitones of the octave in their natural order and relation; as, for example, A, B, C, D, E, F, G, A. (For the origin of this scale see the article GAMUT.) Of the diatonic scale, only two varieties are in use in modern music—viz. the *major* scale (or scale of the major mode), commencing on C; and the *minor* scale (or that of the minor mode), commencing on A. The major scale is complete in itself, requiring no modification of any of its intervals by accidentals, either in its ascending or descending form. The minor scale, on the contrary, is less perfect, and for the satisfaction of the ear the sixth and seventh degrees ascending require elevation by accidental sharps (or their equivalents). In the descending minor scale, however, these alterations are not so necessary, as the scale may either resume its natural form or retain the sharp only on the seventh. (See this fully explained in the article MODE.) The chief characteristic interval in both these scales is the *third*, which is one semitone greater in the major than in the minor. In ancient music several other diatonic scales were in use besides those here described, of which notice has already been taken under the head of MODES ECCLESIASTICAL, to which article the reader is referred. As the diatonic scale comprehends within the octave five tones—viz. C-D, D-E, F-G, G-A, and A-B—and also two semitones—viz. E-F and B-C—it is evident that another kind of scale may be formed by dividing the five tones into ten semitones, thus producing the semitonic series which is known as the *chromatic* scale. The intermediate semitones of this scale may be expressed in writing either in sharps or flats, though the former are commonly used for the ascending scale and the latter for the descending. The further subdivision of the scale into quarter tones, forming the *enharmonic* scale, is of little practical importance, though recognized in theory and in certain progressions both in melody and harmony. On the greater number of modern instruments quarter tones cannot be produced; and all musical compositions are therefore written either on the diatonic or the chromatic scale.—The word SCALE means also the entire range or compass of sounds producible by any given instrument, as the scale of the violin, flute, organ, or pianoforte. It is also applied by organ-builders to a graduated rule, plan, or scheme showing the lengths and diameters of the various pipes comprised in any "stop." In like manner,

the length and thickness of the strings of a pianoforte are regulated by a carefully graduated scheme called the *scale*; hence the terms "new" or "improved" scale refer to changes adopted by manufacturers in regard to the length and thickness of the strings. WILLIAM STAUNTON.

Scale of Numbers, a conventional expression of the law of relation between units of different orders. There are two kinds of scales—*uniform* and *varying*. In the uniform scale a unit of any order is equal to a unit of the next lower order multiplied by a fixed number, called the *modulus*. In the varying scale the law which connects the successive units varies in passing from order to order. The uniform scale is used in writing abstract numbers, and, subordinately, in writing compound numbers; the varying scale is employed exclusively in writing compound numbers.

Uniform Scales. In every uniform scale the abstract number 1 is assumed as the primary base, and this is called a unit of the first order. The unit of the nth order *ascending* is then equal to 1 multiplied by the $(n-1)$th power of the modulus; a unit of the nth order *descending* is equal to 1 divided by the nth power of the modulus. Furthermore, the order of any unit is indicated by the place which it occupies, the ascending and descending orders being separated by a point, as shown in the scheme below, in which r is the modulus:

Ascending.					Descending.				
	nth order.		3d order.	2d order.	1st order.	1st order.	2d order.		nth order.
. . . .	r^n	. . . . ,	r^3,	r,	1.	$\frac{1}{r}$,	$\frac{1}{r^2}$	. . .	$\frac{1}{r^n}$ . . . .

As an illustration, let $r = 10$; the resulting scale is then called the *decimal* scale. In this scale, which is our ordinary uniform scale, the number of units of any order is denoted by one of the Arabic digits, and the order of the unit is expressed by the place which it occupies in the scale. Thus, the number 234.7 is equal to 2 units of the third order, or 200, *plus* 3 units of the second order, or 30, *plus* 4 units of the first order, or 4, *plus* 7 units of the first descending order, or 7 *tenths*; this, in the abbreviated language used in reading numbers, is equivalent to *two hundred and thirty-four* and *seven-tenths*. Other uniform scales have been used for special purposes, but they are of little importance except as matters of curiosity. If the modulus is 2, the corresponding scale is said to be *binary*; if it is 3, the scale is *ternary*; if 4, the scale is *quaternary*; and so on. If the modulus is 12, the scale is *duodenary* or *duodecimal*. The last-named scale in a modified form is used somewhat in computing areas and volumes when the linear unit is one foot. (For the method of using this modified form the reader is referred to Peck's *Complete Arithmetic*, pp. 299–302.)

Varying Scales.—In expressing compound numbers the order of any unit is indicated by a proper conventional symbol, and the value of the unit of each order in terms of the unit next higher, or next lower, is written in a table. Thus, the principal units used in expressing British currency are *pounds*, *shillings*, *pence*, and *farthings* or *quarters*; these units are denoted respectively by the symbols £, s., d., and *qrs*. Taken in an ascending order, 4 units of the first order make 1 of the second, 12 of the second make one of the third, and 20 of the third make one of the fourth. The numbers, 4, 12, 20, written with intervening commas, constitute the *ascending* scale, and the numbers 20, 12, 4, similarly written, constitute the *descending* scale, of British currency. In like manner, the numbers 16, 25, 4, 20 express the *ascending*, and the numbers 20, 4, 25, 16, the *descending*, scale of avoirdupois weight. It is to be observed that the scales of compound numbers in the *metric system*, now coming into use in many countries, are essentially *decimal*. W. G. PECK.

Scale of a Series, a conventional method of indicating the law of formation of the successive terms of a series after a sufficient number of leading terms have been obtained. (An illustrative example, showing the character of such a scale and the method of application, is given under the title RECURRING SERIES.) W. G. PECK.

Scales. See BALANCE, by PRES. F. A. P. BARNARD, and WEIGHING AND WEIGHING-MACHINES, by PROF. J. A. WHITNEY.

Scales, of fishes. See COMPARATIVE ANATOMY, by PROF. E. D. COPE, A. M., M. N. A. S.

Scales Mound, p.-v. and tp., Jo Daviess co., Ill., on Illinois Central R. R. P. 748.

Scal'iger, the name of two famous scholars, father and son. (1) JULIUS CÆSAR, b. Apr. 23, 1484, at Padua, the son of Benedetto Bordone, a miniature painter who assumed or received the name DELLA SCALA from the street in which he lived; studied medicine in his native city; lived subsequently for some time at Venice; settled finally at Agen, department of Lot-et-Garonne, France, in 1529, as physician to the bishop of the diocese; married into a noble and wealthy family of the vicinity. D. there Oct. 21, 1558. He attained a great reputation both as a scholar and as a poet, and several of his works are still of interest, such as his commentaries on Hippocrates, *De Insomniis* (1538); Aristotle, *De Plantis* (1556); Theophrastus, *De Causis Plantarum* (1566); and his grammatical work, *De Causis Linguæ Latinæ* (1540). But he was exceedingly vain and irritable. He fabricated a genealogy to prove that he descended from the Della Scalas of Verona, and invented an autobiography corresponding to this dignity. Both Cardanus and Erasmus covered him with ridicule.—(2) JOSEPH JUSTUS, the tenth son of Julius Cæsar, b. at Agen Aug. 4, 1540; received an excellent education; travelled extensively; was appointed professor of belles-lettres at Leyden in 1593. D. there, unmarried, Jan. 21, 1609. His learning was immense. He spoke thirteen languages and read many others with facility; the Greek poets he knew by heart. He more especially devoted himself to the science of chronology, and his *De Emendatione Temporum* (1583) and *Thesaurus Temporum* (1606) have great merits. But he was, if possible, still more arrogant and conceited than his father, and his *Epistolæ* (1627) and the two volumes *Scaligerana* (Gröningen, 1659, and Copenhagen, 1667) give very curious proofs of these faults.

Scal'lop [O. Fr. *escalope*], a name given to various species of the family Pectinidæ, all of which agree in having a suborbicular shell, which is more or less equivalve and provided with ear-like expansions from the enlarged hinge, which is itself nearly straight. The species are numerous, and the animals of many are used to a greater or less extent as food. The common scallop of the New York markets is the *Pecten concentricus*, whose shell has about twenty diverging ribs, and which is of a dusky horn-color, with alternating lighter and darker zone-like areas: it generally attains a length and height of between two and three inches. It is quite common along almost the entire coast S. of Cape Cod. Only the large median abductor muscle is used as food. THEODORE GILL.

Scalp [Lat. *scalpere*], the outer covering of the top of the human head, consisting of the hairy integument, the flattened tendon of the occipito-frontal muscle, and subcutaneous cellular tissue. Wounds of the scalp are peculiarly liable to take on an untoward kind of inflammation, and their treatment requires great care. The removal of the scalp of a dead (or even a living) enemy as a signal of triumph is one of the customs of many tribes of North American Indians.

Scaly Ant-Eater. See ANT-EATER.

Scaman'der, a stream in the plain of Troy, of which Homer says that it was called *Xanthus* by the gods, but *Scamander* by men. It is probable, however, that it received the name Xanthus from the yellow or brownish color of its water, which was believed to have the power of dyeing the wool of sheep which drank of it. The discrepancies between the statements of Homer concerning this river and those of later writers, such as Strabo, Pliny, Pomponius Mela, and Ptolemy, are probably due to the great changes in the configuration of the coast which took place on account of the heavy deposits at the mouth of the river. A mistake seems also to have been made between the river itself and a canal which connected its bed with the sea at a point above its junction with the Simois, and which is still navigable for small barges.

Scam'mony [Gr. σκαμμωνία], a cathartic drug obtained from *Convolvulus scammonia*, a twining plant of the natural order Convolvulaceæ, indigenous in Greece, Syria, Anatolia, and Southern Russia. The root of this convolvulus contains a milky juice, which, collected from the cut surface of a fresh root, dries into a slate-colored lump, hard and brittle, and constitutes the drug in question. But at the time of collection the juice is much adulterated, so that scammony varies greatly in purity. The purest quality is called *virgin* scammony. The active principle of scammony is a resin, which may be used in medicine instead of the crude drug. Scammony has been known from a remote period. It is a powerful drastic cathartic, and in overdose is capable of exciting dangerous inflammation. Its principal advantage is the fact that an emulsion of the drug is nearly tasteless, but it is very seldom used except in combination with other purgatives. Resin of scammony is an ingredient of the U. S. compound extract of colocynth and compound cathartic pill. EDWARD CURTIS.

Scan'derbeg, whose true name was GEORGE CASTRIOT, was b. at Croia about 1410, a son of the Christian prince

John Castriot, who ruled as chief one of the many Albanian districts. George was the youngest of four brothers, who were all delivered up as hostages to Amurath II. in 1423 when he invaded Epirus and made John Castriot a tributary. The three elder brothers died by poison, but the sultan became so fond of George on account of his beauty and brightness that he had him educated in Islamism as his own son, and gave him the name of ISKANDER BEG ("Prince Alexander"). While yet a youth he distinguished himself greatly in the Turkish wars in Asia, but when in 1432, on his father's death, Amurath II. incorporated the principality as a Turkish province, the young man felt deeply offended and began to dream of vengeance. In 1443 he invaded Hungary as second in command of a great Turkish army. The first battle was lost, or rather Scanderbeg gave the victory to Johannes Hunyady, and fled during the confusion of the defeat with a few followers to Croia, having previously procured from the secretary of the sultan, whom he slew immediately after to escape discovery, an order according to which the Turkish commander of Croia was to cede his power to the bearer of the letter. By this stratagem he came into possession of the principal fortress of the country. He now abjured Islamism and called his countrymen to revolt against the Turks. The whole country responded and arose; all the Albanian chiefs declared themselves willing to follow him and pay him tribute; and with an army of 15,000 men he marched out to meet the Turkish army of 40,000 which the sultan had sent against him. He gained a brilliant victory, and other still more brilliant victories followed soon after. Amurath himself, who invaded Albania at the head of an army of 100,000 men, was defeated and repelled, and Mohammed II., who succeeded him in 1450, had no better luck, though several Albanian chiefs, wearied by the continual war, left Scanderbeg, and even joined the Turks. By the truce of 1461 he kept his paternal heritage. In the following year he went to Italy to aid the pope, who had formerly aided him against John of Anjou, and here he gained the great battle of Troja (1462). But the pope persuaded him to break the truce with the Turks, and immediately after his return home the war against Mohammed recommenced. Again the Turks were worsted in several great battles; Scanderbeg defeated them in all twenty-two times. But on Jan. 17, 1467, he d. in Lissa, and, although the Albanians continued the war, the spell was broken, and the country finally subjugated by Mohammed II. Scanderbeg's *Life* was written by his friend, Marinus Barletius (Frankfort, 1537), and by Dr. C. C. Moore (New York, 1850).

Scandiano, Italy. See APPENDIX.

Scandina'via, known to the ancient Romans under the name of **Scandia** or **Scandinavia,** a name which probably originally belonged to Skone alone, the southernmost part of Sweden, consists, according to purely physical features, of Norway, Sweden, and Finland. An arm of the White Sea, running through to the Gulf of Finland, formerly separated Finland from the plains of Russia, and this epoch is probably not so very distant, as in the peninsula of Finland a process of upheaval is still going on, amounting to about four feet in a century. Political circumstances have connected Finland with Russia, and the name *Scandinavia* now generally means simply that peninsula which, comprising Sweden and Norway, stretches between lon. 5° (entrance of Sognefjord) and 30° 50′ E. (Vardöhns at the entrance of Varangerfjord), and between lat. 55° 20′ (Falsterbo) and 71° 11′ N. (North Cape in Magerö). The isthmus which connects Scandinavia with Finland is 70 geographical miles broad; at all other points the country is surrounded by the sea—N. by the Arctic Ocean, W. by the Atlantic, S. by the North Sea, which communicates with the Baltic through Sagerrak, Kattegat, and the Sound, and E. by the Baltic. The length of the coast-line amounts to 600 geographical miles when considered as a straight line, and in reality to about four times as much. The area amounts to 1500 geographical sq. m., of which 8078 belong to Sweden, 5751 to Norway, and the rest to Russia, which stretches over the isthmus into the peninsula. The coast formation presents great varieties. The northern and western coasts are rocky and steep. The walls of the mountains which traverse the peninsula from the North Cape to Lindenæs rise immediately and nearly perpendicularly out of the sea, which enters the long, narrow, deep, fissure-like valleys (*fjords*), carrying the largest vessels far into the interior of the country. The entrances to these fjords are generally girded by a multitude of larger and minor rock-islands, the so-called *Skärgaard*. Sognefjord and Hardangerfjord are the two largest and most beautiful fjords of the whole coast; the North Cape, a steep wall of rock 1200 feet high, one of the most striking points, and Lofoten, a group of islands, noticeable as the principal scene of the Norwegian fishery. The climate is so mild, on account of the presence of the Gulf Stream, that up to North Cape no harbor freezes. The southern coast, from Stavanger to Christianiafjord, shows a similar formation, but is less rich in fish: on the other side of Christianiafjord the fjord formation ceases, but the steepness and the Skärgaard continue, though on a smaller scale. The eastern coast stretches for 160 geographical miles to the N. nearly in a straight line, and here the harbors are generally situated at the mouths of the rivers. With respect to its surface formation, the peninsula consists of two divisions, of which the one comprises that part of Sweden which stretches to the S. of a line drawn between the lakes of Mälar and Venern. This region contains in its centre a low mountain or hill land, whose middle elevation is indicated by the level of Lake Wetter, 272 feet above the sea. The highest point of this mountain district is Taberg, 1032 feet high, and rich in iron. The plains which extend to all sides are fertile, though in many places the bottom rock looks through the thin layer of vegetable earth, and numberless erratic boulders, often of enormous dimensions, are scattered all around. Extensive forests and lakes occupy the rest of the surface. In general, this part of Scandinavia bears the character of lowland. The other division, on the contrary, comprises the mightiest mountains of Europe, not equalling the Alps in elevation, but covering nearly double the area. The Scandinavian mountains form a continuous plateau without any chain formation. To the W. this plateau breaks off so abruptly that no large river could be formed, and the watershed is nowhere more than 10 geographical miles distant from the Atlantic; while to the E. it slopes down gradually through a number of terraces to the coast-plains of the Bothnian Gulf, which generally are about 10 geographical miles broad and covered with forests and swamps. This terrace formation is especially apparent in the courses of the rivers, which generally expand into long lakes, and then pass on over the edge of the terraces in falls and rapids. The watershed is everywhere elevated far above the tree-line, and especially around Hardangerfjord and Sognefjord it bears extensive snowfields, from which magnificent glaciers descend, often close to the Atlantic. It consists of vast plateaus (*fjeld, heidi*, or *widder*), which in the northern part are called kjölen; they are covered with meagre pastures or swamps, and here and there single peaks arise, called *hauba, kaabe*, or *tind*. The valleys are narrow and deep, often cut into the plateau like glacier-fissures, and entirely without lateral depressions or passes—a circumstance which makes the interior communication exceedingly difficult. In consequence of this surface formation the population is not gathered into villages, but scattered in single houses throughout the narrow valleys. The average elevation of the Scandinavian mountains ranges in the N. between 1000 and 2000 feet; nor are the peaks so very high, Sulitelma, the highest, reaching only 5796 feet. Farther to the S., however, the elevation increases. In the Dovrefjeld, across which the road leads from Christiania to Trondhjem, the average elevation amounts to 3000 feet; the highest point of the road reaches 3726 feet; the snow-line descends to 5000 feet; and the highest peak, Sneehättan, rises 7099 feet. To the S. W. of Dovrefjeld stretch Jötunfjeld and Hardangerfjeld, with an average elevation of 4000 to 5000 feet, and here the highest peaks rise close to the sea, such as Store Galdhöpiggen, 8017 feet. Farther to the S. the mountains gradually decrease; the average height of Byddefjeld is only 3000 feet. The Scandinavian mountains are rich in useful minerals. There is very little coal, but the iron ore is inexhaustible, and the Scandinavian iron is of excellent quality. Copper is found in Sweden at Falun, and in Norway at Röraas; silver in Sweden at Sala, and in Norway at Kongsberg. The main body of the rock consists of granite, the upper layer often of mica-schist. On the southern coast of Norway zircon-syenite appears in considerable extension, besides various kinds of porphyry. On the north-western and southern coasts of Norway graywacke, lime, clay, and flint-slate are found; Tertiary rocks appear only in Skone, and here alone coals are found. The water-supply of the country is extraordinarily rich; an area of more than 1000 geographical sq. m. is covered with lakes, swamps, and rivers. The south-eastern slope of the mountains sends numerous parallel rivers to the sea. The Torneå-Elv, with the Muonio, communicating with the Kalix; the Luleå, Piteå, Umeå, and Angermann Elv; also the Dal-Elv, the largest river of Sweden, formed by two arms, run in a south-eastern direction to the Baltic. From the southern slope of the mountains comes the Klara Elv, issuing from the Fœmund Lake, and entering the Venern Lake. After leaving this lake it receives the name of Göta-Elv, and on its way to the Kattegat it forms several falls, of which the Trollhättan is the most remarkable; an immense canal carries vessels by it. The Glommen, which forms the largest river-system of Scandinavia, rises in the vicinity of Röraas, expands at various places into lakes,

and forms near its mouth, at Frederikstadt, the fall of Sarpfoss; its largest affluent is the Longen. Between the Dovrefjeld and the plateaus around Sognefjord is situated the small lake of Lesso, at an elevation of 1930 feet. From it issue to the W. the Rannea, which falls into the Molde-fjord, and to the S. E. the Longen, which rushes down into the deep Guldbrand's Valley, expands into the Mjösen, the largest lake of Norway, and assumes the name of Vormen. The rivers of the southern, and especially of the western, coast are insignificant. The largest lakes of Sweden are the Venern (94.78 geographical sq. m.), the Wetter (35.68), and the Mälar (22.23). The climate presents great differences, caused by the extension from N. to S. and by the higher elevation of the surface to the W. On the W. coast the annual rainfall amounts to 80″, in Stockholm to 18″; here the winter is mild and the summer cool, while in the interior the climate has a more continental character. In Bergen, January shows a middle temperature of + 1° 3′ and July of + 12° 6′, while in Christiania, January shows a middle temperature of − 5° 0′, and July of 13° 0′, and in Falun, January − 6° 1′, July + 13° 0′.

The oldest part of the population consists of Lapps and Finns, who came from Finland across the isthmus and penetrated as far as the reindeer led. They confined themselves to the N. and the plateaus of the S.; into the fir forests then covering the valleys and plains the animal did not descend. Later, a Germanic immigration took place, partly through Denmark, partly across the Baltic. Under violent struggles the Lapps and Finns were driven back, and this movement is still going on, somewhat in the same manner as in the North American backwoods. In the rough climate the Germanic tribes developed into audacious warriors and pirates. They were governed by a number of petty kings, who often made war upon each other, but also often united and undertook extensive campaigns to foreign countries. The Norwegian tribes, the Normans, became famous in history by their conquests in the period from the ninth to the eleventh century. The Swedish pirates were called Waringer or Warägen; they appeared in Constantinople in 1043. Christianity met with great opposition in the country. It was first preached among the Swedes in 829 by a Danish monk, Ansgar. In Norway it began to spread under Harald Haarfagre in the beginning of the tenth century, and it was thoroughly established in the country under Olaf Trygveson and St. Olaf, who died in 1033. Contemporary with the introduction of Christianity the union of the many petty kingdoms began to take place, and two empires, Norway and Sweden, were established. The language of the people was originally one, represented by a most remarkable literature, and still living in Iceland, but it afterward branched off into two, Swedish and Danish. AUGUST NIEMANN.

Scandinavia, p.-v. and tp., Waupaca co., Wis. P. 1065.

Scandina′vian Mythol′ogy found its earliest and most authentic representations in the two Eddas, of which the elder consists of weird old songs compiled by Sæmund Sigfusson Frode (1054–1133); the younger, of prose pieces, generally ascribed to Snorre Sturleson (1178–1241). Both of these two sources originated in Iceland. They are consequently of Norwegian descent, and there are traces of a difference between the Norwegian, the Swedish, and the Danish conceptions of that mythology, which in its general features was common to them all. The difference seems, however, to have arisen simply from the circumstance that in certain localities a preponderance was given to certain myths, as we find to be the case in Greece. But a much deeper difference existed between the mythology of the Scandinavian people and that of the kindred race in Germany, though it is impossible to demonstrate this difference in details on account of the entire lack of authentic German sources. The most prominent among modern writers on Scandinavian mythology are A. Munch, *Nordmandenes Gudelære, i Hedenold* (Christiania, 1847); Keyser, *Nordmandenes Religionsforfatning i Hedendommen* (Christiania, 1847); N. F. S. Grundtvig, *Nordens Mythologie* (Copenhagen, 1808 and 1832); N. M. Petersen, *Nordisk Mythologi* (Copenhagen, 1849); Jakob Grimm, *Deutsche Mythologie* (Göttingen, 1835).

The cosmogony of the Scandinavian mythology is obscure and vague when compared with that of the Greeks. Its ideas are grotesque when they are grand, and narrow when they are really suggestive and clear. Instead of the Greek Chaos, into which order entered by the separation between heaven and earth, the Scandinavians began from the contracted conceptions of a North and a South, between which an abyss (*ginnunga gap*) expanded. The sparks from Muspelheim, the land of fire, reached the ice-needles which trickled down from Niflheim, the land of frost, and from this contact originated life in the form of an immense giant, Ymer, the father of the evil race of the Jotuns. Another living being was also called into existence by this primitive process of the elements, the cow Audhumbla, who produced Buri by licking the salty ice of Niflheim. From Buri descended the three brothers, Odin, Vili, and Ve, who slew Ymer and built the world from his corpse. Of his blood, in which all the Jotuns were drowned with the exception of one couple, they made the ocean; of his skull the sky, on which sparks from Muspelheim were fixed as stars; of his brains, the clouds; of his bones, the mountains; of his flesh, the earth; of his hairs, the forest, etc. The Jotuns, the evil race, were thrown down to Utgard. Loki was their chief. The Asers (*æsir*), the gods, ascended to Asgard, where they lived in Odin's splendid palace, Walhalla. In the middle Odin built Midgard from the eyebrows of Ymer, and created the first two human beings, Askar and Embla. This whole world-fabric was sustained by the sacred ash tree, Ygdrasil, at whose root sat the three goddesses of destiny, *nornir*, Urd (what is completed and has passed), Verdhandi (what is just now being born), and Skuld (what shall be in time to come).

The ideas which the Scandinavians entertained with respect to that which would take place after death and at the end of the world are much more distinct and impressive. They believed firmly in the immortality of the soul, or rather in a future life; and this belief formed the fundamental rule for their whole moral conduct. He who was brave and fell on the battle-field was led by the Walkyries to Walhalla, where he lived, together with the gods and the heroes, in great enjoyment. But he who was a coward and died on the straw-sack would be thrown down into Helheim, the realm of shadows, where Hel reigned, the daughter of Loki, more blue than flesh-colored, and with vipers crawling around her skull. These ideas bore absolute sway over the life of the ancient Scandinavian people—not so much because they represented moral ideals, arrived at after long observation of life and deep pondering over its meaning, as because they expressed the ruling passions of the race. Life in Walhalla was simply a continuation and glorification of life on earth. But, singularly enough, the ancient Scandinavians did not believe that Walhalla would last for ever. Although there are evident traces of influence from Christianity in the form in which the ideas of the fall of the Asers have come down to us, there must, nevertheless, have been an opening for such an influence in the original system; and it is probable that the old doctrine of the norns at the root of all existence has formed the links of connection or transition.

With Odin (Ang.-Sax. *Wodan*, whence Wednesday) and his wife Frigg (whence Friday) in Asgaard there lived Thor (whence Thursday), the god of the thunder, who had a girdle around his loins which doubled his strength when he tightened it, a hammer in his hand with which he cleft the mountains and crushed the Jotuns, and a carriage which was heard through the whole world when he drove it over the sky; Tyr (whence Tuesday), the god of war, with an artificial hand of iron, having lost the natural one in a wager with Loki; Heimdal, who stood on the rainbow watching the entrance to Asgaard, and who could hear the grass grow and see a thousand miles into the depth of the night; Freya, the goddess of beauty and love, who drove a span of doves and made all plants blossom when she looked at them; Ægir, the god of the sea; Bragi, the god of poetry; Frey, the god of the winds; and others. Loki, the principle of evil, was by descent a Jotun, but on account of some mysterious transactions with Odin at the beginning of time he had access to Walhalla, where he did all the mischief he could; he was the cause of its fall. It was foretold that if Baldur, the son of Odin and Frigg, died, the Asers would perish. Warned by bad dreams, Frigg went around and asked everything to swear that it would do Baldur no harm. The rocks, the sea, the clouds swore; all things, living and lifeless, took the oath. Only the mistletoe was forgotten. Loki knew it, grasped the tree, and made a spear of it. Meanwhile, in Walhalla the gods determined to try the power of the oath. Thor threw his hammer against Baldur, Tyr hit him with his sword, but Baldur was invulnerable. Then Loki asked Hödur, Baldur's blind brother, to thrust a spear after Baldur, and reached him that made of the mistletoe. Hödur threw it, and Baldur fell dead on the floor. Immediately the Jotuns and all the monsters of nature arose against the gods, and a war began between Niflheim and Walhalla. The suns and the stars took fire and burnt up; the earth sank to the bottom of the ocean, and all living beings on it perished; the Asers were killed, and the end of the world had come. But out of the sea a new heaven and a new earth would arise, in which the All-father should reign, and he would pass a new judgment upon men—not according as they were brave or cowardly, but according as they were good or bad.

It can hardly be doubted that this last tale of the fall

of the Asers was formed under influences from Christianity; but, on the other hand, it is also certain that there was in the original Scandinavian paganism not an element of skepticism, such as sprang up very early in the Greek mythology, but a longing beyond Walhalla, an instinctive feeling that the Asers, with all their magnificent splendor of victory and conquest, with all their boundless energy and vigor, with all their stern dignity and justice, were not the highest form of the highest truth. The old Norseman confided more in himself than in his gods. He held festivals in honor of them, and made magnificent sacrifices to them of 99 horses, 99 dogs, 99 cocks, and 99 slaves; but he had no priests, no Eleusinian mysteries, no oracles, no temples or theatres, no processions with songs and dances. In the din of the battle he felt the presence of the gods, and in his rapture he saw the doors of Walhalla flung open to his view. But when he sat at home and the trance was over, a sad and sombre aspect spread over him, and over his gods too. He became restless, cynical, and cruel, and he knew of no other check to his passions than his pride. CLEMENS PETERSEN.

Scanso'res [Lat., from *scandere*, "to climb"], an order of birds popularly known as climbers, distinguished by having the toes in pairs, two before and two behind, thus facilitating the habits from which they derive their name. The most important members of this are parrots, toucans, cuckoos, and woodpeckers.

Scaphiopod'idæ [from Lat. *scaphiopus*; Gr. σκάπτειν, to "dig," and πούς, "foot"], a family of amphibians of the order Salientia or Anura, comprising forms somewhat resembling in superficial appearance toads, but quite different anatomically. According to Prof. Cope, they have procœlian vertebræ, "no costal elements or coccygeal diapophyses; diapophyses of the ninth vertebra much dilated, thin, and triangular; coccygeal style without condyloid articulation, its axial portion restricting that of the sacrum and connate with it; external metatarsi bound; distal phalange continuous, simple. Manubrium cartilaginous. Tongue nearly entire." Almost all, too, have the cuneiform bone developed as a shovel-like process, by means of which they are enabled to excavate the earth with considerable facility; in allusion to which the family has been named. They are mostly nocturnal animals, and are very rarely to be seen. In accordance with this nocturnal habit, the pupils of the eyes are vertical. The family is represented chiefly in the U. S., in which are three species of *Scaphiopus* and two of *Spea*. The genera *Didocus*, *Pelobates*, and *Cultripes* of the palæarctic region (Europe, etc.) also belong to the family, and one species of *Spea* is found in Mexico. The only species found in the Eastern U. S. is *Scaphiopus Holbrookii*. THEODORE GILL.

Scaph'oid [Gr. σκάφη, "boat," and εἶδος, "likeness"] or **Navic'ular Bone,** a name applied to one of the bones of the wrist, and another of the foot, named from a fancied likeness to a boat (Lat. *navicula*).

Scap'ula [Lat.], the shoulder-blade, a bone of the anterior or upper extremity, forming part of the shoulder. It is regarded as a pleurapophysis of the occipital (fourth cephalic) vertebra. In man and nearly all mammals it is (save in exceptional cases) firmly united to the coracoid bone, which is regarded as a process of the scapula, though representing a hæmapophysis of the occipital vertebra. The dorsum of the scapula is marked by a prominent keel or spine. The scapula is developed from seven centres, and is in man not fully ossified till the twenty-fifth year of life.

Scap'ular [Lat. *scapularis*], (1) a garment worn by lay brethren and professed monastics of various Roman Catholic orders. It is a long piece of serge, one end of which falls in front and another behind the wearer. Its size, color, and proportions vary. (2) A small concealed emblem worn by many Roman Catholics, who bind themselves to a certain round of religious exercises called the "Devotion of the Scapular." There are several scapulars, as that of the Passion and that of the Seven Sorrows of Mary, but the original one, that of Our Lady of Mount Carmel, was, it is claimed, revealed by the Virgin to the blessed Simon Stock, an English Carmelite and general of that order, who died in 1265.

Scarabæ'us [Lat., "beetle"], in ancient art, a figure of a beetle, often worn as a charm or seal. Egyptians, Phœnicians, Etruscans, and Romans reverenced the scarabæus. The Egyptians frequently made scarabæi three or four feet long. They were made of gold, precious gems, granite, porphyry, and many other materials. Beetles are often found embalmed in Egypt. They are of four or five species of the genus *Ateuchus*, all insects which enclose their eggs in a ball of Nile mud. It is supposed that the Egyptians regarded the ball as a symbol of the earth. They also thought that all scarabæi were males. Hence, the scarabæus was the symbol of the paternal principle in nature. Some of the Gnostics also revered the scarabæus. SCARABÆUS is also the name of a genus of beetles, the type of a family (Scarabæidæ) to which the sacred scarabæi belong.

Scar'borough, town of England, in Yorkshire, on an inlet of the North Sea, has a good harbor protected by a high promontory. Its mineral springs enjoy a high reputation, and the city is much frequented by fashionable visitors, on account both of these springs and its sea-bathing. A considerable trade in corn, butter, salt fish, and bacon is carried on. P. 21,259.

Scarborough, p.-v. and tp., Cumberland co., Me., on Atlantic Ocean and on Boston and Maine R. R. P. 1692.

Scarborough, p.-v., Ossining tp., Westchester co., N. Y., on Hudson River and Hudson River R. R.

Scar'idæ [from the old Latin and Greek name, *Scarus*, of one of the species], a family of teleocephalous fishes well represented in the tropical seas by forms generally known under the name of parrot-fishes, from some resemblance of their mandibles to the bill of a parrot. The body is oblong and compressed; the scales large and cycloid; the lateral line interrupted behind; the head compressed; the cheeks unprotected; the opercula normal and unarmed; the nostrils double; the mouth terminal and with a short lateral cleft; the jaws well exposed, and with the teeth soldered to them, so that they form a cutting edge, but with imbricated series of older worn teeth; palate smooth; branchial apparatus confluent below; branchiostegal rays five; dorsal single, with a longer anterior spinous part (containing nine spines), and a shorter posterior portion (with ten articulated rays); anal fin corresponding to the posterior half of the dorsal, and provided with two spines and eight soft rays; caudal distinct; pectorals with branched rays; ventrals thoracic, with one spine and five soft rays; the lower pharyngeal bones are ossified together in a solid mass; the superior pharyngeal apparatus is represented only by the third bone of the typical series, and those of the opposite sides are united and are connected by a sliding articulation, with the much-enlarged fourth superior branchihyals; the vertebral column has eleven abdominal and fourteen caudal vertebræ. The family is remarkable for its homogeneous character, and especially for the constancy in the number of the rays of the dorsal and anal fins. About 130 or 140 species are more or less known, and these have been distributed among five genera—viz. *Scarus*, *Scarichthys*, *Callyodon*, *Callyodontichthys*, and *Pseudoscarus*; about 100 of the species belong to the last-named genus, and about 14 to the first one. The species are confined to the tropical regions, and in these latitudes are everywhere to be found on coral-reefs and among the groves of coral. They are reported to browse upon the coral, which they cut by means of their strong trenchant jaws.

A species of the family (*Scarus cretensis*) was one of the most celebrated fishes of the ancients. It was known to the Greeks and Latins under the name σκάρος or *scarus*, and was the subject of several fables; it was believed to ruminate its food, and was celebrated for the skill with which it evaded the toils of the fishermen. According to some ancient authors, when one was taken by line the others aided it and cut the line; or, if it was caught in the meshes of a net, its companions endeavored to draw it out by its tail, or one of them presented to the captive its own tail, so that he might pull the latter out. The species, it was believed, was originally not found in the Italian seas, although it was abundant in the Grecian Archipelago and the Sicilian waters; but in the reign of Claudius, according to Pliny, Optatus Elipertius introduced it into the Italian sea between Ostia and Campania, where for five years it was assiduously protected, and afterward became abundant. It was regarded, at least for a time, as being the very first of fishes (Galen says, "*Nunc scaro datur principatus*"), and even its excrements, far from being rejected, were regarded as enhancing its value, and were cooked with it. Although still esteemed, it does not enjoy the same reputation as formerly. What is true of this species must also be, to a great extent, of all the members of the families, as they are very closely related to each other. THEODORE GILL.

Scarlati'na [N. Lat.], or **Scarlet Fever,** one of the acute eruptive or exanthematous fevers. Chiefly a disease of childhood, with immunity for adults, increasing as the period beyond puberty lengthens. It is an infectious disease, but propagated often by contagion or close aggregation of children, as in schools, asylums, or at play; therefore occurring sometimes in local epidemics; at other times with a graver type and great mortality, involving whole communities. In different individual cases, as well as different seasons and epidemics, it assumes variable degrees, from a trivial disorder to a malignant and hopeless attack.

However, no case is without danger. While in the well-defined scarlatina sore throat, high fever, and the scarlet eruption or "efflorescence" are present, in the undeveloped and fatal attacks the kidneys are perhaps equally liable to be seriously involved. Physicians recognize three marked varieties: (1) *scarlatina simplex*, simple scarlet fever, in which the "rash" or eruption is fairly developed, the patient comfortable, and complications do not exist; (2) *scarlatina anginosa*, where an unusual soreness of the throat, with formation of pseudo-membrane resembling diphtheria, is present; (3) *scarlatina latens*, a latent form, where the eruption may be absent or doubtful, but grave injury is done by the scarlatinal poison in the blood to the nerve-centres or the kidneys. Like other contagious diseases, scarlatina has its period of "incubation" or development; four to six days usually intervene between exposure and the consequent attack. The fever develops, sometimes a simple and steady rise of temperature, more often with projectile vomiting, nervous excitement, and exhaustion indicative of a powerful impression on the nervous centres. The temperature may rise to 104° or 107° F., higher in fatal cases. The throat is already florid and tender, the tongue studded with sensitive red papillæ. At the end of twenty-four hours of fever the eruption appears—an efflorescence composed at first of minute red points upon a flushed surface, and later of a uniform scarlet hue. It develops upon the body and neck before the face, being especially developed over the upper half of the back. The face and lower extremities are soon involved, and the cuticle, destroyed by the high temperature of the surface, may begin to fall by the fifth day. This process of "desquamation" varies. In mild cases, when sponging or bathing has been employed to allay fever, no flaking or falling of the cuticle is seen. In others it may slowly separate in shreds and patches. Still again, the cuticle covering fingers and toes may exfoliate intact, forming perfect casts or like the finger of a glove. During and following this desquamation danger is greatest of acute inflammation of the kidneys, the "desquamative nephritis" constituting the most serious sequela or complication of scarlet fever. Scarlet fever is a grave disease. The mortality is very variable, from 1 in 5 to 1 in 25, according to class of patients and type of epidemics. The chief causes of death are early convulsions, diphtheritic throat complications, and uræmic poison and dropsy from implication of the kidneys. Scarlatina is chiefly to be distinguished from measles, since these are the two prominent eruptive fevers of childhood. It lacks the early developments of measles—watery eyes, sneezing, cold in the nose, loaded tongue—and presents its peculiar eruption two days earlier than that of measles.

(1) In scarlet fever treatment is chiefly directed to confining the temperature within limits by the use of aconite, diaphoretic drinks, blanketing, frequent sponging, or even the wet pack. (2) To favoring the action of the kidneys by digitalis and emollient alkaline drinks, as flaxseed tea and soda. The inunction of lard, practised by the Germans, and of butter of cacao, protect the skin and guard the kidneys from congestion. (3) To maintain the strength and counteract the poison of the disease. Quinine and tincture of iron are chiefly indicated, in free and frequent doses. Sulphite and sulpho-carbolate of soda and salicylic acid may be administered for their antiseptic effect. Liberal liquid diet throughout, and mild alcoholic stimulus when convalescing. The throat may require cold gargles, cold and disinfecting sprays. Secondary kidney disorder—dropsy and scanty urine—calls for dry cups over the kidneys, the hot air bath, elaterium as a purge, digitalis, and alkaline diuretics.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Scarlat'ti (ALESSANDRO), b. at Trapani, Sicily, in 1649; brought his first opera on the stage in 1680 in Rome in the palace of Queen Christina of Sweden; lived afterward alternately in Rome and Naples as chapel master; composed 118 operas, of which only the titles of 20 are known, 200 masses, 3000 cantatas, and minor pieces. D. in Naples Oct. 24, 1725. He was the inventor of the overture, and the first composer who gave to orchestral accompaniment an air of separate design. His son, DOMENICO SCARLATTI, b. 1683, d. 1759, was considered the greatest pianist of his time, held positions in Madrid and Lisbon as court-pianist, and composed operas and many pieces for the piano.

Scarlet Fever. See SCARLATINA.

Scarlett (Sir JAMES). See ABINGER, LORD.

Scar'lett (Sir JAMES YORKE), son of the first Lord Abinger, b. in England Feb. 1, 1799; educated at Eton and at Trinity College, Cambridge; entered the army in 1818; colonel 1851; major-general of cavalry, and distinguished himself at Balaklava; obtained command of the entire cavalry, and was knighted 1855; adjutant-general 1860, lieutenant-general 1862. D. at Burnley Dec. 6, 1871.

Scar'pa (ANTONIO), b. at Castello-Motta, Friuli, June 13, 1747; studied medicine at Padua; travelled extensively; was appointed professor of anatomy at Modena in 1772, and in 1783 at Pavia, where he d. Oct. 31, 1832. He was considered one of the greatest anatomists of his time, and many important questions of the science were settled by his works, *Anatomicæ Disquisitiones de Auditu et Olfactu* (1789), *Tabulæ Neurologicæ ad illustrandam Historiam Cardiacordum Nervorum* (1794), *De Anatomia et Pathologia Ossium* (1827), *Sull' Aneurisma* (1804), *Sull' Ernie* (1807).

Scar'panto, an island in the Mediterranean, 32 miles long, 8 miles broad, between Rhodes and Crete, belonging to Turkey. It consists mostly of naked rocks, whose highest peaks rise 4000 feet. Its inhabitants, numbering about 5000, are mostly engaged in carpentering.

Scarron' (PAUL), b. in Paris in 1610 of a good family; was destined for the Church, but spent his youth in the grossest dissipations, and was in 1637 overtaken by paralysis, which for ever deprived him of the use of his legs. He now took up literature as a means of subsistence, and developed a brilliant talent for burlesque. His comedies and poems are now forgotten, but his *L'Énéide Travestie* (1648), *Mazarinade* (1649), which cost him the pension Anne of Austria had bestowed upon him, and especially his *Roman comique* (1651; translated into English by Oliver Goldsmith, 1775), became literary types, and are still read with interest. In 1652 he married Françoise d'Aubigné, afterward Madame Maintenon, and she, as well as the irresistible humor of her lame husband, made their home a rendezvous for all the Parisian wits, who, however, had to contribute to the maintenance of the establishment, as Scarron always wanted money and was a consummate beggar. D. at Paris in 1660. Complete edition of his works in 10 vols. by Bruzen de la Martinière (1737).

Scars'dale, p.-v. and tp., Westchester co., N. Y., on New York and Harlem R. R. P. 517.

Scau'rus [signifying a person who has a defect in his ankles or feet], the cognomen of a patrician family in ancient Rome belonging to the Æmilia gens. The family was poor and lived in obscurity, when it was suddenly raised into wealth and notoriety by MARCUS ÆMILIUS SCAURUS, b. in 163 B. C. His father was a dealer in coal on a small scale, but he himself studied eloquence; served in the army; was *prætor urbanus* in 120, consul in 115, censor in 109, consul again in 107, and left an immense fortune to his son. In 111 he accompanied the consul Bestia to Africa as his legate in the war against Jugurtha. Both received large sums from the Numidian king, to whom the consul granted a peace on very favorable conditions. In Rome, however, indignation grew very hot, and Bestia was arraigned, while Scaurus secured for himself a seat in the committee of investigation. He was always more cautious in concealing his crimes than rash in indulging his vices; that is the principal feature of his character. D. about 89 B. C. With his descendants the family rapidly declined and soon became extinct.—His son, MARCUS ÆMILIUS SCAURUS II., a stepson of Sulla, committed the same crimes as his father, but he lacked his talent of concealing them. He received a large bribe in Judæa from Aristobulus, committed the most outrageous extortions in Sardinia, perpetrated frauds in the elections, etc. For some time he escaped punishment through his powerful connections and by squandering large portions of his wealth on the entertainment of the people; finally, he was exiled.—His son, MARCUS ÆMILIUS SCAURUS III., sold Sextus Pompey, his half-brother, to the generals of Mark Antony in 35 B. C.; and his son, MAMERCUS ÆMILIUS SCAURUS, the last Scaurus, committed suicide in 34 A. D., having been accused of high treason, adultery, etc.

Scelidosauridæ. See APPENDIX.

Sce'nery Hill, p.-v. and tp., Washington co., Pa.

Scep'ticism, in philosophy [σκέπτομαι, "to look about carefully"], is the doctrine which sets up, as its highest principle, doubt or suspense of judgment in view of the contradictory nature of phenomena. It endeavors to establish the subjectivity of all cognitions, and to show their incompatibility with each other; it infers, as a consequence, the impossibility of knowing truth, and takes its stand simply and solely upon its own individuality. Scepticism therefore deepens and intensifies mental independence, and is regarded as a necessary clearing up preparatory to philosophic thinking. At least since the time of Descartes this has been the case, and some writers—as Herbart, for example—insist upon the point that all beginning in philosophy is sceptical, and, on the other hand, that all scepticism is elementary philosophy. It is most important to note that all scepticism is based upon the observation of method, and in this respect is a higher activity of the mind

than the mere dogmatism which it attacks. All modern philosophy is a struggle to found itself upon method, and thus to place its structure above the assaults arising from scepticism. Its arguments emanate neither from the stage of sense-perception nor from that of simple reflection—*i. e.* neither from the first nor second intention of the mind, so-called, but from a *third* intention, a perception not of external objects, nor of species or genera, but a perception of the activity or process of reflection itself. Hence, simple common sense, alike with the deepest speculative insight, may be attacked and undermined by scepticism, but sceptical arguments can have no weight except for those minds that abandon other points of view and give attention to the method of cognition.

The ancient scepticism is directed against sense-perception, and usually counts Pyrrho of Elis as its founder. Gorgias, the Sophist, had reached the doctrine of nihilism: nothing exists; nothing can be known if it does exist. Socrates had asserted that he knew only that he knew nothing. The Megarian Stilpo had shown the contradictions in sense-perception involved in predicating universals of individual objects. The scepticism of the second and third schools of the Middle Academy, founded respectively by Arcesilaus and Carneades, was of a modified type. But Pyrrho, who seems to have learned much from Stilpo, developed scepticism as a system of philosophy, and made universal doubt the highest principle, and ἐποχή (suspension of judgment) and ἀταραξία (tranquillity of mind, imperturbability) the practical objects to be attained. With Pyrrho, Timon the Sillograph and Ænesidemus are reckoned as the representatives of the old sceptics. The last-named collected Pyrrho's arguments in the form of ten tropes, as follows: Knowledge of truth is uncertain, because of the difference (1) in the organization in animals resulting in different modes of knowledge (how can we decide?); (2) in the human constitution in tastes, feelings, desires, capacities, etc.; (3) in the structure of the organs of sense, the same object being white to the eye, sweet to the taste, rough to the touch, etc.; (4) in the mental and physical conditions at different times; (5) in the position, distances, and intervals of objects; (6) in the appearance of objects by reason of their complication with each other; (7) in the appearance of objects owing to their variation in quantity, size of parts, etc.; (8) in objects on account of the general relativity of things known; (9) in the frequency with which objects are observed; (10) in regard to education, all customs, habits, laws, ideas, faith, and theories being derived from it. The later school of sceptics includes Agrippa, Favorinus, Sextus Empiricus, and others. Agrippa reduced the tropes to five: (1) the discordance of opinions renders all uncertain; (2) every proof rests upon grounds which again need proof, and so *ad infinitum*; (3) all our ideas are relative; (4) all systems rest upon hypotheses; (5) the vicious circle, demonstrating the grounds on which the proof rests by that which is proved by them. Sextus Empiricus has left us a complete account of ancient scepticism, and himself sums up the whole as follows: Nothing is certain in itself, as is proved by the diversity of opinion, and nothing can be made certain by proof, since it derives no certainty from itself, and, if based on other proof, leads us either to the *regressus ad infinitum* or to a vicious circle.

Among famous sceptics of later times are Algazel the Arabian, Duns Scotus the Schoolman, Agrippa of Nettesheim, Glanvill, Nicolaus Cusanus, and Hirnhaym, who reject science in the interest of faith. Montaigne, Charron, Sanchez, and Le Vayer revive the ancient scepticism. Hume is the greatest modern sceptic. He saps all dogmatism by making habit or "invariable sequence" the origin of the idea of causality, and gives rise to the Kantian system and its derived schools, which "criticise the faculty of cognition" and build their structures upon insight into method, and thus eliminate scepticism by making its partial view (of method) a complete one. W. T. HARRIS.

Scep′tre [Gr. σκῆπτρον], a rod or truncheon borne by kings and other magnates as an emblem of authority. It has been employed as one of the regalia of almost all monarchies which have any record. The English sceptre now in use dates from Charles II.'s time; it is cruciform. The sceptre for Scotland dates from the time of James V. There are several smaller sceptres made for queen's-consort.

Scha′dow (JOHANN GOTTFRIED), b. at Berlin May 20, 1764; studied drawing and sculpture in his native city and at Rome 1785–87; was appointed professor at the Academy of Art in Berlin in 1788, and d. there Jan. 28, 1850. His principal works are statues of Ziethen in Berlin, Frederick the Great in Stettin, Leopold of Dessau in Berlin, Luther in Wittenberg, etc.; he has also modelled the quadriga over the Brandenburg gate of Berlin.—His son, FRIEDRICH WILHELM VON SCHADOW-GODENHAUS, b. at Berlin Dec. 6, 1789; d. at Düsseldorf Mar. 19, 1862; studied painting in Rome with Cornelius and Overbeck, and was converted to the Roman Catholic Church; became director of the Academy of Düsseldorf in 1826, and was ennobled in 1843. He was one of the founders of the romantic school, and the principal founder of the school of Düsseldorf. His principal works are *Mignon*, the four evangelists, *Paradise*, *Purgatory*, *Hell*, the *Fountain of Life*, etc.

Schaef′fer (CHARLES FREDERICK), D. D., b. at Germantown, Pa., in 1807; graduated at the University of Pennsylvania 1827; was successively pastor of Lutheran churches at Carlisle and Easton, Pa.; professor of theology in the Lutheran seminary at Columbus, O., of German in Pennsylvania College, Gettysburg, and of theology in the Lutheran seminary at Philadelphia. Author of several theological works in English and German, and translator of Kurtz's *Manual of Sacred History* (1855) and Lechler's *Commentary on Acts* (1866).—His brothers, DAVID FREDERICK (1787–1837) and FREDERICK CHRISTIAN (1792–1831), were also doctors of divinity in the Lutheran Church, and authors of some religious treatises.—Their father, FREDERICK DAVID SCHAEFFER, D. D. (1760–1836), was Lutheran pastor successively at Carlisle, Germantown, and Philadelphia.

Schä′fer (HEINRICH), b. at Schlitz, Hesse, Apr. 25, 1794; studied theology in Giessen; was appointed librarian to the ducal library of Darmstadt in 1819, and professor of history at Giessen in 1833. D. July 2, 1869. His *Geschichte von Portugal* (5 vols., 1836–54) and *Geschichte von Spanien* (3 vols., 1831–67) form parts of Ukert and Heeren's *Geschichte der Europäischen Staaten*.

Schaff (PHILIP), S. T. D., LL.D., b. at Coire, Switzerland, Jan. 1, 1819; studied at Coire, Stuttgart, Tübingen, Halle, and Berlin; took the degree of B. D. and passed the examination for a professorship in Berlin 1841; travelled as tutor of a Prussian nobleman through several countries of Europe; returned to Berlin and lectured in the university on exegesis and church history 1842–44; was called (upon the recommendation of Neander, Tholuck, and others) to a professorship in the theological seminary of the German Reformed Church of the U. S. at Mercersburg, Pa. This position he filled from 1844 till 1863. He removed to New York Dec., 1863; made a second visit to Europe 1865; was secretary of the New York Sabbath committee 1864–69, and delivered courses of lectures on church history in the theological seminaries at Andover, Hartford, and New York. In 1870 he accepted a call to the professorship of sacred literature in the Union Theological Seminary, New York, which place he still (1876) occupies. He received the honorary degree of D. D. from the University of Berlin 1854; was elected member of the Leipsic historical, the Netherland, and other literary societies in Europe and America. He is one of the founders and honorary secretaries of the American branch of the Evangelical Alliance, and was sent three times (1869, 1872, and 1873) as commissioner to Europe to make arrangements for the general conference of the Alliance, which, after a second postponement in consequence of the Franco-German war, was held in New York Oct., 1873. He was also one of the Alliance delegates to the emperor of Russia in 1871, to intercede with him in behalf of the religious liberty of his subjects in the Baltic provinces. He is president of the American Bible revision committee, which he organized in 1871 at the request of the English committee, and he was sent to England in 1875 to negotiate with the British revisers and university presses about the terms of co-operation and publication of the Anglo-American revision.

His books are mostly historical and exegetical. He wrote *History of the Apostolic Church* (New York, 1853; Edinburgh, 1855; Leipsic, 1854, etc.), *History of the Christian Church from A. D. 1–590* (New York and Leipsic, 3 vols., 1867, to be continued to the present time), *History and Collection of the Creeds of Christendom* (New York and London, 1876, in 3 vols.). He is editor of the Anglo-American reproduction and adaptation of Lange's *Critical, Theological, and Homiletical Commentary on the Bible*, begun in 1864, and to be completed in 24 vols. (of which 20 have so far appeared in New York and Edinburgh). Of his minor books we mention—*Sin against the Holy Ghost* (Halle, 1841), *James and the Brethren of our Lord* (Berlin, 1842), *The Principle of Protestantism* (1845), *Life of St. Augustine* (New York, 1853; London, 1854; Berlin, 1854), *Historical Development* (Philadelphia, 1846), *German Universities* (Philadelphia, 1857), *Lectures on the Institutions of America*, delivered in Berlin 1854, and additional lectures on the *Civil War and the Overthrow of Slavery*, delivered and published in the same city (1865; also in English, New York, 1866); *German Hymnbook, with Hymnological Introduction and Notes* (Philadelphia and Berlin, 1859; new ed., with tunes and

appendix, 1874), *Christian Catechism* (1863), *Critical Edition of the Heidelberg Catechism*, with its history to the tercentenary celebration 1863, revised ed. 1866); *Person of Christ*, [illegible] *to Strauss and Renan* (1865; translated into several languages); *Christ in Song* (New York, 1868; London, 1869 and 1870); *Bible Revision* (New York, 1873), *The Vatican Council* (New York, 1875). He founded and edited the *Kirchenfreund* (the first German theological monthly in America, 1848–53; *Evangelische Zeugnisse*, 1862–63), edits, with Prof. Henry B. Smith, the *Philosophical and Theological Library* (begun in 1873, and published in New York and London); he wrote several documents for the New York Sabbath Committee and the Evangelical Alliance, and contributed articles to American and foreign reviews, to Herzog's, Smith's, and other encyclopædic works.

Schaffhau'sen, the northernmost canton of Switzerland, is bounded N. by the grand duchy of Baden and S. by the Rhine. Area, 116 sq. m., with 37,721 inhabitants. It consists mostly of a number of valleys, which slope toward the Rhine and are very fertile. Wheat and other kinds of grain, fruit and wine of superior quality, hemp and flax are extensively cultivated; the rearing of cattle and the manufacture of steel and silk are important.

Schaffhausen, town of Switzerland, capital of the canton of Schaffhausen, on the right bank of the Rhine, 3 miles above the celebrated falls. It is an old, curiously-built town, with some manufactures of ironware and silk goods. P. 10,303.

Schagh'ticoke, tp., Rensselaer co., N. Y., on Hoosac River and on Troy and Boston R. R., has important manufactures. P. 3125.

Scharn'horst, von (GERHARDT DAVID), b. at Bordenau, in Hanover, Nov. 12, 1756; entered the Hanoverian army in 1776; became a lieutenant of artillery in 1780, and teacher in the school of artillery in Hanover in 1782; attracted much attention by his military writings; was invited to enter the Prussian service, and became in 1801 director of the military academy of Berlin. His lectures here became quite celebrated, but his ideas called forth a strong opposition from the older military men, and in 1803 he was removed to the staff, where he advanced to the rank of general. After the Peace of Tilsit, in 1807, he took charge of the whole administration of military affairs in Prussia until 1810, when he was compelled to retire at the request of Napoleon. He continued, however, to exercise a decided influence, and it was chiefly due to his energy and his ideas that Prussia in 1813 was able to bring a large and effective army into the field. He was wounded at Grossgörschen, and d. at Prague June 28, 1813, on his way to Vienna to persuade Austria to join the allies against Napoleon.

Schäss'burg, town of Austria, in Transylvania, on the Great Kökel, has manufactures of woollen and linen fabrics and a large trade in wine and fruits. P. 7996.

Schauf'fler (WILLIAM GOTTLIEB), D. D., b. at Stuttgart, Germany, Aug. 22, 1798; resided in Russia during his youth; studied theology, and went to Turkey as an independent missionary 1825, but having soon convinced himself that he needed a more thorough training, came to the U. S. in 1827; graduated at Andover 1830; was ordained Nov. 14, 1831; was missionary to the Jews in Constantinople, Turkey, 1831–55, and after that to the Moslems; has translated the entire Bible into Hebrew-Spanish and into Turkish, the New Testament, the Pentateuch, and Isaiah in the latter language having been printed in Germany under his supervision; and published an *Essay on the Right Use of Property* (1832). He is also author of *Meditations on the Last Days of Christ* (1837).

Schaum'burg-Lip'pe, a principality and state of the German empire, between Hanover and Westphalia, comprises an area of 207 sq. m., with 32,059 inhabitants. The southern part is hilly and well wooded; the northern is flat, and here is found the large lake, Steinhuder-meer, occupying an area of 22,000 acres. The revenue for 1873 was 139,535 thalers; expenditure, 137,264. Cap. Bückeburg.

Schee'le (KARL WILHELM), b. at Stralsund, Pomerania, at that time a Swedish possession, Dec. 19, 1742; was apprenticed to an apothecary in Gottenburg; studied afterward chemistry in Stockholm and Upsala, and settled in 1777 as apothecary at Köping, near Stockholm, where he d. May 21, 1786. By his comprehensive and minute chemical analyses he discovered tartaric acid, manganese, chlorine, barytes, the pigment called "Scheele's green," and the coloring matter of prussian blue. In his *Chemical Observations and Experiments on Air and Fire* (1772; translated into English by Kirwan) he described oxygen, unaware of its previous discovery by Priestley.

Scheele's Green, also called **Swedish Green.** In this country the common name is **Paris Green,** a name which is now applied in France to a special *aniline-green* product. The correct name above, by which it is known in all chemical books, proceeds from its discovery by the great Swedish chemist Scheele. It is a compound of the poisonous arsenious acid and cupric oxide, which, on account of its extreme brilliancy and beauty of color, has come into use throughout the world, but more especially throughout America, to an extent which has for many years been with chemists a constant subject of protest, often strenuous, but apparently always unavailing. While it is almost as poisonous as arsenious acid itself, it has become so common an article of trade as to be purchasable without any restriction from every dealer in pigments and colors throughout the land. Worse than this: it is commonly used for coloring paper for ornamental use, as for binding books, making lamp-shades, and even for *labels* and *stamps* for legal documents (*gummed*, and applied by *wetting in the mouth*). Schoolbooks bound in such bright-colored paper are placed in the hands of young children, who have been sometimes destroyed, and oftener diseased, by swallowing some of the deadly poison. Such paper is often used for wrapping up articles of food, medicine, and confectionery. Wall paper stained with Scheele's green is very common, and the dust therefrom, when inhaled, produces serious arsenical disease. H. WURTZ.

Schef'fer (ARY), b. at Dordrecht, Holland, 1795; exhibited in the salon at Amsterdam when but twelve years old; was taken to Paris by his mother in 1811; acquired eminence in 1822 by the well-known picture of *Francesca di Rimini*, now in the possession of the duc d'Aumale. This was followed by the *Gaston de Foix* and the *Suliote Women*. D. June 15, 1858, at Argenteuil, near Paris. Scheffer is best known by his *Mignon*, *Faust and Marguerite*, *Dante and Beatrice*, *Christus Consolator*, *The Temptation*, *Christus Remunerator*, *St. Augustine and Monica*, *The Kiss of Judas*, *The Holy Women*, all of which have been engraved or photographed. His earliest works were weak and sickly; his last are still sentimental and romantic; but his best, though pale and thin in color, and tinged with a profound melancholy, have a depth of enthusiasm and a mastery of technical treatment which entitle him to a place among the masters. Scheffer's life was embittered through his sympathies. A republican at heart and a faithful Orleanist, the success of the Napoleonic dynasty increased the natural melancholy of his disposition, and added more sombre hues to his art. The pictures of Scheffer number in all about 160. He painted several portraits, one of Queen Marie Amelie, wife of Louis Philippe. O. B. FROTHINGHAM.

Scheldt, the most important river of Belgium, has its rise in a small lake in the department of Aisne, France, and by a circuitous passage enters Belgium near Tournay; thence moves N. N. W. past Tournay, province of Hainault, and at Hérinnes becomes the boundary of this province and E. Flanders, and at Escamaffles becomes the common boundary between W. and E. Flanders; thence N. N. E., past Oudenarde, to Ghent, where it receives the Lys on the left; thence E. S. E. to Dendermonde and N. N. E. to Antwerp, at which point it becomes a noble stream, with a fine harbor sufficient for largest ships. Leaving Antwerp, its course is N. W. The island of S. Beveland divides it into two arms; the left, or S., known as the Hond or W. Scheldt, and the most important, enters the North Sea near Flushing. The right, or N., called the E. Scheldt arm, is divided again by the island of N. Beveland before it falls into the sea. It has an entire length of 210 miles, and is navigable to Condé, near its source. Among its numerous affluents, the Scarpe, Lys, and Darme from the left, and the Dender and Rupel from the right, are the most important. A system of canals connects this stream with the principal cities of Belgium. The entrance to the river is rendered somewhat difficult for large vessels by sandbanks which form at its mouths. These mouths are almost opposite that of the Thames, thus increasing its commercial and naval importance.

Schel'ler (IMMANUEL JOHANN GERHARDT), b. at Ihlow, Saxony, Mar. 22, 1735; studied theology and philology at Leipsic, and became rector in 1772 of the gymnasium of Brieg, where he d. July 5, 1803. His Latin-German dictionaries, in 7 vols., in 2, and in 1, published between 1780 and 1792, were often reprinted, and are still used.

Schel'ling, von (FRIEDRICH WILHELM JOSEPH), b. at Leonberg, a village near Stuttgart, Würtemberg (the birthplace also of the illustrious Kepler), Jan. 27, 1775; d. at the baths of Ragatz, Switzerland, Aug. 20, 1854. His father, distinguished as an Orientalist, was a country clergyman who became prelate at Maulbronn; he directed his son's education. In his sixteenth year young Schelling entered the theological seminary at Tübingen, and studied theology in connection with philosophy and philology. In his seventeenth year (1792) he wrote a thesis

for his degree of master of philosophy, taking as his theme the origin of evil as set forth in Gen. iii. As early as 1793, in his essay on myths, historical sagas, and philosophemes of antiquity, there begins to appear in outline his most important theory, developed in later life. In the spring of 1796 he went to Leipsic, and there remained for two years. He had already published his essay *On the Ego as Principle of Philosophy*, in which he had repudiated the Kantian dualism, and pointed out the common source of the two sides, theoretical and practical, subjective and objective, and set up the theory of a faculty of knowing which could grasp the unconditioned ground of these two sides—a faculty or activity which he called "intellectual intuition." At Leipsic he pursued studies in mathematics and natural science, and paid special attention to medicine. His attitude toward Fichte's system was at first that of an expounder, afterward that of a critic. He put forth his *Ideas on the Philosophy of Nature* (1797) and *Concerning the World-Soul* (1798), indicating his departure from this standpoint. The "Science of Knowledge" (*Fichte*) had made the Ego all in all, and nature a mere subordinate affair. Consciousness being regarded as the essential principle, and the will as the highest, ethical science was the sole outcome, and the natural sciences, as well as all partially unconscious activity of man as displayed in art, religion, poetry, and the mythologies, was ignored. Schelling's function was to call attention to this unconscious evolution of Reason—the side of the absolute Ego which Fichte had slighted, perhaps with justice if a choice was to be made, but certainly not with impunity. Schelling, however, went so far in this new direction as to make Nature a coequal pole of the absolute, with Mind as the other, apparently influenced in this by Spinoza, who had made "thought and extension" the two poles of his "substance." Accordingly, the union of the ideal with the real, of mind with matter, was the ultimate principle with Schelling's system. In æsthetic art this union was to be found. The Beautiful is the highest realization of the Absolute, and that "toward which the whole creation moves." This standpoint was criticised subsequently by Hegel, who restored the supernatural realization of the highest principle in the human soul as above its mere incarnation, which then sinks into a subordinate phase of spiritual life as a mere probationary stage thereof, a step in its progressive development. If the Beautiful be the highest principle, immortal life, a soul divorced from body, becomes a mere abstraction, and with this God, as supernatural, loses consciousness and perfection. Schelling, who remained almost entirely silent from 1812 to 1834, during the period of the activity of Hegel, whose system was that of Schelling, with this essential modification (the substitution of religion for art as the highest activity, and indeed the preference of conscious thought as found in theology or speculative philosophy to all other forms—being in this particular Aristotelian), seems to have felt this defect in his system, and after the death of Hegel (1831) to have developed his system from the amended basis. He calls, therefore, his earlier system, which lays so much emphasis on nature-philosophy and art, his negative system, and his later one, in which he endeavored to make freedom the highest ideal, his positive system. From Leipsic he was called to Jena (1799), partly through the interest of Goethe, who was attracted toward his philosophy of nature. At this time he came into contact with and exercised a powerful influence upon the romantic school, becoming intimate with the Schlegels, Novalis, Gries, and others. Caroline Schlegel, twelve years his senior, wife of A. W. Schlegel, patronized his efforts and readily discerned his promise as the philosopher who should unite the severely ethical systems of Kant and Fichte with the genial æsthetic naturalism of Goethe. Caroline Michaelis, daughter of the distinguished Orientalist, Michaelis (married in 1784 to a physician, Dr. Böhmer, by whom she had three children), had married, eight years after the death of her first husband, A. W. Schlegel, from whom she finally obtained a divorce in 1803, after an unhappy marriage relation of seven years. According to her statement, she had married Schlegel not from love, but out of gratitude for his friendly assistance given to her and to her mother in struggles and perplexities which they encountered. She married Schelling soon after the divorce mentioned, and exercised a great influence upon him by her appreciation and sympathy until her death in 1809. The philosopher not long afterward married Pauline Gotter.

If Fichte may be regarded as building his system chiefly on Kant's *Critique of Practical Reason*, Schelling certainly builds upon the *Critique of Judgment* and the *Metaphysical Principles of Natural Science*. Kant's use of the forces of attraction and repulsion for the construction of matter suggested an entire system of philosophy in his fertile mind. Polarity became the principle of matter and of mind as well. In 1800–01 he edited the *Journal of Speculative Physics*, and set forth the doctrines of this fundamental conception, showing how the giant mind of the world develops from its sleep in nature ("petrified in nature") to consciousness in man. In 1802 appeared his dialogue, *Bruno, or on the Natural and Divine Principle of Things*, in which the theory of Giordano Bruno is given in the style of the Platonic *Timæus*. In the same year he associated himself with Hegel for the publication of the *Critical Journal of Philosophy* (Tübingen, 1802–03), the latter furnishing the greater part of the articles for it. In his *Lectures on the Method of Academical Study*, delivered in 1802 and published the next year, he gives the outlines of his entire system in a popular form. The tendency toward mysticism here makes its appearance, and is quite marked in his works written during the next few years. In his *Philosophy and Religion* (1804) he makes finiteness and materiality to be the result of a lapse from the Absolute, to recover from which lapse is the object and goal of human history. Theosophic doctrines appear in his essays *On the Philosophy of Nature* (1806) and *On the Relation of the Plastic Arts to Nature* (1807). The influence of Franz Baader upon Schelling belongs to this period, and is manifested in the noteworthy treatise, *Philosophical Inquiries into the Nature of Human Freedom* (1809), in which he seems to follow Jacob Böhme in his theological distinctions. In this treatise also, which does not strictly accord with his system of transcendental idealism already given, the stress that he lays upon freedom and personality indicates the first appearance of his latest system, his "positive philosophy." He defended his system against the charges of naturalism, Spinozism, and atheism in a controversial work against Jacobi in 1812. In 1808 he had gone to Munich as secretary of the Academy of Arts and Design. When in 1826 the University of Munich was founded, after the removal of that at Landshut, Schelling became professor, and for a time formed the chief attraction of the university. At Erlangen in 1820 he wrote the *Philosophy of Mythology* and the *Philosophy of Revelation*, mythology, according to his view, being an imperfect revelation. In 1834, upon the occasion of the publication of Hubert Becker's translation of Cousin's estimate of French and German philosophy, Schelling wrote a preface for it, and criticised the Hegelian philosophy as being merely negative, and as substituting logical abstractions for the living and real. The dialectic of Hegel he regarded as a fiction of hypostatization, whereby self-movement is ascribed to the Idea. In his lectures on the history of modern philosophy, delivered at Munich, he unfolded this critical view more fully. Ten years after Hegel's death, Schelling became his successor at the University of Berlin, and in his opening lecture (1841) endeavored to unite his earlier and later systems, pronouncing the system of Identity to be the necessary negative phase of his entire philosophy, and needing only to be supplemented by his philosophy of mythology and revelation, which he regarded as the positive phase. The publication (1842) of the substance of his lectures at Berlin, from notes taken by Paulus and Frauenstädt, showed very clearly that the work on freedom already mentioned lay at the basis of his later views. He distinguished in God, after the fashion of Böhme, (1) a blindly necessary or unpremeditating Being—the primordial "abyss" of the divine nature; (2) the three potencies of the essence of God: (*a*) unconscious will, the *causa materialis* of creation; (*b*) conscious will, the *causa efficiens*; (*c*) *causa finalis*, the union of the two—that by which all things are made that are made; (3) the three Persons, who proceed from the three potencies by overcoming the first or unconscious phase by means of the theogonic process. These Persons are the Father, Son, and Spirit—the possibility, the power, and the completed deed of overcoming that "primordial abyss of unconsciousness." In nature, only potencies are at work; in man, personalities. Both Schelling and Fichte laid great stress on the distinction between Pauline and Johannean Christianity. Schelling makes three periods of Christianity: (*a*) Petrine, or Catholicism; (*b*) Pauline, or Protestantism; (*c*) Johannean, or the Church of the future.

The two sons of Schelling (K. F. A. and HERMANN) published a complete collection of his writings (Stuttgart and Augsburg, 1856–61) in 14 vols., of which the first division, in 10 vols., contains the works published during his life, arranged in their chronological order, while the second division, in 4 vols., gives what had remained unpublished, and is chiefly the exposition of his later system. Schelling's works have not been, to any great extent, translated into other languages. His introductions to the *Sketch of a System of Nature-Philosophy* and to the *System of Transcendental Idealism* (1799), however, have been translated and published in the *Journal of Speculative Philosophy* (St. Louis, 1867). WILLIAM T. HARRIS.

Schells'burg, p.-b., Napier tp., Bedford co., Pa. P. 342.

Schem (Alexander J.), b. at Wiedenbrück, Germany, in 1826; studied at the gymnasium of Paderborn 1839–43; at the universities of Bonn 1843–45, and of Tübingen 1845–46; edited Westphalian newspapers 1849–51; came to the U. S. 1851; was professor of Hebrew and of modern languages at Dickinson College, Carlisle, Pa., 1854–60, after which he devoted himself to literature in New York, chiefly in the departments of geography and statistics; edited ecclesiastical almanacs for 1860 and 1868–69; wrote for religious and political newspapers; aided Rev. George R. Crooks in the preparation of his *Latin-English School Lexicon*; was one of the editors of the *Methodist* and of the *Methodist Quarterly Review*; was a contributor to Appleton's, McClintock & Strong's, and Johnson's *Cyclopædias*, and prepared a revised American edition of the *Conversations-Lexicon* in the German language, in 12 vols. (1869 *seq.*).

Schem'nitz, a large mining town of Northern Hungary, on the Schemnitz, at an elevation of 2300 feet above the sea, has a celebrated mining school, with chemical laboratories and a splendid collection of minerals. The mines, which yield gold, silver, copper, and iron, extend below the city. P. of town and suburbs, 22,000.

Schenck (Noah Hunt), D. D., b. at Pennington, N. J., in 1825; graduated at Princeton 1844, and at Gambier Theological Seminary 1853; was ordained in the Protestant Episcopal Church; was for some years rector of Emanuel church, Baltimore, and became in 1867 rector of St. Anne's church, Brooklyn, N. Y. He founded and edited at Chicago the *Western Churchman* 1858–60; was co-editor of the *Protestant Churchman* 1867; and has published many sermons, essays, and treatises.

Schenck (Robert Cumming), b. at Franklin, O., Oct. 4, 1809; graduated at Miami University in 1827; studied law and was admitted to the bar, locating at Dayton; member of State legislature 1841 and 1842, and member of Congress 1843–51; U. S. minister to Brazil, and employed on diplomatic missions to Buenos Ayres, Montevideo, and Paraguay, 1851–54; appointed brigadier-general of volunteers in May, 1861, he commanded a brigade at the battle of Bull Run, July 21, subsequently in Western and Northern Virginia; engaged at battle of Cross Keys, Apr., 1862. At the second battle of Bull Run he was severely wounded and incapacitated until December, when, having meanwhile been promoted to be major-general from Aug. 30, he was placed in command of the 8th army corps and Middle department. Resigned from the army Dec., 1863, and resumed his seat in Congress, having been re-elected, serving at the head of the committee on military affairs and that of ways and means; appointed minister to England in 1871; resigned 1876.

Schenec'tady, county of E. New York, intersected by Mohawk River and Erie Canal, and traversed by the New York Central, Schenectady and Saratoga, Schenectady and Duanesburg, Schenectady and Troy, and Albany and Susquehanna R. Rs.; is watered by Norman's Kill and other streams; has an uneven surface, which becomes rugged in the southern part, while the valley of the Mohawk is extremely productive, and has important manufactures, chiefly in the city of Schenectady. Staples, Indian corn, broom corn, oats, hay, potatoes, hops, butter, and wool. Cap. Schenectady. Area, 220 sq. m. P. in 1870, 21,347; in 1875, 24,895.

Schenectady, city, cap. of Schenectady co., N. Y., on Mohawk River, in the beautiful valley of that name, about 17 miles by railroad and 30 miles by canal or river W. of Albany. It was patented Nov. 4, 1684; created a borough Oct. 23, 1765; incorporated a city Mar., 1798. Erie Canal passes through the city, also New York Central, Troy and Schenectady, Schenectady and Athens, Schenectady and Susquehanna, Schenectady and Saratoga R. Rs. It has 16 churches, and is the seat of Union College, one of the oldest and most successful in the State, incorporated in 1795, noted as having Dr. Nott for president for sixty-two years, from 1804 to 1866; has first-class graded schools with academical department and preparatory school for boys for college. Among its manufacturing establishments are large locomotive works, the Washington Agricultural Works, forgeworks, 2 foundries, a shawl factory, hoop-skirt factory, knitting-mills, sash, door, and blind factory, 3 planing mills, varnish factory, and 2 carriage-factories. The city is supplied with water by the Holly system, is lighted with gas, has 2 daily and 4 weekly newspapers (1 German), 1 monthly and 1 quarterly magazine, issued by college students, the St. Andrew's Home of the Friendless, and Vale Cemetery. Masons, Sons of Temperance, and I. O. of O. F. have lodges here. There are public halls, 1 park, and a State armory. P. in 1870, 11,026. It is one of the oldest settlements in the State; was burned and nearly all its inhabitants massacred by French and Indians in the winter of 1690. J. J. Marlett, Ed. "Evening Star."

Schenevus, p.-v., Maryland tp., Otsego co., N. Y., on Albany and Susquehanna R. R., has 1 newspaper. P. 549.

Schen'kel (Daniel), b. at Dögerlin, canton of Zurich, Switzerland, Dec. 21, 1813; studied theology in Bâle under De Wette and Hagenbach, afterward in Göttingen; was appointed pastor at Schaffhausen in 1841; professor of theology at Bâle in 1849, and in 1851 at Heidelberg, where his liberal views exercised considerable influence, but also met with great opposition. He edited *Allgemeine Kirchenzeitung* (1852–59) and *Allgemeine Kirchliche Zeitschrift* (1859–72), and *Bibel-lexicon* (1869–75, 5 vols.); wrote *Das Wesen des Protestantismus* (3 vols., 1846–51), *Christliche Dogmatik* (2 vols., 1858–59), *Das Charakterbild Jesu* (1864; translated into English by W. H. Furness, 1866), besides a number of pamphlets, essays, etc. He is the founder of the German Protestant Union.

Scherr (Johannes), b. at Hohenrechberg, Würtemberg, Oct. 3, 1817; studied philosophy and history at Tübingen; resided partly in Stuttgart, partly in Switzerland, and was appointed professor of history at the polytechnic school of Zurich in 1860. He was a very prolific writer; his principal works are *Geschichte der deutschen Literatur*, *Geschichte der englischen Literatur*, *Schiller und seine Zeit*, *Geschichte der deutschen Frauenwelt* (2 vols.), *Blücher, seine Zeit und sein Leben* (3 vols.).

Scherz'er (Karl), b. at Vienna May 1, 1821; worked as a printer in Leipsic and Paris; travelled in North and Central America 1852–55; accompanied the Austrian expedition around the world 1856–59; led an expedition in 1869 to Eastern Asia, Siam, China, and Japan, and was appointed Austrian consul at Smyrna in 1872. He has described in German all his travels; in 1875 he published *La Province de Smyrne*.

Sche'veningen, village of the Netherlands, province of South Holland, on the North Sea, 2 miles N. E. of the Hague, of which it is almost a suburban watering-place, has valuable fisheries and manufactures of sailcloth and ropes, and is the most celebrated sea-bathing resort in the country. P. 7436.

Schiedam', town of the Netherlands, province of South Holland, on the Schie, is a neat and well-built place, and has fine buildings, among which the town hall and exchange are the most remarkable. Its principal industry is gin manufacturing, for which it has 236 distilleries, besides 74 maltworks. Large herds of cattle and swine are fed from the refuse of the distilleries, and an extensive trade is carried on. P. 20,778.

Schil'ler, von (Johann Christoph Friedrich), the renowned German poet, who is ranked, by the critical judgment of all lands, as only second in genius and widespread influence to his great contemporary, Goethe, was born in the little village of Marbach, in Würtemberg, on Nov. 10, 1759. His father was a military surgeon, who was made captain in the army for his services in the Netherlands and Bohemia. He was an instance, very rare in those days, of a man who tried, in middle life, to make up for the deficiencies in his early education. His mother, Elizabeth Kodweiss, was a baker's daughter, with some natural taste for music. As a boy, Schiller exhibited signs of a highly imaginative and spiritual nature, and his childish ambition was to become a clergyman. But Duke Karl of Würtemberg insisted, against the wish of the parents, on having the boy educated in a new academy—the Karl's-School—which he had founded according to the most approved plan of military discipline. Theology was not taught in this academy; Schiller, therefore, entering at the age of fourteen, first selected law, but afterward changed to medicine, in which branch he was graduated in his twenty-first year. There can be no doubt that the rigid, soulless discipline to which he was subjected for seven years was one cause of the fierce, reckless, rebellious spirit which breathes through his earliest works. Even before leaving the academy he had written his play of *The Robbers*, and after his graduation and appointment as military surgeon to a regiment in Stuttgart, he published it at his own expense. The impression it made was immediate and universal; the time was ripe for a revolt in literature against the French classicism, which had governed the intellectual tastes of Europe for a century. Baron Dalberg, then director of the theatre at Manheim, announced *The Robbers* for representation on the stage, and Schiller, being refused leave of absence, went to Manheim without it, and witnessed its first successful performance Jan. 13, 1782. On his return to Stuttgart he was arrested and temporarily imprisoned; the duke endeavored to exact a pledge from him that he would write no more poetry, and the probability of sterner measures being taken induced Schiller to take refuge in flight. In September of the same year, under an assumed name, in company with a musician named Streicher, he left Stuttgart, and for nearly

a year afterward remained in concealment on an estate belonging to the noble family of Wolzogen, near Meiningen. During this time he completed his plays of *Fiesco* and *Intrigue and Love*. The first of these, rejected by Dalberg, was finally produced at Manheim, and became so popular that the author was offered the post of dramatic poet to the theatre there with a meagre salary. He accepted the position, undertook also the editing of a new dramatic periodical, *Thalia*, and remained in Manheim until the spring of 1785, when a cordial invitation from Körner (the father of the famous poet, Theodore Körner) drew him to Leipsic. Soon afterward he followed Körner to Dresden, and was supported in the most generous manner by that faithful friend during two years while writing his tragedy of *Don Carlos*, his historical sketch *The Revolt of the Netherlands*, the romantic fragment *The Ghost-Seer*, and a number of lyrical poems. In the summer of 1787, Schiller visited Weimar for the first time, and made the acquaintance of the authors Wieland and Herder. He also met his future wife, Charlotte von Lengefeld, whom he returned to see the following summer, and in the garden of the Lengefeld family at Rudolstadt first met Goethe. The interview has a special interest from the fact that these two poets, destined to be such friends and colaborers, mutually repelled each other at first sight. Nevertheless, it was through Goethe's influence that Schiller early in 1789 was offered the place of professor of history at the University of Jena. He at first hesitated to accept on account of want of preparation, but he was tired of his homeless life, and saw in the appointment the possibility of marriage. His opening lectures were remarkably popular. He married Charlotte von Lengefeld early in 1790, and devoted himself with ardor to a life of study and creative activity. But during the following year he was brought to the verge of the grave by an inflammation of the lungs; the report of his death was circulated, and he was already so well known beyond the boundaries of Germany that two Danish noblemen, the prince of Augustenburg and Count Schimmelmann, sent him the sum of 1000 thalers annually for three years, in order that he might rest and recover his strength. His *History of the Thirty Years' War* was published in 1793, and in the autumn of that year he returned to Würtemberg with his family, and remained until the following spring, his visit being wisely ignored by the duke. Through consultation with the publisher Cotta a literary periodical called *The Hours* was projected, and this led to the most important crisis of his life. Goethe's co-operation was too important to be overlooked: the two poets met again, discovered unexpected points of sympathy, and soon became united in a personal and literary friendship as noble as it is rare in history. Schiller soon freed himself from the influence of Kant, which had seriously interrupted his poetical activity; stimulated by Goethe, he wrote his finest ballads and lyrics, and was greatly encouraged by the success of his periodical, *The Hours*. His plan for a great drama based on the history of Wallenstein was resumed, and the completion of the work as a trilogy or triple drama in the year 1799 placed him at once in the first rank of authors. His ill-health, however, made it more and more difficult for him to discharge the duties of his professorship at Jena; a closer intercourse with Goethe became an intellectual necessity, and in the year 1800, after the grant of a liberal pension by the duke, Karl August, he removed to Weimar. His friendship with Goethe drew upon both the bitter hostility of most of the secondary authors of Germany, and many attempts were made, but in vain, to estrange the two great friends. The splendid rhythm, rhetoric, and artistic completeness of form of Schiller's *Song of the Bell*, *The Diver*, and his classical ballads bore down all narrow criticism, and secured his fame as a poet in the universal judgment of the German people. His *Wallenstein* was a great success upon the stage; not less so his *Marie Stuart*, which appeared in 1800, and *The Maid of Orleans*, in 1801. In the year 1802, Schiller was ennobled by the emperor, Francis II. His next work, *The Bride of Messina* (1803), was an interesting attempt to unite the stately formalism of the antique Greek chorus with the free romantic element of modern dramatic art. Notwithstanding many passages of rare lyrical beauty, the experiment cannot be considered successful, although the play is still occasionally given on the German boards. *William Tell*, which appeared in 1804, although poetically inferior to *Wallenstein*, was Schiller's greatest dramatic success. He visited Leipsic and Berlin when it was produced, and was received with the greatest popular enthusiasm. There was a chance of his obtaining the post of director of the royal theatre in the latter city, but the duke doubled his pension in order to retain him, and he was also unwilling to relinquish his intercourse with Goethe. He began a new play, *Demetrius*, and was well advanced in the work when, in the spring of 1805, his failing vital power reached its limit. A simple cold apparently turned the balance, and on the 9th of May he died, aged forty-five years and six months. A dissection showed that under no circumstances could his life have been prolonged for more than six months more. His remains were exhumed in 1826, placed in a granite sarcophagus, and transferred to the vault of the grand ducal family, where they now repose beside those of Goethe. Schiller had two sons and two daughters, only two of whom left issue; his present (1876) surviving descendants are his grandsons, the baron von Schiller and the baron von Gleichen-Russwurm, the latter of whom is a distinguished landscape painter. As a poet Schiller has a right to be placed at least among those of the second rank, in the list which includes Virgil, Tasso, and Byron. In him the interest belonging to individual character is associated with his genius, and lends to it the magnetism which accompanies universal popularity. On the hundredth anniversary of his birth, in 1859, a "Schiller fund," amounting to several hundred thousand dollars, was created in Germany, and the annual income is devoted to the assistance of needy authors, some fifteen or twenty of whom are now wholly or partially supported from this source. All the principal cities of Germany have erected statues in his honor. The unselfish devotion of his life to his art is recognized with a fervor which takes no note of his early irregularities; and without ever having made the slightest profession of democracy he is everywhere celebrated in Germany as the poet of the people. The explanation of this fact must be sought for in the sincerity of his nature, no less than in the persecution of which he was temporarily the object. Carlyle finely says of him: "He was a high ministering servant at truth's altar, and bore him worthily in the office he held." The recognition of his powers has rather increased than diminished since his death. BAYARD TAYLOR.

Schil'ling (JOHANNES), b. at Mittweida, Saxony, June 23, 1828; studied sculpture in Dresden, Berlin, and Rome; settled in 1856 at Dresden, and was appointed professor at the academy in 1868. The first work which attracted attention was *Amor and Psyche*. The most remarkable of his later works are the Schiller monument in Vienna and the four allegorical groups on the Brühl Terrace in Dresden.

Schim'melfennig (ALEXANDER), b. in Germany in 1824; was an officer under Kossuth in the Hungarian insurrection, after which he came to the U. S.; published *The War between Russia and Turkey* (1854); became in 1861 colonel of a Pennsylvania regiment; served under Siegel and Pope in Virginia; brigadier general Nov. 29, 1862; commanded a brigade at Chancellorsville and at Gettysburg; was sent to garrison St. John's Island Feb., 1864. D. at Minersville, Pa., Sept. 7, 1865.

Schin'kel (KARL FRIEDRICH), b. at Neu Ruppin, Prussian province of Brandenburg, Mar. 13, 1781; studied architecture in Berlin, Italy, and France, and was appointed professor at the Academy of Berlin in 1820. D. Oct. 9, 1841. He built the guard-house, theatre, museum, Potsdam gate, etc. in Berlin, and other buildings elsewhere; published *Sammlung architektonischer Entwürfe* (1820–37); after his death appeared *Werke der höheren Baukunst* (1845–46).

Schi'o, town of Northern Italy, province of Vicenza, on the Leogra, near the borders of the Trentino, has recently risen to importance by the establishment of first-class woollen factories. A railway 20 miles long was opened in 1876, connecting with Vicenza. P. about 16,000.

Schism [Gr. σχίζειν, to "split"], a division in the Church on points of worship and discipline. A schismatic is one who separates himself, or improperly cuts off others, from the Church. The New Testament word refers to differences rather than divisions. Some of the chief divisions, either voluntary or forced, are the Ebionite (second and third centuries), Novatian (251 A. D.), Miletian (305), Donatian (311), Arian (first under Damasus, 355; second under Miletian, 361), Nestorian (428), Monophysite (482). The great schism between the East and West (c. 880) arose from hierarchical rivalry, the conflict concerning courts of appeal between Pope Nicholas I. and Photius, patriarch of Constantinople, limits of jurisdiction, doctrines and rites. Their mutual excommunication dates 1054. The papal schisms concerning the election of popes were 963, 1159, 1164, 1168, 1178, and the great schism, with rival courts at Rome and Avignon, 1378–1418. With discussions and corruptions rose new sects, some fanatical, some reforming, but in their separation from the Church differences of doctrine were emphasized, and generally they were called heretics. ISAAC RILEY.

Schist [Gr. σχιστός, "split," "cloven"], a somewhat flaky rock, usually less perfectly laminated and harder than the shales and slates, and most commonly metamorphic.

There are many varieties of schist, and the term is somewhat loosely employed.

Schla'gintweit (HERMANN), b. May 13, 1826; ADOLF, b. Jan. 9, 1829, killed at Kashgar Aug. 26, 1857; ROBERT, b. Oct. 27, 1833, were sons of an eye physician of Munich; received a careful education, and distinguished themselves early by their enthusiastic study of physical science, especially geology. Twice they explored the Alps, and communicated the results of their researches in *Untersuchungen über die physicalische Geographie der Alpen* (1850) and *Neue Untersuchungen* (1854), which attracted general attention. From 1854 to 1858 they undertook, supported by the King of Prussia and the British East India Company, comprehensive explorations of the Himalayas, Thibet, Hindostan, and Deccan, the results of which have been communicated in *Results of a Scientific Mission to India and High Asia*, with an atlas of panoramas, views, and maps, of which 5 vols. have appeared, and *Reisen in Indien und Hochasien*, written by Hermann alone, of which 4 vols. have appeared. Robert also travelled extensively on the American continent, and wrote in 1870 *Die Pacific Eisenbahn in Nordamerika*, and in 1871 *Californien, Land und Leute*. —A fourth brother, EMIL, b. July 7, 1835, studied first law at Berlin, afterward Oriental languages and history, and published *Buddhism in Tibet* (1863), *Die Gottesurtheile der Indier* (1866), *Die Könige von Tibet* (1866).—A fifth brother, EDUARD, b. Mar. 8, 1831, entered the Bavarian army, and fell in the battle of Kissingen, July 10, 1866. He published *Der Spanisch-marokkanische Krieg* (1863).

Schlat'ter (MICHAEL), b. at St. Gall, Switzerland, July 14, 1716; educated at his native city; studied divinity; preached for some time in Switzerland; came to Pennsylvania in 1746 as a missionary to the German Reformed immigrants; was pastor of churches in Philadelphia and Germantown 1746-51; visited the German settlers scattered in the colonies of Pennsylvania, New Jersey, Maryland, and Virginia, organizing churches; took the preliminary steps in the formation of the first American synod of the German Reformed Church Sept., 1747; revisited Europe 1751; procured six other ministers for the American churches; became superintendent of the German charity schools in Pennsylvania 1755; accompanied the expedition against Nova Scotia as chaplain of the Royal American regiment 1757, and suffered imprisonment by the British authorities at Philadelphia on account of his Revolutionary services 1777. D. near Philadelphia Oct., 1790.

Schle'gel, von (AUGUST WILHELM and FRIEDRICH), two brothers, b. at Hanover—the former in 1767, the latter in 1772; became the founders and leaders of the romantic school in German literature, and acquired great celebrity for poetical and critical talents, comprehensive and generally correct knowledge, and exquisitely refined and generally sound taste. AUGUST WILHELM led a somewhat restless life. He studied theology and philology at Göttingen; acted as a tutor in Amsterdam; lectured in Jena from 1797 to 1802, and in Berlin from 1802 to 1805; travelled for several years with Madame de Staël through France, Switzerland, Italy, Spain, and Austria; accompanied Bernadotte in 1812 as private secretary; travelled once more for several years with Madame de Staël, and settled down at last, in 1818, as professor at the University of Bonn, where he d. in 1845. He was married twice, and both times divorced. He was editor of and contributor to numerous periodicals. He wrote ballads, tragedies, and literary satires, but his most valuable works are his translations of Shakspeare (1797-1810), of Calderon (1803-09), and from Sanskrit (1823-39), and his celebrated *Lectures on Dramatic Art and Literature*, delivered at Vienna in 1808, and published next year in 3 vols.—a book wonderful as a whole, charming in its details, and, although it now needs manifold correction, instructive and full of true information.—FRIEDRICH VON SCHLEGEL was less volatile in his manners, as he was less versatile in his talents. He studied philology in Göttingen and Leipsic; lectured in Jena 1800, in Dresden 1802, in Paris 1803; joined, with his wife, the Roman Catholic Church in 1808; and lived after that time mostly in Vienna, writing and lecturing. D. on a lecturing tour to Dresden in 1829. Like his brother, he wrote poems and tragedies and contributed much to periodicals, but his principal works are his *Philosophy of Life* (1827), *Philosophy of History* (1828), and *Philosophy of Language* (1829), and his famous romance *Lucinde* (1799), a book which is now never placed in a private library on account of its naked indecency. Although there were great differences between these two brothers, and they often followed different lines of conduct, yet the fundamental characteristics of their minds were the same, and they always worked in the same spirit. August Wilhelm was elegant, but a little superficial; Friedrich was deeper, but his depths easily became a little obscure. August Wilhelm was witty, Friedrich was cutting. August Wilhelm's talent was description, Friedrich's was discrimination. But they both lacked conviction and creative power, and, like all people who hunger and hunt after conviction and have no power of attaining it, they made a retrograde movement, and sought refuge in adoration of that which formerly had given rest and blessedness to the mind of mankind. The Middle Ages, with their naive and passionate ideas of kingdoms and popedom, became their ideal, and through them the ideal of the romantic school. Much confusion and much real harm came from this mental peculiarity of theirs, but both brothers nevertheless had a precious faculty of appreciating a mental phenomenon exhibited in literature or art, in morals or æsthetics, in its pure objectivity, without mixing it up with their own subjective whims and passions; and although they failed in their philosophical explanations of this faculty, which they called *irony*, and which they proclaimed as the highest artistic faculty, yet German civilization learned much from them in this respect.

CLEMENS PETERSEN.

Schlei'cher (AUGUST), b. at Meiningen, in the Saxon duchies, Germany, Feb. 19, 1821; studied theology and comparative philology at Leipsic, Tübingen, and Bonn, and was appointed professor at Prague in 1850, and in 1857 at Jena. D. Dec. 6, 1868. His linguistic knowledge was very extensive, but the Slavo-Lettic languages formed his specialty, and some of his most remarkable writings treat this subject—*Die Formenlehre der kirchenslawischen Sprache* (1853) and *Handbuch der litauischen Sprache* (2 vols., 1856-57). He also wrote *Die Sprachen Europas* (1850), *Compendium der vergleichenden Grammatik der indogermanischen Sprachen* (1862; translated into English by H. Bendall, London, pt. 1, 1874), *Die Darwin'sche Theorie und die Sprachwissenschaft* (1863), *Ueber die Bedeutung der Sprache für die Naturgeschichten der Menschen* (1865).

Schlei'den (MATTHIAS JAKOB), b. in Hamburg Apr. 5, 1804; first studied law at Heidelberg, then medicine at Göttingen, and finally botany at Jena, where he was appointed professor in 1839. In 1862 he resigned his office, and after a short stay at Dorpat (1863-64) as professor of vegetable chemistry, he settled at Dresden. His principal works are—*Grundzüze der wissenschaftlichen Botanik* (2 vols., 1842-43), which attracted much attention and gave rise to many controversies; it was translated into English by Dr. Lankester (1849); *Die Pflanze und ihr Leben*, translated into English by Prof. Henfrey (1848); *Baum und Wald* (1870), *Die Rose* (1873).

Schlei'ermacher (FRIEDRICH ERNST DANIEL), b. at Breslau Nov. 21, 1768; d. at Berlin Feb. 12, 1834, was the son of a Reformed clergyman, and was brought up in the community of Moravian Brethren, receiving a profound religious impulse from them. From 1783 to 1787 he attended the pædagogium at Niesky and the seminary of the United Brethren at Barby. He completed his theological course at Halle, and after filling the positions of private tutor, assistant preacher, etc., became in 1796 the chaplain of the Charité-Haus at Berlin; in 1802 court-chaplain at Stolpe, and in 1804 professor (*extraordinarius*) of theology and philosophy at Halle. In 1809 he preached at the Trinity church in Berlin, and the following year received appointment as professor (*ordinarius*) of theology at the new University of Berlin, which position he retained till his death, Feb. 12, 1834. During the ten years previous to going to Berlin he had studied and criticised the Kantian philosophy, and was greatly attracted by Jacobi's exposition of Spinoza. He subsequently studied and translated Plato, and did much by his lectures to encourage the study of the remains of the early Greek philosophy. His activity knew no limits. He labored to effect a union of the Lutheran and Reformed churches on the broad basis that demanded unity in the spirit of Protestantism and allowed diversity as to doctrines and modes of worship. His failure in this led to a misunderstanding with Minister von Altenstein which lasted for some years.

The fundamental point of view of Schleiermacher's system is this: Religion is not a knowing nor a doing, but a feeling—a feeling of the universal life of the Infinite, and of the dependence of the Ego upon it. Hence, with him, religion begins with the feeling of dependence. Reflection upon this feeling gives rise to descriptions of it, and hence the statement of religious principles and dogmas. All religions are historic and positive. Among these Christianity holds a unique place, inasmuch as in it is found the reconciliation with the Infinite, hence the very essence of religion itself. Upon the same framework of antithetic ideas of the universal and particular (infinite and finite, common and special, God and the Ego) he builds his system of ethics. The organizing activity of reason in the realm of the common or universal, securing

identity of common usage, is the first province of ethical action—that of interchange among men. The second is that of organization in the realm of particular individuality, the province of inalienable personality. The third and fourth provinces of ethical action are not those of organization, but of "symbolism," the third being that of symbolism with identity in the realm of thought and language, and the fourth the symbolism with individuality in the realm of feeling. Corresponding to these four provinces are the four institutions: (*a*) state, in which each is for the whole; (*b*) civil society, organized for the benefit of the individual; (*c*) school (college, etc.), for community of culture; (*d*) church, "for individual symbolic activity." The most important of Schleiermacher's writings are—(1) *Discourses on Religion* (Berlin, 1799); (2) *Monologues* (1800); (3) *Confidential Letters on F. Schlegel's Lucinde* (1800); (4–7) *Four Collections of Sermons* (1801–20); (8) *Outlines of a Critique of Previous Systems of Ethics* (1803); (9) *Translation of Plato's Works* (1804–28); (10) *The Christian Faith according to the Principles of the Evangelical Church* (1821–22); (11) *Theological Encyclopædia* (1811). After his death were published (1835) lectures on the history of philosophy, dialectics, psychology, ethics, politics, and pedagogics. The lectures on the life of Jesus, which appeared in 1864, made an epoch when first delivered. According to the authority of Zeller, Schleiermacher is the greatest theologian of the Protestant Church since the period of the Reformation—"a churchman whose liberal ideas will yet prevail in regard to the union of Protestant confessions, the constitution of the Church, and the rights of conscience and individuality in religion"—"a deep-working religious teacher, who formed the heart by the understanding and the understanding by the heart—a philosopher who scattered fruitful seeds, who introduced a new era in the knowledge of Greek philosophy, and who assisted in Germany's political regeneration." He investigated the nature of religion more profoundly than any before him. Physically, he was small of stature, slightly deformed, quick and animated in his movements, his countenance kind and sympathetic. He married in 1809 the widow of his friend Willich. His *Autobiography* (covering only the first twenty-six years of his life) was published in 1851. His *Correspondence with J. C. Gass* appeared the following year in 4 vols. His *Biography* has been written by K. Schwartz, D. Schenkel, W. Dilthey, and others. WILLIAM T. HARRIS.

Schleitz. See REUSS.

Schle'stadt, town of the German empire, province of Alsace, on the Ill, has manufactures of calicoes, woollen and cotton hosiery, linens, soap, and oil, and a large trade in corn, wine, and fruits. P. 10,184.

Schles'wig [Dan. *Slesvig*], the northern part of the Prussian province of Schleswig-Holstein, comprising an area of 3529 sq. m., with 409,907 inhabitants, and bounded N. by Jutland; S. by Holstein, from which it is separated by the river Eider, E. by the Baltic, and W. by the North Sea, formed a part of Denmark from the establishment of that kingdom in the beginning of the ninth century up to 1866. When in 826, King Gorm the Old had gathered all the small Danish kingdoms under one crown, his wife, Thyra Dannebod, induced the Danes to build a wall (Dannevirke) on the frontier between Denmark and Germany; that is, on the frontier between Schleswig and Holstein. The Danes assembled from all parts of the country; while the men worked on the wall, the women tilled the fields, and when, after the lapse of about thirty years, Dannevirke was finished, it was in some respects a gigantic work. It stretched from the gulf of the Schley or Slienfjord to the river Eider, a distance of about 20 miles, was from 20 to 40 feet high, faced Holstein with a broad ditch, with bastions and towers, and communicated with it only through one narrow gate. But it was built of turf, peat, and wood. Henry the Fowler succeeded in setting fire to it, and broke through it. It had to be rebuilt of clay, cement, and stone, but then it held good for centuries. That this wall was not merely an artificial frontier-line between two countries, but the natural boundary between two different tribes destined to develop into two distinct nationalities, is shown by several facts. Those weapons and utensils of stone which characterize the oldest phase of civilization in Scandinavia are found in great numbers in Schleswig, down to Dannevirke, but none were ever found in Holstein on the other side of the wall. Next, the river Eider is generally called the frontier of the "Holy Roman" empire by all kinds of authors, both in the German and Danish literature, up to the end of the eighteenth century, and people on both sides of the river were very well aware of the fact that the influence of the Roman law stopped before the Eider, while the law of Schleswig was a development of purely Scandinavian origin. Nor was the name of the country at that time Schleswig, but South Jutland, and the wars between the German and Danish kings were by no means waged for the possession of this territory, but merely because the Germans wished to christianize the Danes, while the Danes wished to plunder the Germans.

In 1232, King Waldemar II. divided his dominion between his three sons, in accordance with the tendency then ruling universally in Europe. Erik became king in 1241; Abel received Schleswig as a fief; Christopher, Laaland and Falster. Feuds immediately ensued between the king of Denmark and his vassal, the duke of Schleswig; and when the family of Abel intermarried with that of the counts of Holstein, and thereby procured foreign aid, the feuds grew into wars. In 1375 the family of Abel became extinct, and Schleswig returned to Denmark; but in 1386, Margrethe, who was busy with the establishment of the Scandinavian union, enfiefed Count Gerhardt of Holstein with it, on account of his relationship with the family of Abel, and in order to procure peace on her southern frontier while she was warring on the northern. This Holsatian family, which thus held Holstein as a fief of the German crown and Schleswig as a fief of the Danish, died out in 1459, but the Danish king, Christian I., a German prince and the founder of the house of Oldenburg, instead of incorporating Schleswig and sending Holstein adrift into Germany, chose to use Schleswig as a bait by which to catch Holstein. He promised that Schleswig and Holstein should always be united together under one government, and thereby procured his election by the states as duke of Holstein. His successors on the Danish throne used to provide for their younger sons by giving them estates in Schleswig and Holstein. Thus, several ducal lines sprang up; some of them acquired considerable power, and all of them assumed, from natural jealousy, a hostile attitude toward the Danish dynasty. They were Germans by origin and connections; they sought their allies in Germany, and thus the Germanization of certain parts of Schleswig took place in a natural way, nobody noticing it. In 1721 all these ducal lines were driven out of Schleswig, having committed open treason against the Danish crown during the late war with Sweden, and the incorporation of the country as a Danish province was recognized and guaranteed by the European powers. The germanization, however, did not stop. On the contrary, it was even favored by the Danish government—first, because at the court of Copenhagen, German played the same part up to the end of the eighteenth century as French at the court of Berlin during the reign of Friedrich II.; and next, because the government hoped to get a firmer grasp on Holstein by fostering German sympathies in Schleswig. But in the first half of the nineteenth century the idea of nationality began to show itself in politics, and the rapidity and force with which it developed gave very soon the affairs in Schleswig a new aspect. This country, to which Germany never had had, nor ever had made, any claims, had now become partly German, and twice—in 1848, during the general revolutionary excitement in Germany, and in 1864, during the dangerous conflict with Austria concerning the supremacy in Germany, and with the diet concerning the military reorganization—the Prussian government used this circumstance as a safety-valve. The attention of the German nation was artificially drawn away from its own affairs and concentrated on this point, and its natural and honest sympathy was fanned into fanaticism and hatred. In 1848, however, the interference of Russia compelled Prussia to withdraw its troops, and then the insurrection in Holstein was speedily put down; but in 1864, Prussia and Austria conquered Holstein and Schleswig, and by the Treaty of Vienna (Oct. 30, 1864) Denmark was compelled to cede them. According to the convention of Gastein (Aug. 14, 1865), Austria occupied Holstein, Prussia Schleswig, but by the Treaty of Prague (Aug. 23, 1866) Prussia retained them both; and to the article of that treaty stipulating that the northern Danish-speaking part of Schleswig should be given back to Denmark it has paid no regard. CLEMENS PETERSEN.

Schleswig, town of Prussia, province of Schleswig-Holstein, formerly the capital of the duchy of Schleswig, is at the head of the Schley or Slie, a narrow inlet of the Baltic, 20 miles long, and navigable only for small vessels. It is an old town, and was of considerable commercial importance in the Middle Ages. Its cathedral contains many curious monuments, but when its harbor filled up with sand its mercantile enterprise decreased. There are several good educational institutions, and some manufactures of leather, sugar, earthenware, and woollen stuffs. P. 13,850.

Schleswig, tp., Manitowoc co., Wis. P. 1718.

Schleswig-Holstein, province of Prussia, bounded N. by Denmark, S. by the Elbe, which separates it from Hanover, E. by the Baltic, and W. by the North Sea, com-

prises an area of 6766 sq. m., with 995,873 inhabitants. Several islands—Romo, Sylt, and Föhr in the North Sea, Alsen and Femern in the Baltic—belong to the province. A slightly elevated ridge stretches through the centre of the country, sandy, gravelly, and covered with heath in Schleswig—swampy, marshy, and covered with forests in Holstein. To the E. of this ridge the surface is beautifully diversified by hills, and the coast much indented by long, narrow fiords. The soil affords excellent arable land, and forests of oak and beach are numerous. To the W. the surface is perfectly level, and the ground so low that the country in many places must be protected against the North Sea by high dikes; but the soil is rich and affords excellent pasturage. The chief occupations are agriculture in the eastern part, cattle-breeding in the western. Wheat, hops, and fruit are raised in great quantities, and thousands of fat oxen are annually sold in Hamburg and London. The fisheries in the North Sea are considerable, but the manufacturing industry is insignificant. One-half of the population of Schleswig, about 200,000 people, speak Danish; the Frisian language is spoken in the western districts and on the islands of the North Sea; the rest of the inhabitants speak the Low German dialect. The province is of vital importance to Prussia for the formation of a German fleet, partly on account of the harbor of Kiel, the best, if not the only one available for naval purposes, on the coast of Germany, and partly because of the fitness of the inhabitants for maritime occupations.

Schleus'ner (Johann Friedrich), b. in Leipsic Jan. 16, 1756; studied theology and philology in the university of that city; appointed professor of theology in Göttingen 1784, and in 1795 professor of theology and provost of the collegiate church in Wittenberg; devoted himself principally to the lexicography of the Greek Scriptures. After the removal of the University of Wittenberg he was associate director of the theological seminary. His chief productions were—*Lexicon Græco-Lat. in Novum Testamentum* (Leipsic, 1792; last ed. (4th), 1819, 2 vols. in 4 parts), *Thesaurus sive Lexicon in LXX.* (Leipsic, 1821, 5 vols.; both reprinted in Glasgow and London, the former in 2, the latter in 3 vols.). The lexicon to the Septuagint is still the most complete on the subject. Schleusner edited, with Stäudlin, for some years (till 1795), the *Göttingische Bibliothek der neuesten theologischen Literatur*. D. Feb. 21, 1831. H. Drisler.

Schley, county of S. W. Georgia, watered by Cedar, Bear, and Muckalee creeks, has a level surface and a moderately fertile soil. Staples, Indian corn, cotton, and sweet potatoes. Cap. Ellaville. Area, 160 sq. m. P. 5129.

Schlie'mann (Heinrich), b. in 1822 at Kalkhorst, Mecklenburg-Schwerin; received a mercantile education at Fürstenberg and Amsterdam; established a business of his own in St. Petersburg in 1847; travelled much, acquired many languages, and retired in 1863 from business. In 1869 he published at Paris *Ithaque, Péloponnèse et Troie*, giving an account of his travels in those regions; in 1874 followed his *Trojanische Alterthümer*, giving an account of the excavations he had undertaken on the plateau of Hissarlik, and accompanied by an *Atlas trojanischer Alterthümer*, consisting of 217 photographic plates. In 1875 he commenced excavations at Athens and Mycene.

Schlos'ser (Friedrich Christoph), b. at Jever, Oldenburg, Nov. 17, 1776; studied theology and philosophy at Göttingen; spent several years as a private tutor in various families and as librarian to the city of Frankfort, and was appointed in 1817 professor of history at the University of Heidelberg, where he d. Sept. 23, 1861. His principal writings are *Geschichte des 18. Jahrhunderts* (8 vols., 1823–46; often reprinted, and translated into English by Davidson, Lond., 1843–52), *Weltgeschichte in zusammenhängender Erzählung* (9 vols., 1817–24), *Universal historische Uebersicht der Geschichte der alten Welt und ihrer Cultur* (3 vols., 1826–34). His *Weltgeschichte* (19 vols., 1842–54) is mostly a compilation from his other works by Kriegk.

Schlöz'er, von (August Ludwig), b. at Gaggstedt, Würtemberg, July 5, 1735; studied theology at Wittenberg and Göttingen; lived from 1755 to 1759 at Stockholm as private tutor, and wrote here, in the Swedish language, a history of commerce; went to Russia in 1761 with the Russian court historiographer, Müller, and was appointed professor of political science in 1764 at Göttingen, where he d. Sept. 9, 1809. His principal works are his *Allgemeine nordische Geschichte* (2 vols., 1772) and his translation of Nestor's *Russian Chronicles* (5 vols., 1802–09).—His grandson, Kurd von Schlözer, b. at Lubeck Jan. 5, 1822, was German minister to Mexico 1869–71, and subsequently in Washington, and wrote *Choiseul und seine Zeit* (1849), *Geschichte der deutschen Ostseeländer* (3 vols., 1850–53), *Verfall und Untergang der Hansa* (1853), *Friedrich der Grosse und Katharina II.* (1859).

Schmal'kalden, town of Prussia, province of Hesse-Nassau, at the confluence of the Schmalkalde and Stille, has saltworks, iron and steel forges, and manufactures of white lead and paper. The famous league of the German Protestant princes was formed here in 1531. P. 5600.

Schmid (Christian Friedrich), son of a clergyman, b. at Bickelsberg, in Würtemberg, in 1794; was professor extraordinary at Tübingen 1821, professor ordinary 1826, and d. Mar. 28, 1852. His *Biblische Theologie des Neuen Testaments* was published posthumously (1853; 2d ed. 1859; Eng. trans. by G. H. Venables, 1870). R. D. Hitchcock.

Schmid (Leopold), b. at Zurich June 9, 1808; studied theology at Tübingen and Munich, and was appointed professor of theology in 1839, and afterward of philosophy at Giessen. Although a strict adherent of the Roman Catholic Church, his broader and more liberal views, acquired by an extensive study of philosophy, brought him into collision with the ultramontane party. In 1849 his election as bishop of Mentz was not confirmed by the pope, who, however, dared not place his book, *Der Geist des Katholicismus oder Grundlegung der christlichen Irenik* (2 vols., 1848–50), in the *Index*. His *Ultramontan oder katholisch?* (1867) showed a decided opposition to the exorbitant claims of the pope. D. at Giessen Dec. 20, 1869.

Schmidt (Heinrich Julian), b. at Marienwerder, province of Prussia, Mar. 17, 1818; studied philology and history at the University of Königsberg; settled in 1847 at Leipsic as editor, afterward in connection with Gustav Freytag as proprietor of the *Grenzboten*, which supported the Prussian interest in Germany; removed in 1861 to Berlin and edited the *Berliner Allgemeine Zeitung* (1861–63), but retired afterward to private life. His books, *Geschichte der Romantik in Zeitalter der Reformation und Revolution* (2 vols., 1850), *Geschichte der deutschen Literatur seit Lessing's Tod* (3 vols., 1858), *Geschichte des geistigen Lebens in Deutschland von Leibniz bis auf Lessing's Tod* (2 vols., 1860–64), *Bilder aus dem geistigen Leben unserer Zeit* (1870), are both interesting and instructive. The views of the author are decided and lucid, and his style forcible, but sometimes his conceptions look wilful, and his argumentation becomes too subtle to be convincing.

Schmidt (Henry I.), S. T. D., b. at Nazareth, Pa., Dec. 21, 1806; educated at the Moravian pædagogium and theological seminary of his native town; was a teacher in the former institution 1826–29; pastor of Lutheran churches in Bergen co., N. J., 1831–33; professor at Hartwick Seminary, Otsego co., N. Y., 1833–36; pastor of a German Lutheran church at Boston, Mass., 1836–38; professor in Pennsylvania College and Theological Seminary at Gettysburg, Pa., 1838–43; pastor of Lutheran churches in Montgomery co., N. Y., 1844; principal of Hartwick Seminary 1845–47; and became professor of the German language and literature in Columbia College, N. Y., 1848, which post he still fills (1876), having also been an occasional instructor in other departments of the same institution. Author of many theological articles in the *Evangelical Review*, of a *History of Education and Plan of Culture and Instruction* (1842) in "Harper's Family Library," clvi., of several published sermons, addresses, and other miscellaneous pamphlets, a treatise on *The Scriptural Character of the Lutheran Doctrine of the Lord's Supper* (1852), and a *Course of Ancient Geography* (1860).

Schmitz (Leonhard), Ph. D., LL.D., b. at Eupen, near Aix-la-Chapelle, Germany, Mar. 6, 1807; educated at the University of Bonn, where he studied history and philology under Niebuhr and Welcker; became professor in a gymnasium at Bonn; settled in England 1836; was rector of the high school at Edinburgh 1845–66, and principal of the London International College 1866–74, after which he accepted the post of classical examiner in the University of London. He was classical tutor to the prince of Wales 1859, and to Prince Alfred 1862–63; translated into English the lectures of Niebuhr, and Zumpt's Latin Grammar; edited the *Classical Museum* 1844–50; contributed to Dr. Smith's *Classical Dictionaries* and to cyclopædias; is author of Latin and Greek grammars and of a series of histories for schools and colleges.

Schmuck'er (Samuel Mosheim), LL.D., son of Rev. Dr. S. S. Schmucker, b. at Newmarket, Va., Jan. 12, 1823; graduated at Washington College, Pa., 1840; studied theology at Gettysburg; was Lutheran minister at Lewiston, Pa., 1842–45, at Germantown 1845–48, and was admitted to the Philadelphia bar 1850. D. at Philadelphia May 12, 1863. Author of biographies of Catharine II., Nicholas I., J. C. Fremont, Alexander Hamilton, Jefferson, E. K. Kane, Napoleon III., Webster, and Clay, and of various historical compilations.

Schmucker (Samuel S.), D. D., b. at Hagerstown, Md., Feb. 28, 1799; studied at Princeton, but did not grad-

uate; was ordained in the Lutheran Church 1818; was pastor of a church at Newmarket, Va., 1820–26; became professor of didactic theology in the Gettysburg Theological Seminary at its foundation, Sept., 1826, and retained that post until Aug., 1864, having acted for many years as president of the institution, and was emeritus professor from 1864 to his death, at Gettysburg July 26, 1873. Author of numerous works of Lutheran theology in English and German, and contributions to reviews.

Schnaa'se (KARL), b. at Dantzic Sept. 7, 1798; studied law at Heidelberg and Berlin, and held from 1819 to 1857 various judicial offices at Königsberg, Marienwerder, Düsseldorf, and Berlin, but travelled much at the same time in Italy, France, and the Netherlands, and studied art with great enthusiasm. In 1834 he published his *Niederländische Briefe*, and from 1843 to 1864 his *Geschichte der bildenden Künste* (7 vols.) appeared. In 1858 he commenced the publication of *Das christliche Kunstblatt*, together with Grüneisen and Schnorr. D. at Wiesbaden May 21, 1875.

Schnee'berg, town of Saxony, has silver, copper, and iron mines in its vicinity, and manufactures of gold and silver lace. P. 7582.

Schnei'der (JOHANN GOTTLOB), b. at Collmen, near Wurzen, Saxony, Jan. 18, 1750; began his philological studies at Schulpforte, which he continued at Leipsic, and at Göttingen under Heyne, who recommended him to Brunck at Strasbourg to aid the latter in his edition of the Greek poets. Here he added to his classical studies that extensive and thorough acquaintance with anatomy, botany, and zoology which gave so great value to his editions of the ancient authors who treat of those subjects. In 1776 he was appointed professor of ancient languages and eloquence in the University of Frankfort-on-the-Oder. When in 1811 the university was removed to Breslau, he accompanied it, holding the same office, which, however, he resigned in 1816 on his appointment as chief librarian. Of the many valuable editions published by him, the most celebrated were—*Xenophontis Opera* (new ed. by Bornemann and Sauppe, 6 vols., 1815–38), *Scriptores Rei Rusticæ* (4 vols., 1794–95), *Vitruvius* (3 vols., 1807–08), *Aristotelis Historia de Animalibus* (4 vols., 1812), *Theophrasti Opera* (5 vols., 1818–21), *Oppiani Cynegetica et Halieutica*, with Brunck (1776; new ed. 1813), *Eclogæ Physicæ* (2 vols., 1801). Besides these he wrote critical remarks on portions of ancient authors and treatises in German on natural history. A very important contribution to Greek studies was made by Schneider in his large *Griechisch-Deutsches Wörterbuch* (2 vols., 1797–98; 3d ed., with supplement, 1819–21), on which Passow based his lexicon. D. Jan. 12, 1822.
H. DRISLER.

Schneider (KARL ERNST CHRISTOPH), b. Nov. 16, 1786, at Wiehe in Saxony; studied theology and philology at the University of Leipsic; in 1816 appointed professor of ancient literature in the University of Breslau, where he also was associate director of the philological seminary; published *De Originibus Tragœdiæ* (1818); edited, with a critical commentary, *Platonis Civitas* (3 vols., 1830–33; supplement, 1854); German translation of same (*Plato's Staat*), (2d ed. 1850); translation of Plato's *Timæus* (1847), and an edition of *Procli Commentarius in Platonis Timæum* (1851); Cæsar's *Commentarii de Bello Gallico* (2 vols., 1840–55), with elaborate commentary; edited a portion of the Plato in Didot's *Bibliotheca Græca* (Paris, 1846–53). D. at Breslau May 14, 1856. H. DRISLER.

Schnei'dewin (FRIEDRICH WILHELM), b. at Helmstedt June 6, 1810; entered the University of Göttingen 1829, where he studied philology under Mitscherlich, Dissen, and Otfried Müller; appointed in 1833 teacher in the gymnasium at Brunswick; in 1836 instructor in the University of Göttingen, and in 1837 professor (extraordinarius, in 1842 regular professor) in the same, with a share in the direction of the philological seminary, of which he became subsequently associate director. His literary activity was very great. Published *Exercitationes Criticæ in Poetas Græcos Minores* (1836), *Delectus Poeseos Græcæ* (1838–39), *Beiträge zur Kritik der Poetæ Lyrici Græci* (1844), *Martialis Epigrammata*, with critical commentary (2 vols., 1842), *Sophoclis Tragœdiæ* (7 vols., 1849 *seq.*; 2d ed. 1853 *seq.*), *Simonidis Carminum Reliquiæ* (1835), and *Parœmiographi Græci* (2 vols. 8vo, 1839–51, in conjunction with Leutsch), the newly-discovered orations of Hyperides (1853); edited from 1846 *Philologus*, a valuable journal of classical literature. D. Jan. 10, 1856. H. DRISLER.

Schnetz (JEAN VICTOR), b. at Versailles May 15, 1787; studied painting under David, Regnault, and Gérard, and in Italy; began to exhibit in 1819; was director of the French Academy in Rome from 1840 to 1866. D. at Paris Mar. 15, 1870. His most celebrated pictures are—*The Gypsy and Sextus V.* (1820), *The Sacking of Rome* (1835), *Christ and the Little Children* (1855), *The Capuchin Physician* (1867).

Schnorr von Karolsfeld (JULIUS), b. at Leipsic Mar. 26, 1794; studied painting under his father, who was a painter himself, in Vienna and Italy; was appointed professor at the Academy of Munich in 1827, and director of the picture gallery of Dresden in 1846. D. there May 24, 1872. His principal works are his frescoes in Munich illustrating the *Nibelungen*, the history of Charlemagne, Barbarossa, and Rudolf of Hapsburg, his *Luther at the Diet of Worms*, and *Bibel in Bildern* (240 plates, with text).

Schodack', tp., Rensselaer co., N. Y., on Hudson River and Boston and Albany R. Rs., and on Hudson River. P. 4442.

Schoel'cher (VICTOR), b. at Paris July 21, 1804; travelled much in Mexico, the U. S., East and West Indies, Africa, and wrote *De l'Esclavage des Noirs et de la Législation coloniale* (1833), *Abolition de l'Esclavage* (1840), *Les Colonies françaises* (1842), *Les Colonies étrangères et Haiti* (1843), *Egypte en 1845* (1846), *L'Histoire de l'Esclavage pendant les deux dernières Années* (2 vols., 1847). He was a member of the Constituent and Legislative assemblies 1848–51; during the Empire he lived in London, where he published a *Life of Händel* (1857); after the downfall of Napoleon III. he returned to Paris, and represents Martinique in the Legislative Assembly.

Schoell (MAXIMILIAN SAMSON FRIEDRICH), b. at Harskirchen, Hesse-Nassau, May 8, 1766; studied at Strasbourg; travelled as tutor with a Livonian family (1788–90) in Italy, France, and Russia; attempted different occupations until in 1814 he received employment in the Prussian diplomatic corps; was employed as secretary at various legations and congresses. D. at Paris Aug. 6, 1833. His literary activity was very comprehensive; the most remarkable of his works are *Cours d'Histoire* (46 vols., 1830–36), *Archives politiques ou diplomatiques* (3 vols., 1818), *Pièces relatives au Congrès de Vienne* (6 vols., 1816), *Pièces officielles destinées à détromper les Français, etc.* (9 vols., 1814), *Hist. de la Litt. grecque* (8 vols., 1823–25), *Hist. de la Litt. romaine* (4 vols., 1815).

Schöf'fer (or **Schoiffer**) (PETER), b. at Gernsheim, near Darmstadt, in 1430; became in 1450 assistant in the printing establishment of Gutenberg and Faust in Mentz; formed in 1455 a partnership with Faust, whose daughter he married, and carried on the business alone after the death of Faust in 1466. He introduced many improvements in the art of printing. D. in 1503. A monument was raised in his honor at Gernsheim in 1836.

Scho'field (JOHN M.), b. in Chautauqua co., N. Y., Sept. 29, 1831; graduated at the U. S. Military Academy, and promoted brevet second lieutenant of artillery July 1, 1853; captain May 14, 1861. From 1855 to 1860 he was professor of natural and experimental philosophy at West Point, and at the outbreak of civil war was filling the chair of physics in Washington University, St. Louis, Mo. Appointed major 1st Missouri Vols. Apr. 26, he served with Gen. Lyon as chief of staff in the operations in Missouri, participating in the battles of Dug Spring and Wilson's Creek. Commissioned brigadier-general of U. S. volunteers and of Missouri militia Nov., 1861, he commanded the State troops and the district of St. Louis, and in Oct., 1862, was placed in command of the Army of the Frontier; promoted to be major-general U. S. volunteers Nov. 29, 1862, he commanded the district and department of Missouri until Jan., 1864, when appointed to command the Army of the Ohio; was in immediate command of the 23d corps in Sherman's Georgia campaign, participating in the almost constant severe fighting ending with the capture of Atlanta, Sept. 2, 1864. In Nov., 1864, he was placed in command of the forces detached from Gen. Sherman's army to strengthen Gen. Thomas at Nashville, being constantly engaged with Hood's army invading Tennessee, and defeated it at the battle of Franklin, Nov. 30, 1864; joined Gen. Thomas the next day, and commanded the 23d corps at the battle of Nashville and subsequent pursuit of Hood's army. For his services at Franklin he was appointed brigadier-general in the regular army. Transferred with his command to North Carolina and placed in command of that department Feb. 9, 1865, he occupied Wilmington Feb. 22, fought the battle of Kinston Mar. 8–10, and joined Gen. Sherman at Goldsboro' Mar. 22, 1865. Upon the surrender of Gen. Johnston's army (Apr. 26) he was appointed to execute the terms of the convention; in command of the department of North Carolina until June, 1865, and of the first military district of Virginia 1866–67; secretary of war *ad interim* May, 1868–Mar., 1869, when he was promoted to be major-general U. S. A., and assigned to command of department of Missouri. In May, 1870, he assumed command of the division of the Pacific. Became

superintendent of the U. S. Military Academy at West Point July, 1876.

Schohar'ie, county of E. New York, intersected by Schoharie, Cobleskill, and Catskill creeks, traversed by Albany and Susquehanna R. R., has the Helderburg Mountains on the E. border and spurs of the Catskill Mountains on the S. and W.; is well adapted for pasturage, and has several manufactories and saw and flouring mills. Staples, hops, oats, buckwheat, potatoes, hay, flax, maple-sugar, honey, wool, butter, and cheese. Iron ore and sulphur springs are found. Cap. Schoharie. Area, 650 sq. m. P. 33,340.

Schoharie, p.-v. and tp., cap. of Schoharie co., N. Y., on Schoharie Valley R. R., near the junction of Schoharie and Fox's creeks, 40 miles (by rail) W. from Albany. It has 3 churches, an academy and union school, 1 bank, 2 newspapers, and 2 hotels, with the county buildings. P. of v. 1200; of tp. 3207.

A. A. HUNT, ED. "SCHOHARIE REPUBLICAN."

Scholasticism. See SCHOOLMEN, by W. T. HARRIS, A. M., LL.D.

Scholten' (JOHANNES HENDRIK), b. at Vleuten, near Utrecht, Netherlands, Aug. 17, 1811; studied theology and philosophy at the University of Utrecht; appointed professor of theology in 1843 at the University of Leyden, and became the founder and leader of a liberal movement in Dutch theology which attracted much attention, not only in the Netherlands, but also in Germany and France. His principal writings, mostly translated into German and French, are *Geschiedenis der Godsdienst en wysbegeerte* (1853), *De leer der herrormde kerk in hare grondbegin selen* (2 vols., 1848–50), *De vrye wil* (1857), *Het evangelie naar Johannes* (1864), *De oudste getuigenissen aangaande de schriften des Nieuwe Testaments* (1866).

Schom'berg (FREDERICK HERMANN), DUKE OF, b. in Heidelberg, Germany, about 1616, was the son of Count Schomberg by a daughter of an English nobleman, Earl Dudley: served in the army of the United Provinces, afterward in the French army, where he acquired a great reputation as a strategist and tactician; visited England 1660; went thence to Portugal, where he exercised important commands in the war of liberation, and compelled Spain to recognize the independence of that country under the dynasty of Braganza (1668), for which he was made a grandee and received a handsome pension; was again in the French service in Catalonia 1675, where he won the grade of marshal; was at Maestricht (1676) and Charleroi (1677); left France on the Revocation of the Edict of Nantes 1685; went again to Portugal, but was compelled by the Inquisition to withdraw; was appointed by William, prince of Orange, his second in command in the expedition to England 1688; was made duke of Schomberg in the English peerage, knight of the Garter, and master of the ordnance 1689; received from Parliament a grant of £100,000; took a leading part in the expedition against Ireland, and was killed at the battle of the Boyne, July 12, 1690. His brother and son succeeded to his honors and estates, but the titles became extinct in 1719.

Schom'burgk (Sir ROBERT HERMANN), PH. D., b. at Freiburg-on-the-Unstrut, Prussia, June 5, 1804; resided, engaged in mercantile pursuits, at Leipsic 1823, afterward in Virginia as partner in a tobacco manufactory, in which business he experienced pecuniary losses; settled in the island of St. Thomas in the West Indies 1829; devoted himself to botany and natural history; made a scientific examination of Anegada, one of the Virgin Islands, 1830, on which he prepared a report which procured him the patronage of the Royal Geographical Society of England; spent four years in the exploration of British Guiana, where he discovered the great water-lily named by him *Victoria regia*; published a *Description of British Guiana, Geographical and Statistical* (1840), a series of *Views in the Interior of Guiana* (1840), *Researches in Guyana* (1840), and several reports to the Geographical Society, for which he received the gold medal of that body 1839, and which were translated into German by his brother Otto, and published at Berlin with a preface by A. Humboldt (1841); was at the head of the commission for surveying the frontier between British Guiana and Brazil 1841–44; published the *Natural History of the Fishes of Guiana* (2 vols., 1841–43); was knighted 1845; published a *History of Barbadoes* (1847) and *The Discovery of the Empire of Guiana by Sir Walter Raleigh* (1848); was British consul and chargé d'affaires in the Dominican republic 1848–57, and consul-general in Siam 1857–64. D. at Schöneberg, near Berlin, Mar. 11, 1865.—His brother, MORITZ RICHARD, took part in the second exploration of Guiana, of which he published an account in German (3 vols., 1847–48); translated some of the works of Sir Robert into German; went to Australia 1849; and has been since 1865 director of the botanical garden at Adelaide.

Schön'bein (CHRISTIAN FRIEDRICH), b. at Metzingen, Würtemberg, Oct. 18, 1799; studied natural science at Tübingen and Erlangen; visited England and France; was appointed professor of chemistry at Bâle in 1828; discovered OZONE (which see) in 1839; invented GUN-COTTON (which see) in 1845. D. at Baden-Baden Aug. 28, 1868. His principal works are—*Das Verhalten des Eisens zum Sauerstoff* (1837), *Beiträge zur physikalischen Chemie* (1844), *Ueber die Erzeugung des Ozons* (1844), *Ueber die langsäure und rasche Verbrennung der Körper in atmosphärischer Luft* (1845). Hagenbach wrote his *Life* (1869).

Schön'brunn, an imperial palace situated a few miles from Vienna, on the river Wien, built in 1744 by Maria Theresa, contains 1441 rooms, among which are several magnificent state-rooms, and is surrounded with a large and beautiful park, containing a botanical garden, a menagerie, etc. The palace is generally inhabited by the imperial family during parts of the summer. The Peace of Vienna (Oct. 14, 1809) was signed here.

Schö'nebeck, town of Prussia, province of Saxony, on the Elbe, has large saltworks, breweries, and distilleries, and manufactures of powder, chemicals, soap, white lead, and vinegar. P. 8995.

Schön'linde, town of Bohemia, has manufactures of yarn and linen and cotton fabrics. P. 5472.

School Brothers and School Sisters, the collective name of a large number of educational orders or fraternities in the Roman Catholic Church, including the Ursulines, Piarists, Visitation Nuns, Ladies of the Sacred Heart, Sisters of Charity, Sisters of Mercy, and many others (for which consult their respective names).

School'craft, county of the upper peninsula of Michigan, stretching from Lake Superior on the N. to Lake Michigan on the S. E.; drained by Manistique, Sturgeon, Whitefish rivers and other streams; has a broken and densely wooded surface, and embraces the celebrated "Pictured Rocks," a perpendicular stratified wall 250 feet high extending many miles along the lake. Lumbering is the chief industry. There are 2 blast furnaces. Cap. Onota. Area, 1100 sq. m. P. 799.

Schoolcraft, tp., Houghton co., Mich. P. 669.

Schoolcraft, p.-v. and tp., Kalamazoo co., Mich., on the Chicago and Lake Huron and the Lake Shore and Michigan Southern R. Rs., 12 miles S. of Kalamazoo. It contains 3 churches, a union school, 1 bank, 1 newspaper, a large steam flouring-mill, saw and planing mill, and 1 hotel. Principal business, farming. P. of v. 932; of tp. 2136.

V. C. SMITH, ED. "DISPATCH AND NEWS."

Schoolcraft (HENRY ROWE), LL.D., b. at Watervliet (now Guilderland), Albany co., N. Y., Mar. 28, 1793; studied at Union and Middlebury colleges, but did not graduate; wrote for several periodicals; made considerable progress in chemistry and mineralogy, and devoted himself to a scientific study of the art of glassmaking, his father being a manager of extensive glassworks; commenced the publication at Utica in 1817 of a work on *Vitreology*, which was left incomplete through lack of patronage; made a journey down Alleghany and Ohio rivers, up the Mississippi to St. Louis, and thence through the mineral regions of Southern Missouri and Arkansas in 1817–18, of which he published an account, *A View of the Lead-mines of Missouri* (New York, 1819); visited Washington with a fine collection of mineralogical specimens from Missouri, and endeavored in vain to induce the U. S. government to promote the working of the mines of that region; obtained from Secretary Calhoun in 1820 an appointment as geologist to an exploring expedition sent under Gen. Cass to the upper Mississippi and Lake Superior copper region, and published a *Journal* (1821) which obtained immediate popularity; went in 1821 to Chicago, by way of the Miami and Wabash valleys, to act as secretary at a conference of Indian chiefs, as subsequently related in his *Travels in the Central Portions of the Mississippi Valley* (1825); was in 1822 appointed by Pres. Monroe Indian agent for the tribes of Lake Superior; resided nearly twenty years in the vicinity of Michilimackinack and Sault Ste. Marie, where in 1823 he married Miss Jane Johnston, an educated lady partially of Indian blood, being daughter of an Irish gentleman and granddaughter of a Chippewa chief; devoted thenceforth much of his time to the investigation of Indian languages, customs, and traditions; was in 1828 and 1832 a member of the Territorial legislature of Michigan; procured the enactment of several beneficent laws upon Indian affairs; was the principal founder of the Michigan Historical Society (1828) and of the Algic Society at Detroit (1831), the latter being an association for the investigation of Indian antiquities; was at the head of a scientific expedition which in 1832 explored for the first time Lake Itasca and

the sources of the Mississippi; negotiated in 1836 a treaty by which the U. S. purchased from the Chippewas a tract of 16,000,000 acres on the upper lakes, after which he became superintendent of Indian affairs for the northern department, and in 1839 chief disbursing agent for the same department; published in that year *Algic Researches* (2 vols.), a collection of Indian tales and legends; removed to New York 1841; issued the prospectus of an *Indian Cyclopædia* (1842), afterward carried into effect in another form; visited Europe 1842; travelled through the Ohio Valley and Canada 1843; was commissioner to take a census of the New York Indians 1845; obtained from Congress the passage of an act (Mar. 3, 1847) authorizing the collection through the Indian bureau of an extensive series of reports upon all the Indian tribes of the U. S., and spent the remaining years of his life at Washington in the direction of this enterprise and the publication of its results, a series of six 4to vols., illustrated with numerous plates (Philadelphia, 1851–57), forming the most extensive existing repository of information upon the American Indians, and comprising many materials of great value, but unsatisfactory as a whole from lack of systematic arrangement. During the latter portion of his life Mr. Schoolcraft was confined to his chair with paralysis, and was unable to write, but his second wife (formerly Miss Mary Howard of Beaufort, S. C.—herself authoress of several works of fiction) with rare devotion acted as his amanuensis, enabling him to realize a considerable portion of his literary projects. D. at Washington, D. C., Dec. 10, 1864. Among his numerous publications were a *Narrative of an Expedition to Itasca Lake, the Actual Source of the Mississippi* (1834; reissued in 1853, along with the account of the earlier exploration of 1820), *Oneota, or Characteristics of the Red Race of America* (New York, 1844), *Notes on the Iroquois* (Albany, 1848), *Personal Memoirs of a Residence of Thirty Years with the Indian Tribes* (Philadelphia, 1851), and *Scenes and Adventures in the Semi-alpine Regions of the Ozark Mountains* (1853). He was a member of numerous literary and scientific societies in Europe and America; received the degree of LL.D. from the University of Geneva 1846; wrote several poems and novelettes on Indian subjects, and many essays, lectures, magazine articles, memoirs, and reports addressed to the government or presented to ethnological associations. PORTER C. BLISS.

Schoo'ley's Mountain, p.-v., Morris co., N. J., at the base of mountain of the same name, a noted summer resort, has fine scenery and several hotels.

School'men, a name applied to the philosophers of the Middle Ages, whose labors were directed chiefly to adjusting the relations of the Christian religion to philosophy. The teachers of the seven liberal arts (*trivium* and *quadrivium*) in the cloister schools founded by Charlemagne were called *doctores scholastici*, whence the name "scholasticism" as applied to the system of philosophy that arose in those schools and flourished in the universities that were founded subsequently. The grounds of the faith and their reconciliation with human reason were brought under discussion, and the attitude of the Church was readjusted toward the numerous questions which the new intellectual activity of the time brought forth. The first period of scholasticism is characterized by the accommodation of Neo-Platonic principles and the Aristotelian logic to the doctrine of the Church, and it extends from the time of Johannes Scotus Erigena (A. D. 843) to Abelard (d. 1142). The second period extends from Alexander of Hales (d. 1245) to the fourteenth century, and is characterized by the thorough mastery of Aristotle and the ascendency of his authority in matters of philosophy. Aristotle came to be called *præcursor Christi in naturalibus*, just as John the Baptist was called *præcursor Christi in gratuitis*. Johannes Scotus Erigena, at the head of the court school at Paris, was commissioned by Charles the Bald to translate the writings of the pseudo Dionysius Areopagita, which had been received as a present from the emperor of the Eastern empire. Upon the Neo-Platonic basis of those writings he endeavored to render the Christian conception of creation intelligible. The doctrine of emanation was thus substituted for creation. The Platonic theory of ideas—*universalia ante rem*—was adhered to, and the opposite doctrine, that individual things are substances in the fullest sense, was warmly repudiated. The well-known passage in the *Isagoge* of Porphyry, translated by Boëthius, "*Mox de generibus et speciebus illud quidem sive subsistant sive in solis nudis intellectibus posita sint,*" etc., is regarded as the historical occasion of the disputes of nominalism and realism which took up the greater part of the first period of scholasticism, and in a modified form (that of individual reason *versus* a world-soul) was the central theme of the discussions of the second period. It is indeed easy to understand that this question of nominalism and realism (see NOMINALISTS and REALISM) concerned vitally the possibility of Christian theology. If general terms are mere conventional signs, and have no corresponding reality, there can be no spiritual existence, and Roscellinus was right in denying the unity of the Godhead as set forth in the Trinity. Moreover, the doctrines of immortality and free-will could not be sustained. On the other hand, the doctrine of nominalism is closely connected with the rise of independent thinking and the study of nature, although it led to scepticism in spiritual matters. The prominent Schoolmen of the first period were the nominalists Roscellinus and Abelard (who was a moderate nominalist), and the realists Anselm and William of Champeaux. Besides these, there were Eric and Remigius of Auxerre, Gerbert, Fulbert, Berengarius of Tours, and later, Bernard of Clairvaux, Bernard of Chartres, William of Conches, Walter of Mortaigne, Gilbertus Porretanus, Petrus Lombardus (famous author of *Sentences* compiled from the Church Fathers), the St. Victors (Hugo, Richard, and Walter), John of Salisbury, Alanus, Amalrich of Bena, David of Dinant. After the end of the twelfth century scholasticism changed very materially, by reason of the influence of the Arabians, who had cultivated to a high degree the Aristotelian philosophy. The Syrian Christians at Edessa, among whom had existed an Aristotelian school since the fifth century, translated the works of Aristotle into Syriac in the sixth century, and in the ninth century into Arabic. In the tenth century new translations into Arabic, not only of Aristotle, but also of his commentators, Alexander, Themistius, Syrianus Ammonius, and Theophrastus, were widely circulated, and afterward used by Alfarabi, Avicenna, and Averroës. Avempace, Abubacer, and the learned Jews Avicebron and Moses Maimonides elaborated and applied partly Aristotelism and partly Neo-Platonism and the doctrines of the Cabbala. The sluggish intellect of Christendom was thoroughly aroused. The Oriental principle of abstract unity in the Godhead, which had made its appearance in the early history of the Church, and had finally been eliminated by violence after the Council of Nicæa, had made its way through the Ebionitic Christians in Arabia into a new religion, Mohammedanism. A rigid monotheism sprung up, and became a menace to Christianity. Its philosophic thinkers naturally tended to the adoption of the emanation theory, and to the denial of permanence of identity on the part of the individual. The great commentators followed Alexander of Aphrodisias in his interpretation of the *De Anima*, and limited immortality to the world-soul, which should find its particular existence in individual men, capable, it is true, of cognizing universal ideas through participation in this general intelligence, but who could not survive as individuals the death of the body, inasmuch as the faculties of desire, perception, memory, and reflection (νοῦς παθητικός) are corporeal. Christian thought was aroused, and it grappled resolutely with the question whether any particular individual can be immortal; that is, whether the individual can be universal and particular at the same time. This added to the zeal with which Realists combated nominalism. Is the universal or generic only a fiction of the mind? If it is really existent, is it immanent in, or separate from, the particular individual? If the latter, then there can be no immortality. The Christian dogmas establishing the Trinity, human responsibility, and immortality had hitherto been accepted on faith, and few thinkers had arisen since the downfall of the Western empire with any inclination to follow the direction of St. Augustine and attempt to gain theoretical insight into the logical necessity of Christian doctrines. Against pagan religions such as Christendom had encountered in the North and West there was no need of a metaphysical justification, for there was no metaphysics to oppose. But with the Moslem came a philosophical system as complete as Aristotelianism, and skilfully interpreted in the interests of pantheism. There arose a series of great minds who made it their work to master Aristotle and to interpret him in the interests of Christianity. Alexander of Hales, Bonaventura, Albertus Magnus, his pupil Thomas Aquinas, Duns Scotus,—these are the great names in the period of the greatest bloom of scholasticism. Of these, Thomas Aquinas is the greatest, and through him Christian theology gained a consistent, systematic form. Each portion of Aristotle's system was interpreted in the light of the whole, and he came to be regarded as the great pillar of the truth. Besides the five greatest names of this period, above given (of whom Bonaventura the Mystic preferred Plato to Aristotle), there is a host of eminent thinkers—William of Auvergne, Robert Greathead, Michael Scotus (translator of Aristotle), Vincentius of Beauvais, Henry of Ghent, Richard of Middletown, Petrus Hispanus, Roger Bacon, Raimond Lully, Petrus Aureolus, Durand de St. Pourçain, John Buridan, Pierre d'Ailly.

William of Occam, a pupil of Duns Scotus, gave the deathblow to scholasticism, which had already begun to decline. The work of Duns Scotus had been chiefly critical, and had done much to undermine the arguments by which the rational grounds of the dogmas had been established. Occam adopted the doctrine of nominalism, and **denied altogether the possibility of showing the rationality** of the tenets of faith. In his *Centilogium Theologicum* the greater part of his hundred demonstrations attempt to prove that theological dogmas, such as the existence, unity, or infinity of God, the Trinity, creation, incarnation, transubstantiation, etc., involve contradiction of logical principles, and are irreconcilable with reason, and to be accepted only by faith. Scholasticism had done its work. For more than 200 years it had vindicated the dogma before reason. It had erected a vast structure of Christian theology opposed to the pagan systems of thought that had preceded. The Arabian pantheism had been vanquished. Now there arose in the fourteenth century a necessity for more individualism in thinking. The mind must go back to the beginning, and assure itself of its freedom by passing through the twilight of error in order to discover the universality and necessity of truth. Hence, **philosophical investigation needed to be divorced from** theology, and this was accomplished by the labors of Occam. Religious dogmas became solely matters of faith, and human reason turned its activity to another field for a time. WILLIAM T. HARRIS.

Schools. See COLLEGE, COMMON SCHOOLS, EDUCATION, INFANT SCHOOLS, JUVENILE OFFENDERS, MILITARY ACADEMIES, NORMAL SCHOOL, SCHOOL SYSTEM OF BOSTON, and UNIVERSITY.

School System of Boston. The seed out of which the whole public-school system of Boston has sprung is found in an order adopted by the freemen of the town five years after its settlement, in these words: "The 13th of ye 2d month, 1635; Likewise it was then gen^rally agreed upon yt or brother Philemon Pormont shall be entreated to become schoolmaster for ye teaching and nourtering of children wth vs." This was the beginning of the present Latin school of the city, and for forty-seven years it was the only public school in the town. In 1682 two elementary schools were set up, to which is traced the origin of what are now known as the grammar schools. It was not until 1789 that girls were permitted to attend the public schools, and during nearly forty years thereafter they were allowed to attend only half the year, from April to October. **Children were not admitted to the grammar schools until** seven years of age. In 1818 primary schools were established for children from four to seven years of age. In 1821 the English High School, resembling a German Realschule, was established, affording to boys who had finished the grammar school course the advantages of a three years' course in English and French as a preparation for a business career. A normal school to fit female teachers for the public schools was established in 1852, and soon after made a high school for girls as well as a normal school; recently the two departments were separated into distinct schools.

The whole number of children of school age, between five and fifteen years, in the city in 1874 was 56,684; the average number of pupils belonging to day schools of all grades during the same year was 41,942; and the average number belonging to the evening schools was 3601, the total number belonging being 45,543, while the total average attendance at the day schools was 41,613. The primary schools for children from five to eight years of age, with 18,867 pupils belonging, are taught in 87 school-houses, containing 21,645 sittings, by 417 female teachers, with salaries ranging from $600 to $800. The grammar schools for pupils from eight to **fourteen years, with 23,863 pupils, classified in six grades,** are taught in 49 school houses by 511 female and 94 male teachers, salaries of principals being $3200. There are 9 high schools, including the normal, which are accommodated in 8 school houses with 2997 sittings, and are attended by 1019 boys and 1057 girls, and taught by 47 female and 51 male teachers; salaries of principals $4000. Besides these free high schools, there is in the Roxbury district an excellent free Latin school, supported by an endowment and managed by trustees. In addition to the above-named regular schools, the system comprises 20 special schools, in 6 kinds—viz. 11 elementary evening schools, 1 evening high school, 4 evening industrial drawing schools, 1 Kindergarten, 2 schools for licensed minors, and 1 deaf-mute school. The school houses and lots, exclusive of those in recently-annexed districts, are valued at $6,772,400, which gives $181.19 per pupil belonging. The salaries of the high-school teachers amount to $145,744.86, and the whole amount of salaries is $1,015,572.72; the total expenditures **in 1874, for all school purposes, were $1,865,720.29.** The schools are supported by a tax on the personal and real property of the city, and the tuition in them all is gratuitous; stationery, drawing-books and writing-books, and text-books for indigent children, are furnished at the public expense. There is no separate school-tax, but the funds for school purposes are appropriated by the city council out of the general tax levy. The school board has authority to determine the salaries of teachers, and the city is liable to pay them without regard to amount appropriated for schools. School-houses are built by the city council on request from the school board, by which the plans must be approved. The schools were managed until 1789 by the selectmen of the town, the clergy being invited to visit the **schools on examination-days; from 1789 to 1822, by 12** committeemen, in conjunction with the selectmen; from 1822, the date of the city charter, to 1835, by a board consisting of the mayor, the 8 aldermen, and 1 person chosen from each of the 12 wards; from 1835 to 1855, by a board composed of the mayor and president of the common council and 24 other persons, 2 being elected annually from each ward. Until the latter date the primary schools had been managed by a committee appointed by the "grammar-school" board, one member for each school, and numbering at the time of its abolition 180. By a change in the charter in 1855 all the schools were placed in charge of a board of 72 members, elected for three years, with the mayor and president of the common council. The present system of supervision, which went into operation in Jan., 1876, comprises a school board consisting of the mayor and 24 persons elected at large for three years, a board of 6 supervisors elected by the school board for two years, and a superintendent elected for two years. The office of superintendent was established in 1851, and has had only two incumbents. Vocal music and drawing are thoroughly taught in all grades of the schools, each of these branches being under the general supervision of a chief and several subordinate supervisors. The boys in the high schools are regu**larly instructed in military drill, the military organization** comprising 24 companies. The girls in the lower classes **in the grammar schools are taught sewing two hours a week** by special teachers. Fourteen truant officers are employed to enforce the laws relating to school attendance; "absentees" and truants are sent to the reformatory on Deer Island. In the tuition-paying private schools of the city there are about 4000 pupils, and about 5000 in free sectarian (Roman Catholic) schools. JOHN D. PHILBRICK.

Schoon'er, a vessel with two or three masts and fore-and-aft rigged; or, if the foremast have a square topsail, the vessel is called a topsail schooner. When sailing by the wind, schooners have an advantage over square-rigged vessels, and they are easily handled by a small crew.

Scho'penhauer (ARTHUR), b. in Dantzic Feb. 22, 1788. His father was a banker; his mother, Johanna, a writer of novels and books of travels. In his youth he travelled through France and England; entered the University of Göttingen in 1809; studied philosophy under Schulze the sceptic, and gave especial attention to Kant and Plato; **in 1811 heard the lectures of Fichte at Berlin;** wrote his famous essay, *On the Fourfold Root of the Principle of Sufficient Reason*, for his degree at Jena in 1813; adopted Goethe's theory of colors, and wrote in 1816 an essay *On Seeing and Color*. His principal work, on *The World as Will and Representation*, was composed in Dresden and published in 1819. After a visit to Italy he settled at Berlin University as *Docent*, and remained there in this capacity until 1831, with the exception of some intervals spent in Italy. Want of success as a lecturer caused his withdrawal from Berlin in 1831 to Frankfort, where he spent the rest of his life in seclusion. D. Sept. 21, 1860. **His characteristic doctrine is pessimism. The world is the worst of possible worlds. We can alleviate our lot in it by** sympathizing with the suffering, and in a still more effec**tual way by an asceticism which destroys our will to live.** This view of the world he connects with his doctrine of the Will, but not in a very obvious manner. According to him **the Will is the only substantial essence in the universe; it** is Kant's "thing in itself." The intellect, consciousness, our entire theoretical activity, is simply a result of the **Will in its higher forms. The Will constantly energizes toward life, and the stadia of Nature are simply the instru**mentalities of the Will created on its way to life. Mere matter, as the product of forces, is the lowest stage, the result of blind Will; in chemism, where there is reciprocal excitement to activity, the Will is manifested on a higher stage; finally, the Will objectifies itself in organisms, which do not depend upon externally-exciting causes for their activity, but work from internal motives, and select likewise their own food, and hence need intelligence to convert blind exciting impulses into motives. The organism thus evolves a brain in which the Will manifests its highest objectivation. With the brain, and intelligence which is its

function, there arises simultaneously, as result, the world as representation with all its forms: subject and object, space and time, causality, etc. The brain with its intelligence is therefore only the tool or instrument of the will to live. And yet Schopenhauer recognizes the archetypal forms of the various stadia of existences in nature as unchangeable genera—as "ideas" in the Platonic sense. These abide while the individuals perish and are merely phenomenal and illusory. He adheres to the Oriental idea of annihilation, and considers the Christian idea of immortality a delusion. Hence "the happiest moment of life is the completest forgetfulness of self in sleep, and the wretchedest is the most wakeful and conscious." The world presents a continual tragedy before us, in which eternal justice becomes visible as the Nemesis which reduces to nullity again the individuals which have arisen like bubbles upon the surface of the Eternal Will. Hence, the highest act of morality is resignation, renunciation. Enjoyment of art is the only permissible pleasure, because that is cognition devoid of Will. The Nirvana of the Booddhists is the ultimate desideratum in the view of Schopenhauer. In this world, which was the worst possible, the worst features in it, to Schopenhauer, were the contemporary philosophers, Fichte, Schelling, Hegel, and their followers, who achieved popularity and success, while he failed. He exhausts his ingenuity in inventing opprobrious epithets for these "professors of philosophy." But the dependence of his own views upon contemporary systems is quite obvious, especially upon those of Fichte and Schelling. Optimism might as well have been the logical consequence of his theory that the energy of the Will develops the intellect as its tool; for the world as representation must be then regarded as the ultimate final product of the Will, and any pessimistic annulment thereof as retrogression to a less complete standpoint. It was therefore illogical to adopt Booddhism as a consequence of his system. Consistent elaboration would have developed a philosophy much resembling the earlier system of SCHELLING (which see). Besides his three works already named, the following are important: *Upon the Will in Nature* (1836), *The Freedom of the Human Will* (1839), *The Basis of Morals* (1841). *The Parerga and Paralipomena* (1850) contains his views in a fragmentary form, and is the most popular of his works. Julius Frauenstädt has edited his works, and done much to make known his doctrines. Edward von Hartmann, in his *Philosophy of the Unconscious*, the most popular philosophical work of modern times, presents in a modified form the philosophy of Schopenhauer. WILLIAM T. HARRIS.

Schou'ler (WILLIAM), b. at Kilbarchan, Renfrewshire, Scotland, Dec. 13, 1814; came to the U. S. in childhood with his father, who established a cloth-printing business on Staten Island, N. Y., and subsequently at West Cambridge, Mass.; was editor of the Lowell *Courier* from 1841 to 1847, when he undertook the management of the Boston *Atlas*, the leading Whig paper of New England 1847–53; represented Boston four years in the legislature; was a member of the constitutional convention of 1853; editorially connected with the Cincinnati *Gazette* 1853–56 and the *Ohio State Journal* 1856–58, after which he returned to the *Atlas* 1858; was appointed adjutant-general of Massachusetts 1860, and in that capacity rendered important service during the war for the Union. D. at Jamaica Plain, Mass., Oct. 24, 1872. Author of a *History of Massachusetts in the Civil War* (1868) and of *Political and Personal Recollections* in the Boston *Journal* (1870).

Schouw (JOACHIM FREDERIK), b. at Copenhagen Feb. 7, 1789; studied law first, afterward natural science; travelled much, and undertook comprehensive scientific researches in the Scandinavian and Italian peninsulas; was appointed professor of botany at the University of Copenhagen in 1821, and director of the botanical garden in 1841. D. Apr. 23, 1852. His numerous writings, botanical, climatological, and geographical—*Grundtræk til en almindelig Plantegeographie* (1822), *Physisk-geographisk Skildring af Europa* (1832), *Natur-Skildringer* (1839–45), etc.—have been translated into German and French, and his eminent talent as a lecturer contributed much to the diffusion of knowledge among his countrymen and to the awakening of a truly scientific interest. He was also very active in politics, liberal, and as a reformer cautious in his plans and fearless in their execution.

Schra'der (JULIUS), b. at Berlin June 16, 1815; studied painting at the academy of his native city, at Düsseldorf 1837–45, and in Rome 1845–51, and was appointed professor at the Academy of Berlin in 1851. His most celebrated pictures are *The Death of Leonardo* (1851), the great fresco in the New Museum of Berlin, *The Consecration of the Church of St. Sophia in Constantinople* (1853), *Esther before Ahasuerus* (1856), and a number of portraits.

Schreve'lius (CORNELIUS), b. at Haarlem in 1615; succeeded his father in 1642 as rector of the College of Leyden. D. there Sept. 11, 1664. Besides editions of numerous Greek and Latin authors, he published in 1654 a *Lexicon Græco-Latinum et Latino-Græcum*, which was used for more than a century in the schools of Germany, England, France, Holland, and in the U. S., and reprinted innumerable times.

Schri'ver (EDMUND), b. in Pennsylvania in Nov., 1812; graduated at U. S. Military Academy, and promoted brevet second lieutenant of artillery July 1, 1833, captain 1842; resigned July 31, 1846. From 1847 to 1861 he was treasurer of Saratoga and Schenectady and of Rensselaer and Saratoga R. R. Cos., and president of the latter company 1851–61. In Apr., 1861, he accepted an appointment on the staff of Gov. Morgan of New York, with the rank of colonel and A. D. C., and May 14 was appointed lieutenant colonel of the 11th Infantry U. S. A.; colonel and A. A. D. C. May, 1862, and served as chief of staff to Gens. McDowell and Fremont (1st corps), participating in the battles of Cedar Mountain, second Bull Run, and Chantilly; appointed inspector-general U. S. A. (rank of colonel) Mar., 1863, and assigned to the Army of the Potomac, he was engaged at Chancellorsville and Gettysburg 1863, and in the Richmond campaign of 1864, up to the investment of Petersburg; was inspector of the Military Academy 1867–70. Brevet brigadier and major general U. S. A.

Schröckh (JOHANN MATTHIAS), b. at Vienna July 26, 1733; studied at Göttingen; was appointed professor at Wittenberg in 1762, first of belles-lettres, then of history. D. there Aug. 2, 1808. He wrote *Weltgeschichte für Kinder* (6 vols., 1779–84), *Christliche Kirchengeschichte* (35 vols., 1768–1803), *Kirchengeschichte seit der Reformation* (10 vols., 1804–12, the 9th and 10th added by Tzschirner 1810–12), a work of immense learning which later writers have freely used.

Schrö'der (FRIEDRICH LUDWIG), b. at Schwerin Nov. 3, 1744; was left and forgotten, while still a boy, by his parents, who were strolling actors, at Königsberg, where he grew up in squalid and degraded circumstances; found his parents again in 1759 in Soleure, where he was trained to become a dancer; joined them finally in Hamburg in 1764, after going through a course of wild dissipation; undertook in 1771 the management of the troop after the death of his step-father, Ackermann; and raised the stage of Hamburg to a literary and artistic influence in Germany, partly by his plays (collected and published in 1831 in 4 vols., with an introduction by Tieck), partly by the rigid sense of social propriety with which he governed the theatre, but more especially by his grand impersonations of some of the principal Shakspearian characters, such as Lear, which he was the first to introduce on the German stage. D. in Hamburg Sept. 3, 1816. His *Life* has been written by F. L. W. Meyer (1810) and Brunier (1864).

Schröder (SOPHIE), b. at Paderborn, Westphalia, Feb. 28, 1781; entered upon the stage when twelve years old in St. Petersburg, where the troop to which her parents belonged was playing; married in 1795 Stollmers (whose true name was Smets), the director of another band, in 1804 the singer Schröder, and in 1825 the actor Kunst; acted in all the principal theatres of Germany, but principally at Vienna, and acquired a great fame by her impersonations of Phædra, Medea, Merope, Lady Macbeth, Sappho, etc. In 1840 she retired from the stage with a pension from the Austrian court; lived in Augsburg. D. in Münich Feb. 25, 1868. Her *Life* was written by P. Schmidt (Vienna, 1870).—Her daughter, WILHELMINE SCHRODER-DEVRIENT, b. at Hamburg Dec. 6, 1804, made her début as a singer in 1821 in *The Magic Flute*; sang as Donna Anna, Euryanthe, Fidelio, etc., and was soon acknowledged as the first singer of Germany; was received with great enthusiasm in Paris, London, and St. Petersburg; retired from the stage in 1847. D. at Gotha Jan. 26, 1860. She was twice married, the first time to the actor Karl Devrient. Her *Life* was written by Claire von Glümer (1862) and Wollzogen (1863).

Schröd'ter (ADOLF), b. at Schwedt, Prussia, June 28, 1805; studied engraving at Berlin, afterward painting at Düsseldorf, and was appointed professor of drawing at the polytechnic school of Carlsruhe in 1859. His most celebrated works are the *Wine-tasters* (1832), *Auerbach's Cellar* (1847), *Falstaff* (1851), *The Two Monks* (1863), and a number of humorous illustrations and engravings.

Schroe'der (JOHN FREDERICK), D. D., b. at Baltimore, Md., Apr. 8, 1800; graduated at Princeton 1819; studied at the Episcopal Theological Seminary, New Haven; was ordained 1823; was assistant minister of Trinity church, New York, 1824–38, afterward rector of the church of the Crucifixion, New York, and of St. Thomas's church, Brooklyn; established St. Ann's Hall, a seminary for young ladies, at Flushing, L. I., 1839; obtained popularity as a

preacher and lecturer, and published several miscellaneous works, including a volume of essays on biblical topics and Oriental literature, and *The Mission of Washington* (1855). D. at Brooklyn Feb. 26, 1857. At the time of his death he was engaged upon a serial work, left incomplete, *The Life and Times of Washington*, of which 2 vols. were published.

Schroep'pel, tp., Oswego co., N. Y. P. 3987.

Schroon, v. and tp., Essex co., N. Y., a favorite summer resort among the Adirondac Mountains. There are small steamers on the lake, which is drained by Schroon River. P. of v. 300; of tp. 1899.

Schu'bert (FRANZ), b. in Vienna Jan. 31, 1797; d. there Nov. 19, 1828; is best known by his songs, more than 200 in number, 50 or 60 of which are celebrated and will live. He wrote operas that were never published, and symphonies that are little known; the symphony in C is an exception, being a favorite in instrumental concerts. His compositions for the pianoforte, trios, etc. are skilfully wrought and imaginative. His romance, *The Erlking*, is considered as, on the whole, his finest production.

O. B. FROTHINGHAM.

Schubert, von (GOTTHILF HEINRICH), b. at Hohenstein, Saxony, Apr. 26, 1780; studied theology at Leipsic, medicine at Jena, practised as a physician two years at Altenburg; studied geology under Werner at Freiberg; held various positions in educational institutions, and was appointed professor of natural science at Erlangen in 1819, and at Munich in 1827. D. at Lautzorn, Upper Bavaria, July 1, 1860. The most remarkable of his writings are—*Ahnungen einer allgemeinen Geschichte des Lebens* (3 vols., 1806–20), *Ansichten von der Nachtseite der Naturwissenschaften* (1808), *Symbolik des Traumes* (1814), *Geschichte der Seele* (2 vols., 1830); most of these works are based on the philosophy of Schelling, and have a mystic character. His *Altes und Neues aus dem Gebiete der innern Seelenkunde* (5 vols., 1817–44) is of an ascetic character.

Schul'te (JOHANN FRIEDRICH), b. at Winterberg, Westphalia, Apr. 23, 1827; studied law at Berlin; practised in this city, Arnsberg, and Bonn, and was appointed professor of canon law in 1855 at Prague, and in 1872 at Bonn. He wrote *System des katholischen Kirchenrechts* (1856), *Die Lehre von den Quellen des katholischen Kirchenrechts* (1860), *Lehrbuch des katholischen Kirchenrechts* (1868), *Lehrbuch der deutschen Reichs- und Rechtsgeschichte* (2 vols., 1861–70), *Die Rechtsfrage des Einflusses der Regierung bei den Bischofswahlen* (1869). His *Die Macht der römischen Päpste* (1871), in which he protested against the dogma of the papal infallibility, made a great sensation, and occasioned his removal to Bonn, where he sided with Döllinger and Reinkens. He is the lay-reader of the Old Catholics, and has presided over their annual congress since 1871. He recently advocated the abolition of celibacy.

Schultz, tp., Edgefield co., S. C. P. 848.

Schultz-Schultzenstein (KARL HEINRICH), b. at Alt Ruppin, Prussian province of Brandenburg, July 8, 1798; studied medicine at Berlin, and was appointed professor at the university in 1825. D. there Mar. 27, 1871. His comprehensive botanical researches, *Ueber den Kreislauf des Saftes in den Pflanzen* (1824), *Die Natur der lebendigen Pflanze* (2 vols., 1823–28), *Natürliches System des Pflanzenreichs* (1832), *Sur la Circulation et sur les Vaisseaux laticifères dans les Plantes*, crowned by the French Academy in 1839, *Die Cyklose des Lebenssaftes in den Pflanzen* (1841), led him to new views of the character and conditions of life in the animal kingdom; *Ueber Anaphytose oder Verjüngung der Pflanzen* (1843), *Neues System der Morphologie der Pflanzen* (1847), *Die Verjüngung im Pflanzenreich* (1851), which have not been without practical influence on the cultivation of plants; *Die Entdeckung der wahren Pflanzennahrung mit Aussicht zu einer Agriculturphysiologie* (1844), *Ueber Pflanzenernährung, Bodenerschöpfung und Bodenbereicherung* (1864). Corresponding views he developed on the field of animal physiology—*System der Circulation in seiner Entwickelung durch die Thierreiche und im Menschen* (1836), *Ueber die Verjüngung des menschlichen Lebens und die Mittel und Wege zu ihrer Cultur* (1842), *Die Verjüngung im Thierreich als Schöpfungsplan der Thierformen* (1854), and applied them to medicine—*Allgemeine Krankheitslehre* (2 vols., 1845), *Die Heilwirkung der Arzneien nach den Gesetzen der organischen Verjüngung* (1846), and to psychology—*Die Bildung des menschlichen Geistes durch Cultur der Verjüngung seines Lebens* (1855), *Naturstudium und Cultur oder Wahrheit und Freiheit in ihrem natürlichen Zusammenhange* (1866), *Die Moral als Heilwissenschaft und Culturwissenschaft* (1863). His polemical relation to other scientific standpoints he has explained in his *Physiologie der Verjüngung des Lebens im Unterschiede von den dynamischen und materialistischen Stoffwechseltheorien* (1867).

Schul'ze-Delitzsch' (HERMANN), b. at Delitzsch, Prussian Saxony, Aug. 29, 1808; studied law at Leipsic and Halle; travelled in Northern Germany and Scandinavia, and published in 1838 his *Wanderbuch*; held various judicial positions, and sat in the National Assembly at Berlin 1848, where he attracted much attention as a member of the committee to investigate the state of the working-classes. Perpetually harassed by the Prussian government on account of his liberal views, he resigned in 1850 his office, settled in his native city, and devoted himself to the improvement of the condition of the working-classes, in which undertaking he was eminently successful. In 1847 he organized an association of the shoemakers in Delitzsch, which bought all the leather the trade of the place demanded, and sold it to the members of the association at the wholesale price. Similar associations for the purchase of raw materials, provisions, etc. were soon established by other trades and in other cities, and exercised, in connection with corresponding loan institutions and savings banks, a most beneficial influence. Also his writings succeeded—*Das Associationsbuch* (1862), *Die arbeitenden Klassen und das Associationswesen* (1863), *Die Vorschuss- und Creditvereine als Volksbanken* (1867), *Kapitel zu einen deutschen Arbeiterkatechismus* (1863), *Neues Kapitel* (1866), in opposition to Lassalle. (See *Jahresberichte über die auf Selbsthülfe gegründeten deutschen Erwerbs- und Wirthschaftsgenossenschaften*, issued regularly since 1859, when a central bureau was formed for all the existing associations.)

Schu'macher (HEINRICH CHRISTIAN), b. at Bramstedt, Holstein, Sept. 3, 1780; studied mathematics and astronomy at Kiel, Jena, Copenhagen, and Göttingen, and was appointed professor of astronomy at the University of Copenhagen in 1810, and superintendent of the conservatory in 1815, but removed in 1821 to Altona, where he d. Dec. 28, 1850. In 1821 he founded the *Astronomische Nachrichten*, which is still continued. In 1830 he made the observations of the length of the seconds pendulum which formed the basis of the Danish scale of measure. He also gave very accurate accounts of the distances of Venus, Jupiter, Mars, and Saturn from the moon.

Schu'mann (ROBERT), b. at Zwickau, Saxony, Jan. 8, 1810; composed symphonies, cantatas, sonatas, quartets, quintets, an opera, and songs. The opera *Genoveva* was given at Leipsic, and failed. *Paradise and the Peri*, a cantata, is considered fine even by critics of the opposite school. Schumann founded the *New Musical Journal* at Leipsic. He was learned, ingenious, imaginative, and gifted with much poetic feeling. While living at Düsseldorf he became deranged, and attempted suicide by drowning in the Rhine, but was rescued and taken to an insane asylum. D. at Bonn July 29, 1856. His wife, CLARA (WIECK), b. at Leipsic in 1819, an eminent pianist and teacher, introduced to the German public the works of Chopin and Henselt. O. B. FROTHINGHAM.

Schurmann (ANNA). See LABADIE (JEAN).

Schurz (CARL), LL.D., b. at Liblar, near Cologne, Rhenish Prussia, Mar. 2, 1829; educated at gymnasium of Cologne and at University of Bonn 1846–48; aided Prof. Gottfried Kinkel in the publication of a liberal newspaper, commenced after the revolutionary outbreak of 1848; was engaged in an unsuccessful attempt to excite an insurrection at Bonn in the spring of 1849; fought in the Palatinate, taking part in the defence of Rastadt, with the rank of adjutant; went thence to Switzerland; returned to Germany 1850, and succeeded in effecting the escape of his companion, Kinkel, from imprisonment in the fortress of Spandau; went to Paris as correspondent of German newspapers 1851; gave private lessons in Paris 1851–52; came to the U. S. toward the close of 1852, and lived at Philadelphia until 1855, when he settled at Madison, Wis.; entered with great zeal into national politics; was a leader of the German element of the newly-founded Republican party; was an unsuccessful candidate for lieutenant-governor 1857; made his first speech in English in Illinois during the Senatorial contest between Lincoln and Douglas 1858; settled at Milwaukee as a lawyer 1859; attracted attention by a series of lectures in New England in the winter of 1859–60; was prominent in the Republican national convention at Chicago 1860, and in the ensuing Presidential campaign; was appointed by Pres. Lincoln minister to Spain Mar., 1861; resigned that post in December of the same year; was appointed brigadier-general of volunteers Apr., 1862; became major-general Mar. 14, 1863; commanded a division in the second battle of Bull Run and in the battle of Chancellorsville; was temporarily in charge of the 11th army corps at Gettysburg; took part in the battle of Chattanooga; was Washington correspondent of the New York *Tribune* 1865–66; visited the Southern States as special commissioner appointed by Pres. Johnson 1866; settled at Detroit, Mich., the same year, and

founded there the *Post* newspaper; removed in 1867 to St. Louis, Mo., where he became editor of a German paper, the *Westliche Post;* was an active member of the Chicago convention of 1868; was U. S. Senator from Missouri 1869–75; acquired a high reputation for ability by his speeches on finance and national policy; became involved in antagonism with Pres. Grant's administration; presided over the "Liberal" convention at Cincinnati which nominated Horace Greeley for the Presidency 1872; visited Europe in 1873 and 1875; became on his return a resident of New York City; took part in the political campaign of 1875 in Ohio, advocating the election of Gov. Hayes on a "hard-money" platform, was one of the callers of the independent conference of May 15, in New York City, and appointed Secretary of the Interior by Pres. Hayes, March 7, 1877. A selection of his *Speeches* appeared in a volume in 1865.

Schuy'ler, county of W. Illinois, on Illinois River, traversed by a branch of Chicago Burlington and Quincy R. R., has a rolling surface and a productive soil, well adapted to dairying and stock-raising. Staples, wheat, Indian corn, oats, hay, sorghum-molasses, wool, and butter. Cap. Rushville. Area, 416 sq. m. P. 17,419.

Schuyler, county of N. E. Missouri, adjoining Iowa, watered by Chariton, Salt, and Fabius rivers, and traversed by Missouri Iowa and Nebraska and St. Louis Kansas City and Northern R. Rs., and has an undulating surface, partly prairie and partly timber-land. Staples, Indian corn, wheat, oats, hay, tobacco, sorghum-molasses, honey, butter, and wool. Sheep and swine are numerous. Cap. Lancaster. Area, 324 sq. m. P. 8820.

Schuyler, county of Central New York, embracing several small lakes and the southern portion of Seneca Lake, traversed by Northern Central R. R., has a hilly surface, and includes the Watkins Glen on Seneca Lake, famous for numerous picturesque cascades; has a hilly surface and a fertile soil. Staples, wheat, hay, oats, barley, Indian corn, buckwheat, honey, wool, butter, and cheese. Cattle and sheep are very numerous, and there are several tanneries, saw and flour mills, and carriage manufactories. Cap. Watkins. Area, 352 sq. m. P. 18,989.

Schuyler, p.-v. and tp., cap. of Colfax co., Neb., on Platte River and Union Pacific R. R., has 1 newspaper and an extensive trade.

Schuyler, tp., Herkimer co., N. Y. P. 1558.

Schuyler (Peter), b. about 1650; became mayor of Albany and colonel of New York militia; commanded upon an expedition against the French on Lake Champlain 1691; enjoyed great influence with the Five Nations of New York; took to England, at his own expense, in 1710, five of their chiefs, in order to promote vigorous measures against the French in Canada; often warned the New England colonies of expeditions against them sent by the French and Indians; was many years a member and chairman of the executive council, and in that capacity became acting governor of New York in 1719.

Schuyler (Peter), b. at Albany, N. Y., about 1710; settled on the Passaic in New Jersey; commanded the New Jersey regiment in the operations against Canada 1746; attended the congress convoked by Gov. Shirley at New York 1755; was in command at Oswego when that place was taken by the French, Aug. 14, 1756, and for a short time a prisoner in Canada, at which time he purchased from the Indians the freedom of many captives, and was again in command of the New Jersey regiment in Sir Jeffrey Amherst's campaign which resulted in the conquest of Canada 1759. D. at his residence, near Newark, N. J., Nov. 17, 1762.

Schuy'ler (Philip), b. at Albany Nov. 20, 1733. His father died when he was but eight years old, leaving him, as the eldest son, all his large real estate, which, however, Philip generously divided with his brothers and sisters. He later inherited the fine estate of his uncle, Col. Philip Schuyler, at Saratoga. In June, 1755, he was appointed captain of New York volunteers, and was engaged in the expedition against the French at Crown Point. At the end of the campaign of 1756 he left the army, but in 1758 accepted the appointment of commissary with the rank of major. After the peace of 1763 he was active in public affairs and a member of the colonial assembly of New York; was associated with Washington in June, 1775, to prepare rules and regulations for the government of the army, and two days after the battle of Bunker Hill, Congress appointed him a major-general, and placed him in command of the northern department. In the expedition against Canada, Schuyler commanded that by way of Lake Champlain, but was compelled, owing to ill-health, to relinquish his command to Montgomery in September, and return to Albany, after having taken possession of Isle au Noix on Sorel River. At Albany, besides continuing to exercise an active supervision of affairs in the northern department, his influence among the Indians during this period was of great value. The failure of the Canada expedition excited much hostility toward Schuyler, who was blamed for the failure, and insinuations were uttered against his loyalty, which became so offensive that in the autumn of 1776 he sent in his resignation to Congress, which that body declined to accept; but the abuse continuing, Schuyler, in Apr., 1777, proceeded to Philadelphia and demanded a court of inquiry, which entirely approved his management of affairs, and he resumed command of the northern department. The forced abandonment of Ticonderoga by St. Clair, and his retreat to Fort Edward, where Schuyler had just arrived with reinforcements, compelled the latter to fall back to Saratoga, after using every means to obstruct the advance of Burgoyne. The losses thus sustained in stores, ammunition, etc. caused a widespread consternation throughout the country, and the clamor against Schuyler was renewed, and this time Congress ordered his supersedure by Gates. At the time of the latter's arrival (September) to assume command Schuyler occupied a fortified position at the mouth of the Mohawk, to which he had fallen back from Saratoga. Gates had, since Schuyler's resumption of command of the northern department, been unfriendly to Schuyler, and it was with feelings of mortification the latter received the order deposing him at a time when the feeling of depression arising from former disasters had been dispelled by recent victories, and when volunteers were from all quarters swelling his army. He, however, obediently turned over his command, and placed his successor in possession of full information of the situation, and, though without command, remained with the army to aid in any capacity, and was present at the surrender of Burgoyne. A court of inquiry again approved of his management in strong terms, but in Apr., 1779, he resigned, though continuing to render valuable service in the military operations in his native State. From 1778 to 1781 he was a member of the Continental Congress, and in 1789 was appointed U. S. Senator from New York, and again in 1797 to succeed Aaron Burr. In the New York Senate he contributed largely to the code of laws adopted by the State, and was an active promoter of the canal system. In public life he is spoken of as being "distinguished by strength of intellect and upright intentions," and in private life as a "dignified, courteous, and pleasing companion." D. at Albany Nov. 18, 1804. (See his *Life and Times*, by B. J. Lossing, 2 vols., 1860–62; new ed. 1872.)

G. C. Simmons.

Schuyler's Falls, p.-v. and tp., Clinton co., N. Y. P. 1684.

Schuy'lerville, p.-v., Saratoga tp., Saratoga co., N. Y., on Hudson River and Champlain Canal, 30 miles N. of Troy, has 5 churches, a union graded school, 1 bank, 1 newspaper, a paper-mill, 1 foundry, a sash, door, and blind factory, 1 grist and 2 saw mills, and repair-shops. P. 1367.

P. C. Ford, Ed. "Standard."

Schuyl'kill [Dutch for "hidden stream," is said to be so called because the first explorers passed its mouth without seeing it], a river which rises in Schuylkill co., Pa., and after a south-easterly course of 125 miles flows into the Delaware at Philadelphia, which city it traverses. Its lower portion affords extensive wharfage and is of much commercial importance. The river was (1816–25) adapted to slack-water navigation for freight-boats to Port Carbon, 3 miles above Pottsville (which see). In 1872, 625 such boats were reported, belonging to Philadelphia and Reading R. R. Co., but the transportation of coal by railroad has greatly reduced its importance as a navigable stream. The river affords, by the Fairmount and other waterworks, the greater part of the water-supply for Philadelphia. It enters the Delaware between *League Island*, on which is the new navy-yard, and *Mud Island*, on which is Fort Mifflin (which see).

Schuylkill, county of E. Pennsylvania, on both sides of Schuylkill River, traversed by Broad, Sharp, and Mahanoy ranges of mountains, and bounded S. E. by Kittatinny or Blue Mountain, all abounding in deposits of anthracite coal and iron, the richest in the U. S., and intersected by many railroads; has a sterile soil, mining being the almost exclusive interest. About 4,000,000 tons of coal are annually mined. There are 47 flour and 21 saw mills, 26 tanneries, and more than 30 manufactories of castings, pig, and rolled iron. Cap. Pottsville. Area, 750 sq. m. P. 116,428.

Schuylkill, p.-v. and tp., Chester co., Pa., on Schuylkill River and Canal and on Philadelphia and Reading R. R. P. 1593.

Schuylkill, tp., Schuylkill co., Pa., on Little Schuylkill River, in the anthracite coal-region, includes p.-b. of

Tamaqua, an important railroad centre. P. (exclusive of borough), 1840.

Schuylkill Haven, p. b., North Manheim tp., Schuylkill co., Pa., on Schuylkill River and Canal, at the junction of the Mine Hill and Schuylkill Haven branch with Philadelphia and Reading R. R. P. 2940.

Schwab (GUSTAV), b. at Stuttgart June 19, 1792; studied theology and philosophy at Tübingen; was appointed professor of ancient literature in the gymnasium of Stuttgart in 1817; pastor at Gomaringen in 1837, and at the St. Leonhard church in Stuttgart in 1842, where he d. Nov. 4, 1850. His poems, distinguished, like those of Uhland and other members of the Schwabian school, by purity and warmth of feeling and simplicity and naïveté of form, consist of romances and ballads, and were originally published in papers and periodicals. The first collected edition of his *Gedichte* appeared in 2 vols. in 1828–29; a second revised edition, *Neue Auswahl* (1838), has been often reprinted. Of his prose works, mostly consisting of sketches from nature and history, the most remarkable are *Schiller's Leben* (1840), *Sagen des classischen Alterthums* (1840), *Deutsche Volksbücher* (1843), and *Wegweiser durch die Literatur der Deutschen* (1846).

Schwa'bach, town of Bavaria, has large manufactures of pins, type, gold and silver lace, paper, and tobacco, and eight annual well-attended markets. P. 6600.

Schwal'bach, or **Langenschwalbach,** town of the Prussian province of Hesse Nassau, has 2643 inhabitants, and is celebrated as a watering-place, having very strong gaseous and chalybeate springs. In the middle of the eighteenth century it was one of the most frequented watering-places of Europe, and after the visits in 1866 by the empresses of Russia and France it again became fashionable.

Schwal'ber [better known as CHELIDONIUS, the punning Græco-Latin translation of the German *Schwalber*, a "swallow;" Gr. χελιδών], a friend of Albert Dürer, and who wrote the text in Latin verse to his three series of wood-cuts, *The Apocalypse*, *The Passion of Christ*, and *The Life of the Virgin Mary*. Schwalber was a monk of the abbey of St. Egidius (St. Julian, St. Gilgan, St. Giles), built by Conrad III. in 1140 for a society of Scotch Benedictines. He was nicknamed "Musophilus," from his love of learning, and he had a reputation for considerable knowledge of the classic Latin poetry. While a member of this monastery he wrote the text for Dürer's wood-cuts, besides verses about his monastery, *Versic. de Fund. Cœnob. Egid.*, and about the abbots, *Versic. de Abbat. nonullis ejusdem Cœnob.* In 1515, Schwalber left Nuremberg to become abbot in the Schotten Kloster, near Vienna. D. there Sept. 8, 1521.

CLARENCE COOK.

Schwan'thaler (LUDWIG MICHAEL), b. in Munich Aug. 26, 1802, the son of a sculptor; studied in Rome, but wrought in Munich. He was a man of numerous and colossal imaginations and of immense industry. His statues, decorations, models, are seen in the great cities of Germany, but chiefly in Munich. Most of the buildings erected by King Ludwig were designed by him—the frieze of the Barbarossa hall, the colossal statue of Bavaria, the monumental images in the Walhalla. D. Nov. 15, 1848. Schwanthaler was the chief representative of the so-called "romantic" style, and was the founder of the school to which Schaller, Widman, Brugger, and Zumbusch belonged. His influence, however, is local, and is not widening.

O. B. FROTHINGHAM.

Schwartz (CHRISTIAN FREDERICK), b. at Sonnenburg, Prussia, Oct. 26, 1726; studied in the University of Halle 1746–49; was ordained at Copenhagen 1749; embarked at London for India, where he arrived July, 1750; settled at Tranquebar, a Danish mission on the Coromandel coast; transferred his services to the English Society for Promoting Christian Knowledge 1766; when he removed to Trichinopoly, and in 1778 to Tanjore; was sent as ambassador to Hyder Ali at Seringapatam to negotiate a peace, and admitted by him after all other envoys had been refused, and succeeded in relieving the city of Tanjore from imminent danger of famine by his influence with the native farmers, who brought in their cattle on his personal pledge of payment. D. at Tanjore Feb. 13, 1798. He was one of the most celebrated missionaries of modern times. He aided Schultz in translating the Bible into Tamil, and was tutor to the son and heir of the rajah of Tanjore, who erected to his memory in the mission church a magnificent monument by Flaxman, and the East India Company also placed a monument of him by Bacon in St. Mary's church, Madras. (See *Memoirs of his Life and Correspondence*, by Hugh Pearson, D. D. (2 vols., 1833; 3d ed. 1839).)

Schwarz (BERTHOLD), whose true name is said to have been KONSTANTIN ANCKLITZEN; received the name of BERTHOLD on entering a Franciscan monastery at Mentz, Cologne, or Gosslar, and was called SCHWARZ ("black") on account of his passion for the black arts. According to legend, he invented gunpowder in 1330, and in Freiburg, his reputed birthplace, a monument was raised in his honor in 1853. All the details of his life are uncertain, however, while it is certain that gunpowder was known before 1330, though not used in war or hunting.

Schwarz'burg-Ru'dolstadt, principality and state of the German empire, between the Saxon duchies, and comprises an area of 387 sq. m., with 75,523 inhabitants. It is covered with well-wooded spurs of the Thüringerwald, and mining and cattle-rearing are the principal branches of industry. Flax is very extensively grown, and some linen manufactures are carried on. The total revenue for the year 1874 was 878,506 gulden; expenditure 861,431. Cap. Rudolstadt.

Schwarz'burg-Son'dershausen, principality and state of the German empire, in the Prussian province of Saxony, and comprises an area of 324 sq. m., with 67,191 inhabitants. It resembles in every respect Schwarzburg-Rudolstadt, only it is a little smaller. Cap. Sondershausen.

Schwarz'enberg, a princely family of Germany, descended from Erkinger von Seinsheim, who was ennobled in 1417 by the emperor Sigismund, and in 1420 bought the estate of Schwarzenberg in Franconia, whose name he adopted. In 1670 the head of the family was made a prince of the empire by the emperor Leopold I., and in 1746 this dignity was conferred on all members of the house by the emperor Francis I. The most celebrated names of the family are—(1) KARL PHILIPP, b. at Vienna Apr. 15, 1771; d. at Leipsic Oct. 15, 1820. He received a military education, and distinguished himself in the battles of Würzburg, Ulm, Hohenlinden, and Wagram. After the peace of Vienna (Oct. 14, 1809) he went to Paris as Austrian ambassador, and negotiated the marriage between Napoleon and Maria Louisa. Napoleon placed great confidence in him, and demanded that he should command the Austrian contingent in the Russian campaign of 1812. The slowness of his movements and the inefficiency of his measures have provoked much criticism from French historians, but Napoleon himself never uttered a doubt of his loyalty, and requested the Austrian emperor to make him a field-marshal. In the next year he commanded the Austrian army of observation in Bohemia, and when Austria joined Russia and Prussia he was made commander-in-chief of the allied army, gained the battle of Leipsic (Oct. 16–18, 1813), and led the army victorious into Paris.—(2) FELIX LUDWIG JOHANN FRIEDRICH, a nephew of the preceding, b. at Kruman, Bohemia, Oct. 2, 1800; d. at Vienna Apr. 5, 1852. He entered the Austrian army in 1818, and was made a field-marshal-lieutenant in 1848, shortly before the battle of Custozza, but was mostly employed in diplomatic missions to St. Petersburg, London, Brazil, and Naples; and Nov. 22, 1848, was placed at the head of the Austrian government as chancellor of the empire. He found the state nearly dissolved, Vienna, Prague, Hungary, and the Italian provinces in open insurrection, the treasury on the very verge of bankruptcy, the Austrian influence in Germany almost annihilated, and the German states about to reorganize their union under the leadership of Prussia, etc. But all these difficulties he confronted with a courage and energy which excited admiration, even among those who were very far from approving either his aims or his measures. By the aid of Russia he put down the revolution in Hungary, and in a very short time succeeded in tying together once more the discordant limbs of the Austrian empire by means of a military and bureaucratic government. He was, however, by no means a mere repetition of Metternich. He was not averse to reform when it could be achieved in a regular and settled manner. He raised the credit of the state, and he baffled all the Prussian plans in Germany by drawing the southern and middle states over to the Austrian side.—(3) FRIEDRICH JOHANN JOSEPH CELESTINUS, a brother of the preceding, b. in Vienna Apr. 6, 1809; was made archbishop of Salzburg 1836, cardinal 1842, archbishop of Prague 1849. He opposed the declaration of the dogma of the papal infallibility as inopportune, but accepted it afterward.

Schwarzwald. See BLACK FOREST.

Schwedt, town of Prussia, province of Brandenburg, on the Oder, has breweries and manufactures of hosiery, soap, and tobacco. P. 9039.

Schweg'ler (ALBERT), b. at Michelbach, Würtemberg, Feb. 10, 1819; studied theology at the University of Tübingen, where he was appointed professor of classical philology in 1848, and afterward of ancient history. D. Jan. 5, 1857. In theology and criticism he belonged to the Tübingen school of Dr. Baur. Besides annotated editions and translations of the Clementine homilies (1847), Aristotle's metaphysics (1847–48), and Eusebius (1852), he published

Der Montanismus (1841), *Das Nachapostolische Zeitalter* (2 vols., 1846), *Römische Geschichte* (unfinished; 3 vols., 1853–58). But his best-known work is his *Geschichte der Philosophie* (1848), originally written for *Neue Encyklopädie für Wissenschaften und Künste*, but afterward often reprinted in book-form and translated into most European languages—into English by Prof. J. H. Seelye of Amherst (New York, 1856), and by Stirling in England. After his death appeared his *Geschichte der griechischen Philosophie* (1859).

Schweid'nitz, town of Prussian Silesia, on the Weistritz, is well built, contains several interesting public buildings, such as the town-house, the parish church with a tower 327 feet high, etc., and carries on a flourishing manufacturing industry in cloth, paper, leather, chemicals, beet-root-sugar, vinegar, etc. It was formerly a fortress of considerable strength, and played a conspicuous part during the Seven Years' war, but in 1807 the French demolished its outer works, and it has now lost much of its military importance. P. 16,998.

Schweig'ger (JOHANN SALOMON CHRISTOPH), b. at Erlangen Apr. 8, 1779; studied mathematics and physics at the university of his native city, and was appointed professor of chemistry in 1819 at Halle, where he d. Sept. 6, 1857. After the announcement of Oersted's discovery of electro-magnetism in 1819, he invented the electro-magnetic multiplier.

Schweig'häuser (JOHN), b. at Strasbourg June 26, 1742; studied theology and the Oriental languages; went to Paris to perfect his linguistic studies under De Guignes; visited Germany, England, and Holland; was appointed adjunct professor of philosophy at Strasbourg in 1770, and in 1778 professor of the Greek and Oriental languages. After the organization of the university at Strasbourg, he was made professor of Greek literature and dean of the faculty of letters, and was also appointed librarian. His editions are esteemed for the elaborate and learned commentaries annexed; among the most valuable are *Appiani Historiæ* (1782–85, 3 vols.): *Polybii Opera* (1789–95, 8 vols.), the 2d part of 8th vol. containing *Lexicon Polybianum; Epictetew Philosophiæ Monumenta* (1799, 5 vols.); *Athenæi Deipnosophistæ* (1801–07, 14 vols.); *Herodoti Historiæ* (1815, 6 vols., in 12 parts), to which was added a *Lexicon Herodoteum* (1824, 2 vols.). D. Jan. 19, 1830.

H. DRISLER.

Schwein'furt, town of Bavaria, on the Main, is beautifully situated and well built, and has large manufactures of chemicals and pigments, especially ultramarine blue and Schweinfurt green. Large cattle and wool markets are held here. P. 10,325.

Schweinfurt Green, also called **Mountain Green** [Ger. *Wienergrün, Mitisgrün, Berggrün*], a compound of *cupric arsenite* and *cupric acetate*; three equivalents of the former to one of the latter, according to Ehrmann. It is prepared by boiling together arsenious acid and acetate of copper, and is but little used in this country. H. WURTZ.

Schweinfurth (GEORG AUGUST), b. at Riga Sept. 29, 1836; studied botany and natural science at Heidelberg, Munich, and Berlin; made three journeys in the valley of the Nile to investigate the flora and fauna of those regions, 1864, 1865–66, and 1868–71, and wrote *Plantæ quædam Niloticæ* (1862), *Beitrag zur Flora Æthiopiens* (1867), *Reliquiæ Kotschyanæ* (1868), *Im Herzen von Afrika* (2 vols., 1874; translated into English as *The Heart of Africa* in 1874).

Schwei'nitz, von (LEWIS DAVID), PH. D., b. at the Moravian village of Bethlehem, Pa., Feb. 13, 1780; was educated in Germany, where he resided from 1798 to 1812, when he went as Moravian minister to Salem, N. C.; settled in his native town 1821, and resided there until his death, Feb. 8, 1834. He was an enthusiastic cultivator of science, especially botany, and added by his own researches more than 1400 new species to the catalogues of American flora, the greater part being fungi which had been previously little studied. Author of several botanical monographs, the most important being those upon the genera *Viola* (1821) and *Carex* (1825), catalogues of the fungi of North Carolina (1818), of North America in general (1832), and of the plants collected in the N. W. Territory by Thomas Say (1824).—His son, EDMUND ALEXANDER, b. at Bethlehem in 1825; studied theology in the Moravian seminary of his native town and at the University of Berlin; became a clergyman; edited the *Moravian* newspaper for several years; was one of the translators of Herzog's *Real Encyclopædia* (Philadelphia, 1856 *seq.*), and author of *The Moravian Manual, being an Account of the Moravian Church* (1859), *Systematic Beneficence* (1861), *The Moravian Episcopate* (Bethlehem, 1865), and a *Life of Zeisberger, the Western Pioneer and Apostle to the Indians* (2 vols., 1870).

Schwenk'feld, von (KASPAR), b. about 1490 in Silesia; employed in the service of the duke of Liegnitz; embraced the Reformation with great enthusiasm, but developed afterward its ideas in a manner which brought him in conflict with the Reformers. It was especially his conception of the deification of the body of Christ and of the Lord's Supper, and his demands for the establishment of a Church to which only the *holies* should be admitted, which gave offence. He was persecuted both by Roman Catholics and by Protestants. D. in Ulm about 1561. In his *Bekanntniss und Rechenschaft von den Hauptpunkten des christlichen Glaubens* (1547) he gave a representation of his doctrines. A sect, the Schwenkfelders, was organized in Silesia, but most of them emigrated in 1734 to North America and settled in Pennsylvania, where they still number about 1000 members, with their own churches and schools. (See Kadelbach, *Ausführliche Geschichte Kaspar von Schwenkfelds*, 1861.)

Schwenkfelders. See SCHWENKFELD.

Schwerin', town of Germany, capital of the grand duchy of Mecklenburg-Schwerin, on the western side of Lake Schwerin, is connected by railways with Hamburg and Wismar. It is beautifully situated, surrounded with old walls, generally well built, and contains many magnificent buildings, among which the ducal palace is the most remarkable. It has many good educational institutions, museums, galleries, and collections, and numerous manufacturing establishments, though its trade and industry are of little importance. P. 26,804.

Schwerin, town of Prussia, province of Posen, at the influx of the Obra into the Wartha, has several tanneries, tobacco manufactories, and large horse-markets. P. 6142.

Schwerin, von (KURT CHRISTOPH), COUNT, b. in Swedish Pomerania Oct. 16, 1684; studied at Leyden, Greifswald, and Rostock; entered the Dutch army in 1700, and fought at Ramillies and Malplaquet; took service with the grand duke of Mecklenburg in 1706, and distinguished himself by repelling the Hanoverians, who invaded the country; removed afterward to Prussia, as that part of Pomerania in which his estates were situated was ceded to that country; enjoyed the confidence of Friedrich Wilhelm I., and in a still higher degree that of Friedrich II.; won the battle of Mollwitz, Apr. 10, 1741, in the first Silesian war, stormed Prague Sept. 16, 1743, in the second, and fell in the battle of Prague, May 6, 1757, in the Seven Years' war.

Schwytz, one of the four so-called forest cantons in the middle of Switzerland, borders N. on the Lake of Zurich and S. on the Lake of Lucerne, and comprises an area of 353 sq. m., with 47,705 inhabitants, who speak German and profess the Roman Catholic religion. It is entirely covered with mountains, but only one peak, the Rieselstock, on the eastern frontier, 8890 feet high, reaches the line of everlasting snow. Agriculture can only be pursued to a limited extent, though fruits and wine are cultivated. Cattle-breeding is the principal branch of industry, and cheese, cattle, and timber are largely exported. Manufactures are confined to the demands of home use. The capital is Schwytz, a well-built town, with a good college and 6154 inhabitants.

Sciac'ca, town of Sicily, province of Girgenti, on the S. coast of the island, at the foot of Mount Cronium or Monte S. Calogero, occupies a site near the ruins of the ancient *Thermæ Selinuntinæ*, the birthplace of Agathocles (330 B. C.), and the whole district is one of great interest to the antiquary, to the geologist, and to the lover of nature generally. The rocky sides of Monte S. Calogero, itself a smouldering volcano, present innumerable natural caverns, showing more or less traces of the later hand of man, and which were evidently once the homes of the Troglodytes or cave-dwellers. Many of these caverns are now filled with mephitic exhalations, and medicinal springs everywhere abound. Everything indicates the immediate neighborhood of volcanic fires, and in July, 1831, just off this shore there arose a new island from the bed of the sea. The circumference of this island, when measured by Vice-Admiral Hotham, was three quarters of an English mile, with an elevation of 81 feet above the sea. It was evidently composed of volcanic matter, and not long after it totally disappeared. Humboldt gives an interesting account of this phenomenon. The natural beauty of the scenery is here heightened by the picturesque old castles and other ruins, Greek, Roman, Saracenic, and Norman, some of which occupy striking points, and all of which tell strange tales of human vicissitude. The present town contains some mediæval structures of interest, and the sanctuary of San Calogero is worthy a visit. There is some industry and commerce here, but the exports, grain, oil, soda, honey, sardines, dried and salted

fish, limestone vases, etc., might be greatly increased. P. 10,209.

Sciæn'idæ [from the Latin name, *Sciæna*, of a large Mediterranean species], an extensive family of fishes of the order Teleocephali, distinguished by their physiognomy. The body is more or less elongated and compressed; the scales ctenoid and distributed in very oblique rows, the lateral line continuous and extending generally between the median rays of the caudal fin; the head more or less compressed, generally with a convex snout, sometimes with an appendage, the opercula normal and armed; nostrils double; the mouth with a lateral cleft; upper jaw scarcely protractile; teeth acute, and in bands on the jaw; palate unarmed; branchial apertures continuous below; branchiostegal rays seven; dorsal fins two, the first short and with the spines generally feeble, the second longer and with branched rays; anal fin comparatively short, generally with two, but sometimes with one or three, spines; pectoral fins with branched rays; ventrals thoracic, each with a spine and five rays; the skeleton has the vertebræ nearly in normal number (*e.g.* 10 + 14, 11 + 14, etc.); the skull is channelled by muciferous cavities, bridged over by osseous bars; the stomach is cæcal, and pyloric appendages are developed in moderate number; the air bladder has generally a number of slender cæcal appendages. The family is represented by about 130 or 140 species, variously distributed in different parts of the world; most of them are marine and inhabitants of the tropical and sub-tropical regions, but a few are confined to fresh waters. The most characteristic of the latter forms is the American genus, *Haploidonotus*, comprising the sheepshead of the interior lakes and rivers. This genus is most nearly related to the drumfish (*Pogonias chromis*) of the Atlantic seaboard. The family is divisible into several sub-families, distinguished by the relative numbers of the vertebræ, the development of the pharyngeal apparatus, and the form of the head. The principal of these are (1) Sciæninæ, including the croakers (*Micropogon*), king fishes (*Menticirrus*), red bass (*Sciænops ocellatus*), and silvery perch (*Bairdiella punctata*) of the Atlantic coast; (2) Liostominæ, represented by the Lafayette (*Liostomus xanthurus*); (3) Haploidonotinæ, represented by the drum (*Pogonias chromis*) and the fresh-water sheepshead (*Haploidonotus grunniens*, etc.); and (4) Otolithinæ, represented by the weak fishes (*Cynoscion*) of the Eastern coast. The most celebrated foreign fish of this family is the famed *Sciæna* of the ancients, *Sciæna aquila* of modern systematists. This grows to a very large size, sometimes attaining a weight of more than sixty pounds. It was much esteemed by the Romans for the delicacy of its flesh, and, on account of its large size, was generally sold in slices. Its head was the most esteemed part, and it was the custom among the fishermen to present it to three of the principal magistrates of the city as a kind of tribute; in connection with this custom an often-repeated story has been preserved by Paolo Giovio respecting the adventures of a gourmand named Tomisio in his endeavor to be at the feast at which an unusually large head was to be the principal attraction. The otoliths or ossicles of the ear are comparatively large in this fish, as in others of the family, and they were esteemed in former times for medicinal purposes as "colic-stones," and were encased in gold and suspended from the neck. THEODORE GILL.

Scialo'ia (ANTONIO), b. near Naples in 1817; studied law, and gave himself to its practice, but in 1846 he was called to the University of Turin as professor of political economy; in 1848 was minister of agriculture and commerce at Naples; was arrested and imprisoned in 1849, and after three years of confinement was banished. Upon this he returned to Turin, where he resumed his chair in the university, and in 1859 was elected to Parliament; in 1860 became minister of finance, and two years later was sent to Paris to negotiate a commercial treaty between Italy and France; in 1865 again took the portfolio of finance, and during the war of 1866 he signed the decree for a legal-tender paper currency and for a forced loan. He also warmly advocated the imposition of a tax upon personal property. In 1872–73 he was for some months minister of public instruction, and was senator of the kingdom of Italy. His best printed works are *I Principj dell' Economia Sociale* (Naples, 1840), *Sulla Proprietà de' Prodotti d'Ingegno* (Naples, 1843), *Industria e Protezione* (Leghorn, 1843). D. Oct. 18, 1877.

Sciat'ica [L. Lat.], *neuralgia ischiadica*, a neuralgia of the great sciatic nerve, the sacral plexus, or any of the nerves of the thigh and hip. According to Niemeyer, the cutaneous nerve of the thigh, the superficial branches of the peroneal nerve, and the sural nerve are the principal seats of what is called sciatica. Exposure, rheumatism, gout, tumors near the nerve, fæcal masses, hæmorrhoids, diseased vertebræ, metritis, and perimetritis are reckoned among the causes. It sometimes follows a severe labor in childbed. Laxatives, cupping, the moxa blisters, hot baths, and local or general anodynes are frequently palliative, and sometimes curative. Periodic sciatica may often be relieved by quinine. Iodide of potassium and turpentine are both sometimes extremely useful, and so is the constant electric current. It is, however, a most obstinate and distressing complaint.

Scic'li, town of Sicily, province of Syracuse, on a rocky hill overlooking the sea, about 5½ miles from Modica, occupies a healthy position, but has no high roads of communication with the neighboring country, and of course cannot be prosperous. P. 10,887.

Sci'ence [Lat. *scientia*, from *scio*, to "know"]. In a general sense, science means knowledge reduced to order; that is, knowledge so classified and arranged as to be easily remembered, readily referred to, and advantageously applied. Strictly speaking, it is a knowledge of laws, principles, and relations. All science is based on the assumption that the laws of nature are immutable. From this point of view science may be regarded as a knowledge of the laws of nature, embracing the processes of observation and deduction by which they are discovered, and the modes of reasoning by which their operation in the production of phenomena are made known. Pure science is based on self-evident truths, and from these, as premises, laws of relation are deduced by a regular course of logical deduction. Of this nature is mathematical science. Natural science is based on experiment and observation; its fundamental laws are deduced by induction. Knowledge of the relations of quantity is *abstract* science; knowledge of causes and effects is *physical* science. W. G. PECK.

Scientific Schools. *Nomenclature.*—Under this head reference will be made to some of the institutions of the higher grade founded in this country within the present century for giving instruction in the various branches of mathematical, physical, and natural science, and their applications to the useful arts. Such establishments receive different names in different places, and are not readily separated into classes because of the manifold and varied purposes to which they are devoted. The phrases technical schools, polytechnic schools, technological institutions, industrial universities, scientific schools, schools and colleges of science, etc., are generic terms, under which are included seminaries for instruction in civil, mining, mechanical, military, and naval engineering; agriculture, horticulture, and forest-culture; physics, chemistry, metallurgy, and mineralogy; botany, zoology, and geology; etc. Medical schools might fitly be grouped with schools of science, but custom treats of them as professional schools. Schools of music, drawing, and design, painting and sculpture should be regarded as schools of the fine arts.

Historical Sketch.—We begin this survey with a brief historical statement. Soon after the Revolutionary war the need of professional in distinction from collegiate education was felt in the new republic, and efforts were made to establish schools of law, medicine, and theology. The need of training for the officers of the army was also appreciated, and Washington is reported to have said that "an army of asses led by a lion is vastly superior to an army of lions led by an ass." (*Cullum*, I. x.) During Jefferson's administration (Mar. 16, 1802) the U. S. Military Academy at West Point was instituted by Congress, and it has been maintained from that day to this. In consequence of the excellent mathematical instruction thus provided, and the limited opportunities which the country afforded for purely military careers, the graduates of this Academy were for a long time the principal civil as well as military engineers; many of them became renowned as explorers of "the Far West," and many more as teachers of mathematical science in the colleges, East and West. Mansfield, Partridge, Thayer, and other of the early officers of the Academy have thus left their impress upon American education. The history of the Academy has been well presented by Cullum, Boynton, and others. Its roll in June, 1875, included 252 cadets. In 1845, while Polk was President and George Bancroft secretary of the navy, an Academy for the preparation of navy officers was instituted by Congress at Annapolis, Md. The number of cadets in 1875–76 is 322, of whom 48 are cadet-engineers and 274 cadet-midshipmen. Nearly a quarter of a century after the beginning of the U. S. Military Academy the first civil school of science in this country was created at Troy. In 1826 the plans of Stephen Van Rensselaer, which had been gradually developing for some time previous, took form in the incorporation of the Rensselaer Polytechnic Institute, for which he provided a building and funds. Its object was declared to be the application of science to the common purposes of life, and especially the qualification of teachers to instruct in the application

of chemistry, philosophy, and natural history to agriculture, domestic economy, and the arts and manufactures. Under the lead of Amos Eaton the school at once became a success. The graduates were at first, like their chief teacher, inclined to the study of the natural sciences rather than of the mathematics, as the names of James Hall, E. Emmons, A. Fitch, etc. indicate; in later days the graduates have been distinguished for their skill in applied mathematics and the various branches of engineering. Twenty years later, and again by private munificence, an impulse was given to scientific education by the foundation in 1847 of the Lawrence Scientific School as a department of the university at Cambridge, for the purpose of providing instruction "in those branches of science which are more immediately connected with the great industrial interests of the country," such as chemistry, engineering, zoology, geology, etc. The recipient of this gift was Harvard, the oldest classical college in the Union; its donor, Abbott Lawrence; its promoter, Edward Everett; its amount unprecedented, the largest sum "ever given at one time during the lifetime of the donor to any public institution in this country." All these circumstances gave renown to the foundation, and the fame was increased by the appointment of Louis Agassiz, then forty years old, to be one of the professors. The Scientific School of Yale College was projected quite as early as that of Harvard, though it was slower in securing an endowment. The return from Europe of a young agricultural chemist, John P. Norton, led in 1847 to the beginning of a school in which agricultural and technical chemistry were to be taught, and gave shape to certain plans which had previously been projected for a new department of the college to be called "philosophy and the arts." In 1860 the school received a generous endowment from Joseph E. Sheffield, since largely increased, and was named in his honor the Sheffield Scientific School of Yale College. It became a school of mathematical as well as of chemical science, and afterward of natural history and geology. Five years later, in 1852, Dartmouth College received a legacy of $50,000 from Abiel Chandler, by which an institution kindred to those at Harvard and Yale was founded under the name of the Chandler Scientific School.

During the period from 1850 to 1860 the importance of scientific education was discussed in every part of the Union. Many excellent scholars returned from Germany, familiar with European schools of science, and urged their development in this country; full accounts were published of the technical schools of the Continent; the construction of public buildings and public works, the establishment of manufactories, and the development of mines called for scientific experts; while the lectures of Liebig, Johnston, and others, widely distributed among the people, suggested the importance of applying to agriculture also the discoveries of modern science. Organized efforts were put forth in New York, Illinois, and elsewhere for the promotion of agricultural colleges. In 1855 the State of Michigan provided for such a college, which was opened in 1857, and has remained to this day one of the foremost institutions of the purely agricultural class.

Attention was early directed to the possibility of securing from Congress a grant of public lands for the promotion of scientific education. In Dec., 1857, Hon. Justin S. Morrill, then Representative (and now Senator) from Vermont, introduced and advocated a bill bestowing a grant of public lands for this purpose. Public meetings were held in many of the States, petitions were signed and sent to Washington, and essays were printed for the encouragement of the project. The measure passed both houses by a close vote, but failed to receive the signature of the President, James Buchanan. A few years later a similar bill was carried through Congress, again under the lead of Mr. Morrill of Vermont, and having received the approval of the President, Abraham Lincoln, it became a law July 2, 1862. This bill, out of deference to many of those who promoted its passage, or by oversight or compromise, was entitled "An act for the benefit of agricultural colleges," and from this circumstance it is still popularly supposed to be directed exclusively or chiefly to the endowment of agricultural colleges. Its provisions, however, were not so restricted. Under the wise foresight of its chief advocate, Mr. Morrill, those phrases were employed which secured in every State ample encouragement for at least one scientific school, from which literary and classical studies were not excluded, but in which provision must be made especially for those branches of learning which are related to agriculture and the mechanic arts, or, in other words, for the various departments of applied or technical science. Although the national aid was bestowed by this act, every State receiving the grant was left free to determine in what manner the grant should be developed. The amount of land bestowed by this act was a "portion" of 30,000 acres for every Senator and Representative in Congress, or in all, for the 317 members of Congress in 1867, an aggregate area of nearly 10,000,000 acres. The following table, corrected by the U. S. land commissioner in Feb., 1876, exhibits the amount of land bestowed under the provisions of this act:

Distribution of Land to the Several States for Colleges of Agriculture and the Mechanic Arts.

States.	Number of Senators and Representatives.	Acres.	States.	Number of Senators and Representatives.	Acres.
Alabama.......	8	240,000 scrip.	Missouri.... ...	11	330,000 land.
Arkansas.......	5	150,000 scrip.	Nebraska.... ...	3	90,000 land.
California......	5	150,000 land.	Nevada.......	3	90,000 land.
Connecticut....	6	180,000 scrip.	New Hampshire	5	150,000 scrip.
Delaware.......	3	90,000 scrip.	New Jersey....	7	210,000 scrip.
Florida.........	3	90,000 scrip.	New York......	33	990,000 scrip.
Georgia........	9	270,000 scrip.	North Carolina	9	270,000 scrip.
Illinois.........	16	480,000 scrip.	Ohio.... ...	21	630,000 scrip.
Indiana........	13	390,000 scrip.	Oregon.... ..	3	90,000 land.
Iowa...........	8	240,000 land.	Pennsylvania..	26	780,000 scrip.
Kansas.........	3	90,000 land.	Rhode Island..	4	120,000 scrip.
Kentucky......	11	330,000 scrip.	South Carolina	6	180,000 scrip.
Louisiana......	7	210,000 scrip.	Tennessee......	10	300,000 scrip.
Maine..........	7	210,000 scrip.	Texas..........	6	180,000 scrip.
Maryland.....	7	210,000 scrip.	Virginia......	10	300,000 scrip.
Massachusetts..	12	360,000 scrip.	Vermont......	5	150,000 scrip.
Michigan.....	8	240,000 land.	West Virginia..	5	150,000 scrip.
Minnesota......	4	120,000 land.	Wisconsin.....	8	240,000 land.
Mississippi.....	7	210,000 scrip.			

From the bestowal of that grant until now the progress of scientific schools in the U. S. has been rapid; private munificence has supplemented the public bounty, excellent buildings have been constructed, apparatus and laboratories have been provided, and thousands of scholars have been taught.

Schools of Science in the Older Colleges.—Having reviewed the mode in which scientific schools have grown up in this country, we proceed to speak of their actual condition. The older colleges have now, most of them, established special courses of study, leading to special degrees (Ph.B., Sci. B., C. E., Mech. Eng., etc.). Thus, at Cambridge there is the Lawrence School, the Museum of Comparative Zoology, and the Bussey Institution, and there was the School of Mining; but the modifications of the main college (or "college proper," as it used to be called) have of late been such that the significance of these special schools is lessening, while the scientific advantages of the central college or university are increasing. Pres. Eliot in his report for 1875 favors the abandonment of such independent trusts, while his administration favors the college extension. The number of students in the Lawrence School in 1875–76 is 34; in the college, 776; in the university, 1278. In Yale College the Sheffield School has grown to be a second college, side by side with the original college, under the same trustees, with a different body of professors, who are united with the college professors in one faculty, called the "philosophical." The Sheffield School teaches chiefly the mathematical, physical, and natural sciences, pure and applied, and looks to the preparation of young men for modern scientific vocations, such as chemists, engineers, naturalists, etc. It received in 1863 the Connecticut portion of the national grant, but its chief endowment has come from the benefactor whose name it bears. The popularity of scientific education is illustrated by the number of students resorting here; in 1865–66 it was 93, and 249 in 1874–75. More than 1000 students have been trained in the decade 1865–75, and 75 of the former students are now professors of science in American colleges. Brown University, under Dr. Wayland, early took steps tending toward the modern scientific courses. For want of funds its progress has not been so rapid in this direction as that of some other colleges. Its receipts from the national grant of 1862 have not been adequate to fulfilling the purposes to which it is devoted. Union College claims to have been the first to introduce the system of scientific education by the substitution of modern languages and mathematical and physical science for Greek and Latin. It early established a special school of civil engineering, under W. M. Gillespie, which is still maintained. Wesleyan University at Middletown also claims to have been among the first of American colleges to provide special courses of instruction in science. These courses received a new impulse in 1870, when the institution was provided with a good building for scientific uses by the gift of Orange Judd. Columbia, like Yale, maintains the old classical curriculum, and simultaneously promotes with vigor a scientific department under the name of the School of Mines. This new institution is not restricted, as its name might imply, to mining, but it provides, as a comprehensive school of science, courses in analytical chemistry, engineering, geology, etc. Dartmouth retains the Chandler School, already referred to, and has affiliated with

it the school endowed by the New Hampshire portion of the grant of 1862; and it also has a special endowment for advanced instructions in engineering, given to it by Col. Thayer, formerly superintendent of the U. S. Military Academy. Princeton has received from John C. Green a liberal foundation for the establishment of a school of science which bears his name, and which is akin in scope to those already named. It is provided with an excellent hall adapted to such instructions, which was opened to students in 1873. Lafayette College at Easton, Pa., has received a special gift from Mr. Pardee for the endowment of a scientific school, which was inaugurated in 1873. The building constructed at his expense is spacious and convenient. Rutgers received the national grant of 1862, and with it maintains a scientific school in which agriculture has been given prominence.

These examples, which might be multiplied, show the mode in which instruction in science has developed in the older colleges of this country. The tendency has been to maintain (with such modifications as circumstances permitted) the traditional college course, and, parallel with it, to establish scientific courses. The efforts made to enlist bachelors of arts in the pursuit of graduate courses in science have been attended hitherto with but moderate success. Enough has been said to show that most of the older colleges in this country, inheriting the classical curriculum, have supplemented it, in one form or another, with a school of science. The newer foundations, like those of Ezra Cornell at Ithaca and Johns Hopkins in Baltimore, and especially the State universities, as in Michigan, Wisconsin, Minnesota, Kentucky, California, etc., have not been restricted by traditions, and have generally recognized with equal liberality, so far as their means would allow, the claims of literature and science. It may therefore be said that in American colleges and universities hostility toward science is almost unknown. Those who prefer the classical training, and those who advocate religious education, have favored schools of science, or at least have refrained from all opposition to them.

Many schools of science have been instituted independent of literary and classical colleges. One of the earliest phases of this movement was the foundation of agricultural colleges, upon which large sums of money were expended in New York, Pennsylvania, Maryland, and elsewhere, rarely if ever with results which were equal to the expectations. In Michigan, however, the agricultural college already referred to, established in accordance with a provision of the State constitution, and incorporated in 1855, and aided greatly by the Congressional grant of 1862, has maintained a course of almost uninterrupted vigor. In Massachusetts the State College of Agriculture at Amherst, a more recent foundation, likewise aided by the Congressional grant, has proved a success.

Two other technical schools have rapidly attained to positions of great influence—the Massachusetts Institute of Technology in Boston and the Stevens Institute of Technology, a school of mechanical engineering, in Hoboken, N. J. The first mentioned of these was founded by an association of which Prof. W. B. Rogers was long president. It received a small share of the Congressional grant of 1862, the most of which in Massachusetts was directed to the agricultural colleges, but it has also received State aid and generous contributions from individuals. Degrees are conferred in either of ten departments—civil engineering, mechanical engineering, mining, architecture, chemistry, metallurgy, natural history, physics, science and literature, philosophy. The number of graduates from 1868 to 1875 is 126. The number of students in 1874–75 was 288. The building and collections of this institution are noteworthy. The Stevens Institute has for a specialty mechanical engineering, and by concentrating its funds on this department has been able to accomplish excellent results. Its founder, E. A. Stevens, Esq., of Hoboken, bequeathed a lot of ground and the sum of $650,000 to found an institution of learning, and his executors determined its specific scope. The hall and its equipments, including the physical and mechanical collections, are of great value and well adapted to their purpose.

A third institution deserves mention here—the Thayer School of Civil Engineering, founded, in connection with Dartmouth College, by a gift of $70,000 from Gen. Sylvanus Thayer, U. S. Eng., for the advanced professional training of civil engineers.

There is obvious danger that the multiplication of these schools will tend, like the multiplication of colleges, to mutual injuries. Certainly, foundations enough have been created, and their distribution is wide enough through the country, for all present and probable necessities; and the interests of education require that further gifts and appropriations should be concentrated on the existing institutions rather than directed to new projects.

The scope of most of the schools referred to in this article is liberal; in the Eastern States, and to some extent in the Western States, the plans have been based upon the best European experience, and carefully adapted to our own country, needing only ampler funds for their execution. Sometimes the purely industrial claims are magnified, and manual labor is exalted beyond mental, but such tendencies are lessening every year. The most enlightened persons, whether devoted to business, legislation, or study, concede that the country has much to gain from the prosecution of scientific research, and that scientific vocations afford attractions to many who desire an intellectual calling, but are repelled from classical and professional study. In most schools of science in this country provision is made for the study of German, French, and English, and in some of them the study of Latin is also acquired; so that their graduates receive some degree of literary culture in connection with their scientific training. Many of the institutions provide for graduate as well as undergraduate instruction.

To these general remarks we append three lists which are believed to include the more important institutions of this country for instruction in the various branches of mathematical and physical science, pure and applied. Some unendowed and undeveloped projects are not included in these lists:

I. *Schools of Science aided by the National Grant of 1862, which was bestowed by the several Legislatures on the Institutions named.*

	Institution.	State.	Location.
1	Agric. and Mech. Coll. of Ala.	Alabama	Auburn.
2	Ark. Industrial University	Arkansas	Fayetteville.
3	University of California	California	Oakland.
4	Sheffield Scientific School of Yale College	Conn.	New Haven.
5	Delaware College	Delaware	Newark.
6		Florida.	
7	Ga. State Coll. of Agric. and Mechanic Arts	Georgia	Athens.
8	N. Ga. Agricultural Coll.	Do.	Dahlonega.
9	Ill. Industrial University	Illinois	Urbana.
10	Purdue University	Indiana	La Fayette.
11	Iowa State Agricultural Coll.	Iowa	Ames.
12	Kan. State Agricultural Coll.	Kansas	Manhattan.
13	Kentucky University	Kentucky	Lexington.
14	Agric. and Mech. Coll. of La.	Louisiana	New Orleans.
15	State Coll. of Agric. and the Mech. Arts	Maine	Orono.
16	Maryland Agricultural Coll.	Maryland	College Station.
17	Mass. Inst. of Technology	Mass.	Boston.
18	Mass. Agricultural Coll.	Do.	Amherst.
19	Mich. Agricultural Coll.	Michigan	Lansing.
20	University of Minnesota	Minnesota	Minneapolis.
21	University of Mississippi	Mississippi	Oxford.
22	Alcorn University	Do.	Rodney.
23	Univ. of Mo.	Missouri	Columbia.
24	" " School of Mines.	Do.	Rolla.
25	Agric. Coll. (Univ. of Neb.).	Nebraska	Lincoln.
26	Coll. of Agric. (Univ. of Nev.)	Nevada	Elko.
27	N. H. Coll. of Agric. and Mech. Arts (Dartm. Coll.).	N. H.	Hanover.
28	Rutgers Scientific School (Rutgers College)	New Jersey	New Brunswick.
29	Cornell University	New York	Ithaca.
30	University of N. C.	N. C.	Chapel Hill.
31	Ohio Agric. and Mech. Coll.	Ohio	Columbus.
32	Oregon Agricultural Coll.	Oregon	Corvallis.
33	Agricultural Coll. of Pa.	Pa.	Near Bellefonte.
34	Brown University	R. I.	Providence.
35	S. C. Agric. Coll. and Mech. Inst. (Claflin Univ.)	S. C.	Orangeburg.
36	East Tennessee University	Tennessee	Knoxville.
37	Agric. and Mech. Coll. of Texas	Texas	Bryan.
38	Univ. of Vermont and State Agricultural College	Vermont	Burlington.
39	Va. Agric. and Mech. Coll.	Virginia	Blacksburg.
40	Hampton Normal and Agric. Institute	Do.	Hampton.
41	West Virginia University	West Va.	Morgantown.
42	University of Wisconsin	Wisconsin	Madison.

II. *Schools of Science maintained by the National Government.*—(1) U. S. Military Academy, West Point, N. Y. (School of Engineering at Willett's Point, N. Y.). (2) U. S. Naval Academy, Annapolis, Md. (Torpedo School at Newport, R. I.).

III. *Schools of Science unaided by the National Grant of 1862.*—New Hampshire: (1) Thayer School of Civil Engineering in Dartmouth College, Hanover; (2) Chandler Scientific School of Dartmouth College, Hanover; Massachusetts: (3) Lawrence Scientific School of Harvard College, Cambridge; (4) Bussey (Agricultural) Institution of Harvard College; (5) Massachusetts Institute of Technology, Boston; New York: (6) Rensselaer Polytechnic School, Troy; (7) School of Mines of Columbia College, New York; (8) Scientific Department of Union College, Schenectady; New Jersey: (9) Stevens Institute of Tech-

nology, Hoboken; (10) John C. Green School of Science of Princeton College; Pennsylvania: (11) University of Pennsylvania, Scientific Department, Philadelphia; (12) Pardee Scientific Department of Lafayette College, Easton; (13) Lehigh University, South Bethlehem.

The scope of this article is purposely restricted to the scientific schools of this country. Its limits permit but a brief reference to the corresponding schools in Europe. France, Germany, Austria, Switzerland, Belgium, and other continental states have long been distinguished for the excellent provision they have made for the promotion of scientific education, and many English and American writers, during the last twenty years, have diligently observed and carefully described the scope of such institutions. Numerous papers on this subject are scattered through Barnard's *American Journal of Education*, the twenty-first volume of which is devoted to the subject (Hartford, 1870), and a special report of Prof. J. W. Hoyt on the Paris Exhibition of 1867 is included among the *Reports of the U. S. Commissioners*, published by the government (Washington, 1870, 8vo). The need of corresponding schools in England has been urgently presented, and liberal appropriations have been made by the government for the encouragement of special advanced schools of science and art and for the promotion of scientific instruction in popular schools. The diligence of the British government in collecting such data as illustrate the experience in this respect of other nations is remarkable. The latest and fullest information of this character is given in the *Reports of the Royal Commission of Science* (1872–75), eight reports, with evidence, index, etc., published under the secretaryship of J. Norman Lockyer, Esq. D. C. Gilman.

Scil'la [anc. *Scylla*], town of Southern Italy, province of Calabria, on the famous rock mentioned by the ancient poets as so perilous to the mariner who sought to avoid Charybdis: "Incidit in Scyllam cupiens vitare Charybdim." Though there has been great exaggeration, the navigation here is certainly dangerous from the fact that when opposite Cape Pelorus a strong current urges the vessel toward this rocky coast. Scilla was a fortress of no small strength, and has been the scene of severe fighting between the English and the French. It is now a place of some industry and commerce. P. 7448.

Scil'ly Isl'ands, a group of islands belonging to Great Britain, situated 30 miles W. of Land's End, the south-western promontory of Cornwall. It consists of 140 isles and rocks, of which only 6 are inhabited—namely, St. Mary, Tresco, St. Agnes, Sampson, Bryher, and St. Helen's. Total area, 5770 acres. P. 2627, of whom about 1500 live on St. Mary, where Hugh Town, the capital, is situated. On St. Agnes is a lighthouse; and on Bishop Rock (see Lighthouse Construction), 6 miles westward, is one of the finest "rock" lighthouses existing. All the islands are rocky, consisting of granite with a thin layer of light sandy soil. Agriculture and fishing are the principal occupations; good crops of barley, oats, and potatoes are raised. The Romans called the islands *Cassiterides* ("Tin Islands"), but the meaning of this name is as yet unexplained, for the islands contain no tin. The present name is Cornish, and means "cut off." The navigation around these isles is very dangerous. In 1705 the fleet under Admiral Sir Cloudesley Shovel fell upon these rocks, when his ship and several others were lost. The recent loss of the steamship Schiller near Bishop Rock is familiar.

Scim'itar [a word probably of Basque origin], a curved sword, of which the convex edge is sharp. It is generally employed in Asia, where it receives an admirable temper, but it is useless for thrusting, though as a cutting instrument no sword surpasses it.

Scin'cidæ [Lat. *Scincus*; Gr. σκίγγος or σκίγκος, an ancient name], an extensive family of lizards (order Sauria) of the group Leptoglossa. As limited by Gray, it includes those forms in which the body is subcylindrical or fusiform, and with the tail cylindrical or tapering; the scales generally smooth, but sometimes peeled or striated; the head subquadrangular and regularly shielded, with the rostral plate moderate, and the nostrils lateral, and in a special nasal shield interposed between the frontal and labial shields; the limbs variable in development, typically four, generally more or less weak, sometimes atrophied. According to Prof. Cope, the temporal fossa is roofed, the premaxillary double, the palatine maxillary laminæ dilated, and rarely a xiphisternal fontanelle is developed. The tongue is short, flat, and squamous. The family embraces numerous genera, distributed in almost all parts of the world. There is every gradation in the development of the members, from those forms in which the limbs are quite strong and provided with five digits each, to those in which they are entirely wanting, and the number or development of these parts is of comparatively little systematic value in the group. In the U. S., according to Prof. Cope, there are fourteen species—one belonging to the genus *Oligosoma* (*O. laterale*), and the thirteen others to the genus *Eumeces*. Theodore Gill.

Scinde. See Sindh.

Scindia, or **Sindia.** See Gwalior.

Scintilla'tion of the Stars [Lat. *scintillatio*]. The phenomena of scintillation or twinkling are sufficiently known in a general way, but it is only within a few years that sufficient details have been recognized (by the help of the spectroscope) to establish a sure theory. Prof. Respighi of Rome is the astronomer whose observations are most carefully made, and whose theory best explains the facts noticed.

When the spectroscope is properly applied to a star near the horizon, as seen by a telescope of moderate power, its spectrum is seen to be crossed or partially occupied by moving dark and bright bands of various breadth and intensity. If the spectrum be horizontal and the star near the horizon, these bands are transversal to the spectrum, but form an angle with the vertical as the star's altitude increases, which becomes a right angle at an altitude of about 40°; and beyond this the bands are longitudinal, faint, and ill-defined. When the prism is turned into a vertical direction, the bands are transversal, whatever be the star's altitude, if less than 30°, but less well defined; they are less numerous and rapid in their motion for low stars than for high, and their inclination to the vertical is always from the zenith toward the violet end of the spectrum. Their motion is generally from the violet to the red end of the spectrum for a star E. of the meridian, and *vice versâ* for a star W.; but for one on the meridian they are sometimes stationary, and sometimes vibrate backward and forward from one color to another. The bright bands and masses are not so frequent and regular as the dark ones; both kinds are more regular in continued good weather and with an atmosphere nearly at the point of saturation; in these cases even the planets exhibit the scintillation-bands.

The explanation of these phenomena depends upon atmospheric dispersion; the existence of strata of air which have a different index of refraction, owing to variations in density, temperature, or moisture, from the surrounding atmosphere; and lastly, upon the various motions of these strata with respect to the rays which reach the telescope. The atmospheric dispersion is about one-seventieth of the refraction. The red and violet rays which are seen side by side in the image of a star 5° above the horizon are perhaps a rod (5 mètres) apart at the distance of 70 miles from the eye, and three rods apart at a triple distance, so that some rays from the star may pass through a stratum of entirely different refractive power, and be turned aside so as not to reach the telescope; this process will produce dark lines in the spectrum; while other rays not similarly directed may be refracted into the telescope, producing bright spots in other portions. There can be no doubt of the existence of such strata, nor any reasonable hesitation in believing that those which produce scintillation must be very far off, for in this case a slight difference in the indices of refraction would produce a greater effect. If the star be in a direction nearly E. or W., the motion of these strata relatively to the rays is chiefly due to the motion of the earth. In the E. the violet rays from a low star reach the disturbing stratum before the red rays, and the dark band will be seen to pass from the violet to the red end of the spectrum. W. of the meridian this is reversed, and upon the meridian, when the stratum is horizontal, the band will appear stationary; but when not, the varied form, position, and motions of the disturbing strata will produce an unsettled flitting of the spectral bands, as it is observed. The phenomena become more complicated at greater altitudes, and at the same time less definite to observation.

The earlier observations were not sufficiently complete to furnish a consistent theory. Arago's was the earliest of any value; it was chiefly based upon observations made with a vibrating telescope, and is mainly derived from the idea that the light-waves which reach the eye may be at different phases—that is, tend in part to destroy each other's influence, and this intermittently. Montigny, who investigated the subject by the help of a prism, but without a cylindrical lens, supposed that some of the rays were totally reflected by strata of irregular density. Both these older theories may possibly help explain some share of the phenomena, although there are theoretical difficulties, especially with Arago's, which are hard to clear up; Respighi's alone is adequate to account for all the effects so far as yet observed. His papers are to be found under the title *Sulla Scintillazione delle Stelle* in the *Atti dell' Accademia Pontificia de' Nuovi Lincei*, anno xxi. xxii.; Arago's,

in his *Œuvres complètes*, edition Barral, vii. 1–96; Montigny's, in the *Mémoires couronnés de l'Académie royale de Belgique*, vol. XXVIII. T. H. SAFFORD.

Sci'o, Chios, or **Khio** [Turk. *Sâkiz Adasi*], a rough and rocky but very beautiful and fertile island in the Ægean, in the latitude of Smyrna, separated from the W. extremity of Asia Minor by a strait only 5 miles wide at the narrowest point. It is 32 miles from N. to S., from 18 to 8 from E. to W., 110 miles in circuit, and has an area of about 400 sq. m. There are no perennial streams, but numerous large wells keep up a perpetual verdure and ensure bountiful crops. The principal products are cotton, wool, silk, oil, wine, cheese, figs, lemons, oranges, and especially gum-mastic, which exudes from a species of lentisk, and is much used for chewing by ladies in the Levant, as also in certain varnishes and in distilling a kind of gin. The oldest inhabitants were Ionians. Homer was said to have been born there. The island has been repeatedly ravaged and desolated—by the Persians in 499 B. C., by the Athenians in 412 B. C., and by the Turks, first in the early part of the fourteenth century, and again in 1822. This last was one of the greatest atrocities on record. As the private property of the sultana, the island had long been mildly governed, the people had become wealthy, refined, and unwarlike, and were not at all disposed to join their countrymen in the struggle for Greek independence. Stirred up at last by the Samians to take part in the revolt, the Turks came down upon them in great wrath. Thousands were massacred, other thousands sold into slavery, and the whole island ruthlessly laid waste. In Feb., 1822, there was a pop. of at least 100,000, and in August there remained not more than 30,000; some say not more than 16,000. The island is now flourishing again, with a pop. of 50,000 or 60,000, most of whom are Turks. R. D. HITCHCOCK.

Scio, capital of the island of Scio, has a good harbor, formed by two moles and defended by a citadel, some manufactures of silk and velvet, and a lively trade. P. 14,500.

Scio, p.-v. and tp., Washtenaw co., Mich., on Michigan Central R. R. P. 2495.

Scio, p.-v. and tp., Allegany co., N. Y., on Genesee River and Erie R. R. P. 1652.

Scio, P. O. name of NEW MARKET, Harrison co., O., on Pittsburg Cincinnati and St. Louis R. R.

Scio'ta, p.-v. and tp., McDonough co., Ill., on Toledo Peoria and Warsaw R. R. P. 1138.

Sciota, tp., Shiawassee co., Mich. P. 1270.

Sciota, tp., Dakota co., Minn. P. 328.

Scio'to, county of S. Ohio, on Ohio River, traversed by Scioto and Little Scioto rivers and their branches, has a broken surface and a fertile soil, and is crossed by the Portsmouth branch of Marietta and Ohio R. R. In the E. part iron ore is abundant, as also some coal, and there are many furnaces, foundries, and manufactories. Agricultural staples, Indian corn, oats, hay, and potatoes. Dairying is carried on to some extent. Cap. Portsmouth. Area, 550 sq. m. P. 29,302.

Scioto, tp., Delaware co., O., on Scioto River and Cleveland Columbus Cincinnati and Indianapolis R. R. P. 1542.

Scioto, tp., Jackson co., O., on Little Scioto River. P. 1505.

Scioto, tp., Pickaway co., O., on Scioto River. P. 1545.

Scioto, tp., Pike co., O., on Scioto River. P. 772.

Scioto, tp., Ross co., O., on Scioto River, includes the city of Chillicothe. P. 2318.

Scioto River, a beautiful stream which rises in Auglaize co., O. Its course to Columbus is S. E., and from that city it flows S. to Portsmouth, where its waters are discharged into the Ohio. It is 200 miles long, and for 130 miles may be navigated in good stages of water. Its valley is extremely productive of grain and live-stock.

Scio'toville, p.-v., Harrison tp., Scioto co., O., on Little Scioto River and on Portsmouth branch of Marietta and Cincinnati R. R. P. 480.

Scip'io, tp., Allen co., Ind. P. 420.

Scipio, tp., Laporte co., Ind. P. 856.

Scipio, tp., Hillsdale co., Mich. P. 1107.

Scipio, p.-v. and tp., Cayuga co., N. Y. P. 2070.

Scipio, tp., Meigs co., O. P. 1761.

Scipio, tp., Seneca co., O. P. 1635.

Scipio, the name of one of the most illustrious patrician families in ancient Rome, belonging to the Cornelia gens. The first member of the family mentioned in history is PUBLIUS CORNELIUS SCIPIO, who was *magister equitum* to the dictator Marcus Furius Camillus in 396 B. C.; the last is PUBLIUS CORNELIUS SCIPIO, who was consul under Nero in 56 A. D. The family tomb, situated on the left of the Via Appia, near the Porta Capena, about 400 paces from the modern Porta S. Sebastiano, was discovered and excavated in 1780, and has been described in full by Visconti, *Monumenti degli Scipioni* (1785). The oldest inscription found in the tomb was that of LUCIUS CORNELIUS SCIPIO BARBATUS, who was consul in 298 B. C. His grandson was that PUBLIUS CORNELIUS SCIPIO who was consul in 218 B. C., and who, after attempting in vain to prevent Hannibal from crossing the Rhone, was defeated at the Ticinus, and shortly after at the Trebia. In 217 B. C. he took the command of the Roman forces in Spain, where he was afterward joined by his brother Cneius. They carried on the war here with some success, but in 212 B. C. they were both killed—Publius in the battle of Anitorgis, Cneius in the battle of Urso. In 211 it was determined in Rome to send a proconsul to Spain and prosecute the war with greater vigor, the proprætor Caius Nero, who succeeded the Scipios, having been unable to achieve anything; but as it was impossible to provide a sufficient armament, and as it was well known that the Carthaginians maintained a great force in the Peninsula and had succeeded in forming alliances with the natives, the fierce Celts and Iberians, there was in the whole of Rome only one man who offered himself for the position—PUBLIUS CORNELIUS SCIPIO, AFRICANUS MAJOR, a son of the Scipio who fell at Anitorgis. He was very young (b. in 234 B. C.), and although he had fought with distinction at the Ticinus, where he saved his father's life, at Trasimenus, and at Cannæ, he had never before held a superior military command. But he was the only one available, and he was consequently entrusted with the task; perhaps also the irresistible charms of his person contributed something to the result. He believed that the gods had destined him for something great, but this belief he did not hold as a superstition, which makes men overbearing and cruel when they succeed, suspicious and fanatical when they fail. With him it was a lofty self-confidence, which led him to pursue the most audacious plans because they were the shortest way to the goal, but which after the victory made him magnanimous and full of sympathy. Arrived in Spain in 210 B. C., he did not attack any of the three Carthaginian generals—Hasdrubal, Barca's son, Hasdrubal, Gisco's son, and Mago, who were in different parts of the peninsula—but swooped down on Nova Carthago, the capital of the Carthaginian empire in Spain and the emporium of all its treasures, provisions, materials, hostages, etc. In 209 he defeated Hasdrubal, Barca's son, at Bæcula; in 207, Hasdrubal, Gisco's son, and Mago at Silpia; and when in 206 he returned to Rome the Carthaginians had been totally expelled from Spain, and the natives had been so captivated by Scipio that they asked him to remain and become their king. Next year he was elected consul. It was his plan to drive Hannibal out of Italy by invading Africa, but this idea seemed too daring to the old senators; they refused to give him an army. Nevertheless, a sufficient number of volunteers gathered to his standard, and in 204 B. C. he landed in Africa near Utica. Masinissa joined him; Hasdrubal, Gisco's son, and Syphax were defeated; another Carthaginian army was annihilated; Hannibal was recalled, and by the battle of Zama (Oct. 19, 202 B. C.) the power of Carthage was broken and a new goal raised for the policy of Rome—the dominion not of Italy only, but of the whole western basin of the Mediterranean. After this time he mingled only occasionally in public life. His task was done. His belief that he was a god-sent man had proved true, and he assumed an attitude corresponding to this idea, refusing to accept the honors which the people in their enthusiasm offered him, and refusing to obey the laws which the state imposed on him as on other citizens. Conflicts soon arose, and he had no party to support him. He was an aristocrat, but not an oligarch. The jealousies and intrigues of the nobility were as disgusting to him as the foolishness and venality of the people. The old Roman party hated him, and so did the new Roman. He had inaugurated a new epoch in Roman politics, and thereby made the village wisdom of the old fathers an empty sound, and now it seemed as if he were about to inaugurate a new era in Roman civilization and make the austerity and boorishness of the old virtue ridiculous. He was an elegant man, familiar with Greek literature and art; he used silver plate on his dinner-table and studied grammar. Cato was his sworn enemy. On the other hand, he was utterly averse to those ideas of a new disposition of power and property which just then were taking shape in Roman society and in his own family; his daughter Cornelia was the mother of the Gracchi. Nevertheless, although unsupported by any, he made the people and the state bow to his will. When his brother Lucius, whom he accompanied as legate in the war against Antiochus simply

for the purpose of procuring celebrity and influence for him, was accused of having been bribed by Antiochus, proved guilty, and imprisoned. Scipio rescued him from the hands of justice by force, and the tribunal found it advisable to submit to this violence. When he himself was accused of having taken bribes, he said nothing to defend himself, but explained to the assembled people what good and great deeds he had done, and ended by asking them to accompany him to the capitol to thank the gods who had sent him among them; which they did. The day after this event, one of the few fairy-tales in history which are true, he left Rome and retired to his country-seat at Liternum, where he d. about 183 B. C.—His son adopted PUBLIUS CORNELIUS SCIPIO ÆMILIANUS, AFRICANUS MINOR, b. about 185 B. C., a son of Lucius Æmilius Paulus, the conqueror of Macedonia, whose sister was married to Scipio Africanus Major. He did not excite great expectations while a young man. His strongly-marked literary propensities even made people believe that he was unfit to uphold the great traditions of the family by which he had been adopted. Nevertheless, during his first campaign in Spain in 151 B. C. he attracted great attention, not only in the army, but even in Rome, by his personal valor, the integrity of his character, and his talent as a general. In the beginning of the Third Punic war he commanded under Manilius, but soon both soldiers and citizens agreed that he was the only fit commander-in-chief. In 148 B. C. he was made consul, and in 146 B. C. he took Carthage and razed it to the ground. In 134 B. C. he again made a brilliant campaign in Spain, which ended with the capture of Numantia. While here he heard that Tiberius Gracchus, whose sister Sempronia he had married, had been murdered in Rome, and he said openly, and repeated it often afterward, that he considered the murder just. On his return to Rome he employed all his talent and energy to elude and frustrate what Gracchus had begun, but one morning in 129 B. C. he was found dead in his room, and it was generally believed that he had been murdered. He was an intimate friend of Polybius, who accompanied him on all his campaigns, and Cicero has perpetuated the friendship of Scipio and Lælius by his treatise, *Lælius sive de Amicitia;* he was also a great patron of Terence, whose comedies people said he had a part in.—One branch of the family of the Scipios bore during several generations the surname Nasica. From this branch descended QUINTUS CÆCILIUS METELLUS PIUS SCIPIO, who was adopted by Quintus Metellus Pius, and who played a conspicuous part in the struggle between Pompey and Cæsar. True to the traditions of the Scipios, he sided with Pompey, and commanded the army of the optimates in the battle of Thapsus (46 B. C.). He was defeated, and killed himself. CLEMENS PETERSEN.

Sci're Fa'cias [Lat.], the technical name of a peculiar common-law writ based upon a record, and ordering the party against whom it is directed to show cause why some act should not be done in relation to such record in favor of the party at whose suit it is issued. Its peculiar name, like that of many other common-law writs, is derived from the operative words addressed to the sheriff, originally in Latin ("*quod scire facias præfato N.*," etc.), "that you cause said N. to know that he must show cause why," etc. A *scire facias* might be used at the common law in reference to three species of records—judgments, recognizances, and letters patent. When based upon a judgment, its object might be twofold—either (1) to revive such judgment if by lapse of time a legal presumption had arisen that it was paid or released, and to obtain authority to issue execution thereon; or (2) to extend the judgment, and enforce it for or against other parties who were not parties to the original recovery, but who were or had become so connected with such original parties that the same rights or liabilities existed for or against them: as, for example, when in an action against several joint debtors the judgment recovered against some of them, the others not having been served with process, is afterward extended and made to embrace these latter defendants. When based upon a recognizance, the object of a *scire facias* was simply to procure the issuing of an execution by which the obligation might be enforced. (See RECOGNIZANCE.) In these cases the sole design of the writ was to continue the judgment and to keep it in force, and the proceeding upon it was in no respect an action. When based upon letters patent, the *scire facias* was issued on the application of the government, and its object was to procure them to be annulled by the court for some cause affecting their validity. In this case it was the commencement of an action, in which the defendants put in a plea or answer, and the issues of fact thus raised were regularly tried. In New York and many other States the writ of *scire facias* has been abolished, and a simple motion has been substituted, for the purpose of reviving and continuing a judgment or of extending it to other parties. In several of the States a proceeding in the nature of *scire facias* is used to accomplish the same object, as it is under U. S. statutes in the national courts to annul letters patent: while in a few commonwealths the ancient writ is still retained.

JOHN NORTON POMEROY.

Scit'uate, p.-v. and tp., Plymouth co., Mass., on the Atlantic, was settled as early as 1628 by Puritans from Kent, England; has been the native place of several eminent men, but has now become a place of little importance, chiefly occupied with fishing, the lumber-trade, and the collection of Irish moss from the rocks on the sea-shore. There are 4 churches. (See the *History of Scituate*, by Samuel Deane, 1838.) P. 2350.

Scituate, tp., Providence co., R. I. P. 3846.

Sciur'idæ [Lat. *Sciurus*, a "squirrel"], a family of mammals belonging to the order Rodentia and sub-order Simplicidentati, including the squirrels, marmots, etc. The external form is very variable; the skull is well developed and delicate in organization; the infraorbital foramen is only represented by a small anterior foramen, the zygomatic process of the upper jaw being an imperforate, thin, and oblique plate, which rises from the general level and forms a dead wall in front of the orbit; post orbital processes are more or less developed; the lower jaw has its descending ramus subquadrate, the upper angle acute and sub-erect, and the lower rounded or subtruncate and bent inward; molar teeth $\frac{4-5}{4} \times 2$, provided with roots, and (except the anterior upper one when present) of nearly equal size, with tubercular crowns; perfect clavicles are developed; the hind limbs moderately large; the fibula and tibia separate from each other. The family is quite an extensive one, at least 150 species being known, and is represented in almost all quarters of the world except Australia. There are all gradations, between the slender and graceful form of the squirrel and the heavy, almost bear-like, form of the woodchuck; and hence these two types, distinct as they at first sight appear, cannot be even differentiated into distinct sub-families. This transition is manifest from the arboreal squirrels (*Sciurus*) through the ground-loving *Tamias* with well developed tails; the *Spermophilus*, or prairie-squirrels, with shorter tails; *Cynomys*, or the prairie-dogs, with stouter forms; and *Arctomys*, or the woodchucks, with still more robust forms. The latest writer, J. A. Allen, on the American species, recognizes as inhabitants of the U. S. 24 species (*Sciurus*, 5 species; *Tamias*, 3 species; *Spermophilus*, 11 species; *Cynomys*, 2 species; and *Arctomys*, 3 species), besides a number of varieties.

THEODORE GILL.

Scleroder'ma [Gr. σκληρός, "hard," and δέρμα, "skin"], a sub-order of plectognath fishes, in which the bones of the upper jaw are but imperfectly united, the teeth independently developed, and the scapular arch, with the hypocoracoid and hypercoracoid bones, both developed. The form is typically fish-like, in which respect the species differ much from the other members of the order. The dermal armature is developed in the form of small scale-like plates or bristles; the dorsal fin is represented by from one to six spines; the pelvic elements are well developed. To the group thus distinguished belong two well-defined families—Triacanthidæ, including the most fish-like forms, and Balistidæ, comprising the more aberrant species.

THEODORE GILL.

Scleros'toma [Gr. σκληρός, "hard," and στόμα, "mouth"], a genus of parasitic nematoid worms found in the intestine of the horse and some of the ruminant animals. They have a slender, elongated body, a resisting integument, and a complete intestinal canal running in a straight direction from the mouth at the anterior extremity to the anus posteriorly. The sexes are separate. In the male there is a long, filiform, convoluted spermatic tube, with its external orifice at or in the immediate neighborhood of the anus, and provided with external copulatory appendages. In the female the ovarian tubes, in which the eggs are produced, are also very long, and folded in the interior of the body. The external genital orifice, or vulva, is situated at an intermediate point between the mouth and the anus. The characters above described are those common to all the nematoid worms. This genus is distinguished from the remainder principally by the structure of its head, which is of a truncated globular form, with a comparatively large orbicular mouth, and is sustained internally by a capsule of horny consistency; whence the name, *Sclerostoma* ("hard-mouth"), is derived. The worm is of a white color, cylindrical in form, and twenty or thirty times longer than wide. The integument is marked by numerous fine transverse striations. In the male there are two long and slender copulatory spicules, which protrude from the genital orifice, and the orifice is bordered on each side by a membranous expansion, sustained by ribs or ridges of somewhat firmer consistency, in the same manner as the extended web

of a frog's foot is sustained by the toes. The two lateral expansions are united posteriorly by a third, of smaller dimensions, the whole thus forming a copulatory pouch which nearly surrounds the genital orifice at the posterior extremity of the body. In the female, which is considerably larger than the male, the caudal extremity is conical and tapering, and extends for a certain distance beyond the anus. The vulva is situated considerably in advance of the anus, toward the anterior extremity. The most important species of this genus at present known is *Sclerostoma equinum*, so called from its being found in the intestine of the horse. It is of very frequent occurrence, and, according to Dujardin, is sometimes to be found in all the horses examined for that purpose. It is often, also, very numerous; as many as 1000 having been counted in a space of two inches square on the inner surface of the intestine. Notwithstanding, however, its numbers and frequency, it does not appear to cause any serious injury to the animal in whose body it is domiciled. Its usual locality is the large intestine, where it fixes itself to the inner surface of the mucous membrane, but it is sometimes found in the upper part of the small intestine, in the pancreas, and even in the tunic of the testicle. Its specific characters are the following. It is of a reddish-gray or brown color, and from a little over one inch (the male) to an inch and a half or two inches (the female) in length. The edge of the mouth is bordered by one or more ranges of finely-toothed eminences or fringes directed inward, and the body is marked, in addition to the usual transverse striation, with ten or twelve longitudinal lines. A remarkable fact in regard to this worm is that it occurs also in *aneurismal tumors of the mesenteric artery*. Aneurisms of this nature are not found in other cavities of the body, but only in the abdomen, in the arterial branches supplying the intestine; and they have been met with only in the horse, the ass, and the mule. They are never present in the foal when newly born, though they have been found in colts within one or two years after birth. At later periods, on the contrary, they are very frequent, and, according to Davaine, but few old horses are entirely free from them. They are usually of small size, not more than three-fourths of an inch in thickness, and do not appear to produce any marked injurious effect. Each aneurism contains one or more sclerostomata, imbedded partly in the clot occupying the cavity of the artery, partly in the substance of its thickened wall. The aneurism is usually regarded as caused by local irritation due to the presence of the worm. J. C. DALTON.

Sclo'pis (FEDERIGO), COUNT, b. at Turin in 1798; took his legal degree in the university of his native city in 1818, and in 1827 gave his first historical lecture, *I Longobardi in Italia*, before the Turin Academy of Sciences. This was followed by *La Storia dell' Antica Legislazione nel Piemonte* (Turin, 1833), *La Storia della Legislazione Italiana* (4 vols., Turin, 1840–64), *Ricerche Storiche sopra le Relazioni Politiche tra la Dinastia di Savoia ed il Governo Britannico* (Turin, 1853). In 1845 he was elected corresponding member of the Institute of France, and in 1869 foreign member of the same; in 1847 was made president of the superior commission of censorship in Piedmont; in Mar., 1848, accepted the portfolio of grace and justice; in 1849 was named senator, and from 1861 to 1864 was president of the Italian Senate; was also elected president of the Turin Academy of Sciences. In 1868, Victor Emmanuel bestowed upon him the highest order of the kingdom, that of the Annunziata, and in 1871 he was still further honored by being selected as representative of the kingdom of Italy in the congress of arbitration which assembled at Geneva for the settlement of the important Alabama question; was elected president of this congress by his colleagues, and performed the duties of his office with signal ability. D. Mar. 8, 1878.

Sco'field (GLENNI W.), b. in Chautauqua co., N. Y., Mar. 11, 1817; graduated at Hamilton College 1840; studied law, and was admitted to the bar at Warren, Pa., 1843; was a member of the State assembly 1850–51, and the State senate 1857–59; became president judge of the eighteenth judicial district 1861; sat in Congress 1863–75, being a Representative for the State at large during the latter term, and was for several years chairman of the committee on naval affairs.

Scolecophid'ia [Gr. σκώληξ, σκώληκος, an "earthworm," ὄφις, a "serpent," and εἶδος, "form"], a sub-order of serpents, including sluggish, worm-like species. It is chiefly distinguished by anatomical characters. As now understood by Prof. Cope, it includes those forms in which the mastoid forms a part of the cranial wall, the coronoid bone is present, and no ectopterygoid is developed. It was formerly, however, limited to those forms which, in addition to these characters, were distinguished by the absence of the prefrontal, the non-development of alveolar ridges on the maxillary or malar processes, and the development of rudiments of a pelvis without pubis, in contradistinction to the Catodonta, in which the prefrontal is present, the maxillary has an alveolar ridge and a malar process, and a rudiment of a pelvis with pubis is developed. As thus limited, the Scolecophidia are equivalent to the family Typhlopidæ, and the Catodonta to the family Stenostomidæ. THEODORE GILL.

Scolopac'idæ [Lat. *scolopax*, a "woodcock"], a family of wading birds, including the snipe, woodcock, and related forms. The bill is long and slender, rather soft and flexible, and with the sides compressed and grooved to the tip, which is blunt; the lower mandible has no angle at its lower margin; the nostrils are basal, elongated, and situated in a groove closed by a membrane; the wings are long and pointed, the first or second primary being longest; the tail is usually short and even; the legs elongated; the thighs exserted and naked; the tarsi elongated and slender; the toes moderately long and attenuated, the anterior being connected more or less by a basal membrane, the hinder short or wanting. The family is a very extensive one, and by some (*e. g.* Lilljeborg) has been subdivided into two—Scolopacidæ, in which the orbits are closed below, and Totanidæ, in which they are open below. By many authors (*e. g.* G. R. Gray) it is divided into five subfamilies: (1) Scolopacinæ, including the snipes, woodcocks, etc., with 5 genera and 35 species; (2) Tringinæ, or sandpipers, with 6 genera and 27 species; (3) Totaninæ, or the longshanks, tatlers, and plovers, including 2 genera and 19 species; (4) Recurvirostrinæ, or the avocets, including 3 genera and 13 species; and (5) Limosinæ, or the godwits, with 3 genera and 26 species. All these types are widely distributed, and among them are some of the most cosmopolitan of birds. They differ much in habits. The typical members of the family are wading or shore birds, but some are found in uplands far from water, and others in inland forests. (See CURLEW, SANDPIPER, SNIPE, WOODCOCK, etc.) THEODORE GILL.

Scomberesoc'idæ [Lat. *scomber*, a "mackerel," and *esox*, "pike"], a family of fishes comprising some remarkable forms. The body is more or less elongated, and generally rectilinear, but sometimes subfusiform; the scales are cycloid, a lateral peak developed along each side of the belly; the head is more or less subquadrangular and flattened above; the jaws are very variable in development, sometimes very much elongated, and sometimes short and subtruncate; the upper is constituted by the intermaxillaries at the middle and the maxillaries at the sides; the teeth are variable in development; the branchial apertures confluent below; branchiostegals in considerable number; the dorsal fin single and far back, composed mostly of branched rays; anal fin opposite the dorsal; caudal distinct and generally emarginated, and with its lower lobe longest; pectorals with branched rays and variable in development; ventrals abdominal. The air-bladder is generally present, but is shut off from any communication with the intestinal canal; the pseudobranchiæ are hidden and glandular; the stomach is not distinct from the intestine, which is quite straight and without pyloric appendages. As thus defined, the family includes two quite dissimilar types—on the one hand, the Beloninæ, and on the other, the Scomberesocinæ, Hemirhamphinæ, and Exocœtinæ. The first is rather the type of a distinct family; the others, however, are closely related, although presenting very different forms. In the Scomberesocinæ both the upper and lower jaws are attenuated into a snipe-like bill; in the Hemirhamphinæ the lower jaw is alone extended into a long flattened styliform apparatus, while the upper jaw is subtriangular and transverse; and in the Exocœtinæ both jaws are short. In the Scomberesocinæ and Hemirhamphinæ the pectorals, although well developed, are not excessive, but in the Exocœtinæ are extremely large and adapted for flight; and to this group belong the celebrated flying-fishes. The species are mostly inhabitants of the tropical seas, in all of which they are found in greater or less numbers. One species of Scomberesocinæ, two of Hemirhamphinæ, and four of Exocœtinæ, as well as one of Beloninæ, have been obtained along the eastern coast of the U. S. THEODORE GILL.

Scom'bridæ [from *scomber*, the Latin name of the mackerel], an important family of fishes, including the mackerels, tunnies, and related forms. The body is elongated and fusiform; the scales very small or wanting (generally cycloid, but about the thorax larger and sometimes ctenoid ones are developed, which form the so-called corselet of the tunnies); the lateral line is distinct and frequently sinuous; the head conic and pointed forward; the opercula unarmed and well developed; the mouth with a lateral cleft; upper jaw not at all protractile; teeth present on the jaws, and generally on the palate; branchial apertures large and confluent below; branchiostegal rays generally seven; dorsal fins two, the first composed of

rather slender spinous rays, the second with branched rays, the posterior of which are free and developed as finlets; anal similar to the second dorsal; caudal forked, and well adapted for powerful propulsion; pectorals pointed; ventrals thoracic, each with one spine and five rays; the vertebral column has numerous vertebræ; the stomach is sacciform, and pyloric cæca are developed, generally in large number. In extreme youth the preoperculum is armed at its angle with several radiating spines, which are soon, however, absorbed and lost. The family is divisible into four sub families—(1) the Scombrinæ, distinguished by the short first dorsal and the wide space between it and the second, and the pectorals high up, including the genus *Scomber*, or common mackerels; (2) the Orcyninæ, in which the spinous dorsal is contiguous to the soft, the pectorals comparatively low, the caudal peduncle with a median adipose carina, and two others (one above and one below) converging backward, and the pyloric cæca very numerous—including *Orcynus*, *Sarda*, *Cybium*, and related forms; (3) Thyrsitinæ, in which the spinous dorsal is also long and pectorals comparatively low, but the caudal peduncle not carinated, and the pyloric cæca in rather small number (7 — 10)—including the genera *Thyrsites*, *Ruvettus*, etc.; (4) Gempylinæ, distinguished from the others by the very long body (the height being less than a tenth of the length) and the numerous spines of the first dorsal—represented by the genus *Gempylus*. The family includes many forms frequenting the high seas, and among them are some of the best and most powerful swimmers to be found in the class of fishes. The typical forms at least—*i. e.* the Scombrinæ, or mackerels, and Orcyninæ, or tunnies—go in large schools, and some of the species are subjects of great fisheries. The species vary in size from the dimensions of a small mackerel to those of the great tunny, which sometimes attains a weight of over 1000 pounds. Some of these are great wanderers. In the summer of 1871, for example, there appeared suddenly on the coast of Massachusetts large numbers of a small tunny (*Orcynus alliteratus*) which had previously been unknown as an inhabitant of our coast, although familiar as a Mediterranean fish. (See also MACKEREL and TUNNY.)

THEODORE GILL.

Scoo'ba, p.-v., Kemper co., Miss., on Mobile and Ohio R. R., has 1 newspaper.

Sco'pas [Σκόπας], b. in the island of Paros, flourished between Ols. 97 and 107 (about B. C. 390 to 350). He worked mostly in marble, the product of his native place, and chose his favorite subjects from the myths of Dionysus and Aphrodite. With Praxiteles, he formed the character of the second or later Attic school of sculpture, in contradistinction to the earlier school of Phidias. He was celebrated also as an architect, and constructed the temple of Athena Alea at Tegea, and engaged with Leochares and others in embellishing the mausoleum at Halicarnassus. The statement that he assisted in the erection of the temple of Artemis at Ephesus rests on a doubtful passage of Pliny. Among the most noted works ascribed to Scopas were the group of Niobe and her children and the group of sea-deities escorting Achilles to the island of Leuce. His separate figures are enumerated by Sillig in his *Dictionary of Ancient Artists* (Müller, *Ancient Art and its Remains*, § 125, etc., Sillig, s. v.). H. DRISLER.

Scopel'idæ [from the generic name, *Scopelus*], a family of fishes of the order Teleocephali, related to the Salmonidæ, etc. It has been variously defined, but if we consider it coextensive with the Scopelidæ saurina of Günther, its characters may be summarized as follows: The body is compressed and oval or elongated; the scales present and cycloid or wanting; the lateral line nearly concurrent with the back; the head compressed or depressed; the opercula normally developed; the mouth with an extensive lateral cleft; the upper jaw with margin formed by the intermaxillary only, the supramaxillary being behind; teeth on the jaws as well as palate; branchial apertures very wide; branchiostegal rays in large number; dorsal fin short or of moderate length, and in (or nearly in) the middle of the length of the body; adipose fin developed; anal short and posterior; caudal large and distinct; pectorals with branched rays; ventrals abdominal, but as such rather far forward; the pyloric appendages are generally few, but sometimes (*Harpodon*) numerous; the intestinal canal very short; no air-bladder is developed; the eggs are enclosed in sacs of the ovarium, and excluded by oviducts. The genera thus embraced are *Scopelus* and *Scopelosaurus*, in which the body is scaly and phosphorescent spots are developed; *Odontostomus*, in which the body is naked; and *Synodus* (= *Saurus*, *Trachinocephalus*, *Saurida*, *Harpodon*, *Aulopus*, and *Chlorophthalmus*), in which the body is scaly and no phosphorescent spots exist. The species are mostly inhabitants of warm waters, and the typical species are open-sea forms. THEODORE GILL.

Scordi'a, town of Sicily, province of Catania, in a fertile and healthy district, about 15½ miles S. E. of Catania. P. 6203.

Score, in music, the full and complete draught of all the parts of a composition, whether vocal or instrumental, or both in combination. When several parts on their respective staves are thus arranged one over the other, the bar-strokes are frequently extended or "scored" in continuous lines drawn through all the parts; and the derivation of the term "score" is usually traced to this marking or scoring. WILLIAM STAUNTON.

Scores'by (WILLIAM), b. at Cropton, Yorkshire, England, May 3, 1760; became a skilled navigator; made thirty successful whaling-voyages to the arctic seas, and introduced many improvements in apparatus for the whale fishery. D. in 1829.

Scoresby (WILLIAM), D. D., F. R. S., son of Capt. William, b. at Cropton, England, Oct. 5, 1790; went to sea in one of his father's ships when ten years old; became chief mate at the age of sixteen; spent the intervals between his annual voyages in scientific studies at Edinburgh under Profs. Jameson and Brewster; reached the highest northern latitude that had then been attained May, 1806; became captain of his father's ship 1811; made important observations on the electrical phenomena of the arctic regions, and by his communications to Sir Joseph Banks, president of the Royal Society, was instrumental in inducing the government to send the first (1817) of the long series of arctic exploring expeditions. After seventeen voyages to the Greenland or Spitzbergen regions, he published his *Account of the Arctic Regions* (2 vols., 1820) and his *Journal of a Voyage* (1823). When above forty years of age Capt. Scoresby passed through a course of literary and theological study, graduating in divinity at Cambridge; filled several pastorates; received the degree of D. D.; was noted for philanthropic labors; visited the U. S. 1847, and made a voyage around the world for magnetic research 1855–56. D. at Torquay Mar. 21, 1857. Author of valuable works on magnetism and several scientific books. He wrote a *Life* of his father (1851), and his own *Life* was written by a nephew (1861).

Scorpæn'idæ [from Lat. *Scorpæna*; Gr. σκόρπειος, "scorpion-like"], a family of fishes of the order Teleocephali and sub-order Acanthopteri. The body is more or less oblong and compressed; the scales developed in variable manner, sometimes wanting, but typically ctenoid and imbricated; the lateral line continuous and concurrent with the back; the head compressed, and often inflated laterally, and more or less armed with ridges and spines; the cheeks protected by an enlarged suborbital bone, which articulates with the inner angle of the preoperculum; the mouth with a lateral cleft; the upper jaw moderately protractile; teeth acute and present on the jaws as well as palate; branchial apertures continuous below, but with the branchial membrane often well developed at the middle; branchiostegal rays generally seven; dorsal differentiated into a longer spinous and a shorter rayed portion; anal with its rayed portion smaller than that of the dorsal, and armed generally with three spines; caudal well developed and free; pectorals with at least the inferior rays generally somewhat enlarged and simple, not branched; ventrals thoracic, with a spine and generally five rays; the stomach is sacciform, and pyloric appendages are developed in moderately small number. The family includes many genera, the principal of which are *Scorpæna*, *Sebastes*, *Sebastosomus*, *Pterois*, *Pteroidichthys*, *Tænianotus*, and *Apistus*. They are chiefly inhabitants of the tropical or subtropical regions, but *Sebastes* proper is peculiar to the northern seas, and of *Sebastosomus* and *Sebastomus* a number of species are found on the western coast of the U. S., as well as corresponding latitudes of the Asiatic portions of the Pacific. In some (*Apistus* and *Minous*) an independent pectoral filament or ray is developed. THEODORE GILL.

Scorpio, in astronomy. See ZODIAC.

Scor'pion [Lat. *scorpio*], also applied in various parts of the U. S. to different species of lizards—viz. (1) in the Southern States to *Eumeces fasciatus*, a representative of the family Scincidæ, a glossy, smooth lizard with reddish head and dark-greenish or olivaceous body; (2) in some regions, with the qualification *brown* ("brown scorpion"), to *Sceloporus undulatus*, a small lizard with rough carinated scales, marked on the back with undulating cross-bands of black, and on the belly with a white median line, on each side of which the color is greenish; and (3) in Arizona to the *Heloderma horridum* or *suspectum*, a large lizard with tubercular scales and marbled with black and red, which labors under the suspicion of being poisonous. THEODORE GILL.

Scorpions, or **Scorpiones,** a group of articulates belonging to the class of Arachnoids, and by some regarded

as an order, and by others as a sub order within the class. They are provided with eight pulmonary sacs, with which are connected as many spiracles opening on the latero-abdominal surface; the abdomen is not separated by decided constriction from the cephalo-thorax, and the six caudal segments are narrow and elongated, and the last one provided with a poison sac and terminal hook-like sting; the maxillæ are developed as long forceps, and simulate the anterior legs of crabs; beneath and behind the last pair of legs from the abdomen are developed two laminated or comb-like appendages; the integuments are coriaceous, consisting chiefly of chitine; six or more eyes are developed toward the front on the surface of the cephalo-thorax. The latest writer on the group, Prof. T. Thorell (1876), considers it as an order, and recognizes as belonging to it four families distinguished by the form of the sternum, the pectoral combs, the armature of the fingers of the mandibles, the palpi, and the eyes. These families are—(1) Androctonoidæ (= Scorpionidæ of others), with two sub-families and nine genera; (2) Telegonoidæ, with three genera; (3) Vejovoidæ, with two genera; and (4) Pandinoidæ, with two sub families and seventeen genera. Representatives of the order are found in all tropical and warm regions, to which they are mostly confined. They frequent dark places, and conceal themselves for the most part under stones, logs, etc., and are wont to frequent ruined houses. They run with considerable rapidity, keeping then the tail elevated. Like crustaceans, they shed their skin. They feed chiefly on insects, which they catch and convey to the mouth by the forceps-like maxillæ, and then suck their blood. They are viviparous, and gestation is said to last for the greater part of the year. They are rather dangerous animals, and their sting is very painful, although rarely fatal. The result of the sting depends much upon the size and irritability of the animal and the temperature of the climate. The most esteemed antidotes are ammonia, administered externally as well as internally, and other caustics and stimulants. Thirteen species have been recognized by Dr. Horatio C. Wood as inhabitants of the south-western portions of the U. S. Of these (using the nomenclature of Wood, but which does not coincide with that of Thorell), *Scorpio Allenii*, is found in Lower California; *Buthus carolinianus*, in all the Southern States, from South Carolina to Kansas and Texas; and *Buthus spinigerus*, in Texas; the other species are mostly confined to Southern California. The order came early into existence, and truly typical species are found in the Carboniferous rocks of both Europe and America. (See T. Thorell, *On the Classification of Scorpions*, in *Annals and Magazine of Natural History*, 4th series, vol. xvii. pp. 1–15, Jan., 1876.) THEODORE GILL.

Scorzone'ra [Sp. *escorza*, a "snake"], a garden vegetable popular in parts of Europe, but quite unknown in the U. S. *Scorzonera Hispanica*, *glastifolia*, *deliciosa*, and *tuberosa* (Compositæ) all furnish edible roots, whose taste is compared to that of asparagus, celery, hazel nuts, and salsify. The black skin is washed off, the root soaked a while in fresh water, and the roots are then boiled fifteen minutes. Scorzonera is very highly esteemed by many, and is especially praised as food for invalids. It is very hardy and of easy cultivation.

Scot (REGINALD), b. in Kent, England, early in the sixteenth century; was educated at Hart Hall, Cambridge, after which he retired to his paternal estate near Smeeth, and there passed a retired life, dying in 1599. Author, among other works, of *The Discoverie of Witchcraft* (1584), one of the first published denials of the reality of witchcraft—a book which was burned by the common hangman and replied to by King James in his *Demonology*.

Scotch Bush, p.-v., Florida tp., Montgomery co., N. Y. P. 120.

Scotch Confession of Faith. It was drawn up by John Knox and his compeers at the request of the Scotch Parliament, which assembled at Edinburgh in Aug., 1560, after the death of the queen-regent, Mary of Guise (June), and the close of the civil war. It consists of a preface and twenty-five articles on the chief doctrines of religion, which are briefly, tersely, and vigorously stated. It agrees with the other Reformed confessions of the sixteenth century, but is more pronounced in its opposition to the Roman Catholic Church than most of them. It was rather hastily composed in four days, twice read article by article in Parliament, and adopted by the same as being "based upon the infallible word of God." Only three temporal lords voted against it, for the reason that they believed as their forefathers believed; the Roman Catholic bishops were called upon to object and refute, but kept silence. Seven years later (1567), after the abdication of Queen Mary, the confession was readopted, and the Reformed Kirk of Scotland formally acknowledged and established. In 1580 the confession was signed by King James II., and a supplementary confession (sometimes called the *second* Scotch confession) added to it. It continued to be the only doctrinal standard of Scotland recognized by the civil government till the Revolution of 1688, but it was practically superseded by the Westminster Confession, which is more logical and complete, and was adopted by the Covenanters and the General Assembly during the Commonwealth. The Scotch Confession is printed in the acts of the Scotch Parliament for 1560, in Knox's *History of the Scotch Reformation* (ed. Laing, vol. ii.), in Calderwood's *History of the Kirk of Scotland*, in Dunlop's *Collection of Scotch Confessions* (vol. ii.), in Niemeyer's *Collectio Confess. Reform.*, and in Schaff's *History of the Creeds of Christendom*, vol. iii. PHILIP SCHAFF.

Scotch Grove, p.-v. and tp., Jones co., Ia. P. 929.

Scotch-Irish, tp., Rowan co., N. C. P. 1465.

Sco'ter, a name by which are designated species of sea-ducks belonging to the genus *Oidemia* of Fleming. These are distinguished by the bill being much swollen at the base, with the terminal part depressed and broad, and the extension of the feathers of the chin forward as far as the nostrils; the color is, to a great extent, black. The American species are *Oidemia americana* (the common scoter), *O. Trowbridgii* (long-billed scoter), *O. perspicillata* (commonly called surf-duck or sea-coot), and *O. velvetina* (the velvet duck or white-winged coot). THEODORE GILL.

Sco'tists, among the SCHOOLMEN (which see), the followers of John Duns Scotus. Their principal adversaries were the Thomists. The Scotists held to freedom of the will and the immaculate conception of the Virgin. The Franciscans were generally Scotists, while the Dominicans were Thomists.

Scot'land [Lat. *Scotia*] was originally the name of Ireland, and the inhabitants of that island, a Celtic tribe, were called *Scots*. To the northern part of the island of Great Britain, the present Scotland, the name was not applied until the tenth century, when an invasion from Ireland succeeded in consolidating a Scotch empire here. The country was then, and for several subsequent centuries, designated as *Nova Scotia*. The Romans called it *Caledonia*, and its inhabitants, also a Celtic tribe, *Caledonians* or *Picti*. In the reign of Titus (79–81) Julius Agricola penetrated to the Frith of Tay, and constructed a line of forts from the Forth to the Clyde, but beyond this limit the Romans never extended their dominion. In 120, Hadrian built a continuous wall of turf between the Solway and the Tyne, and twenty years afterward Antoninus Pius connected the detached forts of Agricola by a rampart of earth; but in 208, Alexander Severus abandoned this boundary and constructed a wall of stone from the Solway to the Tyne, a little S. of the wall of Hadrian. In the mean time, the country between the two walls, the province of Valentia (subsequently the kingdom of Strathclyde, the *Regnum Cambrense*), had been thoroughly Romanized; but when, in 420, the Romans entirely abandoned Britannia, the free Picts again swept down over the Lowlands and far into England, ravaging and devastating the country with savage but irresistible valor. The Britons now called the Anglo-Saxons to their aid, and the Picts were once more confined to their Highlands; in 449 a Saxon chieftain, Edwin, founded Edinburgh. In 503 the Scots—that is, the Celts from Ireland—crossed over to Britain and founded, under the leadership of Fergus, a Scotch kingdom along the western coast of Caledonia, from the Firth of Clyde to the present Rosshire. The Celts of Ireland were Christians, having been converted by St. Patrick, and in 563, St. Columba went over from Ireland and settled among the heathen Picts, spending the rest of his life, till 597, in converting them to Christianity. In 836, Kenneth, a lineal descendant of Fergus, became king of the Scots, and in 843 he also became king of the Picts, transferring his residence to Forteviot in Stratherne, the old capital of the Picts. Thus, the Scots and the Picts, two tribes of the Celtic race and speaking two dialects of the Celtic language, coalesced and formed one empire, which soon began to be designated *Scotia*, *Nova Scotia*, *Scotland*, though the Celts of Ireland continued for centuries to protest against this application of the name. The southern boundary of this empire was the wall of Antoninus; beyond that line stretched the kingdom of Strathclyde, which at one time reached as far S. as the northern frontier of Wales. Soon, however, the boundary between these two empires began to move. One Cumbrian province after another was incorporated with Scotland, and under Malcolm II. its southern border was advanced to the Tweed. But while thus the Scotch kingdom was externally much extended, the Scotch people underwent an internal change by which the Celtic character almost disappeared. So many Teutonic elements were absorbed that in the course of a couple of centuries a new national type was developed, in which the Celtic element was hardly more than recognizable. Teutonic language,

ideas, and blood poured into Scotland both from the N. and the S. The Norwegians and the Danes held the islands before the time of Kenneth, and afterward, at times, also large tracts of the mainland, and a lively intercourse took place between the Scots and the Scandinavians, both as friends and as foes. The Hebrides and the Isle of Man were not united to Scotland until the reign of Alexander III. (1249–86), who defeated Haco, king of Norway, at Largs, on the coast of Ayr; and the islands of Orkney and Shetland not until the reign of James III. (1460–88), who married Margaret, daughter of King Christian I. of Denmark, and received them as her dowry. Still greater was the Teutonic influence coming from the South—first Anglo-Saxon, then Norman. Various Anglo-Saxon provinces were incorporated with the Scoto-Pictish kingdom—Cumberland in 950, Strathclyde in 970, Lothian in 1018—and Malcolm III., who slew and succeeded Macbeth in 1057, was educated at the English court and married an English princess. Her brother, Edgar Atheling, and many Anglo-Saxon nobles, sought refuge and support with Malcolm during the Norman invasion of England, but in 1072, William the Conqueror penetrated into Scotland and compelled Malcolm to submit and do homage to him. What this homage meant became a question of much contention between the Scotch and English kings, and was not settled until the reign of William the Lion (1165–1214). He was captured by Henry II. of England, and regained his liberty in 1174 only by declaring himself a vassal of the English king; but in 1189, Henry's successor, Richard Cœur de Lion, who wanted money for his campaign to the Holy Land, ceded his right of supremacy for 10,000 marks. Once more, however, the question arose of Scotch allegiance to England. When Margaret, the so-called "Maiden of Norway," daughter of King Eric of Norway, granddaughter of Alexander III., and heiress to the Scotch crown, died on her voyage from Norway to Scotland, several pretenders appeared, and finally John Balliol obtained the crown by the aid of Edward I., to whom he swore allegiance. But another party of the Scotch people arose and made the fiercest resistance to Balliol and the English—first under William Wallace, who fell into the hands of Edward I. and was put to death in London 1305; then under the younger Robert Bruce, who routed the English under Edward II. at Bannockburn June 24, 1314, invaded England twelve times in fourteen years, and ravaged the country so fearfully that Edward III. was glad to buy peace of him by resigning all his claims to supremacy over Scotland. With Robert II. (1371–90) the house of Stuart ascended the throne, and the history of Scotland from this time to the establishment of the union with England is given in the articles on ROBERT II.–III., JAMES I.–VI., MARY STUART, KNOX, etc. Most of the kings of the Stuart dynasty were valiant and energetic men, but most of them ascended the throne as minors and ended their lives by untimely deaths. This circumstance gave the power of the nobility an exorbitant development, and for centuries the history of Scotland became one long contest between the Crown and the nobility, and one confused maze of feuds between the various noble families. In these troubles the kings sought support from the Church; they flattered and enriched it. The Scotch Church was the richest in Christendom. In the sixteenth century it owned one-half of all the real estate in the country. But its members were the most debased set of men within the pale of Romanism, and were able to maintain their social position only by means of the dense ignorance which they spread around them. The nobility were jealous and afraid of the Church, and embraced the Reformation with great eagerness; and the great crisis in Scotch history in the sixteenth century was essentially a contest between Romanism and absolutism on the one side, represented by the Crown, and Protestantism and feudalism on the other, represented by the nobility—a contest in which the final decision was given by a third party, the middle class, the burghers, who, under the leadership of Knox, carried the Reformation through and put certain limits to the power both of the Crown and the nobility. Other elements were mixed up in the contest. The relation between Scotland and England during this period consisted mainly in a continuous border feud, which was carried on almost without intermission, and which now and then grew into actual warfare on a great scale. Nevertheless, by degrees there developed an English party within the Scotch people. During the wars between England and France the Scotch went to France to fight against the English, and this circumstance opened the way for a French influence in Scotland, which became of very great importance when James V. married Mary of Guise. France understood that, in a conflict with England, Scotland could be used as one of the most effective weapons, but in her attempts to form a close alliance with this country Roman Catholic France was compelled to seek her main support from the Roman Catholic clergy in Scotland, and thus she caused, most unwillingly, the nobility and the Protestants to turn their eyes to England. Meanwhile, statesmen arose on both sides of the Border who wished to stop the perpetual hostilities, and who understood that a union between the two countries was the only means of achieving this end. It was a favorite idea with Henry VIII., and after the death of James V., during the regency of the count of Arran, a treaty was made by which Mary, the queen of Scotland, was betrothed to the prince of Wales, the son of Henry VIII., and it was agreed that when ten years of age she should be brought to England, in order to be educated there. But Henry's demand of political supremacy soon brought discord, and before the treaty was half a year old it was broken and war was declared. After the death of Henry VIII. the duke of Somerset tried to re-establish the treaty, but in vain; and after the battle of Pinkie (Sept. 10, 1547), Scotland threw herself into the arms of France. The queen-mother, Mary of Guise, assumed the regency, and the queen was brought to France to be educated, and betrothed to the dauphin. At last, however, by the victory of Protestantism in Scotland, and the extinction of the house of Tudor in England, the union actually took place.

The history of Scotland has been written by William Robertson (2 vols., 1759), P. F. Tytler (9 vols., 1828–43), John Hill Burton (7 vols., 1867–70). See also *Domestic Annals of Scotland*, by R. Chambers (3 vols., 1859–61), and various essays and monographs by Innes, Pinkerton, Chalmers, Hailes, and others. (For the geography and statistics of the country see the article on GREAT BRITAIN. For Scottish language and literature see ENGLISH LANGUAGE AND LITERATURE.) CLEMENS PETERSEN.

Scotland, county of N. E. Missouri, adjoining Iowa, watered by Wyaconda and Fabius rivers, consists chiefly of fertile prairies, and is traversed by Missouri Iowa and Nebraska R. R. Staples, Indian corn, oats, hay, sorghum-molasses, tobacco, honey, wool, and butter. Sheep and swine are plentiful. Cap. Memphis. Area, about 400 sq. m. P. 10,670.

Scotland, tp., Bulloch co., Ala. P. 760.

Scotland, p.-v. and tp., Windham co., Conn. P. 643.

Scotland, tp., McDonough co., Ill. P. 1162.

Scotland Neck, p.-v., Halifax co., N. C.

Scotland, Reformed Church of. It is difficult to determine the precise time when Christianity was first introduced into Scotland. In the twilight of traditional history there arises the figure of St. Rule as he landed with the bones of St. Andrew on the rocky shore which has since borne the name of St. Andrew's, and of St. Ninian, who, amid the mud houses of the Scots on the banks of the Solway, erected his wonderful stone church. We get out of this dim and shadowy twilight when we reach the mission of St. Columba, who, founding his monastery on the lone isle of Iona, extended his missionary work all over Scotland, and even into England. This was about 563 A. D., and from this period down to the middle of the tenth century, the Culdees, as they were called, continued to propagate Christianity, though often impeded in their work by the incessant hostilities of the Scots and Picts.* Meanwhile, another stream of Christian influence was poured into Scotland from the South, representing the Roman form of ecclesiasticism; and the Culdee worship with its simpler ritual came into conflict with the Roman observances and modes of worship. We cannot here trace the progress of this conflict, and can only notice that after the Scottish and Pictish monarchies were united in one king during the reign of Malcolm III., and largely through the influence of Margaret, his Saxon queen, many of the Culdees yielded to the powerful influence of the Roman Church. From this time, the middle of the twelfth century, till the dawn of the Reformation, the history of the Church in Scotland is one of constantly increasing power and wealth, and of growing corruption. Two points bearing directly upon the future history of the Scottish Church may be mentioned here. The first, that not only was a system of diocesan bishops established all over the land, but the parochial system of Scotland owes its establishment to this period. The other is, that the Scottish ecclesiastics maintained a brave and successful struggle for independence against the claims of the primacies of Canterbury and York, who successively sought to assume control over the Scottish bishops.†

During the four centuries preceding the Reformation the Roman Church had not only attained universal supremacy, but one-half of the wealth of the nation had passed into its hands. In the end of the fifteenth century the feudal

* Jamieson's *Hist. Cul.*; Cunningham's *Ch. of Scot.*; Hetherington's *Hist. Ch. of Scot.*

† Jamieson, Cunningham, Hetherington, as above, and Lee's *Lectures*.

power of the greater nobles was greatly weakened, not only by the absorption of the wealth of the country by the clergy, but also by the rising up of a middle class of lesser landholders and burghers, who had become the most powerful party in Scotland in intelligence, industry, and resources. In the beginning of the sixteenth century the writings of the continental Protestant divines were introduced into Scotland, and the result was seen in the awakened religious and spiritual earnestness of this middle class. Patrick Hamilton, a youth of high mental endowments, returned from Wittenberg in 1527, and immediately began to preach the Reformed doctrines at Edinburgh and other places in Scotland. Steps were soon taken to arrest him, and he was committed as a prisoner to the castle of St. Andrews. He was tried for heresy, condemned, and burned at the stake (1528). We cannot dwell on the persecutions which followed for the next thirty years, or on the historical circumstances which resulted in the triumph of the Reformation in Scotland.*

The peculiar and essential features of the Reformed Church of Scotland, besides the profession of the evangelical faith common to all the churches of the Reformation, were (1) The government of the Church by that order of men which is indicated in the New Testament by the terms presbyters and bishops or overseers; (2) the subjection of the Church in all things spiritual to Christ as her only Head, and to his word as her only rule. The first General Assembly of the Reformed Church of Scotland was held in 1560, but her history goes back to the year 1557, when the "First Covenant" or "Common Bond" was signed. The subscribers to this document, after declaring their faith in "the Evangel of Christ," promise "before the majesty of God to maintain and defend the whole congregation of Christ, and every member thereof, to the death," and "to renounce and forsake all superstitions, abominations, and idolatries." The word *congregation* was then used as the distinctive name of all those who held to the doctrines of the Reformed Church, having the same signification as the word *kirk*, which was subsequently introduced, and the leaders of the Reformation in Scotland were known as "the Lords of the Congregation." The various congregations which belonged to "the Congregation" used the liturgy of Edward VI.; and the Apostles' Creed, together with King Edward's Catechism, formed the articles of religion by which they were bound into a doctrinal unity.† At the death of the regent, Mary of Guise, in 1560, the Parliament of Scotland met, and on Aug. 24 an act was passed which is described as "The Confession of Faith and Doctrines believed and professed by the Protestants of Scotland, and authorized by the Estates in Parliament."‡ This confession was in fact "the Order of Geneva," including the confession of faith prepared for the English congregation at Geneva by John Knox. It was presented to Parliament by "the Lords of the Congregation;" but immediately afterward, on Dec. 20, 1560, the first General Assembly of the Kirk of Scotland was held, and from this date the Assembly "took order for God's glory and the weal of his Kirk in the realm of Scotland."§ At this Assembly "the Book of Discipline of the Church was allowed and approved:" this book was afterward submitted to the council, but they refused to sanction it. This marks the point at which the controversy between the ecclesiastical and civil authorities began. The Book of Discipline was rejected by the state, but the Church proceeded at once to carry it into execution. The principles of religious liberty were not understood in that age, and the Scottish Reformers did not hesitate to enact laws which involved the infliction of civil penalties for offences that were purely religious, though, to their credit, it should be stated that these penalties were seldom inflicted; but with these exceptions the great principles both of faith and order which were then agreed to, remain, amid all the changes of confessions, as those held by all the branches of the Reformed Church in Scotland to this day. It is especially worthy of note that in this "first Book of Discipline," while "the duty of nations and their rulers to own the truth of God and to advance the kingdom of his Son," is clearly stated, it is at the same time maintained that the Kirk possesses an independent and exclusive jurisdiction, "which flows directly from God and the Mediator, Jesus Christ, and is spiritual, not having a temporal head on earth, but only Christ, the only King and Governor of his Church."

For seven years, from the death of the regent Mary of Guise (1560) till the abdication of Mary Queen of Scots, the Kirk was without state endowment, and indeed without any recognition by the state of her jurisdiction. At a very early period lay patronage was introduced into Scotland. Laymen who had endowed churches and monasteries reserved for themselves and their heirs the right of presenting incumbents to the benefices thus founded. At a later period these rights of presentation were to a large extent annexed to bishoprics, priories, abbacies, and other religious houses, so that at the time of the Reformation there were only 262 out of the 940 benefices the patronage of which remained in the hands of laymen. The rights of presentation which belonged to the religious houses were after the Reformation a continual subject of contention between the Assembly and the queen. In 1565 the General Assembly drew up six articles for the queen's consideration, with a view to their ratification by Parliament. The second of these articles had reference to the law of patronage, and demanded that the absolute right of the queen or of any lay patron to present a minister without examination be disallowed. To this the queen answered that it seemed to be "no way reasonable that she should defraud herself of so great a part of the patrimony of the Crown as to put the patronage of benefices forth of her own hands."‖ The patronage to these benefices continued to be held by the queen, or was by her distributed among her favorite nobles.

Immediately after the queen's abdication the Parliament met on Dec. 15, 1567, and passed an act in favor of the Reformed Kirk, ratifying the act of 1560 by which the Confession of Faith was sanctioned and adopted, and among other statutes one for the examination and admission of ministers by the Kirk, reserving, however, the right of presentation to the lay patrons. This Parliament also "declared and granted the jurisdiction of the Kirk anent preaching of the true word of God, correction of manners, and administration of the holy sacraments."¶ A similar act was passed in 1592, ratifying and enlarging the rights of the Kirk in regard to her jurisdiction over the appointment or deprivation of ministers. The acts of 1567 and 1592 have always been regarded as the solemn recognition and sanction by the nation of the constitution of the Reformed Church, and the great charters of her Presbyterian government and freedom from the supremacy of the Crown in all causes spiritual and ecclesiastical.

We have next to consider as briefly as possible the history of that period which resulted in the Scottish confession of 1560 being exchanged for that of the Westminster Assembly. In 1603, James ascended the English throne, and this was immediately followed by a tyrannical invasion of the Church's independence by the civil power, and the partial overthrow of the Presbyterian polity and government. The struggle against the attempt of the kings of the Stuart line to subdue the Kirk, and the further development of the doctrines of the independence of the Kirk, form deeply interesting chapters in the history of the Church of Scotland, but we must pass them over here with this brief notice. After a long and bitter struggle, both in England and in Scotland, against the royal encroachments on the civil and religious liberties of the people, an ordinance of the English Lords and Commons in Parliament was passed on June 12, 1643, calling the Westminster Assembly. The General Assembly of the Kirk met in Edinburgh on Aug. 2 in the same year. Commissioners from England were present, and the result of their conferences was that on Aug. 17 "the Solemn League and Covenant" was passed unanimously by the General Assembly; it was then carried to the Convention of Estates and unanimously ratified by them.** Commissioners were also appointed to represent the Kirk of Scotland in the Westminster Assembly. The Confession of Faith of the Westminster divines was finished in 1646, and on Aug. 4, 1647, it was adopted by the Scottish General Assembly, with two modifications; and two years later the Estates of Parliament ratified this decision.†† During the twelve years of Cromwell's government, while Scotland was rent asunder by political intrigue, the Church was left to carry out her discipline and instruction of the people, though the General Assembly was not allowed to meet. Charles II. was restored to the throne in 1660, and in the following year the Scottish Parliament declared the ecclesiastical as well as civil supremacy of the king. An attempt was then made to conform the Scottish Church to that of England by the establishment of the episcopal form of government. For the next twenty-five years the statute-book of Scotland is crowded with inquisitorial and persecuting acts. The struggle of the Reformed Church against this exercise of the royal prerogative was a long and bloody one, and there is much to kindle admiration in the spiritual earnestness and devotion to principle of a high-hearted nation, who fought even to death against what they considered not only as an attack upon their liberties, but

* Knox, Calderwood, Spottiswoode, and Taylor Innes.
† Knox, i. 275, and Innes, 7.
‡ Knox, iii. 266, Keith, i. 311; Innes, 8; Hetherington, 80.
§ *Booke of the Universall Kirke of Scotland;* Knox, ii. 223, and Innes, 22.
‖ *Booke of the Universall Kirke,* 34.
¶ Calderwood, Hetherington, and Innes.
** Baillie, i. 387; Hetherington, 351; Innes, 60.
†† Innes, Cunningham, Calderwood.

still more as a subversion of the rights of Christ's Church. So severe was the persecution that even to be present at a field conventicle was punishable by death and confiscation of goods. Yet the great body of the Scottish people steadfastly resisted the attempt to enforce conformity.* In the year 1688 the event known as the Revolution took place, and soon after William of Orange landed the Estates of Scotland presented to him a claim of rights, declaring that the superiority of any office in the Church above that of presbyters is and hath been a great and intolerable grievance. In Apr., 1689, the Scottish Parliament met and passed an act abolishing prelacy.† In 1690 the Parliament again met and passed acts rescinding the statute of 1669, which had declared the king's supremacy, and ratifying the Confession of Faith and settling Presbyterian church government. The same Parliament passed an act abolishing lay patronage, though the new monarch was known to be strenuously opposed to its abolition.‡ In 1693 the Parliament passed an act for "settling the quiet and peace of the Church," but this act expressly provided for summoning the General Assembly by royal authority. So far from settling the peace and quiet of the Church, the consequence of this act was that a fresh storm of ecclesiastical trouble swept over Scotland. The General Assembly met in May, 1694, prepared to assert the freedom of the Kirk and her intrinsic power to meet in synods and assemblies. The king instructed the royal commissioner that if the act of supremacy was not accepted he should at once dissolve the Assembly; but the members of the Assembly had determined in that case to disregard the royal dissolution and to continue their sessions. At the last moment the breach was avoided, instructions were sent to the commissioner to withdraw the threat of dissolution, and the independence of the Kirk was again confirmed.§

With the beginning of the eighteenth century came the union of the two kingdoms of England and Scotland and the merging of the two legislatures in one Parliament. In the article on the Free Church (which see) will be found a full statement of the successive legislative acts in reference to the law of patronage and the independence of the Church, and also of the long-continued struggles between the two parties in the Church itself, which resulted in the first secession in 1733, in a second secession in 1752, and ultimately in the formation of the Free Church of Scotland in 1843. During the first part of this period the Moderates, as they were called, in distinction from the Evangelicals, were the ruling party in the Church. They exercised their power for the most part with toleration and forbearance, except in the cases arising out of the exercise of lay patronage. They were confessedly lacking in spiritual insight and practical zeal, but many of them were distinguished for their intellectual and literary influence and for their high personal and social characteristics.

In the beginning of the present century the Church of Scotland established missions in Australia and in the provinces of British North America. These missions were gradually formed into presbyteries and synods. Recently, the different branches of the Scottish Church in Australia dissolved their ecclesiastical connection with the parent churches, and now occupy a separate position as a Church possessing supreme jurisdiction. A similar union has still more recently taken place in Canada. The Church of Scotland during this century has established missions in India, which have been distinguished for their zeal and success in teaching. Missions to the Jews are also sustained at Alexandria, Smyrna, and Salonica.

During the last twenty years there has been a remarkable development of spiritual and intellectual life among the clergy of the Scottish Church and a corresponding growth of religious power in the congregations. The law of patronage has been abolished, so that each parish as it becomes vacant, on the payment of a small sum to the patron, has now the right of electing its own minister, subject to the assent of the presbytery.

There are in the Scottish Church upward of 1000 parishes, with about 200 chapels. There are 84 presbyteries, consisting of from 12 to 24 ministers, with an elder from each kirk session. There are 16 synods, comprehending each from 3 to 7 presbyteries. The General Assembly is the supreme court of the Church, and meets annually in Edinburgh. It consists of representatives from all the presbyteries, and also from the royal burghs and the four universities. The queen is represented in the General Assembly by the lord high commissioner, but he takes no part in the deliberations. The General Assembly decides in all cases that may be brought before it by appeal from the inferior courts, and passes laws for the regulation of the affairs of the Church; but, according to what is called the Barrier act, no law introducing an innovation or change in the established laws can be passed until it has received the approval of the majority of the presbyteries. David Inglis.

* Innes, Calderwood, Cunningham, Hetherington.
† 1 William and Mary, c. 3.
‡ Crookshank, Hetherington, and Innes.
§ Carstair's *State Paper*, 52; Innes, 79.

Scott, county of W. Arkansas, watered by Fourche la Fave, Petit Jean, and other affluents of Arkansas River, has a hilly soil. Staples, Indian corn, tobacco, and butter. Swine are numerous. Cap. Waldron. Area, 850 sq. m. P. 7483.

Scott, county of W. Illinois, on Illinois River, has a level surface abounding in coal and limestone, and is traversed by several railroads. Staples, Indian corn, wheat, wool, and butter. Cap. Winchester. Area, 255 sq. m. P. 10,530.

Scott, county of S. E. Indiana, watered by tributaries of White River, and traversed by Jeffersonville Madison and Indianapolis and Ohio and Mississippi R. Rs. Staples, Indian corn, tobacco, sorghum-molasses, wool, and butter. Cap. Scottsburg. Area, 180 sq. m. P. 7873.

Scott, county of E. Iowa, bounded E. by the Mississippi and N. by Wapsipinicon River, has a high, rolling surface, with some deposits of coal and limestone, and is traversed by Davenport and St. Paul and by Iowa division of Chicago Rock Island and Pacific R. R. Manufactures of carriages, clothing, furniture, and saddlery are numerous; horses, cattle, and swine abound. Staples, Indian corn, wheat, oats, barley, hay, potatoes, wool, and butter. Cap. Davenport. Area, 450 sq. m. P. 38,599.

Scott, an unorganized county of W. Kansas, on Smoky Hill River and Walnut Creek, has a rolling surface and a fertile soil. Area, 720 sq. m.

Scott, county of N. Kentucky, watered by Little Fork of the Eagle and Elkhorn River, and traversed by Louisville Cincinnati and Lexington R. R., has a hilly but fertile surface. Cap. Georgetown. Area, 240 sq. m. P. 11,607.

Scott, county of S. E. Minnesota, bounded N. by Minnesota River, has a rolling prairie surface, with abundance of timber, and is traversed by St. Paul and Sioux City and Hastings and Dakota R. Rs. Staples, wheat, Indian corn, oats, hay, and butter. Cap. Shakopee. Area, 390 sq. m. P. 11,042.

Scott, county of Central Mississippi, watered by Young Warrior and other tributaries of Pearl River, has a level surface, a sterile soil, and extensive pine forests, and is crossed by Vicksburg and Meridian R. R. Staples, Indian corn and cotton. Cap. Forest. Area, 540 sq. m. P. 7847.

Scott, county of S. E. Missouri, on Mississippi River, has an uneven surface, the river-bottoms being low and swampy, covered with vast forests of cypress, and is traversed by Cairo Arkansas and Texas and St. Louis and Iron Mountain R. Rs. Staples, Indian corn, wheat, tobacco, and sorghum molasses. Cap. Commerce. Area, about 400 sq. m. P. 7317.

Scott, county of N. E. Tennessee, adjoining Kentucky, watered by Big Fork of Cumberland River, has a stony and sterile soil, chiefly occupied by the Cumberland Mountains, which are covered with thick forests and have deposits of coal. Staples, Indian corn, tobacco, butter, and honey. Cap. Huntsville. Area, 315 sq. m. P. 4054.

Scott, county of S. W. Virginia, adjoining Tennessee, intersected by N. fork of Holston and by Clinch River, traversed by Clinch Mountain and several parallel ranges, includes the celebrated "Natural Tunnel" made by Clinch River through the mountains of the same name; has deposits of bituminous coal and of iron, and a generally fertile soil, well adapted for pasturage. Staples, Indian corn, wheat, oats, tobacco, maple-sugar, honey, wool, and butter. Sheep and swine are numerous. Cap. Estillville. Area, 450 sq. m. P. 13,036.

Scott, tp., Mississippi co., Ark. P. 659.

Scott, tp., Poinsett co., Ark. P. 592.

Scott, tp., Sharpe co., Ark. P. 680.

Scott, tp., Champaign co., Ill. P. 755.

Scott, tp., Ogle co., Ill. P. 829.

Scott, tp., Harrison co., Ind. P. 996.

Scott, tp., Kosciusko co., Ind. P. 700.

Scott, tp., Montgomery co., Ind. P. 1111.

Scott, tp., Steuben co., Ind. P. 1024.

Scott, tp., Vanderburgh co., Ind. P. 1677.

Scott, tp., Fayette co., Ia. P. 337.

Scott, tp., Floyd co., Ia. P. 196.

Scott, tp., Fremont co., Ia. P. 1277.

Scott, tp., Hamilton co., Ia. P. 270.

Scott, tp., Henry co., Ia. P. 1113.

Scott, tp., Johnson co., Ia. P. 964.
Scott, tp., Madison co., Ia. P. 1229.
Scott, tp., Mahaska co., Ia. P. 1103.
Scott, tp., Poweshiek co., Ia. P. 512.
Scott, tp., Bourbon co., Kan. P. 1729.
Scott, tp., Linn co., Kan. P. 1306.
Scott, tp., Taney co., Mo. P. 554.
Scott, p.-v. and tp., Cortland co., N. Y. P. 1083.
Scott, p.-v. and tp., Adams co., O. P. 1409.
Scott, tp., Brown co., O. P. 1070.
Scott, tp., Marion co., O. P. 495.
Scott, tp., Sandusky co., O. P. 1274.
Scott, tp., Allegheny co., Pa. P. 1807.
Scott, tp., Columbia co., Pa. P. 1165.
Scott, tp., Lawrence co., Pa. P. 902.
Scott, p.-v. and tp., Luzerne co., Pa. P. 1132.
Scott, tp., Wayne co., Pa. P. 817.
Scott, tp., Colleton co., S. C. P. 1361.
Scott, tp., Fauquier co., Va. P. 5745.
Scott, tp., Boone co., West Va. P. 792.
Scott, tp., Putnam co., West Va. P. 1794.
Scott, tp., Randolph co., West Va. P. 594.
Scott, tp., Brown co., Wis. P. 1385.
Scott, tp., Columbia co., Wis. P. 832.
Scott, tp., Crawford co., Wis. P. 800.
Scott, p.-v. and tp., Sheboygan co., Wis. P. 1448.

Scott (Charles), b. in Cumberland co., Va., in 1733; served in Braddock's campaign 1755; raised the first company S. of James River for service in the war of the Revolution; became colonel of the 3d Virginia battalion Aug. 12, 1776; brigadier-general Apr. 2, 1777; distinguished at Trenton, Germantown, Monmouth, and Stony Point; taken prisoner at the surrender of Charleston 1780; settled in Woodford co., Ky., 1785; brigadier-general of Kentucky volunteers in St. Clair's unfortunate expedition against the Miami Indians 1791, but made a successful incursion to the Wabash, defeating the Indians; commanded a portion of Wayne's army at the battle of Fallen Timbers, 1794; was governor of Kentucky 1808–12. D. Oct. 22, 1820. A town and a county in Kentucky bear his name.

Scott (David), b. at Edinburgh Oct. 10, 1806, son of a landscape engraver; educated at the High School; showed precocious talent for designing and engraving; visited Italy in 1832. D. Mar. 5, 1849. He was a man of powerful imagination and originality. Among his paintings are *Nimrod, Sarpedon, Wallace, Mary Queen of Scots receiving her Death-Warrant, Jane Shore found dead in the Street, Achilles, Orestes, Paracelsus, Peter the Hermit, Christ in the Garden.* His conceptions were vast, but his smaller pieces were touched with great loveliness. Scott made a wonderful likeness of R. W. Emerson. He was an author too; wrote an able series of papers on art in *Blackwood* (1840); competed, unsuccessfully, for the decoration of the Houses of Parliament, the disappointment whereat is supposed to have hastened his death. O. B. Frothingham.

Scott (Dred). See Dred Scott Case.

Scott (Sir George Gilbert), R. A., F. S. A., grandson of Thomas Scott; b. at Gawcott, Buckinghamshire, England, in 1811; d. in London Mar., 1878; became an architect and a prominent member of the school which effected the so called "Gothic revival;" was largely employed in the restorations of the ancient cathedrals of England, including Westminster Abbey, and the building of new churches, colleges, and secular public edifices. Among his recent works are the university buildings at Glasgow, the Indian, foreign, home, and colonial offices, London, and the national memorial to Prince Albert in Kensington Gardens, which procured him the honor of knighthood Aug. 9, 1872. He was the chief promoter of the Architectural Museum at Westminster, was lecturer on architecture at the Royal Academy, and has published several professional treatises.

Scott (Gustavus H.), U. S. N., b. June 13, 1812, in Virginia; lieutenant in 1841, commander in 1856, captain in 1863, commodore in 1869, rear-admiral in 1873; retired in 1874. Served afloat during the civil war, and commended for good "service and gallantry." F. A. Parker.

Scott (Henry L.), b. in North Carolina Nov., 1814; graduated at the U. S. Military Academy, and entered the army as brevet second lieutenant of infantry July 1, 1833; captain 1847. From 1842 to 1848 he served as A. D. C. on the staff of his father-in-law, Gen. Winfield Scott, and in the war with Mexico as his chief of staff, gaining the brevets of major and lieutenant-colonel for gallantry; was acting judge-advocate 1848–50; again on the staff of Gen. Scott 1850–61, being advanced to the grade of lieutenant-colonel in 1855. In May, 1861, he was appointed an inspector-general U. S. army; retired from active service Oct., 1861; resigned Oct. 31, 1862. Author of a *Military Dictionary* (1861).

Scott (John), b. at Alexandria, Pa., July 14, 1824; was admitted to the bar 1846; was a prosecuting attorney 1846–49; was for ten years solicitor for the Pennsylvania Central R. R. Co.; was elected to the Pennsylvania legislature 1862, and was U. S. Senator 1869–75.

Scott (John Morin), b. in New York City in 1730, descended from the baronial family of the Scotts of Ancram; graduated at Yale 1746; became a prominent and wealthy lawyer in New York; was an early and vigorous opponent of the oppressive measures of the British ministry, co-operating with William Livingston, Sears, Lamb, and the "Sons of Liberty," in which organization he was a popular orator; was defeated as a candidate for the Continental Congress of 1774; was perhaps the most influential member of the general committee of New York, appointed in 1775, and of the provincial Congress 1775–76; aided in drawing up the constitution of New York 1776; was chosen by the Continental Congress as one of the first brigadier-generals of New York troops June 9, 1776; served at the battle of Long Island and in Westchester co. until Mar., 1777, when he became secretary of state of New York, which office he filled until 1779; was delegate in the Continental Congress 1780–83, and chosen an honorary member of the Society of Cincinnati 1784. D. in New York Sept. 14, 1784.

Scott (Julia H. **Kinney**), b. at Shesequin, Pa., in 1809; was married to David L. Scott in 1825. D. at Towanda, Pa., in 1842. She wrote many fugitive poems, which after her death were published in a volume (1843) by Mrs. S. C. Mayo, and again in 1854 by Mrs. C. M. Sawyer.

Scott (Levi), D. D., b. at Cantwill's Bridge (now Odessa, Newcastle co.), Del., Oct. 11, 1802; educated at a neighborhood school, but mainly self-taught; received the degree of A. M. from the Wesleyan University, Middletown, Conn., and D. D. at Delaware College, Newark, Del., both honorary; was principal of Dickinson grammar school, Carlisle, Pa., from 1840 to 1843; also bishop of the Methodist Episcopal Church from 1852 to date.

Scott (Michael), b. probably at Balwirie, Fifeshire, Scotland, early in the thirteenth century; was knighted by Alexander III.; travelled in England and France; resided for some years at the court of the emperor Frederick II. of Germany; is said to have written treatises on natural history and the occult sciences, and acquired a vast reputation as a magician, being introduced in that capacity by Dante in his *Inferno.* Supposed to have d. in Scotland in 1293.

Scott (Michael), b. in Glasgow, Scotland, in 1789; educated at the high school and university of that city; resided in Jamaica, engaged in agriculture and commerce, 1806–22; published anonymously in *Blackwood's Magazine* two brilliant sea-novels, *Tom Cringle's Log* and *The Cruise of the Midge*, which were ascribed to Chamier or to Marryatt until after his death in 1835.

Scott (Robert), D. D., b. in Devonshire, England, in 1811; studied at Shrewsbury school; graduated at Christ Church, Oxford, 1833; became a fellow of Baliol and college tutor; took orders in the Church of England; was rector of Duloe, Cornwall, and of South Luffenham, Rutlandshire; became master of Baliol 1854, professor of exegesis 1861, and dean of Rochester 1870. He translated several works forming part of the Oxford *Library of the Fathers*, and was associated with Dean Liddell in the preparation of a well-known *Greek Lexicon* (1845; 6th ed. 1869).

Scott (Robert Kingston), b. in Armstrong co., Pa., July 8, 1826; graduated in medicine at Starling College, O.; settled as a physician in Henry co.; became lieutenant-colonel of Ohio volunteers Oct., 1861, colonel July 5, 1862; was at Fort Donelson, Shiloh, and Corinth; commanded a brigade under Hurlbut in Tennessee, in Mississippi under Logan, and in Georgia under Sherman; made prisoner near Atlanta, but soon exchanged; took part in the "march to the sea;" was assistant commissary Freedmen's Bureau in South Carolina 1865–68, and governor of South Carolina 1868–71.

Scott (Robert N.), b. Jan. 21, 1838, at Winchester, Tenn.; appointed second lieutenant of 4th U. S. Infantry Jan. 21, 1857, adjutant July, 1861, and captain Sept., 1861. He served on the Pacific coast until 1861, being in command of the U. S. steamer Massachusetts during the San Juan difficulties in 1859. He was with the Army of the Potomac as acting adjutant-general 1st brigade regular infantry Mar.–June, 1862; was engaged in the siege of Yorktown and battle of Gaines's Mill, where he was wounded and brevetted for gallantry, and as acting adjutant-general of Casey's division Aug., 1862, to June, 1863. From June, 1863, to Sept., 1864, he was senior aide-de-camp to Maj.-Gen. Halleck; assistant adjutant-general of volunteers

(major and lieutenant-colonel) Sept., 1864, to Jan., 1867; at head-quarters of the army and military division of the James to July, 1865, and adjutant-general military division of the Pacific July, 1865, to Dec., 1866; aide-de-camp to Gen. Halleck from Jan., 1867, till 1872, except for a part of 1870, when in command of posts in Mississippi and Kentucky; assigned to 16th Infantry in 1870; transferred to 3d Artillery Jan., 1871; professor of military science at Faribault, Minn., 1872–73, since when has commanded at Fort Ontario, N. Y. Brevet lieutenant-colonel Mar. 13, 1865, "for services in connection with organization of the volunteer armies of the U. S." Author of *Digest of the Military Laws of the U. S.* (1872).

Scott (Thomas), D. D., b. at Baytoft, Lancashire, England, Feb. 16, 1747; had limited educational advantages, but by private study qualified himself as a minister of the Church of England; was ordained 1772; became in 1780 curate of Olney, where he was intimate with the poet Cowper; in 1785 chaplain to the Lock Hospital, and in 1801 vicar of Aston Sandford, Buckinghamshire, where he d. Apr. 16, 1821. He wrote several works of a strongly Calvinistic stamp, and published in 1796 a popular *Family Bible, with Notes*, often reprinted in England and the U. S.

Scott (Thomas A.), b. at Loudon, Franklin co., Pa., in 1824. After a common-school education he was placed in business in 1834, working in several different positions until 1850, when he entered the employ of the Pennsylvania R. R. Co. as general agent of the eastern division. In 1859 he was elected vice-president of the company, and in 1874 its president. Three years before he had been made president of the Pennsylvania Company. He has also been president of the Texas Pacific R. R. since its organization in 1871, and is controlling director of the Southern Railway Security Co. In 1861 he was assistant secretary of war. J. B. Bishop.

Scott (Sir Walter), b. in Edinburgh Aug. 15, 1771, the son of Walter Scott, a writer to the Signet, and Anne Rutherford, daughter of Dr. John Rutherford, professor of medicine in the University of Edinburgh. The first six children of his father and mother died in infancy between the years 1759 and 1766. The children born after this date, five sons and one daughter, survived to maturity. They were, in the order of their birth, Robert, in the navy and subsequently in the East India Company's service; John, a major in the army; Walter; Anne; Thomas, paymaster of the 70th regiment, d. in Canada; and David. Walter was a strong and healthy child until about eighteen months old, when he became incurably lame in his right leg—a weakness which sadly interfered with his love of active sports, but never marred his cheerfulness, good temper, or courage. At the age of eight he was placed in the High School of Edinburgh, where he remained for four years, the first two in the class of Mr. Luke Fraser, and the remaining time under the tuition of the distinguished rector, Dr. Alexander Adam, of whom Scott gives a pleasant account in his fragment of *Autobiography*. Personally popular, and making himself respected by his courage and general ability to take care of himself, he was not regarded as a very bright scholar, although even then giving evidence of his love of knowledge, of a strong memory for whatever pleased him, and of special delight in history, poetry, fairy-tales, and romances. In 1783 he entered the university, and for a year or more attended the classes in Greek, Latin, logic, and ethics, giving some attention also to history and law. In the ancient languages he made but little progress, although more successful in other studies. It is not surprising, then, that in thorough knowledge and discipline he should have found himself at fault. Years afterward, and when he had become famous, he writes in his *Autobiography*: "It is with the deepest regret that I recollect in my manhood the opportunities which I neglected in my youth. Through every part of my literary career I have felt pinched and hampered by my own ignorance; and I would at this moment give half the reputation I have had the good fortune to acquire if by doing so I could rest the remaining part upon a sound foundation of learning and science." His progress in the university was arrested by a severe attack of illness, which seems to have broken up all plans of further study, and in 1785–86 he entered into indentures with his father to serve the usual apprenticeship to a writer to the Signet. In 1792 he was called to the bar. During these and the succeeding years he was crowding his mind with vast accumulations of "ponderous and miscellaneous" knowledge of poetry and archæology, fiction and history, not easy to condense or reduce to system and order. "My memory of events," he says, "was like one of the large old-fashioned stone cannons of the Turks, very difficult to load well and discharge, but making a powerful effect when by good chance any object did come within range of its shot." He had already begun to collect books and articles of antiquarian interest, "the germ of the magnificent library and museum of Abbotsford." His mind was already turning toward letters, and in 1796 he made his first considerable publication, being translations from the German of Bürger. This was followed in 1799 by a translation of Goethe's *Goetz von Berlichingen*, *The House of Aspen*, and several ballads.

In the mean time, in 1797, he was married to Charlotte Margaret Carpenter, a young lady of French birth and parentage, but a resident in England. Two years later, through the influence of his friends, he obtained the appointment of sheriff depute of Selkirkshire, an office with light duties and which brought the important addition to his resources of £300 a year. In 1802 he published two volumes of the *Minstrelsy of the Scottish Border*, which was completed the next year by a third volume. It was received with great favor, and may be considered as opening the way to his general fame. It brought him also into familiar acquaintance with men of genius and lovers of legendary lore, such as Richard Heber, long member of Parliament for the University of Oxford, and that eccentric genius, John Leyden.

From this time onward to the year 1831, when, at the age of sixty, he gave to the world the fourth series of *Tales of my Landlord*, there was but one year (1807) which was not marked by some independent work in verse or prose, bearing the impress of his genius, giving new impulse to literature and new fame to the land of his birth. There is room to mention only the most important of these. In 1805 was published the *Lay of the Last Minstrel*. It took the world by surprise, and was received with unbounded delight, not only for its chivalric spirit, its "vivid richness of coloring," its pathos, beauty, grace, and airy freshness, but as giving the promise of original poetic fervor and power to which the kingdom had long been a stranger. Edition after edition was called for, and sold as soon as published. "In the history of British poetry," says Mr. Lockhart, "nothing had ever equalled the demand for the *Lay of the Last Minstrel*." This was followed in 1808 by *Marmion*, perhaps the strongest and boldest of his poems, and in 1810 by *The Lady of the Lake*, in some respects more pleasing than any. In these his poetic power culminated. The poems subsequently published—*The Vision of Don Roderick* (1811), *Rokeby* (1812), *The Bridal of Triermain* (1813), *The Lord of the Isles* (1815)—were unequal to the earlier, and in various ways gave evidence of a waning popularity, which Scott was among the first to recognize. Another reason for this perceptible loss of popular favor was the appearance of another brilliant light in the early poetry of Lord Byron.

During these six or eight years Scott had been advancing in fame and in pecuniary resources. In 1806 his friends had procured for him the appointment to one of the clerkships of the court of sessions, worth about £1300 a year, the emoluments of which, however, by an express arrangement, he did not receive until the death of his predecessor in 1812. Still earlier, in 1805, he had become a regular partner in the printing-house of James Ballantyne & Co., although this connection was kept a profound secret from nearly every one of his most intimate friends. This was undoubtedly one of the most important steps of his life. "He continued bound by it," says his son-in-law, "during twenty years, and its influence on his literary exertions and his worldly fortunes was productive of much good, and not a little evil." In 1808 he took a prominent part in establishing the *Quarterly Review* in London, in opposition, politically, to the *Edinburgh Review*, the acknowledged advocate of the Whigs; and in the same year became a secret partner in the publishing-house of John Ballantyne & Co. In 1811 he began to gratify his ambition for territorial aggrandisement by the purchase of 100 acres of land on the banks of the Tweed, near Melrose, for £4000. To this he added estate after estate adjoining, purchasing at high rates, till he had expended nearly or quite £40,000, to which must be added £25,000 more for preparing the grounds and erecting the mansion where for a few years he dispensed a splendid hospitality, and to which his fame drew visitors from every part of the civilized world.

On the decline of his popularity as a poet his fertile mind turned to another form of literature, with which for ten or twelve years he surprised and enchanted the world. In 1814 appeared, anonymously, a novel under the title of *Waverley*. The next year *Guy Mannering* was published; in 1816, *The Antiquary* and the first series of the *Tales of My Landlord*; in 1817, *Rob Roy*; in 1818, *The Heart of Midlothian* (2d series of *Tales of My Landlord*); in 1819, *Tales of My Landlord* (3d series) and *Ivanhoe*. This splendid series of novels, thrown off with an ease and rapidity without parallel, marks the high tide of his genius. Those which follow are on a somewhat lower level, but the

abundance of the production was hardly diminished. *The Monastery* and *The Abbot* followed in 1820; *Kenilworth* and *The Pirate* in 1821; *The Fortunes of Nigel* in 1822; *Peveril of the Peak*, *Quentin Durward*, and *St. Ronan's Well* in 1823; *Redgauntlet* in 1824; *The Tales of the Crusaders* in 1825; and *Woodstock*, written in the midst of impending troubles, in 1826. *The Chronicles of the Canongate* (1st and 2d series) followed in 1827 and 1828. *Anne of Geierstein* and *The Tales of My Landlord* (4th series) in 1829 and 1831 close the long list.

The secret of the author of *Waverley*, although known to some and confidently conjectured by almost every one, was not acknowledged until after the bankruptcy of Constable and the Ballantynes had rendered even a formal concealment no longer possible. Early in 1826, Constable was obliged to stop payment, and the Ballantynes, including Scott as partner in the house, being closely connected, failed for a very large amount. The humiliation to Scott was indescribable, but he met the trial with remarkable strength and dignity. The most liberal offers of assistance were made to him by friends and admirers, among them one of £30,000 from an anonymous correspondent, but he firmly declined them all. He refused to take any advantage of circumstances which might have freed him from the claims of his creditors, but insisted that they should stand, and pledged the labor of his future life to the payment of these debts. He at once entered upon that course of untiring industry in writing new works and in the republication of the old with notes and prefaces which enabled him within a few years to pay to his creditors £40,000, and to put things in such shape that soon after his death the principal of the whole was paid by his executors. It was a tremendous exertion, and it cost him his life. In 1830 alarming symptoms, which had appeared the preceding year, were followed by a paralytic attack, from which he partially recovered. In Apr., 1831, the shock was renewed, and in September he left Abbotsford for the Continent, a great part of which he had never visited. Wordsworth commemorated this departure, and gave form and expression to the universal feeling of sadness and hope, in one of his most beautiful sonnets:

> "A trouble, not of clouds or weeping rain,
> Nor of the setting sun's pathetic light,
> Engendered, hangs o'er Eildon's triple height:
> Spirits of power assembled there complain
> For kindred power departing from their sight;
> While Tweed, best pleased in chanting a blithe strain,
> Saddens his voice again and yet again.
> Lift up your hearts, ye mourners! for the might
> Of the whole world's good wishes with him goes!
> Blessings and prayers, in nobler retinue
> Than sceptred king or laurelled conqueror knows,
> Follow this wondrous potentate. Be true,
> Ye winds of ocean, and thou midland sea,
> Wafting your charge to soft Parthenope!"

The admiralty furnished him a ship of war, on which he proceeded to the Mediterranean, touching at Malta, and thence going to Naples. Here his mind almost entirely gave way, and he hurried homeward as rapidly as possible, stopping for a few weeks in London, and reaching Abbotsford in July, 1832. He died Sept. 21, and on the 26th was buried in the grounds of Dryburgh Abbey: Mrs. Scott had died in 1826. His four children, two sons and two daughters, survived him, but none are now living. Anne, his younger daughter, died in London, at the house of Mr. Lockhart, May 24, 1833, and Sophia (Mrs. Lockhart), four years later. Walter, the oldest son, major of the 15th Hussars, died childless in India, and Charles, unmarried, died in Persia. Scott's character was in the highest degree manly, open, tolerant, and kindly. "He died," said Mr. Gladstone, "a great man, and, what is more, a good man. He has left us a double treasure—the memory of himself and the possession of his works. Both of them will endure." Nor will one withhold assent from the judgment of Thomas Carlyle: "No sounder piece of British manhood was put together in that eighteenth century of time. . . . Adieu, Sir Walter, pride of all Scotchmen! take our proud and last farewell."

There is no room in a short article like this to attempt a critical estimate of the genius of Scott, or of the worth of his contributions to the literature of his age, or of his influence on the honor and fame of his native land. His works, both in poetry and in prose, notwithstanding some adverse criticism, have taken their place among the classics of the English language—a place which they will not be likely to lose.

Of the standard editions of his works, probably the most complete and discriminating list is to be found in Allibone's *Dictionary of Authors*. Extended memoirs of Scott have been written by David Vedder, William Weir, George Allan, and (in the *Encyc. Britann.*) by William Spalding. But the great work on the author and the man, and one of the best pieces of biography in any language, is the *Life* by his son-in-law, Lockhart. S. G. Brown.

Scott (William Bell), brother of David, b. in Scotland about 1810; became a distinguished painter and archæologist and head-master of the government school of design at Newcastle-on-Tyne; wrote poems at an early age; published *Hades, and other Poems* (1839), *The Year of the World, a Philosophical Poem* (1846), a memoir of his brother David (1850), *Antiquarian Gleanings in the North of England* (in quarto numbers, 1849–51), *Chorea Sancti Viti* (1851), *Poems* (1854), *Half-hour Lectures on the History and Practice of the Fine and Ornamental Arts* (1861), *Albert Dürer, his Life and Works* (1869), and another volume of *Poems* (1875), with beautiful illustrations executed by himself, and aided his brother in his illustrations to Bunyan's *Pilgrim's Progress*. After more than a generation of neglect the poems of William Bell Scott are now (1875–76) recognized by W. M. Rossetti, the London *Athenæum*, and other good authorities as worthy of a high rank in modern literature.

Scott (Winfield), b. in Dinwiddie co., near Petersburg, Va., June 13, 1786; educated at William and Mary College; studied law, and was admitted to the bar. In 1808 (May 3) he accepted an appointment as captain of light artillery, and was ordered to New Orleans, where a year later, for disrespectful allusion to the conduct of his superior officer (Gen. Wilkinson), he was suspended by a court-martial for one year, rejoining his command at Baton Rouge in the fall of 1811. Promoted to be lieutenant-colonel June, 1812, he was sent to Philadelphia to organize troops for the field, but on application was ordered to the Niagara frontier, reporting to Gen. Smyth Oct. 4, near Buffalo. The attack on Queenstown occurred Oct. 13; Scott, declining to serve under Col. Van Rensselaer, his junior, did not participate in the carrying of the heights and battery, but Van Rensselaer being wounded, Scott was now ordered across to take command, and the battle was fought by him. After a gallant resistance he was overpowered, and, the militia refusing to cross to his support, he was obliged to surrender with his command. Held a prisoner until Nov. 4, he was exchanged soon after. In Mar., 1813, he was appointed adjutant-general with the rank of colonel, and the same month attained the colonelcy of his regiment. Reporting with his battalion to Gen. Dearborn on the Niagara frontier in May, he led the advance in the assault on Fort George, May 27, where he was severely wounded by the explosion of a powder magazine, but first to enter the work. In June he commanded the rear-guard in the retreat from Stony Creek to Fort George, and in connection with the navy made the descent on Burlington and York in September. In October he joined Gen. Wilkinson's army in Western New York, but the enterprise on Montreal being abandoned, he was ordered to Washington, and in Mar., 1814, promoted to be brigadier-general. Reporting to Gen. Brown at Buffalo, he established a camp of instruction, and entered upon the improvement of the drill and discipline of the troops with great zeal, bringing them to a condition of considerable efficiency when (July 3, 1814) the river was crossed and Fort Erie captured. Pursuing the retreating army, the battle of Chippewa (which see) ensued July 5, in which Scott greatly distinguished himself; the battle of Lundy's Lane (which see) next followed (July 25), where Scott was severely wounded after having had two horses shot under him. He was now (July 26) promoted to be major-general, and Congress voted him a gold medal. He was disabled by his wound until October, when, but partially recovered, he was ordered to Baltimore, then again threatened; thence to Washington, where he was engaged as president of a board on infantry tactics and of a court of inquiry in the case of Gen. Winder. Declining to act as secretary of war, he sailed for Europe in July, 1815, returning the following year, and soon after was married to Miss Maria Mayo of Richmond. In 1818 he commenced the preparation of *General Regulations of the Army*, and in 1826 his *System of Infantry and Rifle Tactics*. Ordered to the North-west in the Black Hawk war, he arrived just after the defeat of the Sac Indians at Bad Axe (Aug. 2), which virtually ended the war. During the nullification troubles (1832–33) Scott was ordered to South Carolina, where, by a conciliatory policy and delicate management, a collision between the "nullifiers" and the U. S. troops was prevented. His next service was in Florida and the Creek Nation against the Indians, but being charged by Gen. Jesup with dilatoriness, he was superseded by that officer, and a court of inquiry ordered, which resulted in a verdict of acquittal and approval of Scott's conduct. The Canada border troubles (1837–38) next demanded his attention, followed in 1838 by the duty of emigrating the Cherokee Indians to the upper Arkansas, and in 1840–41 he was engaged in Maine during the disputed territory controversy, conducting the management of each of these delicate and important duties with great judgment and success. In June, 1841, he succeeded to the command of the army as

general-in-chief. In the war with Mexico he was ordered in Nov., 1846, to take command. Assembling his troops at Lobos Island, from whence he moved in transports in February, a landing was effected (Mar. 9) at Vera Cruz. The place was at once invested on the land side, and surrendered, together with the castle of San Juan d'Ulloa, Mar. 29. (See VERA CRUZ.) The battle of CERRO GORDO (which see) was fought Apr. 18, and Jalapa occupied next day; Worth's division, in advance, occupied Puebla, where it was joined by Scott with the reserve by the end of May. Awaiting reinforcements and supplies, the army was delayed here until August, on the 7th of which month the advance was resumed with 10,738 men. The battles of Contreras, Churubusco, and San Antonio (see CHURUBUSCO) were fought Aug. 19–20, and on the 24th an armistice was concluded and negotiations entered into between commissioners. Failing to agree upon terms, operations were resumed Sept. 7, and on the 8th the battle of MOLINO DEL REY (which see) was fought; the heights of CHAPULTEPEC (which see) were carried Sept. 13, as well as the San Cosme and Belen gates of the City of Mexico, the army entering the next day (Sept. 14). A contribution of $150,000 was levied on the capital, and taxation for revenue imposed to the amount of $70,000. The sum of $118,000 was sent by Scott to Washington to serve as the basis for the establishment of an army asylum. The Guadalupe-Hidalgo treaty of peace, signed by the commissioners Feb. 2, 1848, was ratified by Congress. Declining the proffered presidency of the Mexican republic, Scott, having been superseded by Gen. W. O. Butler, and a court of inquiry ordered in his case, arrived in New York May, 1848. Congress in March had extended to him a vote of thanks and authorized a gold medal. In June he was a candidate for nomination in the Whig convention which nominated Gen. Taylor for the Presidency. In 1852 he received the nomination from the Whig party, but was signally defeated by Franklin Pierce, carrying but four States—Vermont, Massachusetts, Kentucky, and Tennessee—though receiving a large popular vote. In 1855 the rank of lieutenant-general by brevet was conferred upon him. In 1859 he was sent to Puget's Sound to arrange the difficulty caused by the occupation of San Juan Island by Gen. Harney.

Though too infirm to undertake the conduct of the army in the great civil war, Gen. Scott unhesitatingly threw the weight of his influence in favor of his government, and in the exciting events preceding actual hostilities rendered important service. On Nov. 1, 1861, he was retired from active service, but without reduction of pay or allowances. He published his *Autobiography* in 1864. D. at West Point May 29, 1866. G. C. SIMMONS.

Scot'ticisms are words and expressions proper to the Teutonic speech of North Britain, with which literary English is often corrupted, particularly in parts of the U. S. occupied by a population derived from Scotland and North Ireland. Sir Walter Scott carefully excluded them from his works as he discovered them, but *suddenty* for "suddenness" remains; and attention was called to them by John Sinclair, M. P., in his *Observations on the Scottish Dialect* (1782). (See also Jamieson, *Dict. of the Scottish Lang.*, revised ed. 1867.) In lecturing, George Combe used *pate* for "head;" a reviewer detects a traveller as Scotch from the expression, "We were not long *of* finishing our breakfast;" and in the U. S. we may trace a Scotch ancestry by expressions like *anunder* ("under"), *backset* ("relapse"), *begrudge* ("grudge"), *bladherskite* ("babbler"), *big-coat* ("great-coat"), *bore-tree* ("elder"), *bowl* ("basin"), *bullirag* (to use abusive language), *chap* or *chappie* ("fellow"), *check* (slight repast), *chuck* ("throw"), *clash* (slanderous talk), draw *cuts* ("lots"), a *cut* of yarn; *fornent* ("opposite"), *glasses* ("spectacles"), *a gone man*, not a *hait* ("whit"), *keel* ("ruddle" or "red chalk"), *killogue* (to "plot"), no *objections* ("objection"), *red* ("comb out") the hair, a *redding* comb; *red up* ("arrange") a room; *Sabbath* (Sunday); *scrunty* ("stunted"); *so* ("as") soon as, used by Hume; *slippy*, *storm-staid*, *summons* (summon), *sundown* ("sunset"), *swap*, *swingle-tree*, *tantrum*, a *tin* ("tin cup"); *what's your will*, *trap* (to get the place of a higher pupil by a correct answer), and many others. Some of these are also Irish, a dialect which seems to have given us *deck* (a pack of cards), *renig* or *renegue* ("revoke" at cards), and perhaps *nither* ("neither"), as well as the archaic *nayther*. S. S. HALDEMAN.

Scottish Language and Literature. See ENGLISH LANGUAGE AND LITERATURE.

Scottow (JOSHUA), b. in England in 1615; came to Boston, Mass., in 1634; became a captain of militia, was confidential agent of La Tour in his negotiations with the colonial government 1654–57. D. at Boston Jan. 20, 1698. Author of *Old Men's Fears, etc.* (1691), and *A Narrative of the Planting of the Massachusetts Colony, etc.* (1694).

Scott River, p.-v. and tp., Siskiyou co., Cal. P. 446.

Scotts'boro, p.-v. and tp., cap. of Jackson co., Ala., on the Memphis and Charleston R. R., has 2 churches, good schools, 2 newspapers, 1 steam-mill, several cotton-gins, and 3 hotels. P. of v. 357; of tp. 1443.
A. SNODGRASS, ED. "HERALD."

Scotts'burg, p.-v., cap. Scott co., Ind., on Jeffersonville Madison and Indianapolis R. R., 79 miles S. of the latter place. It was laid out in 1873, and has 2 churches, good schools, 1 newspaper, 3 hotels, and several large mills and shops. Principal business, manufacturing lumber and barrel-staves. P. about 500.
JOHN H. J. SIERP, ED. "SCOTT CO. DEMOCRAT."

Scott's Creek, p.-v., Jackson co., N. C. P. 529.

Scotts'ville, p.-v., Bibb co., Ala. P. 955.

Scottsville, p.-v., cap. of Allen co., Ky. P. 217.

Scottsville, p.-v., Wheatland tp., Monroe co., N. Y. P. 119.

Scottsville, p.-v. and tp., Albemarle co., Va., 79 miles W. of Richmond, on James River, has 5 churches, 2 public schools, 1 bank, 1 newspaper, 2 hotels, and 1 large mill. Principal business, farming. P. of v. 388; of tp. 5994.
DAWSON & MAHONEY, EDS. "COURIER."

Scott Valley, tp., Siskiyou co., Cal. P. 1259.

Scott'ville, p.-v. and tp., Macoupin co., Ill. P. 1440.

Scotus (DUNS). See DUNS SCOTUS.

Scotus (JOHANNES). See ERIGENA.

Sco'ville (JOSEPH A.), b. in New York in 1811; was long engaged in journalism in his native city, where, during the war, he was correspondent of the London *Herald* and *Standard* over the signature "Manhattan," and became clerk of the common council. D. in New York June 25, 1864. Author of *The Adventures of Clarence Bolton, or Life in New York, Marion* (London, 3 vols., 1864), *Vigor* (1864), and of a work of curious and entertaining research and anecdote, *The Old Merchants of New York, by Walter Barrett, Clerk* (4 series, 1861–66).

Scran'ton, p.-v., cap. of Jackson co., Miss.

Scranton, city, cap. of Lackawanna co., Pa., in Lackawanna Val., 150 m. W. of New York. Founded in 1840 by the Scrantons, it is now the third city in size and importance in Pennsylvania. It is the southern terminus of the Delaware and Hudson Canal Co.'s R. R., which extends to Montreal; the northern terminus of the Lehigh and Susquehanna division of Central R. R. of New Jersey and of the Bloomsburg division of Delaware Lackawanna and Western R. R.; the Delaware Lackawanna and Western R. R. passes through it. A street railway diverges to four parts of the city. It derives its thrift from the operations of numerous collieries within its borders, from its immense rolling-mills and steelworks, its furnaces, its ironworks for manufacturing rails, locomotives, and mining machinery unequalled in America. It manufactures brass and iron castings, coal screens and sieves, huge steam-boilers, stoves and hollow-ware, files, coaches and carriages, silk fabrics, sash and blinds, edge tools of every kind, and turns wood, leather, sheet iron, and brass into useful contrivances. It has 2 daily and 6 weekly papers, 12 banks, 15 incorporated companies, 33 churches, 1 nunnery, 1 opera-house, 2 incorporated benevolent institutions, 2 waterworks, 1 gas company, 1 public library, 6 fire companies and 3 steam fire-engines, 1 driving park, and the largest collection of Indian stone relics in the world. P. in 1860, 9223; in 1870, 35,092; in 1876, 50,000. H. HOLLISTER,
AUTHOR OF "HISTORY OF LACKAWANNA VALLEY."

Scranton (JOSEPH H.), b. at Madison, Conn., June 27, 1813; was in early life a clerk at New Haven; entered into business at Augusta, Ga.; settled in the coal-region of the Lackawanna Valley 1847, and with the aid of other members of his family built up the vast iron and coal interest which has in thirty years converted a country hamlet of two or three houses into the city of 50,000 souls which bears his name; was successively for twenty years the manager, superintendent, and president of the Lackawanna Iron and Coal Co., and president of railways, manufacturing and banking institutions. D. at Baden-Baden, Germany, June 6, 1872.—His brother, GEORGE W., b. at Madison, Conn., May 23, 1811; removed to Oxford, N. J., when eighteen years of age; engaged in the iron and railroad business; was one of the founders of Scranton, Pa., president of Lackawanna and Western and Cayuga and Susquehanna R. Rs., and member of Congress from 1859 until his death, at Scranton Mar. 24, 1861.

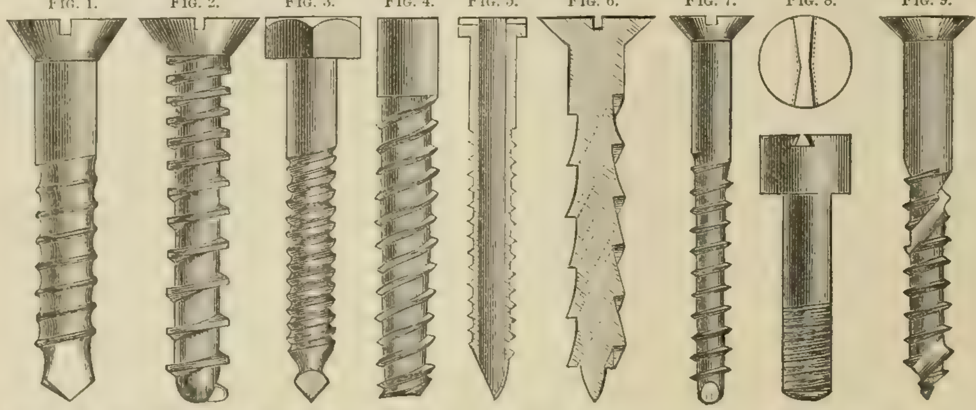
Scream'er, a name given to a South American bird representing the family PALAMEDEIDÆ (which see).

Screw-Pine. See PANDANACEÆ.

Screw Propeller. See STEAM NAVIGATION.

Screws [O. Fr. *escroe*], one of the elementary mechanical powers, so called, is composed of an inclined plane wound spirally around an axis in what is commonly termed a screw. The spiral thread or fillet is provided externally upon a core or stem. In a nut or hollow screw the thread or fillet is provided upon the cylindric inner circumference of a square, polygonal, or other suitable-shaped block or piece. The two varieties of screws are always used in connection with each other, that first named passing into or through the other. The modifications of the screws are too many for enumeration in this brief article, and their peculiarities too varied for extended description here. Screws vary from the micrometer screws used for graduating lines, circles, and scales of mathematical and astronomical instruments to the huge wooden screws employed in the ruder kinds of hop, hay, cotton, and cider-presses, for which latter, it may be remarked, the wood of the birch tree is commonly preferred on account of its solid strength and fineness of grain, which give a comparatively smooth surface to the threads. Screws are used for lifting weights, as in the well-known screw jack; for compressing materials, as in the presses above referred to; for fixing bodies together, as in carpentry, joinery, the making of frames for machinery, and many other operations, and for transmitting motions from one part of a machine to another. The size, proportions, and general construction of the screw must of course vary according to the purpose to which it is to be applied. The same remark applies also to the method by which screws are manufactured. The best example of a screw applied to the transmission of motion is found in the common engine-lathe, in which a screw operates the slide-rest in due ratio with the rotation of the shaft or other article to be turned in the lathe. The fabrication of these screws say, from five to twenty or even more, was formerly a complex, laborious, and imperfect operation, but by the use of the engine-lathe, in which the slide-rest is itself actuated by a screw, screws of this kind and others of similar nature may be made with the utmost exactness and accuracy of finish, and at a small cost compared with former methods. As an example of the state of the art not more than thirty years ago, may be mentioned one of the methods of originating screws, which was simply to wrap a small wire in close coils around a larger wire, and to take an impression thereof between two pieces of hard wood, the hollow or counterpart thread thus indented in the wood serving as a guide in cutting the screw. One of the most common examples of the screw and nut pure and simple is that afforded by the common carriage-bolt. This has a portion of its shank or stem squared, in such manner that when fitted into a hole or socket of corresponding shape it will be kept from rotation, and also has on its squared end a head commonly of circular form; the opposite or cylindric end of the shank is threaded and furnished with a hollow screw or nut; the shank is passed through suitable holes provided in the materials to be clamped between the head and the nut. This simple form of screw has perhaps 100 uses in the arts. Another simple form is the set screw, in the use of which the nut or hollow screw is commonly tapped in the mass; as, for example, the frame of a machine to which something is to be fixed by the set screw. The threads on screws like the carriage-bolt and the set screws are formed by dies worked either by hand or machinery, which are gradually compressed upon the metal until spiral curves are formed with the metal for the threads upset between them. The nuts or hollow screws

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 9.



are formed by taps, which are devices constructed with spirally-arranged teeth, which by being turned in a hole of suitable diameter displace the metal to form the spiral screws with the thread between them, in a manner analogous to that by which the threads are formed externally upon the screws themselves. In screw-hooks, which are used for suspending pulleys from rafters for hoisting hay with horse-pitchforks and various other purposes, the straight shank of a hook is provided with a deep thread, the front surface of which should be as nearly as possible at right angles to the length of the shank, in order to secure a firmer hold upon the wood, the requisite edge to the thread being secured by sloping the back thereof; the threads of such screws may be cut in a lathe, but greater strength is secured by forging the screws on the metal at an ordinary forging heat, although in some cases the threads have been successfully formed by rolling the cylindric shank between two suitably-grooved surfaces; this plan having also been successfully adopted in the fabrication of that variety of set screws sometimes used for fastening planking and scantling together, the thread in such cases imbedding itself in the surface of a hole of suitable diameter previously bored in the wood for the screw.

Wood-screws—so termed because used successfully in wood work, and which must not be confounded with *wooden screws*—constitute a class by themselves, and there are few articles that illustrate more clearly the gradual growth and development experienced in every branch of manufacture. The blanks for making wood-screws were formerly forged out by nailmakers; the next step was the cutting of the blanks from rolled round iron; the heads were formed on these by pinching them while red hot between dies; and the threads were cut by means of a file. A great number of machines, rude at first, but gradually approaching the comparative perfection of the present time, were devised, until now the blanks are cut and headed from coils of wire, and being transferred to a second machine have the heads turned and nicked and the shanks turned and threaded by automatic mechanism, until the screws drop complete into a receptacle. Until within about thirty years the wood-screws were blunt at the end, so that a gimlet-hole had to be bored for their reception. At the period referred to Thomas J. Sloan, an American inventor, originated the gimlet-pointed screw now in universal use, and devised the machinery still employed in its manufacture. It is true that before him an English inventor had proposed to put the tapering point of a gimlet upon the end of the screw, the pitch of this gimlet-point being different from that of the screw itself. As a consequence, the thread of the point and the thread of the screw acted against each other, and the idea was futile. In the Sloan screw the pitch of the body of the screw was continued down to the point; the depth of the thread and its thickness, but not the pitch, being diminished to the very extremity of the thread; it was this slight difference in shape that produced a revolution in the industry, and affords an example of the immense industrial importance from changes that at first sight appear trivial: not only has the screw itself been made better, as it requires no hole previously formed for its reception, but the machinery for making it has been so improved in comparison with that previously in use that the difference in the first cost of the crude material—*i. e.* iron wire—when bought in large and small quantities, is more than the entire cost of making the screws. A simple device added to the machine to remove the slight bur left by the saw in cutting the nick in the head of the screw saved the Eagle Screw Co. of Providence, R. I., $97,000 in fourteen years—an index alike of the value of small inventions and the magnitude of the screw manufacture.

Many modifications of the wood-screw have been pro-

posed in recent years. Among these may be mentioned Barrett's screw (Fig. 1), patented in 1873, which has a drill-point in place of a gimlet-point. In the same year Biswell & Chisholl patented a screw made of Bessemer or homogeneous steel wire. In the same year Russell patented his wood-screw (Fig. 2), having a thread gradually decreasing from the point throughout the whole of its length. The Burdick screw (Fig. 3), also patented in 1873, was of peculiar form, having ovolo screw-threads and being provided with a harpoon-point. The Matthews screw (Fig. 4) of the previous year was formed with a smooth cylindrical neck, and had no nick, and was driven by a kind of clamp, instead of by a screw-driver. Will's screw (Fig. 5), also patented in 1872, had a spoon-shaped point for tapping the wood as the screw was inserted. Stockton in 1873 patented a hammer-driving screw (Fig. 6), having triple driving-threads slanting rectangular to the core, with a conical point; while Bourn, also in 1873, produced a wood-screw provided with a flattened point having a circular cutting edge (Fig. 7). Armstrong's patent (1872) described a screw provided with a nick widening from the centre toward the circumference (Fig. 8), to allow the edge of the driver to be pressed up and wedged near the centre. Ladd & Corning the same year patented a wood-screw provided with a peculiar cutter and point, in substance a combination of a German twist-bit with the screw (Fig. 9), in such manner as to cause the screw to cut its own hole into the wood, instead of pressing the latter laterally. JAMES A. WHITNEY.

Scri'ba, p.-v. and tp., Oswego co., N. Y. P. 3065.

Scribe (AUGUSTIN EUGÈNE), b. at Paris Dec. 24, 1791; studied law; wrote in 1811 his first play, *Les Dervis*, which failed; achieved his first success in 1816 with *Une Nuit de la Garde nationale*, written in connection with Delestre Poirson; provided from 1816 to 1820 the Théâtre de Vaudeville and the Théâtre des Variétés with as many vaudevilles and small comedies with songs as they could perform; wrote for the Gymnase between 1820 and 1830 about 150 plays, mostly one-act comedies of a sentimental or satirical character; composed, finally, from 1830 to his death, Feb. 20, 1861, more than 100 plays in three or five acts, historical, satirical, and even tragical, for the Théâtre Française and other houses, besides a similar number of opera librettos for Boieldieu, Adam, Auber, Donizetti, Meyerbeer, Verdi, and other composers, and some novels and romances. Of his dramatic works, numbering about 400 plays, there exist various collections—one in 20 vols. (1833–37), and another in 26 vols. (1855–58); a collected edition in 50 vols. is now publishing. Most of these plays he produced in connection with some other playwriter—Germain Delavigne, Mélesville, Bayard, Dupin, Legouvé, etc.—and at one time, between 1820 and 1830, this artistic copartnership was organized in thorough business style; one made the plot, another sketched the characters, a third wrote the dialogue, etc. After 1830, however, it became necessary to be a little more careful in order to satisfy the public. In general, his success was complete. For nearly forty years he reigned supreme in all the theatres of the world; he was courted and flattered, and he left a large fortune. Nor can it be said that his success was entirely undeserved; his plots have a novelty and originality, their movements an adroitness and rapidity, and the dialogue an eloquence and piquancy, which always will be of value; but his picture of characters is so superficial, and of passions and sentiments so untrue, that generally his plays cannot be enjoyed. The best are his earlier one-act comedies, such as *Les premiers Amours*; the worst are his later historical dramas in five acts, such as *Bertrand et Raton* and *Le Verre d'Eau*. To judge him rightfully, however, he must not be compared with Sardou, who succeeded him, but with Diderot and Kotzebue, whom he succeeded. He then appears as he is—in poetical respects a bungler, in theatrical a master.

Scribes [Heb. *shoterim*, "writers"], officers already in existence among the Israelites in Egypt (Ex. v. 6–19) and in the desert (Num. xi. 16), whose business apparently it was to keep the genealogical registers, serve processes, and the like. In Palestine they appear to have been chosen from the Levites (1 Chron. xxiii. 4; 2 Chron. xix. 11; xxxiv. 13). From the time of Ezra (fifth century B. C.) they were expounders of the Law. In the New Testament they are generally named in connection with the Pharisees, and are noted for their hypocrisy, ostentation, and arrogance. R. D. HITCHCOCK.

Scrib'ner (CHARLES), b. in New York City in 1821, son of Uriah R. Scribner, a prominent merchant and a member of an old family of New York; was educated at New York University and at Princeton, where he graduated 1840; studied law for three years, and was admitted to the bar, but never practised the legal profession; began the business of book-publishing in the old "Brick Church" in partnership with Isaac D. Baker in 1846, under the style of Baker & Scribner. In 1850, Mr. Baker died, and the business was thenceforth carried on in Mr. Scribner's name. Among the works he successfully brought out may be enumerated those of Donald G. Mitchell, N. P. Willis, Prof. Guyot, Dr. J. G. Holland, G. P. Marsh, Drs. Bushnell, Schaff, Noah Porter, and W. G. T. Shedd. In 1870 *Scribner's Magazine* was established. D. at Lucerne, Switzerland, Aug. 26, 1871.

Scriptures, Holy. See BIBLE, THE, by PROF. W. G. SUMNER, A. B.

Scri'ven, county of E. Georgia, on Savannah and Ogeechee rivers, has a level sandy surface, largely covered with pine timber, and is traversed by Central R. R. of Georgia. Staples, Indian corn, sweet potatoes, and cotton. Cap. Sylvania. Area, 540 sq. m. P. 9175.

Scrive'ner (FREDERICK HENRY AMBROSE), LL.D., b. at Bermondsey, England, Sept. 29, 1813; graduated at Trinity College, Cambridge, 1835; was for many years master of classical schools, especially that at Falmouth, where he was also incumbent of a church 1846–61, since which time he has been rector of Gerrans, Cornwall. He has taken a high rank in the philological criticism of the New Testament; has published valuable editions of the *Greek Testament* (1860) and of the *Codex Bezæ* (1864), a *Full Collation of the Codex Sinaiticus with the Received Text of the New Testament* (1863), and the *Cambridge Paragraph Bible, with the Text Revised and a Critical Introduction prefixed* (1873); is author of a *Plain Introduction to the Criticism of the New Testament* (1861; 2d ed., revised and enlarged, 1874), and other works of kindred character; was appointed one of the company of revision of the authorized version of the New Testament 1870, and was granted a pension from the civil list 1872, "in recognition of his services in connection with biblical criticism."

Scrive'ner's Pal'sy, or **Writer's Cramp,** a derangement of the motor nerves of the fingers and thumb of the right hand, caused by over-exercise with the pen, combined with inattention to the mechanism of the arm. It may also attack musicians, milkers, seamstresses, shoemakers, and others who employ to excess the same nerves, but is then generally known by other special names, such as "cobbler's spasm." It is frequently attended with spasmodic and uncontrollable movements of the fingers. It should be treated with tonics, particularly iron, and galvanism has been employed with good effect.

Scrof'ula [Lat. *scrofa*, "a breeding sow," swine being affected by a similar disease]; also known as **Struma** (from Lat. *struere*, to "build"), since the lymphatic glands are enlarged in this condition. Persons of the lymphatic temperament are most liable to develop the marked symptoms of struma or scrofula. Scrofula is hereditary in many families. In many other persons it arises *de novo* from bad hygiene and regimen, especially in children when rapidly developing. Disordered digestion, uncleanly skin, deficient clothing, foul air, are its causes. Many symptoms of disordered blood-states formerly grouped as scrofulous are now distinguished as having definite causes. Eczema, though often an exponent of struma, is as often due to other causes—nervous influences, rheumatic taint, gastric and intestinal derangements. The scrofulous person is light-complexioned, the skin is white, the body often full, or even obese, but the muscles soft and flabby. In the child the head is large relative to the body, the eyes full and white, the teeth white, tending to fracture and early decay. The chest often lacks symmetry, the breast-bone prominent, the bones of the arms and legs often are unduly long, with prominent bulbous extremities. Such conditions, more advanced, constitute the "rickets." The chief characteristic of scrofula is the susceptibility of the glandular system. Either persistently or with every slight impairment of health the glands of the neck, groin, abdomen, etc. become indurated and enlarged. Such swellings may be evanescent or leave permanent indurations. The glands of the neck frequently are so engorged with "scrofulous" exudative matter that it becomes "caseated"—a state of fatty degeneration—or actually suppurates, producing scrofulous abscess. Scrofula is not, then, a definite specific disease, but a condition of serious perversions of the nutritive qualities of the blood, and resulting affections of the various tissues and organs of the body. Enlarged glands, moist skin diseases, superficial abscesses, unsymmetrical developments of the teeth, nails, and bones are some of its manifestations. Inherited scrofulous taint may remain latent until developed by depressing sickness. Thus, measles, a harmless disorder in robust children, is hazardous when struma lurks in the system. The bottle-fed infant and the foundling are more often scrofulous than the nursed, home-reared child. The mucous and serous surfaces are very

liable to disease in struma,—subacute and tubercular meningitis, hydrocephalus, chronic bronchial catarrh, diarrhœa and cholera infantum, and marasmus. The relation of scrofula and the pulmonary tuberculosis of adults is disputed. That strumous and scrofulous persons are very liable to develop phthisis is, and has always been, generally conceded. Very prominent pathologists to-day regard scrofula and tuberculosis as separated only in degree. The discovery by the microscope that yellow tubercle is merely "caseous" or fatty metamorphosed matter, and gray tubercle an exudation or deposit rather than a definite structure, supports this view. The disastrous effect of pulmonary tubercle depends largely upon the preceding low blood-state, largely upon the close structure and functional disturbance of the lung invaded. Simon terms scrofula the soil for tubercle; Wilks calls scrofula a primary tubercle, a secondary form of a common disease. A majority of cases of pulmonary consumption are, however, disconnected with scrofula or struma, the result of preceding inflammatory processes in the pleura, bronchial tubes, or lung-tissues. The treatment of scrofula is hygienic and nutritive—warm clothing, bathing, friction to the skin, pure air, correct rich diet, special articles of diet, as the hydrocarbons or fats and preparations of phosphates. Iron, iodine, and arsenical preparations act as alteratives to reduce glandular enlargements.
E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Scrophularia'ceæ [from *Scrophularia*, one of the genera], an important natural order of gamopetalous exogenous plants, of nearly 160 genera and 2000 species, mainly herbs, natives of nearly all parts of the world. It is characterized by the bilabiate or more or less irregular corolla, didynamous, or by suppressive diandrous stamens, two-celled ovary, and mostly indefinitely numerous seeds, containing a small and narrow embryo in copious albumen. Bitterish, somewhat acrid, emetic, or narcotic and sedative properties prevail, but the only plant of medicinal importance is foxglove (*Digitalis purpurea*), which is also commonly cultivated for ornament. Other plants of the order largely cultivated for ornament are snapdragon, *Calceolaria*, *Pentstemon*, *Mimulus*, *Veronica*, and one tree—namely, *Paulonia* of Japan. ASA GRAY.

Scrub'grass, tp., Venango co., Pa. P. 997.

Scru'ple [Lat. *scrupulus*, a "small stone"], in apothecaries' weight, is one third of a drachm, 20 grains, the $\frac{1}{288}$th part of the pound Troy. The Romans gave the name *scrupulum* to the $\frac{1}{288}$th part of any standard unit of measure.

Scud'der (HORACE ELISHA), b. at Boston, Mass., in 1838; graduated at Williams College 1858; was for several years editor of *The Riverside Magazine* (Cambridge, 1867 *seq.*), and became a resident of New York City 1875, devoting himself to literature. Author of *Seven Little People and their Friends* (1862), *Dream Children* (1863), *Life and Letters of David Coit Scudder* (1864), *Stories from my Attic* (1869), and other works for the young.

Scudder (JOHN), M. D., b. at New Brunswick, N. J., Sept. 3, 1793; graduated at Princeton 1811; became a physician in New York, where he was house-surgeon to the city hospital; abandoned an extensive practice to devote himself to missionary work; studied theology; was ordained 1819 in the Dutch Reformed Church; was a missionary physician of the A. B. C. F. M. at Tillipally, Ceylon, 1820–39, after which he was transferred to the Madras mission; spent several years (1842–46) in the U. S., visited the Cape of Good Hope for his health 1854, and d. at Wynberg, South Africa, Jan. 13, 1855. Author of several publications on missionary subjects. His labors in the establishment of hospitals and schools in India were very successful. His ten children, eight sons and two daughters, all became missionaries in India; most of them are also physicians. (See his *Memoir*, by Rev. J. B. Waterbury.)

Scudéry', or **Scudéri, de** (MADELEINE), commonly called MADEMOISELLE SCUDÉRY, b. at Havre June 15, 1607; was educated in Paris; became one of the most conspicuous figures in the literary circle of the Hôtel Rambouillet, and acquired great celebrity by her romances, *Ibrahim* (4 vols., 1641), *Artamène, ou le Grand Cyrus* (10 vols., 1649), *Clélie* (10 vols., 1656), *Almahide* (8 vols., 1660), etc.; formed, after the reunions of the Hôtel Rambouillet had been broken up by the disturbances of the Fronde, a *salon* of her own, frequented by the queen and the princes. D. at Paris June 2, 1701, honored and loved, though her celebrity had gone. In artistic respects she has hardly made anything but blunders, but her work was nevertheless not bad or useless. In a time of confusion and violence, when brutal passions and gross sensuality defied every moral or social rule, she placed before the public a picture of the most watery sentimentalism, the tamest moral correctness, the flattest social elegance. The stronger elements of the French civilization, such as the Port Royalists, Bossuet, Boileau, etc., condemned and ridiculed her, for they saw that what she offered was simply the opposite extreme to the reigning ideal of the age. But people in general were struck by the contrast. They found in her books a help against their own brutality, a refining and elevating enthusiasm. To read one volume of one of these romances or *Conversations* or *Entretiens* is very amusing, and throws a stream of electric light on *Les Précieuses ridicules* and *Les Femmes savantes* by Molière.

Scu'do [It. for "shield"], a coin of Italy, now equal to five lire or francs, and nearly equivalent to our dollar. Many different scudi have been struck by the numerous powers which have prevailed in Italy, and their values are extremely various.

Scuf'fletown, p.-v., Laurens co., S. C. P. 1797.

Scull'ing, rowing with one oar (called a scull) in each hand. The principles of the art of sculling are very similar to those of ROWING (which see). The main difference is in the "finish" of the stroke. Instead of drawing the hands up to the chest at the end of the stroke, they are drawn down past the sides to the waist, thus bringing the sculls gradually out of the water, instead of lifting them out suddenly. Among nautical men, sculling means a peculiar way of propelling a boat by the rotation of a single oar at the stern of a boat. It is only used occasionally and for short distances. G. L. RIVES.

Scul'pin, a name having reference to the spines of the skull, and given to various species of acanthopterygian fishes belonging to the family Cottidæ. They are distinguished by the rather stout, club-shaped body and large head, the spines with which the head is armed, and the naked or simply rough body: the mouth is quite large. They are very destructive to other fishes and are a nuisance to the angler. The common sculpins of the Atlantic seaboard are species of the restricted genus *Cottus* (or *Acanthocottus* of Girard). The best known are the *Cottus octodecem-spinosus*, which is the most southerly species, and the *Cottus groenlandicus*, which is the most common N. of Cape Cod. The name deep-water sculpin, or sea-raven, is applied to the *Hemitripterus acadianus*. On the Pacific coast the name is applied to corresponding species of the same genus. The species are rarely or never used as food except by the Greenlanders and the very poor. THEODORE GILL.

Sculpt'ure [Gr. γλάφειν; Lat. *sculptura*; It. *scultura*; Fr. *sculpture*; Ger. *Bildhauerkunst*], the art of carving in stone, marble, or wood, or of casting in metal, figures of men and animals, whether in the round or in relief. The term is much extended, so as to embrace the carving of ornament whether of natural or of conventional forms, the engraving of gems, and even engraving upon metal—the word *sculpsit*, he "carved" or "sculptured it," being continually affixed to the name of the engraver on steel or copper. But within the limits of this article we can only consider sculpture in the higher and more usual application of the term. For the rest, the art of engraving upon metal and wood has already been fully treated in these pages (see ENGRAVING); another branch of the subject is treated under ARCHITECTURE, while the articles GEM and CAMEO will be found to give the gist of all that is known on the subject of engraved stones.

It is now believed that the statues of the sheik Ra-em-ké, of Schafra (or Chephren), and of Ra-hotep and his wife or sister, Nefer-t, discovered by Mariette-Bey at Sakkarah, are the oldest statues in existence. The first of these, and the most remarkable, is of cedar-wood, the second is of diorite, and the other two are of limestone. The statue of the sheik Ra-em-ké is the least ancient of the four. It is ascribed by Mariette to the fifth dynasty (B. C. 3951). Next above it in antiquity is the statue of Chephren (fourth dynasty, B. C. 4235). The oldest are the figures of Ra-hotep and Nefer-t from the pyramid of Maidoum (third dynasty, B. C. 4449). Those who know Egyptian sculpture only by the later examples of the art, when it was subjected to the deadening and formalizing influence of hieratic ideas, can with difficulty believe in the greater antiquity of these statues discovered by M. Mariette, seeing how much more they are pervaded by a sense of life, and how much more closely they are modelled after nature. M. François Lenormant has remarked that art in Egypt appears to have followed a contrary direction in its development from that of any other country whose art is known to us. Other nations began with purely sacerdotal art, and only subsequently and by slow degrees attained to the imitation of nature. The Egyptians are the only people who began with following nature and ended by becoming the slaves of convention. In these Sakkarah statues the bodies have much of the stiffness and immobility familiar to us in Egyptian sculpture, although in even the modelling of the limbs and in a certain warmth of the contours there is much to praise. But it is in the expression of the faces

that we find the most to admire. Life has hardly ever been better rendered than in the face of the sheik, with its pervading benevolence, where the artist has known how to give the effect of a smile without our being able to ascribe it to any one feature of the face. It is a genial radiance, far removed from the grin of the Cypriote and Etruscan faces—far removed, even, from the smile which pursues us in the faces of that later Etruscan, Leonardo da Vinci. There are dignity and breeding, with something of homely simplicity, in the plain face of Nefer-t. She is a human being who has lived and suffered and enjoyed; while in the face of Chephren there is a look of good-natured assurance, and a turn about the shoulders and in the set of his head which agreeably modifies the formalism of his attitude, allowing the spectator to rest in the hieratic symbolism if he will, or to indulge a sympathetic movement toward the monarch as toward a man and a brother. Two points must be noticed even in so brief a review as this. One is, that even in our own day, when so many tricks are played with marble, it would be difficult to conceal and yet show the contours of the body under drapery better than is done in the statue of Nefer-t. Another is, that the statue of Ra-em-ké, made as it is of cedar and mimosa wood, is covered with a thin coating of stucco, on which the flesh-tints were laid, the eyeballs formed of pieces of opaque white quartz, in the centre of which are inserted rounded bits of rock-crystal to represent the pupils. Under each crystal is fixed a shining nail, which indicates the visual point and gives an expression of life. Supposing this statue to have been undoubtedly made at the epoch assigned to it, what a notion it gives of the antiquity of a country where such ingenuity and research had been arrived at at an epoch already long anterior to the oldest recorded dates of man's history! There is nothing childish nor of the plaything order in this statue of the sheik, and those who are disposed to sneer at its pretensions must remember that its processes merely antedate by a few thousand years those which the Greeks were delighting in when, according to our judgment, their art was in its prime. The sculpture of Egypt with which we are more familiar belongs to a much later period than that of the ancient empire or Memphian Egypt. Of this earlier period we have only selected three or four chief examples in illustration, but M. Mariette's discoveries at Sakkarah have been very numerous, and the ancient empire is well represented in its art-remains. After this era was ended there came a long time of confusion, and it was not until the eleventh dynasty (B. C. 3064), the date of the middle empire, or Theban Egypt, that the art of Egypt became purely sacerdotal, and was condemned to formalism and inanition. This was a necessary consequence of the idea that ruled in Egypt, and that imbued the religion, the politics, the laws, and the sciences, no less than the arts—the belief in a law of immutability that made life on this earth one uninterrupted being, without aspiration, without hope, without desire of change, and with no belief in the possibility of change; and the life after death was equally fixed. The statues of the gods and of the kings only reflected this passionless, calm beatitude. After the order of her history settled down into the hieratic rule the art of Egypt may be briefly dismissed as presenting only work interesting to the archæologist and to the historian. There was indeed, after a long period of formalism, a return to the greater naturalness that marked the earliest time, but this was but a flickering flame that soon gave out, and in the time of the Pharaohs had become utterly extinct. The sculpture of the Egyptians is almost entirely unideal, and consists of figures of the gods and in portraitures of kings and heroes. As these were objects of veneration, there was little scope allowed for imaginative treatment, which would have disturbed the attitude of the worshipper and interfered with the stability of the legend. It was the story of Byzantine repression in the history of the art of painting applied to sculpture. The priests dictated everything—not only the subjects, the style, the sentiment, but even the processes—and the result was a despotic uniformity during long periods of time. The Egyptians worked but little in marble, preferring almost any other material, a probable reason being that marble does not belong to the country. Some of their materials were harder to work than marble, and would almost defy the appliances of our own mechanical time. But in Egypt time and labor were all the machinery they had, and they cost nothing in that land of long life, of even climate, and of superabundant food. They cost nothing but human muscle and human tears. The Egyptians had rather more skill in hitting the expression of animal life than in getting human likeness. The cat, the fox, the hawk were well designed by them, though only the heads of these animals are represented as covers to the jars that contain their mummies. This is worth noting, as the Greeks and Romans only in a few instances did anything worth naming in this field.

Next in antiquity to the Egyptian, and more interesting because it had so much greater influence in shaping the art of other nations, is the Assyrian sculpture. Except when introduced into other countries merely as a fashion—as it was into Italy in the later days of the Roman empire—Egyptian sculpture was neither copied nor sought for outside its own country. It had no interest for other people, no attraction. This may have been owing to the isolated position of the country, and to its being out of the beaten track, for it is difficult for us to prefer the Assyrian sculpture, even as art, to that of Egypt. There is a grotesqueness about it, an affectation, a look as if the authors of it wanted to do something great and did not know how, besides a grossness and vulgarity in the type, that repel us from the art of Nineveh and Babylon. But we find Assyrian architecture and sculpture influencing first Cyprus, then Western Asia Minor, then Greece; and in each of these countries the study of its art begins with a time when Assyrian forms are everywhere suggested. It was not until 1842 that the discoveries of M. Botta at Nineveh enabled us to see that the art of Assyria is not derived through the works of other peoples, but as they themselves produced it; and the discovery was one of the most important of our times. The colossal bulls, the bas-reliefs of kings, with all their battles, hunting-scenes, and episodes of court-life, enable us to read their history almost as clearly, though not indeed with such minuteness, as we can that of the old Egyptians on their painted and sculptured walls. But the art of Assyria is rude and unideal, and far behind that of Egypt in real grandeur and refinement of expression. The finest specimen of Assyrian sculpture is the bas-relief of the wounded lioness, transfixed with darts, dragging herself along. Nothing grander in its way than this has ever been produced in the world. But in the portrayal of man the Assyrian failed. His Nimrod is not a hero; he is only a combed and curled Assyrian bull.

Greek sculpture had its rude beginnings in the island of Cyprus, and the light spread thence along the shores of Asia Minor and the islands of the Ægean to the peninsula, where it had its splendid culmination in Athens. In the Metropolitan Museum in New York we may see in the Di Cesnola collection the influences at work that were to join themselves together and produce a new sculpture that should recall none of them in its perfected examples. It took many hundred years, and thousands of workmen laboring in schools or associated in the carrying on of great public works, to produce the mass of work—good, bad, and indifferent—that was to form the public taste, create a public interest in art, and finally make possible the appearance of sculptors who had learned in ways unknown to themselves to distil in their alembics the pure essence of beauty out of a wilderness of roses with all its various loveliness and with all its irregularities, freaks, and abnormal growths. European museums, public and private, are crowded with the evidences of Greek and Asian-Greek skill in sculpture, their delight in form showing itself not only in their sculpture proper, but in their architectural ornament, their coins, their vases. Every city, every town, every district, had its productive centres, and they varied in innumerable ways. As far back as Homer it is evident that the most delicate as well as sumptuous taste prevailed, and was recognized as taste—made a part of the feelings of the common people. It was out of this superabundance that the final perfection came: and it is because we have it no longer that there is no longer perfect sculpture produced anywhere. In Greece, as in Egypt, the oldest statues seem to have been of wood, and Dædalus is the generic name given to all the early workers in this kind. About the years 575 and 525 B. C. we begin to hear of carvers of stone, of modellers in clay, of engraving on metal, and even on gems, and of casting statues in bronze. This points to a growing commerce and intercourse with older people, and from this time down we hear of progress in all directions. Soon the Parian marble began to be worked, and once the discovery made of this most beautiful of all the materials in which the sculptor can work, the progress toward perfection was rapid. But progress was not limited to one material. The Greeks sought perfection in all directions; and this universality of skill, which makes a Greek coin, a Greek vase, a Greek ornament of the best periods almost equal in artistic value, is another reason for the perfection they attained in sculpture. Artistically, the people were developed on every side, and the atmosphere was pervaded with creative talent as well as with the power to enjoy the productions of talent. The statues from the pediment of the temple at Ægina, now in Munich, the later found marbles from Selinus, now in Palermo, with the earlier coins and vases, enable us to trace the progress of the Greek-speaking peoples from the infancy of art to a point where a higher flight was not only possible, but might be looked for with confidence. That higher flight,

in which the last perfection was reached, is found in the sculptures of the Parthenon, in the Venus of Milo, and in a half dozen other pieces which have but one defect—their very perfection. For they stand at the gates of Endeavor with drawn swords, and "Thus far, and no farther," on their lips for the children of men. This is one reason why sculpture lags so far behind painting—that man, having once accomplished in that field the impossible, there is no longer any room for aspiration, and all that has been done since, or nearly all, is the fruit of slavish imitation, or of admiration that unconsciously moulds itself after what it admires. The most famous Greek sculptor of the great era was Phidias, born at Athens about 488 B. C. He made statues in bronze, in ivory, in marble. The most famous of the works ascribed to him—for much of what is commonly asserted with regard to him is clouded with doubts—are the sculptures of the Parthenon, the statues of the pediment, the high relief of the *metopes* and the low relief of the frieze, and a statue of the Olympian Jove at Elis, made of ivory and gold. The greater part of the sculptures of the Parthenon were brought to England by Lord Elgin, and are now in the possession of the English government; they are deposited in the British Museum. Others are owned by the French government, and are in the Louvre. The years immediately following Phidias produced a swarm of sculptors. This was the necessary consequence of the appearance of a man of genius, not the least of whose functions it is to develop the talent that lies about him and give it employment. The temples at Ægina, at Phigaleia, at Selinus, could not have created a revolution; they were merely temples amid a host of temples, and differed from them only by having served as a frame for sculptures whose chief value is that they show us how the Parthenon was prepared for. But Phidias appeared, and immediately every latent talent, every hiding genius, sprang to light. Assyria and Egypt, Cyprus and Rhodes, Chios and Samos, Dædalus and Rhœcus, were as if they had never been. Certain names have come down to us of this golden time, distinguished from the crowd of names that are only empty sounds—Polycletus of Sicyon; Myron of Eleutheræ in Bœotia, famous for his brazen heifer; Scopas of Paros; the Athenian Praxiteles; Lysippus of Sicyon. We have the names of the works executed by these artists, and plentiful details about their influence on their contemporaries and their characteristics, with anecdotes, epigrams, historical data, and, with all, the fewest possible proofs that we possess any of their works except in copies. Still, these copies are in most cases so beautiful that though we are not always sure they represent the statues whose names they bear, yet we cannot conceive of works more perfect; they themselves create the standard by which we must judge them.

The Romans did not, so far as we know, produce a single sculptor of eminence, but they had taste enough and sense enough to know the value of Greek sculpture, and they filled their temples, palaces, private houses, and public squares with statues brought from Greece or wrought in Italy by Greek workmen. Greece and her colonies were for long years a quarry whence the Roman people drew infinite riches. The Roman soil has in turn been a quarry whence all the states of Italy and of modern Europe have drawn the cloud of Olympian gods and goddesses and statues and busts of famous men that make their galleries places of pilgrimage. And yet it is known that there must still be a multitude of sculptures left in Greek and Asian ground. How easy to believe it when we know that Di Cesnola found 3000 statues heaped in the ruins of a single temple, and when we read of the discoveries in Lycia, at Ephesus, at Olympia, at Carthage, and in the Troad!

After the break-up of the Roman empire, and in the confusion that followed while the barbarians from without and the bourgeois population within were working together to construct a new society, there was no sculpture worth mentioning produced, partly because the times were not favorable to the production of art of any kind, and partly because the supply of sculpture left by the Romans was ample for all needs. The statues of the gods and heroes—such as had not been defaced beyond all recognition by the barbarians in their conquering fury, or by the early Christians in their fanatic zeal (though, thanks to the reverence or the superstition that animated some pagan spirits, many of them had been buried or walled up beyond the reach of either iconoclast)—such of these statues as still remained were utilized in ornamenting the new buildings which were being constructed out of the ruined structures of old Rome; and the same use was made of the ornamental carvings, the capitals, and the friezes. The sarcophaguses in which the old Romans had been buried were employed as altars for the Christian churches or served as receptacles for the bodies of Christian bishops or princes. The sculptures belonging to the early centuries of our era, even so late as the thirteenth century, show only a steady decline from even the debased standard of art that prevailed under the later Roman emperors. But in the first years of the thirteenth century a certain Nicola was born in Pisa who was the first to bring sculpture back to life again. He was inspired by the study of remains of classic art, especially, it is said, by the daily sight of a sarcophagus sculptured by a Greek artist. Trade with the East was now enriching Pisa as well as other Italian seaports, and a new zeal was stimulating there, as everywhere in the Peninsula, the building and adorning of churches, for which trade was willing enough to pay; so that Nicola Pisano, who, if he had been a century earlier, might have starved for occupation, now found his talent in universal demand. He is credited perhaps with a greater number of works than he really accomplished, but the pulpits in the cathedrals of Siena and Pisa and the tomb of St. Dominic at Bologna are sufficient to prove his power to have accomplished all that has been attributed to him. He was followed by a long line of sculptors—by his son Giovanni of Pisa (d. 1320), his pupil Arnolfo di Lapo (1232–1310), by Andrea Pisano, Andrea Orcagna, Lorenzo Ghiberti, Donatello. These notable names, with a cloud of others less distinguished or with only a local celebrity, took their light from Nicola's torch, and kept its flame alive. The sculptors more truly represent the spirit of the Italian people than do the painters who were their contemporaries, excepting only Giotto, who was more in sympathy with the joy-in-life of the classic time as opposed to the ascetic spirit that was attempted to be forced upon his countrymen by the so-called Christian spirit of the time. Giotto and Nicola Pisano, Giovanni Pisano, and Andrea Pisano (what three splendid stars in the little city's crown!) were the real beginners of the renaissance in art, and they wrote the beauty of holiness all over and about the churches of Italy in place of the gloom and terror with which Eastern Christianity would fain have filled them. The influence of these artists continued very late; and when Ghiberti in the year 1402 began his first gate for the Baptistery of Florence, we find him following closely the spirit and the arrangement of the gate which Andrea Pisano had made in 1330 from designs attributed to Giotto. By the time that Ghiberti was ready to begin the second gate, however, there had been such a change produced in the spirit of the time, and classicism had gained such a mastery, that the next period in the history of Italian sculpture takes a new departure, and looks back to Ghiberti and Donatello as its founders. Giotto and the Pisani are old-fashioned, antique, and the new men both in painting and in sculpture turned their backs frankly on the Galilean, and with Plato adored the dwellers on Olympus. The greatest sculptor of the new time was Michael Angelo (1474–1564), who produced but little, but of that little some part was worthy to stand beside the greatest of man's creating. The statues of the chapel of the Medici, the *Captives* of the Louvre, the *David*, the *Moses*, and the *Madonna* of Bruges make an inheritance such as no one other man ever left to the world. Other sculptors of this late time are Andrea Verrocchio (1432–88), Benvenuto Cellini (who, however, was hardly a sculptor in the true sense), Sansovino, and Luca della Robbia. But the works of these men (excepting Verrocchio), who belong to the times immediately preceding Michael Angelo, were the works of a decline that went forward with such rapidity that the art of sculpture in Italy expired at the end of the sixteenth century, along with her sister art of painting. Bernini (1598–1680), Algardi (1583–1654), and Canova (1747–1822) each in his turn attempted to restore life to the dead, but neither of these had skill to accomplish more than a galvanic resuscitation. Bernini is now laughed at by the Italians, who once adored him, and Canova is no more a name to charm by. Bernini was all sound and fury, signifying absolutely nothing. Canova was theatrical, affected, and vapid, but he had at times more refinement and sentiment (though both of an invalid sort) than had been seen for a long time; and he not only took the fancy of the French, Italians, Germans, and English, but had a great influence, and a most unhappy one, on modern sculpture. Thorwaldsen, a man of independent genius, was shorn of much of his strength by his admiration of Canova, and the modern Italians and the Englishmen of the last age are all followers or imitators of the same sculptor. Canova's principal works are the *Boxers*, the *Perseus*, the *Cupid and Psyche*, the *Graces*. Besides forming Thorwaldsen, he also influenced Bartolini, Dupré, Vela, and a number of lesser men, whose productions seem to condemn Italy to a mediocrity in art the more displeasing because her past has been so interesting.

Contemporary with the new birth of art in Italy was the growth of the art of sculpture in the countries N. of the Alps, where, but chiefly in France, the building of cathedrals and churches, many of them among the most important of man's feats in architecture, gave an opportunity

for sculpture such as has never been enjoyed before anywhere out of India. So much of the religion that made its shrines in these cathedrals came from the East, so much of the ornamentation of its architecture, with all its sacred symbolism, had that origin, one may almost be excused for conjecturing that the East, too, gave the notion of covering with statues the front of these mountains of stone and lining the mouths of the cavern doorways that gave admission to them. Certainly, only Egypt and India show the like; and though in the beginning the ideals of the sculptor have been formed on reminiscences of late Roman work, such as has been left by them in the provinces they once ruled, yet soon an independent spirit was manifest, and the so-called Gothic sculpture showed itself a new thing on the face of the earth, the first untaught, unfettered school of workers that had appeared since the old Greek days. The French sculptors of the thirteenth and fourteenth centuries were freer even than the Italians of the same date from classic influence, and succeeded better than they in creating an original school. Besides, their work was far greater in bulk, and, explored and studied as it has been by scholars and lovers, is only as yet known in part. Nor was its merit ever fully analyzed and done justice to until the appearance in 1866 of vol. viii. of Viollet-le-Duc's *Dictionary of Architecture*, where, under the head of "Sculpture," we have an exhaustive treatise on the subject of the mediæval sculptures in France, accompanied by illustrations. The Gothic architecture began, as is now known, in France—where even in its decline it was lovelier than it was anywhere else in its perfection—and from thence it spread westward into England, eastward into Germany, and southward into Spain. In each of these countries—but notably in England—it produced much exquisite sculpture, but the greater part of it has perished in these three countries, and even in France comparatively little remains. In Germany, in the fifteenth century, some interesting works were executed in stone and metal, chiefly by artists of Nuremberg: the tomb of St. Sebald, the masterpiece of Peter Vischer, the *Beautiful Fountain* with its statues by Schönhofer, the *Sacrament-house* of Adam Kraft, are works of a peculiar character, in which the art is more curious than beautiful, and which, in spite of the romantic interest that has gathered about them, as about almost everything connected with Albert Dürer's city, yet must, we fear, be admitted to belong to a period of decline.

If the history of sculpture were being written here, or only a sketch of it even had been attempted, it would have been necessary to follow in detail the list of sculptors in each country from the time of the Renaissance down to our own day. It would have been obligatory on us to show how sculpture, having remained dormant in England for over two centuries, at last, after some feeble effort at revival, did, as it were, smile in her sleep when John Flaxman came. There was hardly power enough in him, however, sweet as his spirit was, to rouse her to full life, and what he could not do was surely not to be done by Banks or Nollekens, or even in our own day by Gibson, by Westmacott, by Foley, or by McDowell. The art of sculpture in England has never mounted so high as Canova or Thorwaldsen, and from end to end of England not one masterpiece of statuary exists created by English hands.

In France things have been better; and indeed France is the only country where the spirit of the Renaissance survived in art. John of Bologna, born at Douai in the fifteenth century, left the greater part of his work in Italy —all the world knows his *Mercury*—but other Frenchmen dowered their own country. Jean Goujon (1530–72), Jean Cousin, and Germain Pilon, his contemporaries, gave an accent to French sculpture which they themselves learned from Italian art, and which Benvenuto Cellini himself had perhaps done much to teach them. These artists and their pupils and followers found employment in the decoration of the châteaux and palaces which in their time were rising all over France, and in the erection of sculptured architectural tombs—a fashion directly borrowed from Italy—over kings, warriors, and princes. They were followed after a long interval by men who made statues only, without reference to where they are to be placed—a practice which has since their day become universal. In the seventeenth century we have Puget, Coysevox, Girardon, the brothers Coustou, whose work is their own, alike in its defects and its excellences, but it never rises to the highest level nor gives any essential reason for being. In fact, it would seem that this age had nothing to say that it thought worth the saying, for all its utterances in art and literature are those of one who talks for talk's sake. Later in the eighteenth century we have the name of Houdon, whose statues of Voltaire and Washington, with his busts of Molière and Rousseau, have given him immortality as a portrayer of character. The *Voltaire* is indisputably one of the finest and most original of modern works. Another famous name is that of Rude, the author of the bas-relief on the Arch of Triumph, *The Departure;* and Barye, the sculptor of animals, just dead, made himself the greatest fame that has yet been achieved in that field. France has shown distinguished activity in the art of sculpture, and a multitude of clever works have been produced by her artists; but sculpture lives only by architecture and by monumental works, and without them dwindles down inevitably into the pretty, the temporary, the merely ornamental.

The history in Germany has been the same as in France, except that Germany never had so much life nor such fulness of life in her artistic world as were in France, and her list of great men, as well as of little-great men, is thin and poor compared with that of her western neighbor. Rauch and Rietschel are distinguished names, but their work has only superior science and skill to mark it as standing at all above that of the hundreds of craftsmen that in Germany, as all over Europe and in America, mould clay, chip marble, and melt bronze in obedience to what may be called the demands of trade.

In America it has been little better, but it is fair to say that outside of France no country has produced more respectable work in sculpture than our own within the short period of her national existence, leaving out of consideration the names of Canova, Thorwaldsen, and Flaxman. These were not men of genius, and America has produced no man of genius in sculpture; but the talent of these three, and their industry, aided by the wealth of their clients and their large employment, climbed higher than that of our best men has been able to climb. It may be doubted whether we shall accomplish much more in sculpture in our next hundred years than we have done in the first, for it is no longer the custom to call upon sculpture to fill out the shortcomings or add to the beauties of architecture, and the spare commissions of governments, with the uncertain employment of private persons, make it difficult for the sculptor to find a field of work. Yet with all these obstacles we have yet at the end of fifty years—for it is about fifty years since the first statue was cut in marble by an American—produced a few names that deserve not to be wholly forgotten. Horatio Greenough, Hiram Powers, Thomas Crawford, Henry Brown, Erastus Palmer, Thomas Ball, Quincy Ward,—these are the names of men who, though they cannot take any very high place among the illustrious artists of the world, yet have labored faithfully to show their love of art, and deserve at least the honor of having made a solid platform on which future artists can build more shining works. CLARENCE COOK.

Scup. See PORGY.

Scuppaug. See PORGY.

Scup'pernong, tp., Tyrrell co., N. C. P. 1121.

Scur'vy [Lat. *scorbutus*, a hybrid word from a Scandinavian root, *scorb*, and the Latin termination *-utus*], a diseased blood-state, induced chiefly by prolonged privation of fresh vegetable and animal food. Although not exclusively a sailor's malady, its ravages have been most disastrous at sea, devastating, previous to this century, the navies and merchant marine of all nations. Pizarro's squadron included 2700 men, of whom but 100 survived. Ships were often lost adrift at sea, the crew unable to work and perishing. Anson's English fleet in 1742 in nine months lost 626 out of 961 men. The chief cause of this pest of the marine was the exclusive diet—salt meat and hard, dry bread, with impure and deficient drinking-water—upon which sailors subsisted during prolonged voyages. Exposure to cold or to tropical heat, fatigue, and the unsanitary and foul condition of ships contributed to the development of scurvy. As early as 1617, Wodall recorded the virtues of lemon-juice in curing this disease, and in isolated cases its use and a vegetable diet saved the crews so treated. But not until the latter half of the eighteenth century were improved ship hygiene and vegetable diet at sea enforced. Thus, only thirty years after Anson's fearful loss, Capt. Cook sailed on a three years' voyage around the world, losing but one man by disease. Parry in three polar expeditions of a year and a half and two years' duration lost only 7 men out of 334. To-day, scurvy is almost unknown at sea, but it occurs occasionally on land, in garrisons and prisons, and in communities suffering from starvation. All of the symptoms of scurvy are directly connected with the impoverished, impure state of the blood. The fibrine of the blood is less and its coagulability decreased; the salts of soda are lessened, the red corpuscles are dark, poorly oxygenated, and tend to disintegrate. All parts of the body are correspondingly ill nourished. The face is cachectic and sunken, the body emaciated, the limbs are feeble and seem unduly heavy. The gums become dark, bloody, relaxed, and spongy. There is an early tendency for the vitiated blood to escape from its vessels—an occurrence favored

both by its thinned consistency and by the changed nutrition of the capillary walls. At first, mulberry-colored, purple spots of variable size appear on the legs, later on the body—a mere transudation of serum and blood-pigment in solution beneath the epidermis. Later, larger purple spots or diffused patches appear upon a tough, indurated, leathery base, due to effusion of blood in quantity beneath the true skin or between superficial muscles, infiltrating and coagulating in the minute interspaces of the connective tissue. Such patches are painful to touch; they may become the site of bloody blebs or of ulcers. Bloody serum often transudes into the pleural cavities, embarrassing the respiration; also into the pericardium, peritoneum, and the cavities of the joints. "Bloody flux," or dysentery, is frequent; also vomiting of blood and nose-bleed. Death occurs from exhaustion. Critical cases may rapidly change for the better, and mild cases quickly recover, when put upon supporting and vegetable diet. Onions, cabbage, radishes, horse-radish, "scurvy-grass" or spoon-wort, water-cresses—the entire class of the Cruciferæ—are especially efficacious; all the vegetable acids, lemons, limes, oranges, cherries, currants, apples, are valuable. Sauerkraut is extolled by the Germans, combining vegetable food and acids. Animal broths, tonics, and regimen are essential adjuvants to this treatment. Modern improvements in sailing ships and the use of steam at sea, by shortening voyages, have tended to lessen sickness among sailors. The improved hygiene of ships, the supply of fresh meat and vegetables prescribed by law for sailors, and the modern methods of keeping such articles hermetically sealed for long voyages, have rendered scurvy an unknown disease.

E. Darwin Hudson, Jr. Revised by Willard Parker.

Scur'vy-Grass, the *Cochlearia officinalis*, a cruciferous plant abundant upon many sea-shores (but not on those of the U. S.), and also found on mountain-ranges, and sometimes cultivated as a salad-plant. It has the pungent qualities of horse radish, and is of importance as an antiscorbutic. It is often gathered and eaten by mariners, especially during the prevalence of scurvy. The scurvy-grass occasionally cultivated for salad in the U. S. is mostly *Barbarea præcox*, the Belle Isle cress, a European cruciferous plant sparingly naturalized in the U. S.

Scu'tari. (1) [Turk. *Iskudar*; Gr. *Chrysopolis*], the largest of the suburbs of Constantinople, with a pop. of more than 60,000, on the Asiatic side of the Bosphorus, opposite the Golden Horn. It is built on seven low hills, has a palace, barracks, military hospital, 8 mosques, a convent of howling dervishes, and immense cemeteries covering more ground than the city itself. Turks dying on the European side of the Bosphorus prefer to be brought over to the Asiatic side for burial. Florence Nightingale had her hospital here during the Crimean war, and some 8000 nameless dead are now lying in the English cemetery, surrounding an ugly granite obelisk by Baron Marochetti. On a plain near by the persecuting emperor Licinius was vanquished by Constantine Sept. 18, 323.—(2) [Turk. *Iskenderieh*; Gr. *Scodra*], in Albania, European Turkey, lat. 42°, near the S. extremity of a lake of the same name 20 miles in length. The city is 17 miles from the Adriatic, has considerable trade, and a pop. of about 30,000, one-third of whom are Latin Christians, and the rest Mohammedans.—(3) (written also *Skutari*), a village in Southern Greece, near Cape Matapan, on a steep hill overlooking the sea, over against the island of Cerigo. R. D. Hitchcock.

Scutibranchia'ta [Lat. *scutum*, "shield," and *branchia*, "gill"], an order of gasteropod mollusks, proposed by Cuvier for those forms in which the branchiæ are plumose or pectinated, and with the entire body covered by a shell, which is widely open and shield-like; whence the name. In it were included by Cuvier the genera *Haliotus*, *Fissurella*, *Emarginula*, and *Parmophorus*. By Gray the same name was employed for a so-called order characterized by "gills consisting of two series of lamellæ, forming one or two series over or under the edge of the mantle round the foot. Animal hermaphrodite, self-impregnating (?). Shell spiral or symmetrical conical. Rectum often traversing the heart." As thus extended, it included, in addition to the forms referred to it by Cuvier, the Neritidæ, Trochidæ, and related forms, as well as the Dentaliadæ, Patellidæ and allies, and Chitonidæ; and thus was a most heterogeneous mixture. The name has not been adopted by recent authors, the forms referred to it by Cuvier being, with the Trochidæ and kindred types, combined under the ordinal name Rhipidoglossa. Theodore Gill.

Scylla. See Scilla.

Scylla and Charybdis. See Scilla and Charybdis.

Scylli'idæ [from Lat. *Scyllium*; Gr. σκυλλειν, to "tear"], a family of sharks (order Squali) distinguished by the position of their dorsal fins and their laying eggs like those of the rays. The body is more elongated than in the sharks generally; the scales developed as fine shagreen; the head depressed and oval; the nostrils with large flaps; the mouth interior and arched; the teeth small (several series being in use at the same time), compressed, and cuspidate; branchial apertures five, the posterior of which are above the pectorals; spiracles behind the eyes well developed; dorsal fins two, the anterior above or behind the ventrals; anal fin present, variable in position; caudal fin extended toward the end of the tail, and with the lower lobe little produced downward at its front margin; pectorals moderately developed and with rounded angles. The family, as thus defined, embraces the genera *Scyllium*, *Pristiurus*, *Stegostoma*, *Parascyllium*, *Chiloscyllium*, and related ones. They are inhabitants entirely of the seas of the Old World and Australia, none being found in American waters. They are among the few sharks which lay eggs invested in parchment-like cases, like those of the rays. Theodore Gill.

Scym'nidæ [Lat. *Scymnus*, the generic name of one of the species], a family of the order Squali, including sharks distinguished by the combined characters of absence of the anal fins and unarmed dorsals. The form is that common to most of the sharks; the scales are generally developed in the form of shagreen or fine bristly spines; the head is oval and depressed; the eyes are destitute of nictitating membranes; the nostrils have each a simple anterior tag; the mouth is inferior and a little arched; the teeth have trenchant edges, but otherwise differ in form; branchial apertures five, and all in advance of the pectorals; dorsals two, unarmed, the first in advance of the ventrals, the second far behind; anal wanting; pectorals rather small; ventrals very far behind. The family, as generally understood, embraces the genera *Scymnus*, of the Mediterranean and neighboring Atlantic; *Somniosus*, of the northern seas and Mediterranean; *Euprotomicrus*, of the Indian Ocean; *Isistius*, of the tropical seas; and *Echinorhinus*, of the Mediterranean and eastern coast of the Atlantic. Both *Somniosus* and *Echinorhinus*, however, are by some regarded as the types of distinct families.

Theodore Gill.

Scyphoph'ori [Gr. σκύφος a "bowl," and φερω, to "bear"], an order of fishes established by Prof. Cope, and distinguished by the following characters: The skeleton is completely ossified; the basis cranii simple; the parietals narrow, and distinct from each other as well as the supraoccipital; the pterygoid is very peculiar, being enlarged and funnel-shaped, and excavated by a bowl-like chamber (whence the name), which expands laterally and is covered by a lid-like bone; no symplectic exists; the jaws are well developed, but the intermaxillaries coalesce, at least in the old, into a single bone, and the maxillaries are lateral; opercular apparatus complete, but with the interoperculum and suboperculum reduced in size; scapular arch with the several coracoid elements represented; the brain has over the cerebellum a peculiar plicated organ; the air-bladder is simple, and communicates by a duct with the intestinal canal. The order is related to the more generalized form of Teleocephali, as well as to the Nematognathi. It is represented by but two known families, both of which are peculiar to the rivers of Africa; these are the Mormyridæ (which see) and Gymnarchidæ.

Theodore Gill.

Scyros. See Skyros.

Scythe [Ang.-Sax. *sidhe*], a long sharp cutting instrument used in harvesting grass. It is curved, and its concave edge is sharp. It is attached, for use, to a curved handle, called a snath. Shorter and stronger scythes are used for cutting bushes, etc. The introduction of mowing-machines has to a great extent superseded the use of scythes in haymaking, but on grounds where the mowing-machine cannot be employed scythes are still indispensable.

Scyth'ia, the ancient name for the vast regions which extend N., E., and S. of the Caspian Sea and the Sea of Aral. It was not so much used as a geographical term, for the boundaries of these regions were entirely undefined; it was rather a general term by which the Romans denoted a swarm of savage tribes living here, but of whom they knew very little.

Scythop'olis, the *Beth-shean* of Josh. xvii. 11, the *Beth-shan* of 1 Sam. xxxi. 10, now called *Beisan*, the most important city of the ancient Decapolis, and the only one W. of the Jordan, about 4 miles from the river, and nearly 14 miles S. of the Sea of Galilee. It was nearly as well watered as Damascus, four perennial streams running through it. It was a place of great strength, its acropolis rising 300 feet above the plain. The ruins, which are 3 miles in circuit, surpass all others in Western Palestine. Its classic name, *Scythopolis*, is of disputed derivation. The modern village, of some 50 houses, contains a colony of Egyptians brought here by Ibrahim Pasha in 1848.

R. D. Hitchcock.

Sea. See Ocean, by Prof. Arnold Guyot, LL.D.

Sea and River Defences. See Breakwater, Dyke, Embankment, Foundation, Haarlem Lake, Harbor, Harbors of American Lakes, Inundations (Maritime), Inundations and Floods of Rivers, Jetty, and Levees.

Sea-Anemone. See Actinia and Polyps.

Sea-Bear. See Otariidæ.

Sea'board, p.-v. and tp., Northampton co., N. C., on Seaboard and Roanoke R. R. P. 1576.

Seaboard, tp., Princess Anne co., Va. P. 3053.

Sea'brook, p.-v. and tp., Rockingham co., N. H., on Atlantic Ocean and on Eastern R. R. P. 1609.

Sea'bury (Samuel), D. D., b. at Groton, Conn., Nov. 30, 1729; graduated at Yale College 1748; studied medicine and theology in Scotland; was ordained in the Church of England at London 1753; was pastor of churches at New Brunswick, N. J., at Jamaica, L. I., 1756–66, and at Westchester 1766–75; was imprisoned at New Haven as the supposed author of some Tory pamphlets, but soon released; resided in New York City during most of the Revolutionary war; was at one time chaplain of a loyalist regiment; went to England 1781; was consecrated bishop of Connecticut by three Scottish prelates at Aberdeen Nov. 14, 1784, being the first American bishop of the Protestant Episcopal Church; took part in revising the Prayer Book and framing a constitution for the American Church 1789; published 2 vols. of sermons (1791) and a number of single sermons; exercised the duties of his episcopal office at New London, Conn., until his death at that place Feb. 25, 1796. A posthumous volume of *Sermons* was published 1798.

Seabury (Samuel), D. D., grandson of Bishop Seabury, b. at New London, Conn., June 9, 1801; was ordained in the Protestant Episcopal Church 1826; was for several years a missionary at Huntington, Oyster Bay, and Hallett's Cove (now Astoria), L. I.; was editor of the *Churchman* at New York 1831–49; rector of the church of the Annunciation 1838–68, and professor of biblical learning in the General Theological Seminary from June, 1862, to his death at New York Oct. 10, 1872. Author of *The Continuity of the Church of England in the Sixteenth Century* (1853), *Discourses on the Supremacy and Obligation of Conscience* (1860), *American Slavery Justified* (1861), *Theory and Use of the Church Calendar* (1872), and a posthumous volume of *Discourses on the Holy Spirit* (1874), edited by his son.

Seabury Divinity School. This is the property of the Bishop Seabury Mission, and is an institution of the Protestant Episcopal Church, founded in 1860, which contains (1876) 5 professors and 25 students. It has sent forth some 35 clergymen. Its buildings are of stone and very substantial, situated on a beautiful domain of 30 acres in the city of Faribault, Minn., and will with a little outlay accommodate 50 students. In its three years' course of study every department of theological education usual in America is provided for. It has a preparatory department, with a two years' course, to fit for theological study young men not college graduates, served by 2 tutors. The institution is not yet endowed, but is supported by voluntary contributions. Its president is Rt. Rev. H. B. Whipple, D. D. R. W. Lowrie.

Sea-Cat. See Chimæra.

Sea, Collisions at. See Road, Law of the.

Sea-Cow. See Manatee.

Sea-Cucumber. See Holothurians.

Sea-Devil. See Angler.

Sea-Duck. See Scoter.

Sea-Eagle. See Erne.

Sea-Egg, the sea-urchin. See Echinus.

Sea-Elephant. See Elephant Seal and Phocidæ.

Sea-Fan. See Gorgonia.

Sea Fisheries. See Fisheries, by Pres. T. D. Woolsey, S. T. D., LL.D.; Fisheries, by Prof. T. Gill, A. M., M. D., Ph. D., M. N. A. S.; and Fishery, Law of, by Prof. George Chase.

Sea'ford, p.-v. and tp., Sussex co., Del., on Dorchester and Delaware and Delaware R. Rs., 60 miles from Chesapeake Bay, contains 4 churches, 4 schools, 1 bank, a shipyard, 1 newspaper, several planing-mills, 2 hotels, and 10 oyster-houses. Principal business, oyster-packing. P. of v. 1304; of tp. 2699. J. F. Pennington, Ed. "Citizen."

Sea'forth, p.-v., Huron tp., Ont., Canada, on Buffalo and Goderich Railway, 21 miles S. E. of Goderich. It ships annually 1,000,000 bushels of grain, and is underlaid with a stratum of pure rock-salt over 100 feet thick at a depth of 1100 feet. It has productive salt wells, active manufactures, and 1 weekly paper. P. 1568.

Sea-Fox. See Fox Shark.

Sea'ham Harbor, town of England, co. of Durham, on the North Sea, has a good harbor, from which large quantities of coal are exported. P. 6180.

Sea-Hog. See Porpoise.

Sea-Horse. See Hippocampus.

Sea-Kale, the *Crambe maritima*, a perennial cruciferous herb, a native of European sea-coasts, much cultivated in England as a potherb. It requires a generous soil, and its large leaves and sprouts are unfit for eating until blanched.

Seal [Lat. *sigillum*], a means of legally executing or authenticating certain written instruments, and consisting of an impression made upon a piece of wax or other tenacious substance, such as a wafer, adhering to the paper or parchment on which the writing is engrossed. The term is also applied to the instrument itself by which such impression is made, and the common-law doctrines in relation to the effect of sealing arose from the ancient practice, once universal, of using private seals with heraldic devices thereon, instead of written signatures, in the execution of deeds. To constitute a valid seal at the common law, as above defined, there must be a tenacious substance adhering to the paper or parchment, and an impression upon it; an impression made in the material of the paper itself would not suffice. This requirement has been so far modified by statute in New York that the seals of public officers and of corporations may be stamped into the paper, but for all transactions between private persons in that State and in the New England States the seal must conform to the ancient rule of the English law. In most if not all the other States a flourish with the pen, often called a scroll, placed after the signature, answers all the purposes of a seal in private documents. The common law attributed a very high but most arbitrary and technical efficacy to the seal upon instruments of a private nature. Its presence was essential to a valid conveyance of a freehold estate in land; it distinguished a most important class of contracts; and it raised a conclusive presumption of a valuable consideration. This latter rule has been generally modified by modern statutes, which permit the presumption to be overcome by proof. The public or great seals of all independent nations, like their flags, are universally recognized by the governments and tribunals of other civilized countries, so that records, statutes, and the like authenticated by their means are everywhere accepted as correct transcripts. The seals of notaries-public are also regarded as proving themselves, especially throughout the European states. The seals of superior courts and of many administrative officers possess the same attributes within the territorial jurisdiction of the countries to which they belong, but the like authority is not extended to them within the limits of other states or nations unless it is conferred by special statute from considerations of convenience or of comity. John N. Pomeroy.

Seal [Ang.-Sax. *seol*], a name given to representatives of the order or sub-order Pinnipeds, the species of Phocidæ being distinguished as true or hair seals, and those of Otariidæ as fur seals, sea-lions, etc. (See Otariidæ and Phocidæ.)

Seal, tp., Pike co., O. P. 1451.

Seal Engraving. See Gem, by C. G. Leland, A. M.

Seale's Station, p.-v., cap. of Russell co., Ala., on Mobile and Girard R. R.

Seal Fisheries. See Furs and the Fur-Trade, by L. P. Brockett, A. M., M. D.; Fur Seal and Otariidæ, by Prof. T. Gill, A. M., M. D., Ph. D., M. N. A. S.

Sealing-Wax. See Lac, by Prof. C. F. Chandler, Ph. D., M. D., LL.D., M. N. A. S.

Sea-Lion. See Otariidæ.

Seal Islands. See Lobos Islands.

Sealkote', town of British India, in the Punjaub, in lat. 32° 29′ N., near the left bank of the Chenaub. It is a military station, and has manufactories of paper. P. 19,249.

Seals'field (Charles), the assumed name of Karl Postel, b. at Poppitz, Moravia, Germany, Mar. 3, 1793; became secretary to a religious order at Prague, but escaped from the convent 1822, and came to America under his assumed name, which he preserved through life with such care that his real name and place of birth were not known until after his decease. His first occupation in the U. S. seems to have been that of assistant editor of the *Courrier des Etats-Unis* at New York. In 1828 he was in Mexico; proceeded thence to New Orleans and to Philadelphia, where he published his first known work, a novel in English, entitled *Tokeah, or The White Rose.* About 1830 he was in

London and Paris, connected with journalism, and in 1832 became a resident of Soleure, Switzerland, which was thenceforth his chief home, though he spent a number of years in the U. S., where he became a citizen. D. at Soleure May 26, 1864. Author of *Transatlantic Travelling Sketches* (1833), *The Cabin Book, or Sketches of Life in Texas, Rambleton, North and South, Flirtation in America, Life in the New World, Scenes and Adventures in Central America, Pictures of Life in both Hemispheres, The Viceroy and the Aristocracy* (a novel of Mexican life, considered his best work), and *Morton, or the Grand Tour* (1846). A monument to his memory was erected at Poppitz in 1875.

Sea'man [Ang.-Sax. *sæmann*], a sailor. In law, any person whose employment is necessary or whose service is useful in the navigation of a vessel. The U. S. statutes provide for the appointment, by the several circuit courts, of shipping commissioners for ports of entry and of ocean navigation, whose general duties are to facilitate and superintend the engagement and discharge of seamen, and to arbitrate in questions arising between a seaman and the master or owner of a vessel; and at any port for which no commissioner has been appointed the duties of a shipping commissioner are imposed upon the collector of customs. Under pain of the penalties provided, the master of every foreign-bound vessel, other than vessels trading between the U. S. and British North America, the West India islands, or Mexico, or of any vessel of seventy-five tons burden or upward bound from an Atlantic to a Pacific port, or *vice versâ*, must execute before a shipping commissioner an agreement with each seaman of his crew. The articles of agreement must state, as far as practicable, the nature and duration and the port of termination of the voyage, the number and description of crew and their respective employments, the amount of wages each seaman is to receive, the capacity in which he is to serve, and the time he is to begin work on board, a scale of provisions to be furnished, regulations as to conduct and as to fines, short allowance of provisions, or other lawful punishments for misconduct, and any stipulations as to advance or allotment of wages. This provision of law does not apply to masters of vessels where the seamen are by custom or agreement entitled to participate in the profits of the voyage, nor to masters of coastwise or lake-going vessels that touch at foreign ports. Shipping articles for vessels in the coasting-trade of fifty tons burden and upward are more simple in form, and are not executed before a commissioner. In foreign ports the shipping of seamen takes place before a consular officer or commercial agent, who has for this and like purposes the powers of a shipping commissioner.

A seaman's right to wages and provisions accrues at the time he begins work, or on the date specified in the shipping articles for the beginning of work, whichever first happens; but he is not entitled to wages for any period during which he unlawfully refuses or neglects to work when required after the date agreed upon, nor for any period during which he is lawfully imprisoned for any offence. In case of loss of vessel, wages are due only to the date of such loss, but proof that any seaman has not exerted himself to the utmost to save the vessel, cargo, and stores will bar his claim. Wages become a lien upon the ship and freight, and upon the proceeds of them, in the nature of a preferred claim over bonds of bottomry or respondentia; but the right to wages is not dependent upon the earning of freight; and where freight might have been earned seamen have a right of action against the master or owner *in personam*. A proceeding against the ship *in rem* for wages does not abridge the right of action against the owner or master. A seaman cannot forfeit by agreement his lien upon the ship, nor be deprived of any remedy for the recovery of wages, except by agreement for allotment or advance. A stipulation to abandon the right to wages in case of loss of ship, or any right in the nature of salvage, is wholly inoperative; and any assignment other than advance or allotment made prior to the accruing of wages or salvage is equally void. Wages cannot be insured by seamen, nor are they subject to attachment in the courts. Seamen may forfeit their wages, either wholly or in part, by any of the following offences, viz.: desertion, absence without leave, neglecting and refusing without reasonable cause to join the vessel, wilful disobedience or continued wilful neglect of duty, wilfully damaging the vessel, or embezzling or wilfully damaging any of the stores or cargo, and by any act of smuggling whereby loss or damage is occasioned to the master or owner. But upon the commission of an offence for which it is intended to prosecute or enforce a forfeiture, an entry of the offence must be made in the official log-book and signed by the master and by the mate or one of the crew, and the reply of the offender, if still in the vessel, must likewise be entered and signed; which entries must be produced or proved in any subsequent legal proceedings.

The statutes further particularly enjoin the duties and guard the rights and interests of seamen. Provision is made for an examination of a vessel upon complaint of the first mate and a majority of the crew that the vessel is unseaworthy; but if such complaint is without foundation or sufficient cause, the expenses of examination and reasonable damages for detention become a charge against the wages of the complaining seamen. A proper supply of medicines and provisions is made obligatory upon the master or owner; and regulations prescribe the issue of provisions and compensation to the seamen when placed on short allowance without reasonable cause. The master must enter into bond, with security, for the return of the crew to the U. S., and seamen are carefully protected from impressment or detention. It is made the duty of consuls to provide subsistence and a passage to a port in the U. S. for destitute American seamen, and a fund for this purpose is drawn from the extra wages of seamen paid upon their discharge in foreign ports. Marine hospitals are established and maintained by collection from the wages of seamen at the rate of forty cents a month. In case of discharge improperly or prior to the termination of the engagement, except on account of wreck or condemnation of vessel, a payment to the seaman of extra wages is required. Seamen must submit to the usual punishments, lawful and as agreed upon in the shipping articles, but they have a remedy for any cruel or unusual treatment. Flogging is abolished by special enactment of law.

(For a full exposition of the rights and duties of seamen see Parsons's *Maritime Law*, Kent's *Commentaries* (vol. iii.), and the *Revised Statutes of the U. S.*)

P. F. HARRINGTON.

Sea-Mouse, a popular name for annelids of the genus *Aphrodite* (family Aphroditidæ), dorsibranchiate and setigerous marine organisms, remarkable for the beautiful and ever-changing prismatic colors produced by the transparent hairs of the animal. Respiration is performed by means of gills concealed beneath the scales of the back, and the water employed in respiration is filtered by means of a felt-like covering.

Sea-Nettle. See ACALEPHÆ.

Sea-Otter. See OTTER.

Sea-Parrot. See AUK.

Sea-Pie. See OYSTER-CATCHER.

Sea'po, p.-v., Grant tp., Republic co., Kan.

Sea-Porcupine. See DIODON and PLECTOGNATHI.

Sea-Raven. See SCULPIN.

Search. See INTERNATIONAL LAW, SUMMARY, by PRES. T. D. WOOLSEY, S. T. D., LL.D.

Search'-Warrant, a warrant issued by a duly-authorized magistrate, requiring the officer to whom it is directed to search a particular house or other place therein specified for the purpose of discovering (if possible) certain personal property alleged to have been stolen and to be secreted therein, and, if the same shall be found by such search, to bring the goods, together with the body of the person occupying the place (who must be named in the warrant), before the magistrate issuing it or before some other proper magistrate. The U. S. Constitution declares (Amendment IV.) that "the right of the people to be secure in their persons, houses, papers, and effects against unreasonable searches and seizures shall not be violated; and no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched and the persons or things to be seized." A provision either exactly or substantially the same is found very generally in the State constitutions. A practice had existed in England of issuing "general warrants" on behalf of the government in political prosecutions—especially in those for libel or sedition—which were granted on mere suspicion, contained no specifications either of persons, places, or things, and directed the officers to search any house, to break open any receptacle, and to seize and carry away any and all papers and property. These species of warrants were finally pronounced utterly illegal by the higher courts in a series of memorable decisions rendered about the middle of the eighteenth century. The recollection of this judicial controversy between the antagonistic principles of civil liberty and of arbitrary government was fresh in the minds of those who proposed the original amendment to the U. S. Constitution, and the provision quoted above was plainly aimed at all "general warrants," while it permits those which are specific in their nature, and which are often indispensable instruments for the detection of crime and for the due administration of justice. In pursuance of this requirement, contained in the organic law of a State, the complainant who applies for a search-warrant must make a statement, under oath, of the facts which show that a crime has been committed, and that goods have been stolen or

otherwise feloniously taken and carried away, and of the reasons for suspecting that they are concealed in the place which he desires to be searched; and these reasons must be so cogent that they amount to a probable cause for supposing the suspicion to be well founded. The warrant itself must specify and particularly describe all the important features, so that they can be certainly identified—the house or other place to be searched, the person in whose occupancy, possession, or custody it is, and the articles of personal property which are the direct objects of the search; it must be directed to an officer, and not to a private person; and it must command the goods if found, and the person in whose custody they are found, to be brought before the magistrate. If the warrant is thus duly and regularly issued and executed, the complainant who in good faith procured it to be granted is not liable either civilly or criminally, although the property is not in fact secreted in the place directed to be searched, and the suspicion upon which the proceeding was based turns out to be unfounded. The officer who executes such a warrant is also protected by it, although the complainant himself might be liable through want of good faith. JOHN NORTON POMEROY.

Sear'cy, county of N. Arkansas, on Buffalo fork of White River, has a hilly surface largely covered with forest. Staples, Indian corn, cotton, tobacco, and swine. Cap. Marshall. Area in 1870, 850 sq. m. P. 5614. Stone co. has since been erected from the E. half.

Searcy, tp., Cross co., Ark. P. 1018.

Searcy, tp., Phillips co., Ark. P. 1375.

Searcy, p.-v., cap. of White co., Ark., on Little Red River, near Cairo and Fulton R. R., is a shipping-point for cotton, has sulphur springs, and 3 weekly newspapers. P. 874.

Searle (GEORGE W.), b. at Salem, Mass., Feb. 22, 1826; was admitted to the bar at Boston 1827; became law-critic to the Boston *Post;* wrote treatises on legal topics; contributed to professional and literary reviews, and has devoted much attention to questions of social economy, on which he has frequently lectured.

Searle (JAMES), b. in the city of New York in 1730; settled in Philadelphia about 1762, and was one of the signers of the memorable non-importation agreement of Oct. 25, 1765. By this agreement the merchants and other citizens of Philadelphia bound themselves not to order any more goods from Great Britain, and to sell no goods or merchandise on commission, until the Stamp Act should be repealed—one of the most practical and influential movements toward the Declaration of Independence. Aug. 19, 1778, he was elected by Congress a member of the navy board; Nov. 20, 1778, was elected a delegate in Congress from Pennsylvania. The journals of Congress show him to have been an active and prominent member of that body. He was chairman of the commercial committee, and a member of the marine committee and the committee on foreign affairs. In July, 1780, while still a delegate in Congress, he was appointed by the governor and council of Pennsylvania the agent of the State, with the rank of lieutenant-colonel, to negotiate a loan of £200,000 in Europe. He went immediately on his mission, and returned to Pennsylvania in 1782. Mr. Searle possessed a ready pen and a graceful flow of language, and was an ardent and true patriot. He is spoken of as "one of the greatest wits of the time." D. in Philadelphia Aug. 7, 1797, and is buried in St. Peter's churchyard. G. M. CONARROE.

Sea-Robin. See GURNARD.

Sears, tp., Sierra co., Cal. P. 758.

Sears (BARNAS), D. D., LL.D., b. at Sandisfield, Mass., Nov. 19, 1802; graduated at Brown University 1825, and at Newton Theological Seminary 1829; was pastor of a Baptist church at Hartford 1830–32; was afterward professor in the Literary and Theological Institute at Hamilton, N. Y. (now Madison University); studied theology at German universities 1833–36; was professor in Newton Seminary 1836–48, acting as president during the later years; succeeded Horace Mann as secretary of the Massachusetts board of education 1848–55; was president of Brown University 1855–67, and since that time has been general agent of the Peabody Educational Fund. He was several years editor of the Baptist *Christian Review* (1838 *seq.*), a regular contributor to the *Bibliotheca Sacra*, and author (with Edwards and Felton) of *Classical Studies* (1843), *The Ciceronian* (1844), and *The Life of Luther* (1850); edited Nöhden's *German Grammar* (1842), *Select Writings of Luther* (1846), and Roget's *Thesaurus* (1854), and published many addresses, educational reports, and miscellaneous essays.

Sears (EDMUND HAMILTON), D. D., b. at Sandisfield, Mass., in 1810; graduated at Union College 1834, and at Harvard Divinity School 1837; was pastor of a Unitarian church at Wayland, Mass., 1839–40, and at Lancaster 1840–47; was several years an editor of the *Monthly Religious Magazine*, and became in 1865 pastor of a church at Weston, Mass., where he d. Jan. 14, 1876. Author of *Regeneration* (1853; 9th ed. 1873), *Pictures of the Olden Time* (1857), *Christian Lyrics* (1860), *Athanasia* (1857), *The Fourth Gospel the Heart of Christ* (1872), and *Sermons and Songs of the Christian Life* (1875).

Sears (ISAAC), b. at Norwalk, Conn., in 1729; commanded a privateer which cruised against the French 1758–61; was shipwrecked in the latter year; engaged in the West India trade in New York; was the leader of the Sons of Liberty in New York after the passage of the Stamp Act; was an active patriot during the war of the Revolution; sat in the provincial congress and in the assembly of 1783. D. at Canton, China, Oct. 28, 1786.

Sears (ROBERT), b. at St. John, New Brunswick, June 28, 1810; became a publisher in New York City, and compiler of a series of illustrated works, which were among the first of the now well-known class of books sold exclusively by subscription. They reached a sale of above 500,000 copies. Among them were *Illustrations of the Bible, Family Bible, History of China and India, Scenes and Sketches of Continental Europe, Description of Great Britain and Ireland, Information for the People, History of the American Revolution*, and *The Wonders of the World* (2 vols.).

Sears'borough, p.-v., Sugar Creek, Poweshiek co., Ia., on Central R. R. of Iowa, has 1 weekly newspaper.

Sears'burg, p.-v. and tp., Bennington co., Vt. P. 235.

Sears'mont, p.-v. and tp., Waldo co., Me., on St. George River, 10 miles S. W. of Belfast and 30 miles S. E. of Augusta, was settled in 1804, incorporated in 1814, has excellent water power, utilized by a large number of mills, grist-mills, and a tannery, and has several churches and schools. P. 1418.

Sears'port, p.-v. and tp., Waldo co., Me., on Belfast Bay at the mouth of Penobscot River. P. 2282.

Sea'-Serpent, a marine animal said to have been seen often on the coast of Norway, especially in Moldefjord (Pontoppidan, *Natural History of Norway*, London, 1755; *Naturalist's Library*, vol. viii., Edinburgh, 1841), and also on the coasts of New England (*American Journal of Science*, vols. ii., xi., xii., xxviii.; *Report of the Committee of the Linnæan Society of New England*, Boston, 1817; Sir Charles Lyell, *Second Visit to the U. S.*, London, 1849), but which is nevertheless considered fabulous by most naturalists. In the ancient Scandinavian mythology one of the most conspicuous figures is the *Midgaardsormen*, a huge serpent which, hidden on the bottom of the sea, embraces the earth with its folds; and there can be no doubt that the extravagant descriptions which Norwegian peasants, who profess to have seen the sea-serpent, give of this animal are more or less influenced by the old mythological ideas of Midgaardsormen. That, however, which has contributed most to make naturalists suspicious with respect to the very existence of this marine animal is the circumstance that no remains of it have ever been found, and for a long time naturalists generally considered all reports of the appearance of the sea-serpent as the fabrications of superstition and delusion. But in his *Romance of Natural History* (London, 1860–62) Gosse has shown that the argument against the existence of the sea-serpent taken from the non-existence of any remains of it does not hold good, and naturalists are not disposed to deny the possibility that such an animal may exist, and may prove to be some modified type of the Secondary enaliosaurians or some form intermediate between them and the elongated cetaceans. (Agassiz, *Geological Researches*, 1871; *Proceedings of the Boston Society of Natural History*, vol. xvi., Mar., 1874.)

Sea'-Sickness, a nervous affection attended with nausea and convulsive vomiting, produced by the oscillations of a ship at sea. Its origin and nature are still very imperfectly known. It may attack the strong and cautious, while the debilitated and incautious go free. It may attack in calm weather and on smooth waters, while a storm and a rough sea fail to produce it. It may pass away after the lapse of a few hours, or last during a long voyage. Dr. Chapman (*On Sea-sickness, its Nature and Treatment*, London, 1864) explains it as an undue accumulation of blood in the nervous centres along the back, and especially in those segments of the spinal cord related to the stomach and the muscles concerned in vomiting, and recommends as the best remedy against it the application of ice-bags to the spinal column. In some persons its violence is prevented by small doses of opium or by soda-water, or saline draughts in the effervescent state.

Sea'side Grape, the *Coccoloba uvifera*, a small polygonaceous tree of Florida and the West Indies, producing the extract called Jamaica kino. (See KINO.) It has clusters

of purple edible fruit, and a beautiful hard wood, which yields a red dye.

Sea-Slug. See Bêche de Mer.

Sea-Snipe. See Bellows-Fish and Snipe-Fish.

Seasons. See Climate, by Prof. Arnold Guyot, LL.D.

Sea-Spider, or Spider-Crab. See Crab.

Sea-Squirt. See Ascidia.

Sea′-Swallow, a fish. (See Gurnard.)

Sea′ton (John **Colborne**), Baron, b. at Lyndhurst, Hampshire, England, in 1779; educated at Christ's Hospital and at Winchester School; entered the British army 1794; served in Holland 1799, in Egypt 1801, afterward in Italy, Sicily, and Portugal; became military secretary to Gen. Fox and to Sir John Moore, whom he accompanied until his death at Corunna 1809, after which he joined the forces of Wellington, receiving command of a brigade, which was nearly annihilated at Albuera; distinguished himself at the assault of Ciudad Rodrigo, where he was wounded Jan. 8, 1812; at Vera, where he stormed the redoubts on the heights of the Pyrenees Oct. 7, 1813; at Nivelle, the Nive, Bidassoa, and Orthes; contributed to the victory at Waterloo 1815; became major general 1825; was lieutenant-governor of Canada 1828-36; was made governor-general and commander-in-chief 1837; suppressed the "Patriot" rebellion 1837-38; was raised to the peerage and received a handsome pension and the rank of lieutenant-general 1838; was lord high commissioner of the Ionian Islands 1843-49; became general 1854, and field-marshal Apr. 1, 1860. D. at Torquay Apr. 17, 1863. A colossal statue of Lord Colborne was erected at Southampton 1866.

Seaton (William Winston), b. in King William co., Va., Jan. 11, 1785; chiefly educated by private tutors; early acquired a knowledge of printing; edited a paper in Petersburg, Va., and also another in Halifax, N. C.; soon became connected with the *Register* in Raleigh; in 1812 went to Washington City, and joined his brother-in-law, Joseph Gales, in the management of the *National Intelligencer*, with which he was most honorably identified until his death in Washington June 16, 1866. He held a great many local offices in the Federal city; was frequently elected mayor; was a regent of the Smithsonian Institution, and in conjunction with Mr. Gales was one of the public printers for many years, and left a brilliant reputation for his merits as a man and his high character as an editor and statesman. A few years after his death a sketch of his life, with correspondence, was published by one of his daughters, Miss Josephine Seaton, and for a chapter of personal recollections the reader is referred to *Haphazard Personalities* by the present writer. Charles Lanman.

Seat′tle, p.-v., cap. of King co., Wash. Ter., on Admiralty Inlet, near the mouth of Dwamish River, is the seat of the Territorial university, has 1 daily and 2 weekly newspapers, and an active trade in coal and lumber. P. 1107.

Sea-Unicorn. See Narwhal.

Sea-Urchin. See Echinus.

Sea′-Water, Chemistry of. The ocean is constantly receiving, through rivers, solutions of substances leached out of the solid matter of the continents. These substances in solution pass into the body of the great ocean, and by oceanic currents must be more or less distributed throughout its mass, to yield up their water again by evaporation, which sends it back continually to the continental surfaces, to be again condensed, to sink, in part, into the rocks and soils again, and dissolve out again more of the soluble constituents of these. It would then seem, at first glance, as if the water of the great ocean should continually become a stronger and stronger solution of all the substances brought down by rivers, until it should reach the point of concentration possessed by such brines as those of the Dead Sea, the Great Salt Lake, and other similar basins. This result, however—which would surely come about upon a lifeless earth—is under the control, more or less, of the zoic influences that have possession of the oceanic depths. Particularly do those animals that secrete *lime* work continually to prevent the accumulation of this substance in the ocean, at the same time fulfilling another most weighty function. *Lime* is indeed a grand factor in a stupendous chemical process which is proceeding imperceptibly upon the surface of this globe, the existence and nature of which were first pointed out by the present writer to the American Association for the Advancement of Science in 1869. The waters which continually distill through the atmosphere from the vast surface of the ocean, and constantly condense upon, bedew, and bedrench the rocks of the continents, condense together with themselves at the same time a portion of the *carbonic acid* of the atmosphere. This decomposes the silicates, and especially the lime-silicates; and all the rivers are thus continually collecting and carrying down into the ocean, as carbonate of lime, the carbonic acid of the atmosphere, that sole feeder of life, the constituent which furnishes sustenance, directly or indirectly, to all living beings—directly to those of the vegetable, and indirectly to those of the animal kingdom. It is in the ocean, however, that the unceasing work is going on of building up masses of solid calcareous matter, such as we find forming continents and mountain-chains, by coral animals and mollusks. This calcareous matter, comprehending carbonic acid derived from the atmosphere, thus *locks up the latter, for all time* at least, if not for eternity. Hence, we arrive at the curious generalization, that by a slow but omnipotent law life upon the earth is surely destroying and absorbing its own essential pabulum, and thus that the race of man cannot hope to perpetuate itself for ever on this globe. The active agent in this chemical process, without which it could not go on, is the lime of the crystalline silicates of the solid rocks of the earth. (See further on sea-water under the head Water.) Henry Wurtz.

Sea-Weeds. See Phycology, by Prof. Asa Gray, M. D., LL.D., M. N. A. S.

Sea′-Weeds, Chemistry of. Many of this class of plants are of value as food and medicine, containing certain peculiar constituents not found in land-plants, and on some coasts they are cast up on the shore in such enormous masses as to be of no trifling consequence to the inhabitants, being used for fuel, as fodder for cattle, and even as a highly-nourishing food for man. The use of their ashes as sources of iodine and alkalies will be found explained under the heads of Barilla and Kelp. The use of sea-weeds as food is due to the prevalence therein of gelatinous and mucilaginous constituents, sometimes constituting more than half their weight. In addition to this, some species, like *Laminaria saccharina* (exceedingly abundant on the Asiatic coasts of the Pacific, where it is a highly valuable article of food), have a very sweet taste, due to the presence of the peculiar sugar called Mannite (which see). Another celebrated species used for food is known to us as *Ceylon moss*. It contains three-fourths of its weight of gelatinous and starchy matter of a highly nutritious quality. It is known in the East as *âgar-âgar* and *bulung*. Botanists call it *Gigartina lichenoides*, and others *Plocaria candida*. The famous *edible birds' nests* are believed to be constructed of material derived from these latter species. (See Birds' Nests, Edible.) In another species, *Gelidium corneum*, used for confectionery and jellies in China, under the name of *nin-mau*, the French chemist Payen found 27 per cent. of a remarkable substance called by him *gelose*, whose gelatinous character is stated by him to be so intense as to have in this respect *ten times* the value of fish-gelatine or Isinglass (which see). This should be looked into further. Other species used as food are *Fucus saccharinus*, called by the Russians "sea-cabbage," and "jambon" by the Japanese, which is boiled and eaten as food; the "Irish" or "Carrageen moss," called by botanists *Chondrus crispus* (see Carrageen), and many others. The compounds of *iodine* contained in these plants are conceived to give them certain virtues as food, particularly for invalids, as consumptives and others. The gelatinous portions of some sea-weeds become exceedingly hard and elastic upon being dried after previous purification, and have been moulded into various forms as substitutes for horn, shell, etc. for making handles for knives, files, and other tools. It is thought by some that the colored sea-weeds, sometimes very brilliant, would yield useful dyes and pigments, but this has not been followed up. In some countries "drift-weed," so-called, is found to be a highly valuable *manure*, especially for the potato-crop, which requires much *potash*, a large mineral constituent of sea-weeds. H. Wurtz.

Sea-Wolf. See Anarrhichas.

Sebaceous Glands. See Histology, by Col. J. J. Woodward, M. D.

Sebac′ic Acid [apparently from Latin *sebum*, an inelegant form of *sevum*, "tallow;" Ger. *Fettsäure*]; also called **Sebic** and **Pyroleic Acid.** This compound, which has the empirical formula $C_{10}H_{18}O_4$, is formed during the destructive distillation of all fatty bodies which contain oleic acid or oleine. Nitric acid forms it also when acting upon fatty bodies, together with oxalic acid and other lower homologues of the same series, or those having the general empirical formula $C_nH_{2n-2}O_4$, a series of which *malonic*, *succinic*, and *suberic* acids are members. Sebacic acid is most readily obtained by fusing together castor oil and caustic potash, 2 parts of oil being slowly mixed with 1 part of potash, fused with a little water, and heated until the mass is faintly yellow. On boiling the mass with water and adding HCl while hot, sebacic acid crystallizes on cooling in needles. It resembles benzoic acid in appearance. It tastes acid, reddens litmus, melts at 127°, and

sublimes above this. Melted, its density = 1.317. But slightly soluble in cold, very soluble in hot water and in alcohol. Its salts, called *sebates*, are bibasic, like oxalates and succinates. Neither sebic acid nor sebates have obtained as yet any practical application. HENRY WURTZ.

Seba′go, p.-v. and tp., Cumberland co., Me., on Sebago Lake. P. 803.

Sebaste. See SAMARIA.

Sebast′ian, county of W. Arkansas, on Arkansas River, adjoining Indian Territory, traversed by the Poteau Hills and other spurs of the Ozark Mountains, has a fertile soil and considerable mineral wealth, especially bituminous coal. Staples, Indian corn, sweet potatoes, cotton, tobacco, and butter. Swine are numerous. Caps. Fort Smith and Greenwood. Area, about 650 sq. m. P. 12,940.

Sebastian, SAINT, b. at Narbonne in Gaul about 255; educated at Milan; was a captain in the imperial guard when, under Diocletian in 287 or 288, he was seized as a zealous Christian, bound to a tree, and used by the Mauritanian archers as a target. He did not die, however, but having been brought to a Christian home and cured, he was seized a second time, trampled to death, and thrown into a sewer. His body was recognized by the Christians and buried in the Catacombs. Pope Damasus (366–384) built a church over his tomb, relics of him were sent to every corner of Christendom as very powerful against the plague, numerous churches were consecrated to him, and he was generally chosen as patron by associations of archers or riflemen. His feast is celebrated in the Roman Catholic Church Jan. 20, and in the Greek Church Dec. 18. Roman Catholic Church historians ascribe much importance to the *Acta Sancti Sebastiani*.

Sebastian, king of Portugal, known as DOM SEBASTIAN, b. in Lisbon Jan. 20, 1554; succeeded his grandfather, John III., June 11, 1557; headed an expedition which captured Tangier, Morocco, in 1574; embarked for Africa with 15,000 soldiers June 24, 1578; landed near Arzila July 29; took part in a civil war supporting the claims of Muley Mohammed to the throne of Morocco against his uncle, Muley Malek; was joined by the forces of the former, with whose assistance he commenced the siege of Alcazar; fought a great battle Aug. 4, in which a great part of the Portuguese nobility perished, as well as both the rival Moorish kings, and was himself probably killed, though his body could not be found. Having no immediate heir, Portugal was soon annexed by Philip II. of Spain, but the masses of the Portuguese people refused to believe in the death of Dom Sebastian, and a series of pretenders appeared at intervals for many years, and received some popular support. One of them made a great sensation at Venice, Florence, and Naples twenty years later, was repeatedly imprisoned, and finally condemned to the galleys, but had to be released on account of popular sympathy, and is said to have died in prison in Castile. The belief in the future return of Dom Sebastian finally took in Portugal the form of a myth, and continued to exist for more than a century, giving rise to a considerable literature of poems and romances.

Sébastiani′ (FRANÇOIS HORACE BASTIEN), COUNT, b. at La Porta, near Bastia, in Corsica, Nov. 11, 1775; entered the French army in 1789; distinguished himself greatly in Napoleon's Italian campaigns; fulfilled several diplomatic missions to Constantinople, Syria, and Egypt with great success; was made a general of division after the battle of Austerlitz, and held various important commands in Spain and during the campaigns of 1812–14. After the Restoration he lived for some time in retirement; was elected a member of the Chamber of Deputies in 1819; opposed the policy of the cabinet of Polignac with great energy; was appointed minister of foreign affairs 1830, ambassador to Naples in 1834, and to London in 1835; was made a marshal in 1840. D. at Paris July 21, 1851. His only child was the duchesse de Praslin, who was murdered in 1847 by her husband.

Sebastopol. See SEVASTOPOL.

Sebasto′pol, p.-v., Sonoma co., Cal.

Sebec′, p.-v. and tp., Piscataquis co., Me., on Sebec Lake, Piscataquis River, and Bangor and Piscataquis R. R. P. 954.

Sebe′nico, town of Austria, in Dalmatia, on an inlet of the Adriatic, has a fine cathedral and an active trade in wine and rosoglio. P. 5300.

Sebes′ten Plum, the fruit of *Cordia myxa* and *latifolia*, Asiatic trees of the order Cordiaceæ. The fruit is edible, and was once employed in European medicine. The wood is soft, light, and readily takes fire on friction. It was used by the old Egyptians for mummy-cases. The genus is an extensive and interesting one. Florida has one species, the beautiful *Cordia bullata*.

Sebe′wa, p.-v. and tp., Ionia co., Mich. P. 1139.

Sebewa′ing, p.-v. and tp., Huron co., Mich., on Saginaw Bay. P. 907.

Se′bringville, p.-v. of Perth co., Ont., Canada, on Buffalo and Goderich Railway, 4 miles W. of Stratford. It has active manufactures and a large lumber-trade. P. about 500.

Sec′chi (PIETRO ANGELO), b. at Reggio, Italy, July 29, 1818; d. in Rome Feb., 1878; entered the order of the Jesuits in 1833; studied mathematics, physics, and astronomy; came to the U. S. in 1848, and taught mathematics at the college of Georgetown, D. C.; was appointed director of the observatory of Rome in 1850, and acquired a great celebrity by his researches in every field of astronomical science, especially by his meteorological observations and spectroscopic analyses. Among his writings the most remarkable are *Researches on Electrical Rheometry* (Georgetown, 1852), *Spectrum Observations on the Rotation of the Sun* (1870), *Le Soleil* (1870). On the expulsion of the Jesuits from Italy in 1870, Secchi retained his office.

Seccomb (JOHN), b. at Medford, Mass., Apr. 25, 1708; graduated at Harvard 1728; was minister of Harvard, Mass., 1733–57, and of Chester, Nova Scotia, from 1763 to his death at that place, Jan., 1793. Author of a humorous poem, *Father Abbey's Will*, printed in the *Gentleman's Magazine* and also in the *European Magazine* for May, 1732; reprinted by John Langdon Sibley (1854), with historical and biographical notes.

Seces′sion. This word, which denotes any withdrawal from a political or religious organization, has acquired lasting notoriety by being used of the right of a State included under the Constitution of the U. S. to withdraw from the Union and set up an independent government. The way was prepared for broaching and exercising this so-called right by the theory of nullification advanced, and for a time acted upon, by SOUTH CAROLINA. (See that article.) The existing tariff law was declared in 1832 by that State to be "null, void, and no law," and duties on imports were forbidden to be paid after a certain day within its jurisdiction. Gen. Jackson, then President, felt that such a power lodged in a State was a deathblow to the Union and altogether unconstitutional. His energetic opposition and the message on nullification in 1833 put a stop to this political heresy for the time, but only scotched the viper. The heresy amounted to this: that every State has a right to interpret the Constitution for itself, whatever be the decision of the Supreme Court on the subject, and, so interpreting, to retire from the Union. Hence, there is no right to force it to return. This is really a plan to make revolution easy, and to couch under the term *nullification* the extreme act which denies that the "Constitution, and the laws of the U. S. which shall be made in pursuance thereof, . . . shall be the supreme law of the land," and that "the judicial power of the U. S. shall extend to controversies to which the U. S. shall be a party," and that the judges in every State are bound thereby. (Art. III. § 2; Art. IV. § 2.) Secession is but another stage in this process of destroying a legal connection between an ordinance of the U. S. and one of the States. It declares the tie dissolved, and the State or States making the secession to be no longer members of the Union. This is revolution under a soft name, intended to throw a disguise over the proceeding. No such doctrine could be admitted by any stable government. (For an inapplicable precedent see HARTFORD CONVENTION.) T. D. WOOLSEY.

Se-Chuen′, province of the Chinese empire, between lat. 26° and 33° N., and between lon. 101° and 110° E., comprises an area of 166,832 sq. m., with 21,435,678 inhabitants. Principal river, Yang-Tse-Kiang; cap. Ching-Too-Foo. Rhubarb and other drugs, musk, metals, silks, and sugar are produced.

Seck′endorf, the name of a family of German nobility which can be traced back to the middle of the thirteenth century, and still flourishes in various branches. Several of its members have become celebrated in German literature and history: (1) VEIT LUDWIG VON SECKENDORF, b. Dec. 20, 1626; studied law and history at the University of Strasbourg; held various important positions in the service of Duke Ernst the Pious of Gotha, Johann Georg II., elector of Saxony, and Friedrich III., elector of Brandenburg. D. Dec. 18, 1692. He was the author of *Deutsche Fürstenstaat* (1655) and *Commentarius historicus et apologeticus de Lutheranismo* (3 vols., 1692), in their time very famous books.—(2) FRIEDRICH HEINRICH, COUNT VON SECKENDORF, a nephew of the preceding, b. July 5, 1673; studied law at Jena, Leipsic, and Leyden; entered the Dutch-English army in 1693; served successively in the Austrian army against the Turks on the Danube and the Spaniards in Sicily, in the Saxon-Polish army against the Swedes,

and in the German army, of which he was commander-in-chief, against the French, whom he defeated at Klausen Oct. 20, 1735, and developed at the same time an astonishing diplomatic activity as Saxon-Polish ambassador to the Hague at the Peace of Utrecht, and as Austrian ambassador to numberless German courts to bring about the Pragmatic Sanction. After the death of Prince Eugene (1736) he was made commander-in-chief of the Austrian army against the Turks, but was defeated, recalled, accused of treason, imprisoned in the fortress of Gratz, and liberated only after much difficulty. He then entered the service of Charles II. of Bavaria, who, after the death of Charles VI., laid claims to parts of the Austrian heritage in spite of the Pragmatic Sanction, and was elected emperor under the name of Charles VII.; commanded his army with success; expelled the Austrians from Bavaria, and succeeded in negotiating a tolerable peace for his son in 1745. After this time he lived quietly on his estate, Meuselwitz, near Altenburg, in the Saxon duchies, with the exception of a little episode in 1758, when Friedrich II. kidnapped him, shut him up in the fortress of Magdeburg, and pressed $10,000 out of him. D. at Meuselwitz Nov. 23, 1763.—In this century several members have acquired a name as poets: (3) LEO (1773–1809); (4) KARL SIGMUND (1744–85), translator of Camoens; (5) CHRISTIAN ADOLF (1767–1833); (6) GUSTAV ANTON (1775–1823), known also in the U. S. as a lecturer under the name of PATRIK PEALE; (7) ALFRED (1796), known under the name of ALPIN.

Seck'er (THOMAS), D. D., b. at Sibthorpe, Nottinghamshire, England, in 1693; was educated at Tewkesbury with a view to the dissenting ministry; studied medicine at London, Paris, and Leyden, graduating at the latter school 1721; studied theology at Exeter College, Oxford, 1721–22; took orders in the Church of England 1723; became chaplain to the king 1732, bishop of Bristol 1735, and of Oxford 1737; dean of St. Paul's 1750, and was consecrated archbishop of Canterbury Apr. 21, 1758. D. Aug. 3, 1768. He was noted for his eloquence as a preacher and his sternness as a moralist and disciplinarian. His collected *Works* were issued in 12 vols. (1770).

Sec'ond [originally *minuta secunda*, or *scrupulum secundum*, the "second minute," as distinguished from the *prime minute*, or ordinary minute], in the measurement of time and of angles the 60th part of a minute. The term is of Roman origin.

Second, in music, the distance from one degree on the diatonic scale to the next adjoining. (See INTERVAL.)

Second-Adventists. See ADVENTISTS.

Second Creek, tp., Monroe co., West Va. P. 1222.

Secondiglia'no, town of Italy, province of Naples, in a fertile and healthy position N. of Naples, and dates from the eighth century. P. 6487.

Second Sight, according to a superstition formerly very common in the Scottish Highlands, was a gift by which certain persons were enabled to see depicted before their eyes an event which was taking place at some distant place, or which was destined to take place at some future time. It was not considered a supernatural power, but a mysterious sharpness of the natural powers, and the inhabitants of the Western Islands were especially famous for their second sight. Martin first brought this superstition into notice in England by his *Description of the Western Islands*, and 100 years later, in 1775, Dr. Johnson treated it with great gravity in his *Journey to the Hebrides*.

Se'cor, p.-v., Palestine tp., Woodford co., Ill., on Toledo Peoria and Warsaw R. R. P. 407.

Sec'retary-Bird, a name given to the species of *Serpentarius*, which is so called on account of having feathers upon its head recalling a pen behind the ear of a scribe. It is an inhabitant of Southern Africa.

Secretary of Legation, the principal assistant of foreign ministers. Secretaries of legation assist their superiors in their official duties, keep the records of their office, administer oaths, and act as notaries. In the absence of the superior officer the secretary performs his duties, with the title of chargé d'affaires *ad interim*. He is therefore accredited to the government to which he is sent. There are twenty-eight authorized U. S. secretaries of legation, besides assistant secretaries at Paris, London, Berlin, and St. Petersburg.

Secretary of State, an officer at the head of one of the executive departments of the U. S. government and a member of the cabinet. His position is considered the most responsible and important one in that cabinet. He has charge of foreign affairs, and is the organ of official communications with foreign ministers and with our ministers and other officers abroad, as well as with State and Territorial governments at home; signs and seals civil commissions; promulgates the laws and resolves of Congress; compiles the *Blue Book*; and makes an annual report to Congress. His salary is $8000. The two assistant secretaries receive each $3500.

Secretary of the Interior, an officer of the U. S. executive department and of the cabinet, who has charge of patents, land-offices, Indian affairs, pensions, the census, the departments of agriculture and education, and of many other important details of the government. There are several distinct bureaus under him. His salary is $8000. He has an assistant secretary with a salary of $3500. Both are appointed by the President and confirmed by the Senate.

Secretary of the Navy, an officer of the U. S. executive department and member of the cabinet, was first appointed by Pres. Washington in 1798. He executes the orders of the President with regard to naval affairs; renders biennial statements of naval and civil officers of his department for publication in the *Blue Book*; makes annual statements to Congress and to the treasury with regard to naval appropriations and expenditures; supervises the Naval Academy, the naval bureaus, the marine corps, etc. He is appointed by the President, confirmed by the Senate, and has a salary of $8000. There is an assistant secretary of the navy, whose salary is $4000.

Secretary of the Senate, an officer of the U. S. Senate, who keeps its two journals, disburses its contingent fund, has charge of all Senate documents, reports annually concerning his disbursements, and, in connection with the clerk of the lower House, makes an annual statement of all new appropriations, new offices, new salaries, and the like. He has a salary of $3600, besides fees for certified extracts from the Senate journals.

Secretary of the Treasury, an important member of the cabinet of the President of the U. S., whose duties correspond to those of the ministers of finance in most constitutional governments, including control of all receipts and disbursements, the coinage of money, the printing of currency, the relations with national banks, and the collection of trade statistics. Salary, $8000; of the assistant secretary, $3500. This post has been filled by many eminent statesmen, including Hamilton, Gallatin, Crawford, Rush, R. J. Walker, Corwin, Dix, Chase, Fessenden, and Bristow.

Secretary of War, an officer at the head of one of the executive departments of the U. S. government and member of the cabinet, has charge, under the President (who is commander-in-chief), of the affairs of the army and of the Military Academy. He is appointed by the President, confirmed by the Senate, and receives $8000 a year.

Secret, Discipline of the. See ARCANI DISCIPLINA.

Secre'tion [Lat. *secretio*, from *se*, "aside," and *cernere*, to "separate," "divide"], one of the chief physiological processes of the body; the separation of certain elements of the blood, and their elaboration to form special fluids, termed secretions and excretions. Both of these products contribute to the health and nutrition of the body, the secretion performing some positive function, as aiding digestion; the excretion subserving the same purpose negatively by freeing the system of effete matter, the débris of cell and tissue waste, which if detained in the blood develops disease. The function of the perspiratory and sebaceous glands is positive, so far as they preserve the moisture and delicacy of the skin, but is chiefly negative in relation to the nutrition of the body, from which they exhale water and salts; hence is classed as excretion. Bile is variously defined as a secretion, an excretion, and as both, its constituents being effete substances deleterious to health if not promptly excreted, yet performing an important part in the process of intestinal digestion. Secretion is performed in several ways. Certain smooth surfaces, the serous membranes, are lined with glandular epithelial cells capable of developing special homogeneous fluids. The serous shut sacs which invest the lungs, heart, and intestines—the pleuræ, pericardium, and peritoneum—are lubricated by a fluid which they secrete; so also are produced the synovial fluids on the inner smooth surfaces of the joints. A more typical secretory structure is the *tubule*, a cylindrical recess or tube at right angles to the surface, lined with secreting cells; a follicle is a diminutive membranous secreting sac beneath the surface, upon which it has an excretory aperture. Secreting surfaces, as the mucous lining of the bronchial tubes, stomach, and bowels, have many hundreds or thousands of such tubules and follicles to the square inch. An isolated group of tubules ramifying from a single central duct constitutes a simple gland; a number of such groups having a common duct is a compound gland; the larger glands, composed of an extensively-divided tubular system, with corresponding lobules, are termed racemose glands—that is, in structure

resembling a cluster of berries. Such complicated glandular structures serve merely to multiply secreting surface within a limited space; the functional action is the same whether performed on the free surface, in the tubule and follicle, or by the multiple gland. Secretion is the product of cell-activity. The cell derives its material from the blood, its stimulus to action from the nervous system, and it elaborates a peculiar fluid, in each instance predetermined by the inherent function of the gland or organ of which it is an integral part. Secreted fluids are homogeneous, consisting chiefly of water with variable quantities of salts, fatty matter, and in each case a distinguishing component, as pepsine in gastric juice, pancreatine, mucine, synovine, etc. Flint tabulates the secretions as follows: *Secretions Proper*—(1) *Permanent Fluids.*—Serous and synovial fluids, the aqueous and vitreous humors of the eye, fluid of the labyrinth of the ear, the cerebro-spinal fluid; (2) *Transitory Fluids.*—Mucus, sebaceous matter, cerumen or ear-wax, Meibomian fluid of eyelid, tears, milk, saliva, gastric juice, pancreatic juice, intestinal fluids, bile (also excretory). *Excretions.*—Perspiration, urine, bile (also secretion).

E. Darwin Hudson, Jr. Revised by Willard Parker.

Secret Service, a bureau of detective officers of the U. S. government, under the solicitor of the treasury, who are employed in looking out for evasions of the revenue laws. During the civil war there was a secret service in connection with the war department. Neither of these services was established by statute. The chief of the present secret service receives a salary of $3000. The chief of the late military secret service had the rank of a brigadier-general of volunteers.

Sectarianism. See Schism, by Rev. Isaac Riley.

Sec'tor [Lat. *seco*]. A *circular* sector is a part of a circle bounded by an arc and two radii. A *spherical* sector is a part of a sphere that may be generated by a circular sector revolving about a diameter lying exterior to it.

Sec'ular Clergy, in the Roman Catholic Church, designates those bishops, priests, and deacons who do not belong to a monastic order and are not subject to the rule of any special order. Those who belong to such an order are called *regular* clergy, since they obey a monastic rule (*regula*). At present parish priests are both regular and secular, but chiefly the latter.

Secular Games [Lat. *ludi sæculares*, from *sæculum*, an "age"], a great Roman festival of probable Etruscan origin, originally called *ludi Tarentini*, from *Tarentum*, a place in the Campus Martius. It was customary to celebrate these games in honor of Dis and Proserpina once in a hundred years or thereabout, but, in reality, the celebration took place at long but very irregular intervals, and all the greater gods received a share of the honors. They were celebrated (we are informed) only four times during the republic and four times under the emperors.

Sec'ularism [Lat. *secularis*, "worldly"], the belief that the duties of this life, being more clearly ascertainable than those which we call religious, and which depend on a belief in God and in immortality, should have men's first, or even their entire, attention. The Secularists of England are an offshoot of the socialist party founded by Robert Owen. Mr. Owen denounced religion and marriage as evils co-ordinate with property; and because of his theory that a change of man's environment, and not a change in himself, was chiefly necessary to secure his happiness, he stood in an attitude of avowed hostility to the churches and creeds, but was at no time an avowed atheist. Many of his followers went so far, and in 1842 one of them was prosecuted and imprisoned for avowing it. This caused great excitement among his more immediate friends, and led to an active propaganda of atheistic opinions among the working-classes, under the leadership of George Jacob Holyoake. At first this was in connection with the advocacy of socialism, but afterward that topic was abandoned, while on the other side the Owenites, through their Social Congress, labored to sunder socialism from any alliance with theological or anti-theological opinions. Till about 1852, Mr. Holyoake and his friends called themselves sometimes Utilitarians, but more commonly Atheists, as in the title of his most known tract, *The Logic of Death, or Why should an Atheist Fear to Die?* They then adopted the name of Secularists, as expressing the positive side of their opinions and as free from evil associations. Their expectations were for the most part disappointed, in spite of their manifold activity in debates and lectures, in printing books, tracts, and periodicals (*The Reasoner*, and at present *The National Reformer*). They organized Secular societies, held Secular conferences, and erected Secular halls in the leading cities. But several of these halls were sold to pay expenses; their work of publication was carried on at a loss, which was met by a few wealthy patrons, of whom Mr. J. W. Birch, an Oxfordshire magistrate, was the best known. The effort to rally men around a purely negative set of opinions was defeated by the indifference of those who agreed with them. No great and general interest was excited by it, although some of its representatives—notably Mr. Holyoake — were men of extraordinary power as speakers and writers. Once and again it received a temporary stimulus from the unwise prosecution of individual Secularists for blasphemy. Since Mr. Holyoake left the platform their most prominent leader has been Mr. Charles Bradlaugh, the republican agitator. They have several places of meeting in London, and a considerable number of men and women speakers, who frequently hold open-air lectures on Sunday mornings, and sometimes make a tour of the manufacturing districts.

Secularism has many points of likeness to positivism, but with the difference that it is English and democratic, and more dogmatic in its denials. The idiosyncrasies of Robert Owen are still stamped on it, just as the thoughts of Saint-Simon have never been eliminated from the system of his pupil Comte. While Secularists treat the doctrines of theism and immortality as purely speculative and uncertain, they do not exclude from their fellowship those who take an affirmative side in regard to them; and they have a few such persons in their societies. They will co-operate with all who assent to the statements that human morality does not require religious sanctions, and that the duties of the present life are vastly more certain and ascertainable, and therefore, on every principle of prudence, more worthy of men's attention. They further hold that if there be a God to whom men are accountable, he must reflect all that is best and highest in man's moral nature, and therefore he will be better pleased by a life spent in the conscientious pursuit of truth and in the service of our fellow-men than by any dogmatic belief or formal worship. But they, for the most part, profess to see a practical refutation of every sort of theistic belief in the suffering and anguish of the world, in the terrible inflictions of sudden and painful death by the powers of nature, and in the perpetuation of misery, ignorance, superstition, slavery, tyranny, and all those evil conditions in which they find the root of what is evil in man. They distinctly disown those who reject the claims of religion through mere stupid indifference or through a dislike of the restraints it imposes on the passions; they lay emphasis on *duty*, and seek to organize men "for moral work." But, like Owen, they see in man the creature of circumstances, holding that "he owes his actions to the destiny of his organization and position;" and, like Owen, they "labor to find a situation in which it shall be impossible for men to be depraved or poor." But they find the obstacle to this chiefly in men's ignorance of the scientific laws which govern human life, and their distraction from the study and the obedience of those laws by the teachings and the claims of religion. Their skepticism is not that of the rich and prosperous, who find the present world and its visible belongings so comfortable that they have lost all interest in the unseen and the eternal. It is that of men who are utterly dissatisfied with the world and their place in it, and who "regard all tidings respecting the unseen as only fictions that are invented to keep them on their present level."

Whatever be the worth of secularism in itself, it has some value as a criticism upon popular Christianity and its one-sidedness. It shows that the suffering and struggling classes cannot be satisfied with a creed that promises them spiritual rewards in the life to come, but exhibits a stolid indifference to their welfare in the life that now is; or with one that sunders duty to man from duty to God. But it remains to be seen whether a belief that denies any object for the deepest and most universal aspirations of men's spirits, and which sanctions all the indifference to the welfare of mankind which grows out of a materialistic contempt for human nature, can maintain its hold upon those who most need the inspiration of faith in God to help them to face with courage the hardships of their lot.

R. E. Thompson.

Seculariza'tion. This term, in its most general sense, denotes the process of converting objects from a religious or spiritual to a common or secular use, and of removing matters from a purely ecclesiastical control and bringing them under the civil jurisdiction. A strong tendency among all enlightened peoples toward secularization has been shown for a long time in many departments of social activity and of public legislation; the limits of ecclesiastical and civil authority have been more clearly defined; the policy of confining the Church to affairs strictly and essentially spiritual is everywhere accepted as theoretically correct, and in some countries it is already practically triumphant. During the epoch when the Church had attained its highest degree of power its interference with secular matters extended in every direction, but was most distinctly

exhibited in connection with certain special subjects, the control of which it has ever struggled to retain. Vast quantities of lands had gradually accumulated in the hands of the religious houses, and all the most valuable estates of Europe were likely to fall into their ownership. Through the operation of the canon law certain subjects of the utmost consequence to society were brought under the ecclesiastical jurisdiction, the most important of which were marriage, divorce, and the succession of decedents' estates. Education in all its grades and departments was entrusted exclusively to the Church. The progress of secularization has nearly destroyed these spiritual interferences with civil affairs in many countries of Europe and America, and has greatly narrowed their extent in all the others. The first impulse of this grand movement was naturally directed against the threatened monopoly of land. At an early day statutes were passed in England and on the Continent prohibiting the acquisition of land by religious corporations; and this policy has continued to the present day, and has been adopted throughout the U. S. (For a description of these enactments, their design, and effect, see the article MORTMAIN.) In addition to this system of restraint, the accumulated possessions of the ecclesiastics and the spiritual houses have sometimes been seized by the civil authorities and appropriated to secular uses. The most remarkable instances of such enforced changes occurred in England under Henry VIII., in Scotland at the Reformation, and in France during the Revolution. The Italian and the Mexican governments are now pursuing a similar policy to a partial extent. Within the present half century, and almost within the present generation, the law of matrimony has been greatly modified. In England, France, Italy, Prussia, Austria, and several other European states marriage has been made wholly a civil contract and status, divorce is regulated by statute, and both are placed under the jurisdiction of the ordinary tribunals. The same steps had before been taken in reference to successions. So far as education is public or is supported at the public expense, the course of modern legislation in England, France, Italy, and Germany favors a control by the State, and not by the Church. It is in the U. S., however, that the theory of secularization has had the fullest scope, and has been worked out most thoroughly and consistently. The fundamental conception of the State contained in the organic law confines the Church to functions purely spiritual and religious; the Church itself, as a spiritual society, has no legal existence and is not recognized by the law, and all the separate congregations or parishes are in all respects civil and lay corporations. Marriage, divorce, and all other relations domestic or social, successions and all other matters connected with property, are of course under the exclusive dominion of the civil government. A few traces are still left of ecclesiastical influence and privilege, but it is probable that these may ere long disappear. The removal of all distinctively religious instruction from the common schools, with the consequent secularizing of the public educational system, and the repeal of all laws which exempt churches and other ecclesiastical property from taxation, are strongly advocated, and one or both of these measures may soon be accepted as a part of our permanent national policy. JOHN NORTON POMEROY.

Secundus (JOHANNES). See JOHANNES SECUNDUS.

Sédaine' (JEAN MICHEL), b. at Paris July 4, 1719; d. there May 17, 1797; wrote a number of comic operas, a *genre* of which he is the real founder, and also some comedies, of which *Le Philosophe sans le Savoir* (1765) is still played. Philidor, Monsigny, and Grétry composed his operas.

Seda'lia, city, cap. of Pettis co., Mo., at the intersection of Missouri Pacific, the Lexington branch of Missouri Pacific, and Missouri Kansas and Texas R. Rs.; hence it is a railroad centre. It is 189 miles W. of St. Louis, 100 miles E. of Kansas City, and 40 miles S. of Missouri River. It was founded in 1860 by Gen. George R. Smith. Present pop. 10,000, and rapidly increasing. The location is a high rolling prairie, with a stream and abundant timber to the N., S., and W. within 3 miles. The leading business houses and finest private residences are of brick. The city has 8 churches, value $30,000; public high-school building, value $40,000; 2 other public-school buildings, value $10,000; average attendance 1000 pupils. The general offices, car manufactory, and machine shops of Missouri Kansas and Texas R. R., and the machine-shops and car-factories of Missouri Pacific R. R. (middle division), are located here; number of men employed, 500; value of buildings and real estate owned here by the two companies, $175,000; money paid to town annually by them, about $400,000. The city is lighted by coal-gas, and furnished with water by the Holly waterworks system, costing $125,000. The city has 2 daily papers, with weekly editions, 1 weekly and 1 monthly paper; 3 flouring-mills, capacity 100,000 bushels of grain per year; iron-foundry, capacity 5 tons per diem; woollen-mill, capacity 35,000 yards of material per annum; agricultural implement and machine shop, soap-factory; beer-brewery, capacity 30,000 kegs per annum; 5 wagon-shops, broom-factory, grain-elevator, etc. Numerous rich coal-mines, accessible by rail, are within 12, 20, 25, and 50 miles. Mar. 1, 1876, a charter to build a street railroad within one year was granted a company. Sedalia has an opera-house, seating capacity 1000; 2 first-class and 4 second-class hotels; 4 banks, with an aggregate capital of $500,000; a public library, and a gymnasium. The town is surrounded by a "garden spot" of country, and is increasing daily in wealth, population, and prosperity. P. in 1870, 4560.

A. Y. HULL, ED. "DEMOCRAT."

Sedan', town of France, department of Ardennes, on the Meuse, is fortified, and contains an arsenal and several magazines. Its manufactures of cloth and other kinds of woollen fabrics are very celebrated. Sept. 2, 1870, Napoleon and his whole army surrendered here to the king of Prussia. P. 15,536.

Sedan, p.-v., cap. of Chautauqua co., Kan., located in a charming grove on Cana Creek, and surrounded by one of the finest agricultural districts in Southern Kansas, contains 3 dwelling-houses, 1 newspaper, a blacksmith's shop, a grist-mill, and a cotton-gin.

JOSEPH MOUNT, ED. "WIDE AWAKE."

Sedan Chair, a portable vehicle, differing from the litter and the palanquin in that the traveller is carried in a sitting posture. The sedan chair took its name from Sedan in France, where it was invented, but it had long been employed in Eastern countries, notably in Japan. It was first seen in England in 1581, and was long an extremely common and fashionable conveyance. It was carried by two men.

Sed'atives [Lat. *sedare*, to "calm"], a term somewhat loosely employed in medical parlance to designate agents which are soothing or actually anæsthetic over the sensory function, or which in relation to various motor functions tend to diminish activity. Aconite is thus called "sedative," because it lessens the force and frequency of the heart's beats; hemlock, because it paralyzes the voluntary muscular system; and chloroform, because it is a general paralyzer of the cerebro-spinal functions. From these examples it is obvious enough that there is no group of allied agents to which the general term "sedative" can apply; and where used in relation to special paralyzing power the latter term is far more accurate and expressive. EDWARD CURTIS.

Sed'don, p.-v. and tp., cap. of Bland co., Va., on Big Walker's Creek, 21 miles N. of Wytheville, has 1 church, an academy, an excellent court-house and jail, 2 newspapers, and 2 hotels. P. 828.

WM. HICKS, ED. "HOLSTON ADVOCATE."

Seddon (JAMES A.), b. in Virginia about 1815; became a lawyer at Richmond; was a member of Congress 1845–47 and 1849–51, of the Peace Congress and of the Confederate House of Representatives 1861, and became secretary of war on the resignation of George W. Randolph, Nov. 18, 1862.

Sed'ges, the grass-like plants of the natural order Cyperaceæ. They often grow in tufts, are always herbaceous, never hollow-stalked, and have frequently triangular stems. The glumes are single, scale-like, and have a flower in the axil. There are some 120 genera and thousands of species. Many of them are coarse marsh-plants. They furnish large quantities of very inferior hay. A few have edible tubers. Several have pleasant odors and are used in perfumery. The papyrus is one of the most interesting of these plants. Mats, baskets, etc. are produced from some of the species. (See CAREX.)

Sedg'wick, county of S. Kansas, intersected by Arkansas River and its tributaries, and traversed in its N. part by the south-western branch of Atchison Topeka and Santa Fé R. R., which terminates at the county-seat; has prairie surface, half of which consists of fertile bottom-land. Staples, wheat, Indian corn, oats, potatoes, and wool. Cap. Wichita. Area, about 1000 sq. m. P. in 1870, 1095; in 1874, 7429.

Sedgwick, p.-v. and tp., Harvey co., Kan., on a branch of Atchison Topeka and Santa Fé R. R.

Sedgwick, p.-v. and tp., Hancock co., Me., on Penobscot Bay. P. 1113.

Sedgwick (ADAM), LL.D., F. R. S., b. at Dent, Yorkshire, England, in Jan., 1786; graduated at Trinity College, Cambridge, 1808; became fellow 1810; took orders in the Church of England 1817; was appointed Woodwardian professor of geology at Cambridge 1818; was chosen fellow of the Royal Society 1819, in which year he aided in founding the Cambridge Philosophical Society, of

which he became secretary; contributed largely to the popularization of the study of physical science at Cambridge and to the formation there of a museum of geology; became proctor of the university, and made a geological tour in Scotland 1827; accompanied Murchison in his geological researches in Germany, Austria, and Switzerland 1829; commenced a survey of the Lower Palæozoic strata of England and Wales 1831; was president of the Royal Geological Society 1829–31; became involved in a bitter controversy with Murchison as to the use of the terms Cambrian and Silurian; became prebendary of Norwich 1834; was secretary to Prince Albert when the latter was acting as chancellor of the university; contributed largely to the *Transactions* of the Geological, Philosophical, and other scientific societies; was a formidable opponent of the utilitarian school of morals and of the evolution theories propounded by the *Vestiges of Creation* (1844), by Darwin, and by Spencer; was one of the most active members of the British Association, and received the Copley medal of the Royal Society 1863. D. at Cambridge Jan. 27, 1873, being then senior fellow of Trinity College. His works consist chiefly of reviews, lectures, addresses, and memoirs scattered through the publications of learned societies, the most important separate essays being a *Discourse on the Studies of the University of Cambridge* (1834; enlarged ed. 1850) and a *Synopsis of the Classification of the Palæozoic Rocks* (1855). (See Geikie's *Memoirs of Sir R. Murchison* (1874) and Prof. T. S. Hunt's *Chemical and Geological Essays* (Boston, 1875).)

Sedgwick (Catharine Maria), daughter of Judge Theodore, b. at Stockbridge, Mass., Dec. 28, 1789; received an excellent education; undertook after her father's death (in 1813) the management of a private school for the education of young ladies, and continued in that employment fifty years. Published her first work of fiction, *A New England Tale*, in 1822, the success of which decided her to continue the career of authorship; brought out *Redwood* (2 vols., 1824), which was reprinted in England, translated into French, Italian, German, and Swedish, and compared favorably with the novels of Cooper, to whom, indeed, it was attributed in the French version; *The Traveller* (1825), *Hope Leslie, or Early Times in Massachusetts* (2 vols., 1827), reputed her best work; *Clarence, a Tale of our Own Times* (1830), *The Linwoods* (1835), *The Poor Rich Man and the Rich Poor Man* (1836), *Live and Let Live* (1837), *A Love-Token for Children*, and *Means and Ends, or Self-Training* (1838), *Stories for Young Persons* (1840), *Letters from Abroad to Kindred at Home* (1841), a record of a European tour made in 1839; *Historical Sketches of the Old Painters* (1841), *Wilton Harvey and other Tales* (1845), republished from Godey's *Lady's Book*; *Morals and Manners* (1846), *Facts and Fancies* (1848), *Married or Single?* (1857), and *Letters to My Pupils* (1862). She wrote much for the annuals and magazines; contributed the *Story of Le Bossu* to Sands's *Tales of Glauber Spa* (1832); prepared the biography of Lucretia M. Davidson in Sparks's series (1841); and published several volumes of short stories collected from the magazines. D. near Roxbury, Mass., July 31, 1867. (See her *Memoir*, by Mary E. Dewey, 1871.)

Sedgwick (Henry Dwight), second son of Judge Theodore, b. at Sheffield, Mass., in 1785; graduated at Williams College 1804; became an eminent member of the New York bar; published some legal arguments and essays, and contributed to the *North American Review* and to the political and religious journals. D. at Stockbridge, Mass., Dec. 23, 1831.—His brother Robert, b. at Stockbridge in 1787, also graduated at Williams College, and practised law in New York, where he d. in 1841.

Sedgwick (John), b. in Cornwall, Conn., Sept. 13, 1813; graduated at the U. S. Military Academy in July, 1837, and appointed second lieutenant of artillery, his first service being against the hostile Seminoles in Florida; subsequently upon the frontier during the Canada border troubles; recruiting and in garrison until 1846; in the war with Mexico he participated in the siege of Vera Cruz, the battles of Cerro Gordo, Churubusco, Molino del Rey, Chapultepec, and the assault and capture of the City of Mexico, winning the brevets of captain and major for gallantry. In 1855 was transferred to the 2d Cavalry with the rank of major, of which regiment he became lieutenant-colonel in Mar., 1861. In April he was appointed colonel of the 1st; transferred to the 4th Cavalry Aug., 1861, and in the same month was commissioned brigadier-general U. S. volunteers. In the Virginia Peninsular campaign of 1862 he commanded a division of Sumner's corps, and engaged in the siege of Yorktown; in the battle of Fair Oaks, where he arrived, after a toilsome march, in time to decide the day, May 31; of Savage Station (June 29) and Glendale (June 30), where he was wounded. Appointed major-general of volunteers, to date from July 4, 1862, he commanded a division at Antietam, where he was severely wounded three times, and disabled until December, when he was placed in command of the 9th corps. Transferred to the command of the 6th corps Feb., 1863, he was ordered by Gen. Hooker, in May, 1863, to carry the heights of Fredericksburg and effect a junction with the main army at Chancellorsville. On the morning of Sunday, May 3, Fredericksburg was occupied without serious difficulty, but the storming of the heights in the rear of the town was attended with severe loss—nearly 5000. Continuing his march toward Chancellorsville in pursuance of his instructions, his further advance was checked at Salem Heights, about 4 p. m., by the force which Gen. Lee was able to detach for this purpose after the repulse of Hooker in the morning; and by Hooker's inactivity Lee was able the next morning to so far strengthen the force sent to oppose Sedgwick that it was only by great skill and hard fighting the latter was able to hold his ground during the day, withdrawing after dark across the Rappahannock. In the Pennsylvania campaign of 1863 the 6th corps formed the right wing of the army following the movements of Lee, and on the evening of June 30 encamped at Manchester, upward of 35 miles from Gettysburg. The events of the 1st of July demanded the hasty concentration of the army, and before 2 p. m. of July 2, Sedgwick reached the field with his corps, having made the march of 35 miles in 20 hours. So sharp and furious was the struggle the corps was at once engaged, as also in the third day's fight, and pursuit of the enemy, July 5. At the battle of Rappahannock Station (Nov. 7) he commanded the right wing of the army, composed of the 5th and 6th corps, as in the "Mine Run move" (Nov. 26–Dec. 3). In the Richmond campaign of 1864, continuing in command of the 6th corps, he was conspicuous in the battles of the Wilderness (May 5–6), as in the battles of Spottsylvania, where, while directing the placing of some artillery in an advanced position, he was killed early in the day by a bullet from a sharpshooter. His loss caused the most profound grief among his command, by whom he was greatly beloved, and indeed throughout the whole army, to whom he had endeared himself by his many noble qualities. A monument wrought of cannon captured by the 6th corps was erected to his memory at West Point in 1868, on which occasion George William Curtis delivered an eloquent oration.

Sedgwick (Robert), b. in England about 1590; an early settler at Boston, Mass.; had been a member of the Artillery Company in London; aided in founding the Ancient and Honorable Artillery Company 1638; was its captain 1640; became colonel of the Middlesex regiment 1643, and commander of all the militia of Massachusetts 1652; went to England; was employed by Cromwell to expel the French from Penobscot 1654; took part in the West India expedition 1655; was made major-general. D. in Jamaica May 24, 1656. With John Winthrop, Jr., he established the first ironworks in New England 1643–44.

Sedgwick (Theodore), LL.D., b. at West Hartford, Conn., in May, 1746; educated at Yale College, but did not graduate; commenced the study of theology; was admitted to the bar Apr., 1766; began the practice of law at Great Barrington, Mass.; soon removed to Sheffield, which town he represented several years in the Massachusetts legislature; was aide-de-camp to Gen. Thomas in the expedition against Canada 1776; was an active patriot throughout the Revolution; was a member of the Continental Congress 1785–86; took an active part in the suppression of Shay's rebellion 1786–87; settled at Stockbridge 1787; was Speaker of the Massachusetts house of representatives and a member of the State convention for the ratification of the Federal Constitution 1788; member of Congress 1789–96; U. S. Senator 1796–99, serving one term as president *pro tem.*; again member of Congress and its Speaker 1799–1801, and judge of the supreme court of Massachusetts from 1802 to his death, at Boston Jan. 24, 1813. Judge Sedgwick was a laborious and highly-accomplished statesman and jurist, and an enthusiastic Federalist; by his agency was obtained from a court in Massachusetts (1780) a decision in a fugitive-slave case which foreshadowed and led to the abolition of slavery in that State; and subsequently pronounced the decision from the supreme bench that "one man could not have legitimate property in another."

Sedgwick (Theodore), eldest son of Judge Theodore, b. at Sheffield, Mass., Dec. 31, 1781; graduated at Yale College 1798; studied law with his father and at Kinderhook; was admitted to the bar 1801; practised his profession with eminent success at Albany, N. Y., 1801–22, and subsequently at Stockbridge, Mass.; sat in the Massachusetts legislature 1824–25, and again 1827, in which year he carried through a bill authorizing the construction of a railroad from Boston to Albany through the Green Mountains; was thrice an unsuccessful candidate for Congress; an effective speaker, a prominent Democratic politician, an

earnest opponent of slavery and advocate of temperance and free trade; was president of the Berkshire agricultural society 1823 and 1830; travelled in Europe 1836–37. D. of apoplexy at Pittsfield, Mass., Nov. 7, 1839. Author of *Hints to my Countrymen* (1826) and *Public and Private Economy* (3 vols., 1836–39; 2d ed. 1856).—His wife, SUSAN RIDLEY, a granddaughter of Gov. William Livingston of New Jersey, b. about 1789, was married 1808; was authoress of several works of fiction for the young, including *The Morals of Pleasure* (1829), *The Young Emigrants* (1830), *Allen Prescott* (2 vols., 1835), *Alida, or Town and Country* (1844), *Louisa and her Cousins*, and *Walter Thornley* (1859).

Sedgwick (THÉODORE), son of Theodore second, b. at Albany, N. Y., Jan. 27, 1811; graduated at Columbia College 1829; was admitted to the bar May, 1833; was an attaché to the U. S. legation at Paris 1833–34, the minister being Edward Livingston; practised law in New York City 1835–50; was president of the New York Crystal Palace Association 1852, and became U. S. district attorney for the southern district of New York Jan., 1858. D. at Stockbridge, Mass., Dec. 8, 1859. Author of a *Memoir* of his great-grandfather, Gov. William Livingston (1833), a *Treatise on the Measure of Damages, etc.* (1847; 5th ed. 1869), and a *Treatise on the Rules which govern the Interpretation and Application of Common and Statutory Law* (1857); edited the political writings of William Leggett (2 vols., New York, 1840); published several legal, political, and anniversary addresses, and contributed to many reviews and other periodicals, especially the *Evening Post* and Harper's *Magazine* and *Weekly*. He declined the mission to Holland in 1857, and twice declined the post of assistant secretary of state.

Sed'ley (Sir CHARLES), b. at Aylesford, Kent, England, in 1639; studied at Wadham College, Oxford, 1655–56, but did not graduate; was one of the wits and poets of the court of Charles II., leading a licentious life; sat in Parliament, and favored the revolution of 1688. D. Aug. 20, 1701. His *Works*, consisting of plays, poems, songs, speeches, and political pieces, were edited by his friend Ayloff (2 vols., 1702).—His daughter, CATHARINE, though extremely ugly in person, was the favorite mistress of James II.; employed her influence in favor of the Protestant party; at the instigation of Rochester refused to leave Whitehall on the accession of James to the throne 1685; was by him made countess of Dorchester 1686, and married the earl of Portmore in Ireland. D. at Bath Oct. 26, 1717.

Seduc'tion [Lat. *seductio*]. According to the doctrines of the English common law, based upon the maxim *volenti non fit injuria* ("no legal injury can be done to one consenting"), the female whose chastity has been seduced has no remedy against her seducer, but the father is permitted, under certain circumstances, to maintain an action for damages against the man who debauches his infant daughter. This right of action, however, is not founded upon the paternal relation, nor upon the wrong done to the father's honor, nor upon the destruction of the child's character and position in society; it is rested solely upon the harsh and almost brutal conception that the relation of master and servant has been interfered with, and that by the illness and consequent inability to labor on the part of the daughter, which become the natural results of the defendant's act, the father has been deprived for a time of the service which would otherwise have been rendered to him. For this reason the suit may be brought not only by a father, but also by a guardian, a master, or any one standing *in loco parentis* where service is legally due and is actually performed. The legal relation of master and servant existing between the plaintiff and the female at the time of the seduction must therefore be averred and proved, although the service itself may be purely nominal; and it must appear that she was prevented from discharging her duty by means of some physical disability, such as her sickness, which was a direct consequence of the seduction. If no such result follows the wrong, there can be no recovery, since the remedy is not given for the mere act of debauching. Notwithstanding this unnatural basis of the action, the jury are directed that, in estimating the damages, they must award full compensation for the irreparable wrong inflicted upon the plaintiff in all his parental and social relations, for his wounded honor and affections, his personal grief and public disgrace, as well as for his loss and expenses as a master, and that to this compensatory relief they may add exemplary or punitive damages. The common-law theory as thus described has been adopted in a somewhat modified form in a portion of the American States, but there has been a strong tendency on the part of their courts to break away as much as possible from these absurd and arbitrary restrictions; the English rules which define the relation of master and servant, and require a condition of actual service, have been mitigated, and recoveries are permitted which would be impossible under the common law as administered in England. What the courts have cautiously aimed at in some of the States has been fully accomplished by the legislatures in many of them. The statutory rule, which prevails so widely that it may properly be called the American doctrine, has utterly swept away the ancient notion of master and servant, and has rested both the right and the remedy, where the wrong is inflicted, in the family and parental relations. According to this legislation, the action is brought by a parent as the head of the family; the offence is treated as one against the unity, happiness, and purity of the family, and the right and the remedy are thus made to harmonize. The statutes of a few States have gone even farther, and permit the female who has been seduced to recover compensation for the personal injury done to herself. When the marriage relation is invaded by the seduction of the wife, the husband has an action against the seducer, in which full damages may be awarded for the domestic injury, and which is founded upon the simple fact that the union of the parties has been virtually destroyed. JOHN NORTON POMEROY.

Sedum. See CRASSULACEÆ.

See'bach (MARIE), b. at Riga Feb. 24, 1835, the daughter of a comic actor of some reputation; was educated at Cologne for the opera; made her début at Nuremberg, where she acted minor parts in the vaudeville and light comedy; achieved a great success in Hamburg by her impersonation of Gretchen in Goethe's *Faust*; was engaged from 1856 to 1865 at the royal theatre of Hanover; removed in 1866 to Berlin with her husband, the tenor singer Niemann, and visited the U. S. in 1870–71. Her representation of Clärchen in Goethe's *Egmont* was another decided success.

See'bohm (FREDERICK), b. at Bradford, England, in 1833; was called to the bar at the Middle Temple, London, 1856. Author of *The Facts of the Four Gospels* (1861), *The Oxford Reformers of 1498* (1867), and other historical and biographical works.

Seed-lac. See LAC, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D., M. N. A. S.

Seeds [Ang.-Sax. *sæd*], the immediate result of sexual propagation in phænogamous plants, being the ovules after fertilization and the consequent formation of the embryo, which is the germ of a new individual. A seed consists of the embryo; of the matured coats of the OVULE (which see), commonly two, of which the outer, and generally the firmer, is technically called the *testa*, the inner, *tegmen*; and often of a stock of nourishing matter accumulated around or accompanying the embryo. The latter was named *albumen*, from a mainly fanciful analogy; the seed being likened to an egg, the albumen was supposed to answer to its white (albumen) and the embryo to its yolk. Seeds, such as those of peas, beans, and almonds, which have no albumen—that is, no stock of nourishment outside of the embryo—have always a strong and well-developed embryo, abundantly supplied with the same or similar matter stored in its own tissues. The general structure of the seed depending upon that of the ovule, the same terms are mostly applicable to it and to its modifications and parts (such as *anatropous, orthotropous, rhaphe, chalaza*, etc.); but the now closed orifice through which impregnation was effected is called the *micropyle*; the scar left by separation from the seed-stalk or placenta is the *hilum*; the accessory and usually partial external covering, which is sometimes developed by a growth from the micropyle or the apex of the seed-stalk, is an *arillus* or *aril*. The mace of nutmeg and the pulpy covering of *Euonymus* seeds are familiar examples. A *caruncle* and a *strophiole* are nearly similar appendages at the base or hilum, not developed into a covering. Other appendages to certain seeds are the *coma*, or tuft of downy hairs at the summit, as in milkweed, or the base, as in willow, also the wing, as in trumpet-creeper; these and various other appendages aid in the dispersion of seeds. The albumen of the seed, when distinctively present, may differ greatly in abundance, consistence, and nature; as from farinaceous or flowery in wheat to cartilaginous or horny as in coffee, or to the texture and appearance of ivory in the "vegetable-ivory" nuts. In many cases, as in those just referred to, it forms much the larger part of the kernel of the seed; in others the embryo is so minute as to be with difficulty discerned antecedent to germination; while sometimes the embryo is the more conspicuous, and the albumen is reduced to a thin layer. When copious, the albumen generally envelops the embryo, but sometimes the latter enfolds the former, as in mallows, or is coiled around it, as in four-o'-clock and chickweeds. The embryo and its parts have been described in other articles. (See BOTANY, EMBRYO, GERM.) Its most important structural characteristic is the number

of cotyledons or seed-leaves—one in monocotyledonous or endogenous plants: a pair in the dicotyledonous or exogenous. What are called polycotyledonous embryos, such as those of pines, with a whorl of few or several sub-leaves, are considered to be formed of a pair of cotyledons divided, as it were, into leaflets.

As to the duration of vitality in seeds, there are many conflicting accounts. The story of grain found buried with Egyptian mummies having germinated after being exhumed is now generally discredited. All recent attempts under proper observation and due precautions have failed. The appearance of plants new to the station upon soil brought to the surface from excavations can usually be otherwise explained when they appear to involve a high antiquity, although there is no doubt that buried seeds have germinated after a lapse of fifty or more years. The best authenticated case, pointing to a much longer preservation of vitality under such conditions, is that of the growth of raspberry-seeds found in the abdominal portion of a skeleton exhumed from a Roman tomb near Dorchester, England; but it is one not beyond doubt and uncertainty. One or two series of experiments, conducted within the last forty or fifty years by the sowing of seeds of known age, and also by the annual sowing from a stock of a considerable variety of seeds of the same age, indicate a rapid extinction of vitality under ordinary conditions. Out of 338 species, representing 74 natural orders, only 94 kinds grew after 3 years, only 57 after 4 to 8 years, only 16 from 8 to 21 years, 5 from 25 to 27 years, 3 to 43 years. In ordinary cases, leguminous seeds have longest preserved germinating power, in some very well-authenticated instances up to seventy or perhaps one hundred years. Nearly uniform temperature, darkness, and either dryness or burial beyond atmospheric influences, most favor the prolongation of vitality. ASA GRAY.

See'konk, p.-v. and tp., Bristol co., Mass., on Pawtucket River and Boston and Providence R. R. P. 1021.

See'land, the largest and most important of the Danish islands, between the Cattegat and the Baltic, and between the Sound which separates it from Sweden, and the Great Belt which separates it from the island of Funen. Area, 2840 sq. m. P. 637,711. The ground is low and undulating, dotted with small lakes, and studded with forests of oak and beech. The soil is very fertile, and well cultivated.

See'ley (JOHN ROBERT), b. in London, England, about 1834, son of a well-known London publisher; graduated at Christ's College, Cambridge, 1857; obtained a fellowship and lectureship there 1858; became classical teacher at the City of London School 1860; professor of Latin in University College, London, 1863; succeeded Charles Kingsley as professor of modern history at Cambridge Oct. 9, 1869. Author of *Ecce Homo, or The Life and Work of Jesus Christ* (1865), which rapidly passed through many editions and elicited many replies; *Roman Imperialism* (1869), *Lectures and Essays* (1870); and editor of *Livy, with Introduction, Historical Examination, and Notes* (1871).

Seely, tp., Faribault co., Minn. P. 266.

See'lye (JULIUS HAWLEY), S. T. D., LL.D., b. at Bethel, Conn., Sept. 14, 1824; graduated at Amherst College 1849; studied theology at the Auburn Seminary, and also in Germany; was ordained pastor of the First Reformed Dutch church, Schenectady, N. Y., in 1853, where he remained until 1858, when he accepted the professorship of mental and moral philosophy in Amherst College, which he still holds. In 1872 he visited India, where he spent three months, largely occupied in lecturing to educated and English-speaking Hindoos on the truths of Christianity. Some of these lectures were published in Bombay (1873) by request of their auditors, and also at Boston (1874) under the title *The Way, the Truth, and the Life.* He has also published a volume on *Christian Missions* (New York, 1875), besides various sermons, addresses, and articles in quarterly reviews, and translated Schwegler's *History of Philosophy* (New York, 1856). In 1874 he was elected to the 44th Congress by a spontaneous movement of the people of his district, and without having received a nomination from any political party. In 1876 he was elected president of Amherst College, still retaining his professorship.

Seelye (LAURENUS CLARK), D. D., brother of Julius H., b. at Bethel, Conn., Sept. 20, 1837; graduated at Union College 1857; studied at Andover Theological Seminary 1857–59, at Berlin and Heidelberg universities 1860–62; travelled in Europe, Egypt, and Palestine; was ordained pastor of a Congregational church at Springfield, Mass., 1863; was professor of English literature and oratory at Amherst College 1865–74, and became in 1874 president of the new Smith College for Young Women at Northampton, Mass. Author of various contributions to reviews, including articles on collegiate education and on Celtic literature.

See'mann (BERTHOLD), PH. D., b. at Hanover, Germany, Feb. 28, 1825; educated at the lyceum of that city and at the University of Göttingen; was naturalist on board H. M. S. Herald on an exploring expedition around the world 1846–47; made three arctic voyages in search of Sir John Franklin; explored the Feejee Islands and parts of North and South America 1860–62; published *A Narrative of the Voyage of the Herald* (1853), *Popular History of Palms* (1855), *The Botany of the Voyage of the Herald* (1857), *Viti, an Account of a Government Mission to the Fiji Islands* (1862), *Popular Nomenclature of the American Flora*, and other scientific works; contributed to literary, political, and geographical periodicals in England; accompanied Capt. Bedford Pim in his travels in Central America, and joined him in writing *Dottings on the Roadside in Panama, Nicaragua, and Mosquito* (1869); engaged in mining enterprises in Nicaragua. D. at the Javali Mine Oct. 10, 1871.

Seet'zen (ULRIC JASPER), b. near Jever, Friesland, Holland, Jan. 30, 1797; educated at the University of Göttingen, where he gave special attention to natural science; became a friend of Blumenbach and of Humboldt; undertook, under the patronage of the dukes of Saxe-Gotha, an extensive exploration of Asia and Africa; reached Constantinople 1802; proceeded to Aleppo, where he studied Arabic fifteen months, 1803–04; traversed Syria and Palestine to the borders of Arabia, making valuable scientific collections 1804–05; explored Lebanon and the regions E. of the Dead Sea in the costume of a Turk, discovering the sites of many towns before unknown, 1805–06; was again at Jerusalem Mar., 1807; proceeded thence by way of Sinai to Egypt, where he procured a vast collection of MSS. and other objects for the museum of Gotha; explored Upper Egypt, and in the disguise of a Mohammedan pilgrim visited Mecca and Medina; set out for Mocha Mar., 1810, and reached that city, whence his last letter was written Nov. 17, 1810. Nothing certain was ever known of his subsequent history, but he was believed to have been poisoned in 1811 by the imam of Saná. His diary and maps, recovered in 1815, were published at Berlin (3 vols., 1854–55).

Seez, town of France, department of Orne, on the Orne, manufactures gloves and linen. P. 5045.

Sefton, tp., Fayette co., Ill. P. 1227.

Seg'ment [Lat. *segmentum*]. A segment of a circle is a part of a circle included between two parallel chords; these chords are the bases of the segment. If one chord becomes a tangent, the segment has but one base. A spherical segment is a portion of a sphere included between two parallel planes; the circles cut out by these planes are the bases of the segment. If one of the planes is tangent to the surface of the sphere, the segment has but one base.

Segner's Wheel. See BARKER'S MILL.

Se'gni, town of Italy, province of Rome, on a hill S. E. of Rome, 40 miles distant by rail. This was one of the oldest Italian cities, being already a place of importance when it was occupied and strengthened by Tarquin the Proud. Most interesting remains of these remote ages may still be seen here, such as fragments of the old cyclopean walls, a fine gate of the same period, etc. During the Middle Ages it was one of the foremost towns of the Campagna, a favorite sojourn of popes and princes. The cathedral is one of the most imposing in the province, and contains some rich chapels. The present inhabitants are a vigorous race, and bring down for market large quantities of wood from the neighboring mountains. P. 5600.

Se'go, town of Western Africa, capital of the state of Bambara, on the Joliba, in lat. 13° 5' N., lon. 5° W. It is well built, contains many mosques and a large palace, and carries on considerable traffic. P. 30,000.

Sego, p.-v., Madison tp., Perry co., O. P. 33.

Segor'be, town of Spain, province of Castellon, on the Palancia, is beautifully situated, well built, and has large manufactures of brandy, paper, and flour. P. 7232.

Sego'via, an old and interesting town of Spain, the capital of the province of the same name, on the Eresma, on a lofty rock, and is surrounded by old walls surmounted by round towers. Its streets are narrow and crooked, but many of its buildings are magnificent. The aqueduct which carries the waters of the Rio Frio into the city is 2921 feet long and rests on 170 arches, some of which are 102 feet high. It is built of granite blocks without cement or mortar, and is the grandest specimen of Roman architecture in Spain. But the famous cloth manufactories which once supplied Europe have entirely disappeared, and the trade of the city has also sunk into insignificance. P. about 12,000.

Se'guin, p.-v., cap. of Guadalupe co., Tex., on Guadalupe River, has 1 weekly newspaper. P. 988.

Seguin' (EDOUARD), M. D., b. at Clamecy, department of Nièvre, France, Jan. 20, 1812. His ancestors for sev-

eral generations had been eminent as physicians. He was educated at the colleges of Auxerre and St. Louis in Paris, and studied medicine and surgery under Itard, and was subsequently associated with Esquirol. While yet a student he became one of the brilliant coterie of young men who accepted the teachings of Saint-Simon in philosophy and political economy. Ledru Rollin, Pierre Leroux, Michel Chevalier, Louis Blanc, the elder Flourens, and the Pereires were his most intimate friends. At the suggestion of Itard, who had himself attempted without success the training of a wild idiot boy, Dr. Seguin undertook soon after receiving his medical degree the training of a few idiot children. Devoting himself with great assiduity to the study of their psychological condition, he at length comprehended the nature of their infirmity so clearly that he was able to produce most remarkable results by his system of training them. In his first experiments Esquirol was associated with him, and their names appear together on the title-page of his first pamphlet on the subject of idiot training in 1839. Other duties called Esquirol away, but Seguin continued his humane labors, and from the idiot children in the great Hospice des Incurables a number were selected and placed under his care. In 1844 a commission from the Academy of Sciences of Paris, consisting of MM. Serres, Flourens, and Pariset, examined critically Dr. Seguin's method of training and educating idiot children, and in their report to the Academy they gave to it the highest commendation, declaring that up to the time when he commenced his labors (1837) idiots could not be educated or cured by any means previously known or practised, but that he had solved the problem. His work thus approved by the highest scientific authority, Dr. Seguin continued his philanthropic labors in Paris for some years, publishing in 1846 his great treatise, *Traitement moral, Hygiène et Education des Idiots et des autres Enfants arriérés*, which has continued to be the standard textbook for all interested in the education of idiots to the present time. (See IDIOCY, by DR. H. B. WILBUR.) He devoted his spare moments during this period (1839–48) to literary labor, but with direct reference to his specialty. After the revolution of 1848, Dr. Seguin migrated to the U. S.; visited the school for idiotic children in South Boston and the institution for feeble-minded youth at Barre, Mass., both in large measure the outgrowths of his labors in Paris; went to Albany, where Dr. Wilbur was just organizing the experimental school which has culminated since in the New York State Idiot Asylum at Syracuse, and rendered him invaluable assistance in that organization; returning to France, he came back with his family in 1851, and settled in Portsmouth, O., in the practice of his profession. But he could not be content without toiling still more for the helpless idiot children, and in 1854–57 he was at Syracuse teaching and training idiot children, aiding in the establishment of new institutions in Connecticut, Ohio, and Pennsylvania, and for a time was at the head of the Pennsylvania institution. Revisiting France again in 1858, he returned in 1859, and settled in practice at Mount Vernon, N. Y., from whence he removed to New York City in 1863. In 1866 he published *Idiocy, and its Treatment by the Physiological Method*, a valuable textbook and authority on the subject. Though he has not lost his interest in the subject with which he has been so fully identified, his later writings have been largely occupied with physiological education and professional topics. He was a commissioner from the educational bureau at the Vienna Exposition in 1873. Besides the works mentioned above, Dr. Seguin has published *Conseils à M. O. sur l'Éducation de son Enfant Idiot* (Paris, 1839), *Théorie et Pratique de l'Education des Idiots* (2 parts, Paris, 1842), *Hygiène et Éducation des Idiots* (Paris, 1843), *Images graduées à l'Usage des Enfants arriérés et Idiots* (Paris, 1846), *F. R. Pereire, premier Instituteur des Sourds et Muets en France* (Paris, 1847), *Historical Notice of the Origin and Progress of the Treatment of Idiots* (translated by J. S. Newberry, M. D., 1852), *Idiocy, its Diagnosis and Treatment by the Physiological Method; An Address before the New York State Medical Society* (1864), *New Facts and Remarks concerning Idiocy* (1869), an edition of Wunderlich's *Medical Thermometry*, with large additions (1871), *Family Thermometry, A Manual of Thermometry* (1873), *Medical Thermometry and Human Temperature* (1876), *Report as Commissioner to the Vienna Exposition to the Secretary of State* (1876). Dr. Seguin is also the inventor of the physiological thermometer, so largely used by physicians. L. P. BROCKETT.

Seguin (MARC), b. Apr. 20, 1786, at Annonay, department of Ardèche, France, nephew of Montgolfier; studied engineering; was engaged in the construction of railways in South eastern France and in the establishment of steam navigation on the Rhone; wrote *Mémoire sur le Chemin de Fer de Saint-Etienne à Lyon* and *De l'Influence des Chemins de Fer et de l'Art de les tracer et de les construire*, and is said to have arrived in 1839 at the same results in the calculation of the mechanical effects of heat as Mayer in Heilbronn in 1842, and Joule in London in 1843. D. at Annonay in 1875.

Ségur', a family of French nobility mentioned in the history of the middle of the ninth century, produced many names of good reputation in war, literature, and politics, and is still flourishing: (1) LOUIS PHILIPPE, COUNT DE SÉGUR, b. at Paris Dec. 10, 1753; received a military education, and served in America under Rochambeau; was appointed in 1783 ambassador to St. Petersburg, where he gained the favor of Catharine II., and concluded an important commercial treaty between Russia and France in 1787; retired from the public service after the overthrow of the monarchy; lost his large fortune during the Reign of Terror, and sustained himself and his family by literary work; was recalled to service by Napoleon; made a peer during the Restoration. D. at Paris Aug. 27, 1830. His principal works are *Théâtre de l'Hermitage* (2 vols., 1798), originally written for the private stage of Catharine II.; *Contes, Fables, Chansons et Vers* (1801), *Tableau historique et politique de l'Europe de 1786–96* (3 vols., 1800), *Mémoires, ou Souvenirs et Anecdotes* (3 vols., 1825). His *Œuvres complètes* were published in 33 vols. at Paris (1824–30).—(2) His son, PAUL PHILIPPE, b. at Paris Nov. 4, 1780; entered the army in 1799; became a member of the staff in 1802; governor of the imperial pages in 1804; brigadier-general and aide-de-camp to Napoleon during the Russian campaign, but was left without employment by the Restoration; made a peer by Louis Philippe. D. at Paris Feb. 25, 1873. In 1824 he published *Histoire de Napoléon et de la Grande Armée pendant l'Année 1812*, which made a great sensation, and has been often republished. He also wrote *Histoire de Russie* (1829) and *Histoire de Charles VIII.* (2 vols., 1834; translated into English, Philadelphia, 1842).

Sehome, p.-v., Whatcom co., Washington Terr., on Bellingham Bay, Georgia Straits.

Seicentis'ti [It.], in the history of the Italian literature, is the collective name of the writers of the seventeenth century, but as these stood lower than those of the preceding age, and the whole period denotes the lowest point of a long decline, the name becomes associated with the idea of false taste and artificial expression.

Seid'litz, village of Bohemia, near Bilin, is famous for its mineral springs, whose water, containing sulphate of magnesia, sulphate of soda, and carbonic acid, is often used as an aperient.

Seidlitz Powders. See ROCHELLE SALT.

Seidlitz Water. See SEIDLITZ.

Seifhen'nersdorf, town of Germany, kingdom of Saxony, on the Mandan, has large dye-houses, bleaching-grounds, and linen-weaving factories. P. 6076.

Seign'iorage [Fr. *seigneuriage*], in finance, is the charge levied by government to cover the expense of coinage. In England no fixed seigniorage is levied on gold, while a considerable seigniorage is levied on the silver and copper currencies; any person may have standard gold coined in quantities of not less than £10,000. In France, on the contrary, the seigniorage on gold is heavy; and this absence of uniformity in the monetary systems of Europe is, irrespective of the weights of the several denominations, a serious hinderance and loss in international trade.

Seine, a river of France, rises in the department of Côte d'Or at an elevation of 1420 feet above the level of the sea, flows in a north-western direction, passes through Paris, where it is from 300 to 500 feet wide, and enters the English Channel at Havre by an estuary 7 miles wide. Its entire length is 497 miles, of which about 350 below Troyes are navigable by barges, and 40 from Rouen to Havre (to which the term *Seine maritime* is applied) by vessels of 200 to 300 tons. It receives from the left the Yonne, the Essonne, and the Eure, and from the right the Aube, Marne, and Oise. By canals it communicates with the Loire, Saône, Rhine, and Scheldt. "Though surpassed in some respects by the Loire, Saône, and Garonne, yet taken as a whole, with the hills and valleys, forests and meadows, numerous villages and populous towns, and famous cities, which line its banks, it is the finest river in Europe."

Seine, the smallest but the most densely peopled and wealthiest department of France, comprises an area of 185 sq. m., with a population of 2,220,060. The ground is undulating and beautifully varied, traversed by the Seine and the Marne. The soil is not naturally fertile, but it has been made very productive by the skill of the farmers and gardeners. Immense quantities of vegetables, mushrooms, melons, peaches, and strawberries are raised for the market of Paris. Beautiful forests, as those of Boulogne, Vincennes, St. Cloud, and Meudon, cover a large part of

the surface between the cities, and rich quarries of building-stone and gypsum are found.

Seine-et-Marne, department of France, comprises an area of 2154 sq. m., with 341,490 inhabitants. The ground is slightly undulating and the soil very fertile. Extensive forests, yielding excellent timber, are found, among which is that of Fontainebleau. Large crops of wheat, vegetables, and fruits are raised; the wine of the department is mediocre, though it produces one of the most celebrated kinds of table-grapes, the Chasselas de Fontainebleau. On the pastures and meadows numerous cattle are reared, and immense quantities of cheese, the so-called fromage de Brie, are sent to the Paris markets. Of 45,763 children of school age, 3638 received no school education in 1857. Cap. Melun.

Seine-et-Oise, department of France, comprises an area of 2141 sq. m., with 580,180 inhabitants. In the southern part the ground is almost flat; in the northern, hilly and covered with forests. The soil is generally not fertile, but, being well manured and excellently cultivated, yields large crops of fruits and vegetables for the capital. Different branches of manufactures are pursued with great success. Several fine varieties of stone and clay are found, and the porcelain manufactures of Sèvres have acquired a world-wide reputation. Of 35,249 children of school age, 3450 received no school education in 1857. Cap. Versailles.

Seine-Inférieure', department of France, borders on the English Channel, where a range of chalk-cliffs from 200 to 500 feet high faces the sea and forms many good harbors. The ground is generally composed of plains, watered by numerous small streams, and broken only in the south-western part by ranges of low hills. The soil is fertile and well cultivated. Forests abound; large crops of grain, hemp, flax, hops, and fruits are raised, and sheep, cattle, and horses are extensively reared and of good breeds. Manufactures, and especially fisheries and commerce, form important sources of wealth. Area, 2298 sq. m. P. 790,022. Of 87,857 children of school age, 21,359, nearly one-fourth, received no school education in 1857. Cap. Rouen.

Seis'in [Fr. *saisine*]. The ancient English law concerning real property did not conceive of a freehold estate in land—that is, an estate for life, or in fee simple, or in fee tail—as complete without the presence of a peculiar element, partly consisting in a physical fact and partly in a mental condition, which was termed seisin. The mere right of ownership was not enough unaccompanied by the seisin, which made that right perfect. Seisin was not the mere possession of the land, although it is very erroneously defined in many textbooks as synonymous with possession; it was the possession accompanied by a claim to a freehold estate in the land so possessed. It was a fundamental dogma of the common law that there could be only one seisin of the same land at the same time, and that the seisin could never be in abeyance; that is, it must be continuously vested in or held by some person. It might be rightful or wrongful It was rightful when the person seized had also a valid title to the estate which he claimed; it was wrongful when the person seized had no such valid title, but held the possession and claimed the estate in hostility to the one in whom the true title was vested. So much importance was attached by the law to this technical conception that a person who obtained the seisin wrongfully was nevertheless, while it lasted, regarded as holding an estate and as having tangible rights against the true owner. The seisin, however, so closely attended the title that it could not be lost by the entry of a stranger on the land while the owner thereof remained in possession; and if the owner made an entry upon his land, he immediately acquired the seisin thereof, and was enabled to maintain all actions for its recovery based upon the fact of his seisin. In a few instances the seisin passed on a change of ownership without an entry upon the land. It passed in this manner to the heir immediately upon the death of his ancestor, if the latter was seized at the time of his death. It was then denominated seisin in law, to distinguish it from the ordinary case, which required a possession. These highly technical, arbitrary, and even absurd conceptions and dogmas of the old common law have been wholly abrogated in the great majority of the American States, and they can only serve to confuse the simple rules of real property which generally prevail in this country. In the jurisprudence of the U. S. seisin means simply ownership, and as an almost universal rule it passes by the execution, delivery, and record of a valid conveyance; no actual entry on the land is requisite for its acquisition or recovery. There is no good reason why the word should be retained in our legal nomenclature; the simplicity and accuracy of the law would be promoted by its complete abandonment. JOHN NORTON POMEROY.

Seismol'ogy [Gr. σεισμός, "earthquake," and λόγος, "discourse"], the science of earthquakes. (See EARTHQUAKE, by PROF. ARNOLD GUYOT, LL.D.)

Seiss (JOSEPH AUGUSTUS), D. D., b. in 1823 in Maryland; pastor of the Evangelical Lutheran church of the Holy Communion, Philadelphia, and editor of the *Lutheran*; distinguished as a preacher and as the author of a number of books, especially in defence and illustration of Millenarianism. He is also author of the *Baptist System* (3d ed. 1860), *Ecclesia Lutherana* (1867), the *Javelin* (1871), and has been one of the most active and influential laborers in every prominent department of Church activity.

Seistan', province of South-western Afghanistan, Central Asia, between lat. 30° and 32° N. and lon. 61° and 62° E., bordering W. on the Persian province of Yezd. The surface forms a deep valley, or rather an extensive depression, toward which the surrounding table-lands slope gently. The soil consists either of quicksand or of a stiff clay covered with coarse grass and tamarisk bushes, and uncultivable except along the rivers, which from the surrounding highlands gather in the middle of the depression and form the large but shallow lake of Hamoon. The land is mostly a desert. Between 50,000 and 60,000 inhabitants cultivate the river-tracts, but they are exposed both to the robberies of the wild nomadic tribes of the neighboring provinces and to the devastations of the hot, scorching winds, which rise on the Persian deserts, and carrying along with them clouds of dust, sweep down over the land and cover the fields with sand. Horses and cattle will not thrive here, but camels and sheep. Large ruins show, however, that this country once must have been well peopled and wealthy; it was probably ruined by Timoor at the end of the fourteenth century.

Seizin. See SEISIN.

Seja'nus (ÆLIUS), b. at Vulsinii in Etruria, a son of that Seius Strabo who was commander of the prætorian guard in the latter part of the reign of Augustus; grew up in intimate intercourse with the younger members of the imperial family, and gained by means unknown the full confidence of Tiberius, over whose mind he seems to have borne absolute sway for many years. He was an infamous character in every respect, and, outside of scheming, intriguing, lying, and dissimulating, had no abilities. But he was audacious and energetic. He dared to aim at the imperial power, and he came very near his goal. Having succeeded his father in the command of the prætorian guard, he gathered the whole body of these troops, which had hitherto lived scattered over the whole city and its vicinity, into one intrenched camp at the Porta Viminalis, and thereby both increased their importance immensely and gained their favor for himself. To the senate and populace he considered it unnecessary to pay any regard, but, although in possession of the military power, between him and the crown there still stood the whole imperial family. In 23, however, he persuaded Livilla, who was married to Drusus, the son and heir of Tiberius, to poison her husband, and he divorced his own wife in order to marry her. Soon after, he succeeded in making Agrippina, the widow of Germanicus, suspected in the eyes of Tiberius, and she and her two sons, Nero and Drusus, were banished from Rome. In 26 he induced the emperor himself to retire to the island of Capreæ, and the whole administration was now actually left in his hands. Meanwhile, the suspicion of Tiberius became aroused, by what or by whom is unknown, and (Oct. 18, 31) Sejanus was arrested in his seat in the senate, sentenced to death by that assembly, and executed the next day. His body was dragged through the streets, torn to pieces by the mob, and thrown into the Tiber. His immense fortune was confiscated; his children, most of his relatives, and many of his friends were killed. The sources of his *Life* are Tacitus, Suetonius, Dion Cassius, and Velleius Paterculus, all rich in striking scenes.

Sekunderabad' [properly **Sikanderabad,** "Alexander's town"], 3 miles due N. of Hyderabad, the capital of the nizam's dominions in British India, the head-quarters of the Hyderabad subsidiary force, and the largest cantonment of European English troops in India. It is 1830 feet above sea-level; the annual mean temperature is 77.4° F.; the climate may be set down as favorable. Formerly, Sekunderabad had the reputation of being one of the most unhealthy stations in India; now the new European barracks are the most commodious and handsome of the kind in India; they stand on a piece of ground known as Trimulgherry, given to government by the nizam, and enclose a space of 2½ sq. m. The hospital is a very superior building; the prevailing disease is fever. In 1862 the nizam built the "public rooms," consisting of a ball, dining, billiard, and retiring rooms, and presented them as a free gift to the officers of the garrison for the time being; the institution is maintained by the subscrip-

tions of the European residents of the station. In 1790 an agreement was made that the nizam should furnish a contingent of 10,000 men, to be paid by the British government; by the treaty of 1800 some regiments of the East India Company's native troops were added to the subsidiary force, and it was stipulated that this force is to be stationed in perpetuity in the nizam's territories for his own service. To this force European troops were first added in 1803; in 1874 the strength of the troops was 2457 Europeans, 3386 native troops. The troops are annually paraded for inspection by the nizam's military authorities. In Oct., 1874, the railway was opened, which, branching off at Gulbarga from the Bombay-Madras line, ends at Sekunderabad; a very unpleasant march of 140 miles is thus spared to the troops. E. SCHLAGINTWEIT.

Sela'chians [Gr. σέλαχος, "cartilaginous fishes"], the name of the class of ichthyoid vertebrates containing the sharks, rays, and chimæras. (See ELASMOBRANCHIATES in APPENDIX.)

Selachos'tomi [Gr. σέλαχος, "cartilaginous fishes," especially rays or sharks, and στόμα, "mouth"], a name devised by Cope for an order of fishes belonging to the sub-class Teleostei and super-order Chondroganoidea, the only other order of which is that of the Chondrostei, containing the sturgeons. The order Selachostomi is represented in the present epoch by only two generic types, which are closely related, but peculiar one to North America and the other to Eastern Asia. They were formerly classed in the same order as the sturgeons, but are very decidedly different in many respects. The distinctive characters are as follows: The skeleton is mostly cartilaginous and the *chorda dorsalis* persistent; the cranium cartilaginous, or very imperfectly ossified; the mouth is bounded above by the premaxillary bones, and no supramaxillary ones are developed; of the opercular bones, the operculum alone is developed, the suboperculum and interoperculum, as well as preoperculum, being wanting; the symplectic bone is also wanting; the basihyals and superior ceratohyals remain unossified, as well as the branchihyals; the proscapula, as well as post-temporal and interclavicles, are well developed; the coracoid, or paraglenal, is also well developed and entire; the fins are very finely radiated, and the caudal heterocercal. The order is represented by the single family POLYODONTIDÆ (which see), and as yet no fossil remains certainly attributable to the order have been found, although undoubtedly the living representatives of the class are the last of a long line of more or less similar types. The special characters of form of the mouth, dentition, and leaf-like prolongation of the snout are rather of family than ordinal value. THEODORE GILL.

Selborne, BARON. See PALMER (ROUNDELL).

Sel'by, town of England, county of York, on the Ouse, has shipbuilding slips and manufactures of sailcloth, rope, leather, and iron goods. P. 5271.

Selby, tp., Bureau co., Ill. P. 1497.

Sel'bysport, tp., Garrett co., Md., on Youghiogheny River. P. 1419.

Sel'den (HENRY), M. D., a son of William B., b. in Norfolk, Va., Nov., 1817; educated at the University of Virginia, and took his degree in medicine from the University of Pennsylvania 1841; was a private pupil of the celebrated Dr. Gerhard, and became resident physician in Blockley Hospital, Philadelphia; subsequently spent three years in Europe. On his return he soon secured a high position as a successful practitioner, but fell a martyr to professional duties in the prevailing epidemic. D. of yellow fever Oct. 2, 1855. PAUL F. EVE.

Selden (JOHN), b. at Salvington, near Worthing, Sussex, England, Dec. 16, 1584, being descended on the mother's side from a knightly family; studied at Chichester free grammar school, at Hart Hall, Oxford, 1598–1601, at Clifford's Inn 1601–04, and afterward at the Inner Temple, where he was called to the bar; acquired great fame for his classical, Oriental, and political attainments; became intimately associated with Camden, Usher, Sir Robert Cotton, Sir Henry Spelman, and other eminent scholars; was intimate with Ben Jonson; wrote in 1606, when only twenty two years of age, his first treatise, the *Analecton Anglo-Britannicon* (not published until 1615; new ed. 1653), giving an account of the civil administration of Great Britain prior to the Norman Conquest; issued his *Jani Anglorum Facies Altera* (1610; English translation 1682); furnished learned notes and illustrations to Drayton's *Poly-Olbion* (1613); published elaborate treatises on *Titles of Honor* (1614), and on Syrian mythology, as illustrative of the Old Testament, *De Diis Syris Syntagmata duo* (1617), a work which supplied Milton with important material for his *Paradise Lost;* was cited before the court of high commission (Dec., 1618) for having denied the divine right of tithes in a *History of Tithes* (1618), and was compelled to sign a withdrawal (not recantation) of the obnoxious doctrine; was imprisoned five weeks in the custody of the sheriff of London (1621) for having advised the House of Commons to resist King James's claim that their privileges were derived from royal grants; was elected member of Parliament for Lancaster 1623; was for some years an earnest and effective champion of the popular party in the long struggle with the Crown; conducted the prosecution of the duke of Buckingham in 1625, and again in 1628; defended Sir Edward Hampden before the court of king's bench for refusing to pay a forced loan 1627; opposed the royal prerogative on the questions of tonnage and ship-money, and aided in drawing up the celebrated "Petition of Right" 1628, for which conduct he was imprisoned in the Tower by order of the king Jan., 1629; was transferred to the king's bench prison in September, and remained there until 1634, when he was allowed to go at large on bail. During his imprisonment he continued his antiquarian and legal studies; published shortly after his release his most celebrated work, *Mare Clausum* (1635), which was dedicated to Charles, and defended the sovereignty of England over the "narrow seas" in reply to the claims of Holland to the right of fishing on the coasts of England, as advocated by Grotius in his *Mare Liberum;* sat in the Long Parliament (1640) for the University of Oxford; favored the exclusion of the bishops from the upper house, and aided in drawing up the articles of impeachment against Laud, but was subsequently considered a moderate supporter of the royal side, though displaying great impartiality in the questions at issue, and condemning the excesses of both parties; was a lay member of the Westminster Assembly of Divines; took the Covenant, and was appointed by Parliament chief keeper of the rolls and records in the Tower 1643; declined the mastership of Trinity Hall, Cambridge; was one of the twelve commoners appointed commissioners of the admiralty 1645; received from Parliament a grant of £5000 in recompense of his losses and as a reward for his services to the state 1646; was one of the university visitors 1647, and influential in Parliament in protecting the endowments of university chairs from the destructive zeal of the fanatics, and in preserving the library of Archbishop Usher from being dispersed; remained in Parliament after the death of the king, though taking little part in its proceedings; declined Cromwell's request to write a reply to the *Eikon Basilike*, and spent his closing years at White Friars, near London, as manager of the estate of Elizabeth, countess-dowager of Kent, to whom he was said to have been secretly married. D. at London Nov. 30, 1654, and was buried in the Temple church. He bequeathed his valuable library to some public institution at the discretion of his executors, among whom was Sir Matthew Hale, and it was given to the University of Oxford. Among his many works were *Marmora Arundeliana* (1628), a description of the marbles brought from Greece by the earl of Arundel; *De Jure Naturali et Gentium, juxta Disciplinam Hebræorum* (1640), *A Discourse concerning the Rights and Privileges of the Subjects* (1642), an edition of Fleta's celebrated *Commentary on English Law* (1647), *De Synedriis et Præfecturis Juridicis veterum Hebræorum* (3 books, 1650–55), and an edition of *Eutychius* (1656). His *Table Talk*, an amusing and valuable miscellany, was published in 1689 by Rev. Richard Milward, who had been his amanuensis, and by Samuel Weller Singer (Lond., 1847; 3d ed. 1860). His *Works* were edited, with a *Memoir*, by David Wilkins (3 vols. folio, 1626). PORTER C. BLISS.

Selden (WILLIAM), M. D., b. in Norfolk, Va., Aug. 15, 1808; was two years at the University of Virginia; graduated M. D. at the University of Pennsylvania 1830, and spent two years in London and Paris; has been a practitioner in Norfolk since 1833; served during the late war as surgeon in the Confederate army. Published an account of the origin of yellow fever in his native city in 1815, and reported a case of ligature to the subclavian artery for gunshot wound of the axillary in the *Confederate Medical Journal*. He is now one of the leading physicians of Norfolk. PAUL F. EVE.

Selden (WILLIAM BOSWELL), M. D., b. at Hampton, Va., Aug. 31, 1772; studied medicine in the University of Pennsylvania and Edinburgh, Scotland; for half a century was the leading practitioner of Norfolk. His faculty for observation and sound judgment gave him a great reputation. He was probably the first to use calomel in cholera infantum. His only professional publication was an account of yellow fever in Norfolk in 1800. D. July 18, 1849. PAUL F. EVE.

Selenates. See SELENIC ACID.

Sele'ne, in Grecian mythology, the goddess of the moon (Lat. *Luna*), was a daughter of Hyperion and a sister to Helios and Eos. She was also called Phœbe, as the

sister of Phœbus, and in later times she was identified with Artemis, and the worship of the two became amalgamated. In art, however, they were usually distinguished, Selene being smaller, having a rounder face, and wearing a long robe.

Selen'ic Acid. This acid, which is very interesting from its analogies with sulphuric acid and the parallelism of the compounds of the two, has the composition $H_2.O_4.Se$. Mitscherlich discovered it in 1827. The anhydrous oxide, SeO_3, is as yet unknown. It is best prepared from SELENIOUS ACID (which see) by the method of Wohlwill, which consists in forming a selenite of copper, converting this into selenate by the action of chlorine, which gives a mixture of cupric chloride and cupric selenate. The former is dissolved out from the latter by alcohol, and the cupric selenate suspended in water and decomposed by sulphuretted hydrogen. The filtered selenic acid is concentrated by evaporation. The most concentrated liquid acid obtainable boils at 280°, and Mitscherlich found for two preparations the densities 2.52 and 2.62. In this state it contains still a little water. It resembles oil of vitriol in many respects, and, like this, dissolves zinc when diluted, with evolution of hydrogen; but it nevertheless has the extraordinary power of oxidizing and decomposing hydrochloric acid when boiled with it, chlorine being evolved and the selenic acid reduced to SeO_2. The *selenates* are bibasic, like the sulphates, and have a remarkable analogy with the latter, there being biselenates like the bisulphates, and selenic alums similar to common alums; and the corresponding salts of the two acids resemble each other even in solubility, the lead, barium, and strontium selenates being insoluble, like the sulphates. Nitric acid does not act on them, but with hydrochloric acid they evolve chlorine, forming selenious acid and chlorides. HENRY WURTZ.

Sel'enides, compounds of selenium with metals and other elements. Many native mineral selenides are mentioned under SELENIUM (which see). The selenates and selenites, when subjected to reducing agents, yield selenides. They are much less easily dissolved by hot nitric acid than the corresponding sulphides, mercuric selenide (*tiemannite*) being almost unacted on. HENRY WURTZ.

Sele'nious Oxide and **Acid** (SeO_2), the only oxide of selenium known, is a solid white substance obtained by combustion of selenium in oxygen, or by evaporating selenious acid to dryness. It sublimes, without fusing, below redness, condensing in crystals; and is very deliquescent. Its compound with water, selenious acid ($O_3.H_2.Se$), is a strong acid, which decomposes, with heat, the chlorides and nitrates, and forms neutral salts with bases, being exceptional, nevertheless, in being decomposed by heat, as above intimated. The *selenites* are bibasic, and large numbers have been prepared and investigated, but for these the chemical textbooks must be referred to. HENRY WURTZ.

Sel'enite [Gr. σεληνίτης, "moonlike"], a mineralogical name for GYPSUM (which see). Dana believes that the σεληνίτης of Dioscorides was probably really crystallized gypsum, but not the *selenitis* of Pliny. The writer's recent discoveries in molecular structure indicate two distinct varieties of the species selenite or gypsum—allotropic modifications, as they may be called—one having density, when homogeneous, = 2.313 (Mohs found 2.31, and Kenngott, as the mean of 15, found 2.317), and the other = 2.337 (Filhol found 2.331). These two contain the metallic base, the calcium, in *calcite* and *aragonite* molecules respectively. This will be found explained under the head of VOLUMES, MOLECULAR. HENRY WURTZ.

Sele'nium [Gr. σελήνη, the "moon"], one of the elements, thus named by Berzelius, who discovered it in 1817, because closely related to *tellurium*, which had been named by Klaproth after *tellus*, the "earth." Sulphur, selenium, tellurium, and oxygen form Berzelius's natural *amphigen* group of elements, which are certainly separated widely from the *halogen* group in many respects, though fluorine apparently forms a connecting link, having many affiliations with both groups. Selenium must be considered one of the *rarer* elements, though several native mineral compounds of it are known. According to some authorities, it occurs native in the elemental form at a Mexican locality, but this must be dubious, as Dana, in his *Mineralogy*, makes no allusion to it. The mineral *clausthalite* is selenide of lead, *zorgite* a double selenide of lead and copper, these being the principal sources of commercial selenium, and somewhat common in the mines of the Hartz Mountains, at Tilkerode, Clausthal, and Zorge, also at Glasbach in Thuringia. *Lehrbachite* is a selenide of lead and mercury from the Hartz; *berzelianite*, a selenide of copper from the same, and from Skrikerum in Småland, Sweden; *eucairite*, a copper and silver selenide, also from Skrikerum, and found in several Chilian localities; *naumannite*, a silver-lead selenide from the Hartz. There is a silver selenide in crystals at Tasco in Mexico (del Rio); *tiemannite*, a mercuric selenide, from the Hartz; and a few others less known. Certain iron pyrites, as at Fahlun in Sweden, contain selenium; and when these are used for making sulphuric acid, a seleniferous deposit forms in the leaden chambers, in which, indeed, the element was first discovered by Berzelius, and from which, at Fahlun, a good deal is now procured. Traces of selenium were found by Dr. Genth in the Virginian and Georgian *tetradymites* (bismuthic tellurides), but this element seems almost absent from the North American continent, so far as known. In obtaining it from the Hartz Mountain selenides, carbonates are first removed by muriatic acid, and the ore then fused with *black flux* to form selenide of potassium, which is soluble in water. The solution, exposed to the air, allows the selenium, through oxidation of the potassium, to precipitate in the elemental form. The leaden-chamber deposit is deflagrated with saltpetre to form selenate of potash, the latter dissolved in muriatic acid, concentrated, and treated hot with sulphurous acid, which reduces the selenium.

Selenium forms a series of allotropes, like sulphur, phosphorus, and indeed most of the other elements. New discoveries of the writer in molecular chemistry (which will be found explained, in part, under the head of VOLUMES, MOLECULAR) enable him to recognize and define at least four distinct selenium allotropes, with considerable probability, from the facts placed on record by different investigators: (1) *Electro-negative amorphous selenium*, obtained by action of air or of a voltaic current upon HSe in solution. This is amorphous, and soluble in CS_2. Its density when pure and homogeneous = 4.241 at 0°. Schaffgotsch found as a minimum 4.245. (2) *Electro-positive amorphous selenium*, obtained from solutions of selenates or selenites by reduction with SO_2, or by electrolysis. This appears to be the modification experimented on by Berzelius. It is insoluble or difficultly soluble in CS_2. It is called "vitreous selenium." It fuses somewhat above 100°, and on cooling remains soft and *viscous*, so that it may be drawn into threads like sealing-wax for a long time; *viscous* selenium would be a better term. The threads, when slender, are translucent with a deep ruby color. When suddenly cooled it becomes brittle, with vitreous fracture, lustre almost metallic. It is a non-conductor of electricity, and when pure and homogeneous its density at zero should be = 4.322. Berzelius found, as a *maximum*, 4.32. (3) *Lighter crystalline selenium*, obtained by Mitscherlich by crystallization from CS_2. Density when homogeneous = 4.495 at 0° (Mitscherlich, 4.46 and 4.509 at 15°). The crystals, once formed, redissolve only to the extent of 1 per cent. in boiling CS_2. On heating to 150° it passes to the next modification, but by melting and rapid cooling may be brought to a somewhat soluble condition again, probably to modification No. 2. (4) *Metalloidal* and *Black Selenium*, the *Heavier Crystalline Selenium*.—This modification is formed either on very slow cooling of fused selenium, or on heating the allotrope No. 3 to 150° C. It has, when homogeneous, at zero, the density 4.815 (Hittorf found 4.808 at 15°, and Rathke found, for *black* Se, 4.81). Metalloidal selenium is lead-gray, opaque, with metallic lustre and granular fracture, entirely insoluble in CS_2, and conducts electricity. All authorities agree that heat is produced during the condensation of the denser selenium-allotropes from the lighter ones, but the amount of this heat is great according to some, and according to others small. Probably the same allotrope was not always started with.

Selenium does not kindle easily like sulphur, but when heated strongly will burn in the air; and selenides will burn before the blowpipe. A characteristic *odor* accompanies this combustion, compared by some to that of *horse-radish*, by which the presence of selenium in a mineral can be detected by those who know the odor.

Compounds (see also SELENIC ACID, SELENIOUS ACID, SELENITE).—*Seleniuretted hydrogen*, corresponding to *sulphuretted hydrogen*, is one of the most interesting of these. H_2Se is a permanent gas, which may be formed by the action of an acid on selenide of potassium, or by heating selenium in a current of dry hydrogen to its vaporizing-point. At a higher temperature dissociation again occurs. It is very poisonous, producing catarrhal disease when inhaled, and destroying the sense of smell. It does not liquefy at −15° C. HENRY WURTZ.

Seleu'cia, the name of two ancient cities of Asia, built by Seleucus Nicator (312–280 B. C.). The first, *Seleucia Pieria*, was on the Orontes, near its mouth, and formed the port of Antioch. It had an excellent harbor and was strongly fortified. Under the Romans it lost its importance and fell into decay, but its ruins still bear witness to its splendor. The second, *Seleucia on the Tigris*, rose and became the first city of the empire, surpassing Babylon in splendor and Antioch in importance, and containing 600,000

inhabitants. After the fall of the Seleucidæ, in the wars between the Persians and the Romans, it was sacked several times, and at last entirely destroyed.

Seleu'cus I., Nica'tor, founder of the Syrian monarchy and of the dynasty of the Seleucidæ, which ruled over it from 312 to 65 B. C., b. in Macedonia about 358 B. C. His father, Antiochus, was one of the generals of Philip, and he himself accompanied Alexander on his Asiatic campaigns, and is mentioned several times as holding superior commands, in which he distinguished himself. After the death of the great conqueror he followed Perdiccas, and was made commander of the cavalry, but after the disaster at Pelusium on the bank of the Nile in 321 he was one of the foremost of the conspirators who broke into the tent of Perdiccas and assassinated him. By the second division of the empire he received the satrapy of Babylonia through the influence of Antigonus, whom he then supported against Eumenes; but when Antigonus had defeated Eumenes he assumed an authority over all the Asiatic provinces to which Seleucus would not submit, though he was unable to resist it. In 316 B. C. he fled to Egypt, and instigated Ptolemy to join Lysimachus and Cassander against Antigonus. In the war which ensued he commanded the Egyptian fleet, and operated with great success before Tyre and at Cyprus. After the battle of Gaza, in which Demetrius Poliorcetes, the son of Antigonus, was completely routed, Seleucus was able to return to Babylonia, though only with a very small retinue; but his popularity was so great in the province that the inhabitants unanimously rose in his favor, and he was once more established as satrap of those populous and wealthy regions. The date of his return (Oct. 1, 312 B. C.) was afterward fixed as the starting-point of the era of the Seleucidæ, which was used by the Jewish and Arabian historians down to the fifteenth century A. D. In 306 B. C. he assumed the title of king, following the example of the other generals of Alexander, but very little is known of his life during these years, as he principally directed his activity toward the East, where he extended his dominions to the Oxus and Indus. He was a powerful monarch when for the second time he joined the league of Ptolemy, Lysimachus, and Cassander against Antigonus, and he decided the fortunes of the battle of Ipsus (301 B. C.) by his 480 elephants. Of the spoil he received the lion's part, Syria and the southern half of Asia Minor. In 286 B. C. Demetrius Poliorcetes surrendered himself unconditionally to him, and was kept in a sort of mild captivity at Apamea on the Orontes, where he died in 283 B. C.; and in 281 B. C. he completely routed Lysimachus at Corupedion, thus extending his dominion over all the Asiatic countries which had formerly belonged to the empire of Alexander. As Lysimachus had fallen in the battle of Corupedion, the throne of Macedonia was now vacant, and in the following year Seleucus crossed the Hellespont with a magnificent army, but at Lysimachia he was assassinated by Ptolemy Ceraunus (280 B. C.), and thus ended his brilliant career. Philetærus, satrap of Pergamus, redeemed his body and brought it to his son and successor, Antiochus, who buried it in Seleucia on the Orontes and raised a magnificent temple over his tomb. In his internal policy he was a true representative of the ideas of Alexander. He planted Greek colonies everywhere in his Asiatic provinces, and introduced Greek religion and art, Greek laws and customs. He divided his empire into 72 satrapies, and at the head of each he placed a Macedonian or Greek. Of the many cities which he founded, Seleucia on the Tigris and Antiochia in Syria were the most remarkable; both became important and splendid, and flourished through many centuries. (For the vicissitudes of his kingdom see SYRIA; for those of his dynasty, see ANTIOCHUS.)

Self-Defence'. This generic term embraces and describes all the rights which the law confers upon the individual to protect by his own acts and agencies his property or his person against some injury unlawfully attempted to be inflicted by another; and the rules of the municipal law in respect to these rights are in close conformity with the principles of natural justice. In ascertaining the extent to which the rights of self-defence may be exercised, the two cases of property and of person should, for greater convenience and clearness, be considered separately. When the invasion of property is in the nature of a private trespass merely, or is an attempt simply to deprive the true owner of its possession, the proprietor may use so much force as may be reasonably necessary to defend, protect, and retain his own possession, short of taking life; the law does not allow the sacrifice of human life in order to preserve a present right of property, which if lost could probably be regained by a judicial proceeding. If, however, the attack is forcible, and is made with the intent by the assailant to commit some great and heinous felony—if, for example, the assailant is attempting a burglary, or arson of a dwelling-house in the night-time, or enters a house with intent to commit murder or robbery and the like—not only the owner, but any occupant, may repel the attack with all the force that is requisite, and may if necessary kill the assailant in order to accomplish that object. An attack upon the person may be either (1) a mere assault and battery, or (2) an attempt to take life or to do some great bodily harm. In the first instance, the right of self-defence permits the use of so much force as may be necessary to repel the assault, and no more; in the second instance, the same principle permits and justifies, under proper circumstances, the destruction of life. If one's own life is threatened, or if some great bodily harm is about to be inflicted, or if an aggravated and forcible crime against the person is attempted—such as robbery, or rape upon a woman—and the circumstances are such, the danger so apparent, as would lead any reasonable man in the same position to the conclusion that the only mode of escape was by slaying the assailant, the law permits and excuses the homicide. The justification in such a case does not depend upon the actual fact of an impending danger, but upon the sufficiency of its appearance to convince a reasonable man in the same situation that it did actually exist. This right to defend one's self extends also under like circumstances to the person of a husband or wife, parent or child, master or servant; and undoubtedly a private citizen may interpose and prevent, by the use of all necessary force, the actual commission of a violent felony upon the person of any individual. JOHN NORTON POMEROY.

Sel'fridge (THOMAS O.), b. Feb. 6, 1836, in Massachusetts; graduated at the Naval Academy in 1855; became a lieutenant in 1861, a commander in 1870; served with distinguished gallantry on board the Cumberland when sunk by the Merrimack, on the Mississippi River and its tributaries, and in both the Fort Fisher fights, and always commended for "courage and coolness." F. A. PARKER.

Se'lim, the name of three Turkish sultans, of whom the first and the last have exercised a great influence on the destiny of the empire: SELIM I., b. in 1467, son of Bajazet II.; revolted and usurped the throne by the aid of the Janizaries Apr. 25, 1512, putting to death his father, brothers, nephews—in short, every one who was able to offer any resistance to his turbulent will; and he continued to show the same ferocious energy in all he did during his whole reign. In 1514 he began war with Persia, defeated Shah Ismael at Calderoon with immense slaughter, and annexed Diabekr and Koordistan to the Ottoman empire. After conquering Armenia he began war in 1516 with Egypt, defeated the Egyptian sultan Kansu-ghori at Margabik, and conquered Syria; and next year Kansu-ghori's successor, Tonman-Bey, at Gaza and Rudania, and subjugated Egypt. The last lineal descendant of the Abbaside califs, then residing at Cairo, transferred the standard of the Prophet and the religious prestige of his own descent to Selim. Thus, the Ottoman sultan became the chief of Islam, the representative of Mohammed, and the chief Arabic tribes and the sacred cities of Mecca and Medina acknowledged his supremacy. D. Sept. 22, 1520.—SELIM II., b. in 1524, a son of Solyman the Magnificent and Roxolana, succeeded his father Sept. 6, 1566, and d. Dec. 12, 1574. While his generals fought in Hungary, Persia, Cyprus, Tunis, and at Lepanto (Oct. 8, 1571) he spent his days in the harem, always intoxicated.—SELIM III., b. Dec. 24, 1761, a son of Mustapha III., succeeded his uncle, Abd-ul Hamid, Apr. 7, 1789, and was the first Turkish sultan who tried to introduce the civilization of Western Europe into his empire. When he ascended the throne he found the state in a most dangerous condition—revolution in Syria and Egypt, a disastrous war with Austria and Russia, insurrection even in the European provinces, Napoleon leading a French army into Egypt, and the diplomatic relations with England becoming more and more complicated. Nevertheless, as soon as he got his hands free he began his reforms in commercial, industrial, administrative, and military affairs. On the last point especially he met with exasperated resistance. He sought support from France, and the French ambassador to Constantinople, Count Sebastiani, exercised great influence. This circumstance awakened the jealousy of England. An English fleet appeared in 1807 before Constantinople, but was repelled. Soon, however, English and Russian agents succeeded in exciting the religious fanaticism of the people against the sultan; his reforms were depicted as infringements on the laws of the Koran. Open revolution broke out, and on May 31, 1807, Selim was deposed by the Janizaries and the muftis, and his cousin, Mustapha IV., was raised to the throne. He was at first imprisoned in the seraglio, but when Bairaktar, pasha of Roostchook, arose in his support and approached Constantinople with a formi-

dable army, Mustapha IV. put Selim to death (July 28, 1808), and his corpse was thrown across the wall into Bairaktar's camp.

Selim'no, or **Islamje,** a walled town of European Turkey, at the S. foot of the Balkan Mountains, 65 miles N. N. W. of Adrianople, manufactures coarse woollen cloth, firearms, and attar of rose, and has an important annual fair. P. 15,000.

Se'linsgrove, p.-b., Snyder co., Pa., on Pennsylvania and Northern Central R. Rs. and Pennsylvania Canal, 50 miles N. of Harrisburg. It contains 4 churches, a classical and theological institute, 1 bank, a money-order post-office, a building association, a boatyard, 2 newspapers, fine water-power, 3 hotels, and several saw, planing, and sash factories. It is the principal outlet for the produce of the county. P. 1453. FRANKLIN WEIRICK, ED. "TIMES."

Seli'nus, a Greek colony founded in the seventh century before Christ from Megara, and situated at the mouth of the Selinus, on the south-western coast of Sicily, received its name from the quantities of wild parsley (σέλινον) which grew in the vicinity. Of its history very little is known, but it must at one time have been a flourishing city. It was destroyed by the Carthaginians in 409 B. C., but again rebuilt. It finally decayed when in 249 B. C. the Carthaginians removed all the inhabitants to Lilybæum. Its site is now desolate, though covered with interesting ruins. The remains of three temples on a hill close to the city are very interesting, and one of them shows the ground-plan of one of the largest buildings of ancient Greek architecture—359 feet long and 162 feet broad, with eight columns in front and seventeen on the sides. The bas-reliefs found here are also very interesting, and belong to the oldest specimens of Greek sculpture. (See Benndorf, *Die Metopen von Selinunt*, Berlin, 1873.)

Seljooks, or **Seljuks,** a small Turkish tribe settled in the plains on the north-eastern border of the Caspian Sea, who received their name from Seljook, one of their chiefs, who in the latter part of the tenth century moved in a south-eastern direction, conquered Bokhara, and embraced Mohammedanism, and under whose successors they rapidly grew by absorbing other Turkish-Tartarian tribes, conquered the whole of South-western and Central Asia, and developed a marvellous energy during the course of several centuries. The only source, however, of this energy seems to have been religious fanaticism. At times, when this source became temporarily dried up, the vitality of the nation slackened, and when finally this burning but narrow enthusiasm waned away completely to give room for the steady purpose of broad general interests of humanity, the whole race seemed destined to pass quietly out of history. Seljook's grandson, Togrul Beg, conquered Balkh and Khaurezm in 1041, Irak-Ajemee in 1043, Kerman and Fars in 1047, Bagdad in 1055, Irak-Arabi and Mosul in 1061, thus completing the conquest of the whole of Persia, and assumed the title of sultan. Under his nephew, Alp-Arslan (1063–73), and Alp-Arslan's son, Melek Shah (1073–93), the empire still increased in power and prosperity. The latter conquered Arabia, Syria and Palestine, Asia Minor and Armenia, and ruled from the Mediterranean to the Chinese frontier, and from the Caspian to the Arabian Sea. From the history of Persia we know that the internal administration of this vast empire was regular, firm, just, and not altogether destitute of an interest in science and literature, nor wholly averse to undertakings of public benefit. Melek Shah, who removed the residence from Bagdad to Ispahan, instituted a celebrated law-school in Bagdad, and established an observatory there, the first in Asia. He also encouraged the building of roads, canals, bridges, etc. At his death the Seljook empire was divided between his four sons, and soon a large number of small independent sultanates was formed; which circumstance finally caused the ruin of the Seljook dominion. The sultanate of Iran was at first the central and principal state, and exercised a sort of authority over the others. But in 1194 it was swallowed up by the sultanate of Khaurezm, and this was again overthrown by the Mongols in 1221, Jelal-ed-din being completely routed by Genghis Khan on the western bank of the Indus. The sultanate of Aleppo fell in 1114, that of Damascus in 1155. The sultanate of Iconium (the present Konieh), comprising Asia Minor, and generally called by the Orientals the sultanate of Roum (Romans), lasted until 1299, and became the starting-point for a new departure of the Seljook tribe under the Ottoman dynasty. The sultans of Iconium maintained a perpetual war with the Byzantine empire and the crusaders, but in the thirteenth century they were compelled to pay tribute to the Mongols, though they did not lose their independence. With the overthrow of the Seljook dynasty in 1299, and on the ruins of its dominion, arose the Turkish empire.

Sel'kirk, a small, mountainous county of South-eastern Scotland, comprises an area of 263 sq. m., with 14,000 inhabitants. Cattle-rearing and agriculture are the principal occupations. Chief towns, Galashiels and Selkirk.

Selkirk, or **Sealchraig** (ALEXANDER), b. at Largo, Fifeshire, Scotland, about 1676; made several voyages to the Pacific; was sailing-master to a privateer called the Cinique Ports Galley, and having quarrelled with the captain, one Stradling, was put ashore, at his own request, Sept., 1704, on the uninhabited island of Juan Fernandez, off the coast of Chili, with some nautical instruments, a few books, a knife, kettle, axe, gun, and a supply of ammunition. Here he remained until Feb. 12, 1709, when he was relieved by Capt. Woodes Rogers of the privateer The Duke. He lived chiefly on the flesh of wild goats, which abounded in the island, and of which he killed above 500. He became mate to Capt. Rogers, whom he accompanied around the world; arrived in England Oct. 1, 1711, when his narrative appeared in an account of the voyage (1712), also in several separate publications. Selkirk returned to his native place; eloped with a girl, whom he married and brought to London; subsequently entered the navy, rose to the rank of lieutenant, and d. on board the man-of-war Weymouth in 1723. As is well known, De Foe's celebrated story of *Robinson Crusoe*, which appeared in 1719, has been generally supposed to be based upon the adventures of Selkirk, by whom the incidents were said to have been communicated to De Foe, but there is little reason for supposing that the latter had more than a general knowledge of the facts of the case. *The Life and Adventures of Alexander Selkirk* (Edinburgh, 1829) by John Howell, is the latest and best source of exact information on the subject.

Selkirk (THOMAS **Dundas**), FIFTH EARL OF, b. in Scotland in 1774; spent several of the later years of his life in promoting emigration to the Red River of the North, British America, where the colony now called Manitoba was long known as "the Earl of Selkirk's Settlement." He published several tracts on emigration, and political speeches. D. at Pau, France, in 1820.

Sel'ler's, tp., Hardin co., Ill. P. 560.

Sel'lersville, p.-v., Rock Hill tp., Bucks co., Pa., on North Pennsylvania R. R.

Sel'ma, city and tp., cap. of Dallas co., Ala., at the head of steamboat navigation on Alabama River, on Selma Rome and Dalton, Alabama Central, and Western R. Rs., has 13 churches, 2 daily and 3 weekly newspapers, 2 banks, 3 cotton-warehouses, 3 railroad machine-shops, and several mills and manufactories; was during the civil war an important military centre, having an arsenal, a navy-yard, artillery-foundries, and powder-works, and was captured by the Union forces Apr. 2, 1865, after a sharp engagement. P. 6484; of tp. 1651.

Selma, p.-v. and tp., Johnston co., N. C., on Richmond and Danville R. R. P. 1167.

Sel'ters Nie'der, v. of the German empire, province of Hesse-Nassau, is famous for its mineral springs, which furnish the so-called seltzer water.

Selt'zer-Water [Ger. *Selterswasser*], naturally, the water of a mineral spring at Selters, in the valley of the river Ems, in Nassau, which has been known since the ninth century. Having become the most famous and widely-known, probably, of all mineral waters, it is now very skilfully and successfully imitated and fabricated by chemical means in this country as well as throughout Europe. It is an alkaline water, containing over 6 grains of carbonate of soda to the gallon, with 30 cubic inches of free carbonic acid. There are also minute quantities of *lithia*, *baryta*, and *strontia*, and of *fluorine*, with other commoner ingredients usually found in mineral springs. H. WURTZ.

Sel'va, or **Silva** [Sp. *selva*; Port. *silva*, "forest"], a name applied in South America to great wooded tracts, chiefly in the Amazon Valley. They are mostly very level and densely covered with trees, mixed with underwood and lianas, rendering them very difficult to traverse except by boats, for the streams are often deep and navigable. Much of the Selva is annually overflowed. The area is more than 700,000 sq. m.

Selvatico (PIETRO ESTENSE), MARQUIS, b. at Padua in 1803; having studied literature, physical science, painting, and architecture under the best masters, he travelled through Italy and the greater part of Europe; in 1850 was appointed professor of æsthetics and of the history of art in the Academy of Fine Arts at Venice, and in 1855 was named inspector of the schools of design throughout the Venetian provinces. Political considerations induced him to resign these posts in 1858 and retire to private life. He is the architect of several churches in Venetia, and as an art-critic has not his superior in Italy. He has published numerous works, among which the following are especially notewor-

thy: *La Cappellina degli Scrovegni in Padova ed i Freschi di Giotto* (Padua, 1866), *L'Architettura e la Scultura in Venezia* (Milan, 1847), *Storia estetico-critica delle Arte del Disegno* (Venice, 1852–56), *Scritti d'Arte* (Florence, 1859), *L'Arte nella Vita degli Artisti* (Florence, 1870), *Guida di Venezia, Guida di Padova, Il Disegno Elementare e Superiore ad Uso delle Scuole* (Milan, 1874).

Sel'wyn (George Augustus), D. D., b. at Richmond, Surrey, England, in 1809; educated at Eton and at St. John's, Cambridge; became tutor at Eton and curate of Windsor; was consecrated first bishop of New Zealand 1841; visited many of the groups of islands in the Pacific in a small "missionary ship;" was appointed bishop of Lichfield, England, 1867, and made a tour through the U. S. and Canada 1874. He was the author of several religious treatises. Died in London, England, April, 1878.—His brother William, b. 1806, became professor of divinity at Cambridge 1855; was one of the revisers of the Old Testament translation; author of several theological works, and a benefactor of the Divinity School at Cambridge, where he d. Apr. 24, 1875.

Semaphore. See Naval Signals and Telegraph.

Sem'ele, in Grecian mythology, a daughter of Cadmus and loved by Zeus; was persuaded by Hera to demand of her lover that he should visit her once in all his royal majesty. Zeus begged her to desist from this demand, but as she would not, and he had sworn to grant her any wish, he came to her with thunder and lightning, and she perished in the flames. She was the mother of Bacchus.

Semen'dria, or **Smederewo,** town of the principality of Serbia, on the Danube, is beautifully situated, but poorly built. It is fortified, and has manufactures of firearms, important fisheries on the Danube, and extensive wine-cultivation in the vicinity. P. about 5000.

Sem'inary, tp., Fayette co., Ill. P. 920.

Sem'inole Na'tion County, the reservation in the Indian Territory occupied by the Seminoles (which see).

Sem'inoles, a tribe of Indians lately resident in Central Florida, but now, for the most part, settled on a reservation in the Indian Territory, originally formed a part of the Creek or Muskogee nation, from which they separated about 1750, when they absorbed some remnants of other Floridian tribes, especially the Mickasuckees, who are sometimes erroneously considered as the true Seminoles; received from the Creeks their present name, signifying "vagrants" or "wanderers;" were allies of the British forces in their forays upon Georgia, during the war of the Revolution; were associated with the Tallapoosas in a treaty of peace made with the Spaniards at Pensacola May, 1784; were included by the Creeks in the provisions of their treaty of 1790 with the U. S., but disavowed that instrument, and commenced border-forays 1794; were gradually reinforced by fugitive slaves and by negroes whom they carried away from the frontier plantations; received a considerable accession of numbers by a new secession from the Creeks 1808; ravaged the Georgia frontier in 1812, and again in 1817, when they massacred some scores of persons; were punished by Gen. Gaines, and subsequently by Gen. Jackson, who pursued them into Florida (Apr., 1818) and destroyed the Suwanee and Mickasuckee towns, a circumstance which led to the purchase of Florida the following year; disposed of a large portion of their lands and agreed to deliver up fugitive slaves by the treaty of Moultrie Creek, Sept. 18, 1823, and by the so-called treaty of Payne's Landing, 1832; sold their remaining lands for a sum of money and a reservation beyond the Mississippi. The latter instrument was informal, if not fraudulent, and was repudiated by the great body of the tribe. Pres. Jackson, however, acting upon the advice of the Senate, resolved to enforce that treaty, which gave occasion to a long and bloody war, begun Dec. 28, 1835, by the chieftain Osceola, and which in a few years cost the U. S. $10,000,000 and 1500 lives. In 1842 most of the Seminoles had been taken prisoners or had come to terms and been transported beyond the Mississippi; only about 300, under their chief Billy Bowlegs, remaining in the Everglades of Florida. A portion of the emigrants settled on the Rio Grande in Mexico. Treaties were made with the Seminoles in their new home in 1845 and in 1856, granting them lands W. of the Creeks, and a considerable annuity. The Confederate government made a treaty Aug. 1, 1861, with a portion of the tribe, the rest remaining loyal, and a civil conflict ensued in which the loyal Seminoles were defeated with great loss Dec. 25, 1861, and withdrew into Kansas. The two bands were reunited 1865, when they sold their old reservation to the U. S. and purchased a new one of the Creeks. They are now industrious and prosperous agriculturists, having in great part adopted civilization and Christianity through the influence of Presbyterian missions. In 1822 they numbered nearly 4000; in 1858, 2253; in 1865, 2959 (including negroes); and in 1874, 2438, besides about 150 in Florida and an unknown number in Mexico. They have some 8000 acres of land under cultivation, possess personal property valued at about $250,000, have 5 schools, and receive an annuity from the U. S. of $25,000 by virtue of treaties, the last of which bore date Mar. 21, 1866. Porter C. Bliss.

Semipalatinsk', town of W. Siberia, on the Irtish, in a district of the same name, in lat. 50° 24′ N. Its houses are mostly built of wood, and stand single, surrounded with gardens. It is a military station, and carries on an important trade with China, Toorkistan, and the Kirgheez. P. 14,135.

Semir'amis, according to Ctesias, the wife of Ninus, the founder of the Assyrian kingdom, a woman of extraordinary beauty, passion, and military prowess, who flourished nearly 2200 years B. C., survived and eclipsed her husband, and after a reign of forty-two years abdicated in favor of her son, Ninyas. All this is now admitted to be mythical. Ninus is merely a personification of the power of Nineveh, and what is related of Semiramis apparently belongs to Beltis, wife of Bel, the second person in the old Chaldean Triad, her name only being historical, but of much later date. Herodotus (*Hist.*, i. 184) mentions a Semiramis who ruled over Babylon five generations before Nitocris. This Semiramis of Herodotus is certainly not to be identified with the Semiramis of Ctesias. The name appears to have been derived from Sammuramat, or Sammuramit, found upon the monuments. Lenormant makes her the queen of Bin-lik-his III. (857–828 B. C.). Rawlinson makes her the queen of Vul-lush (or Iva-lush) III. (810–781 B. C.). R. D. Hitchcock.

Semitic Languages. See Appendix.

Semitic Races. See Man, by M. B. Anderson.

Sem'ler (Johann Salomo), b. at Saalfeld, duchy of Saxe-Meiningen, Dec. 18, 1725; studied theology at the University of Halle, where he was appointed professor in 1752 and director of the theological seminary in 1757. D. Mar. 14, 1791. He took a prominent part in the starting of the rationalistic movement in the German theology, but he was cautious in forming his views and careful in arguing them; and although his talent as an author was rather small, his works are pervaded by a spirit of genuine historical criticism, which exercised a great influence. His principal works are *Apparatus ad liberalem Veteris Testamenti Interpretationem* (1773), *Abhandlung von der Untersuchung des Kanons* (4 vols., 1771–75), *Versuch einer biblischen Dämonologie* (1776), *Versuch christlicher Jahrbücher* (2 vols., 1783–86), and an *Autobiography* (2 vols., 1781–82).

Sem'lin, town of Austria, in the Military Frontier, at the confluence of the Save and the Danube, opposite Belgrade. The city is poorly built, a large portion of it consisting of thatched mud huts, but it carries on a very important transit-trade between Austria and Turkey, and has improved considerably of late. P. 8915, consisting of Slavonians, Germans, Servians, Greeks, Croats, gypsies, and Jews.

Sem'mering, or **Söm'mering,** a branch of the Noric Alps, forming the boundary between Lower Austria and Styria, rises 4416 feet above the sea, and contains, at an elevation of 3066 feet, the principal pass leading from Vienna to Trieste. The first carriage-road was built here in 1728 by Charles VI., who placed at the turning-point of the road a memorial column with the inscription, *Aditus ad maris Adriatici litora.* In 1840 a longer but more comfortable road was completed, and in 1854 a railway was opened between Gloggnitz on the Austrian and Mürzzuschlag on the Styrian side, ascending an elevation of 2893 feet, and leading through fifteen tunnels and over fifteen viaducts. The road was constructed by Carlo Chega, and was considered the most audacious and most ingenious engineering work of its kind.

Semmes (Raphael), b. in Charles co., Md., Sept. 27, 1809, of Scotch-Irish parentage; became a midshipman in the U. S. navy 1826; was a volunteer aide to Gen. Worth in the Valley of Mexico 1847; became commander 1855; was secretary of the lighthouse board 1859–61; resigned at the beginning of the civil war; obtained a commission in the Confederate navy; obtained great notoriety by his exploits as commander of the Sumter and the Alabama in capturing and burning many scores of American merchant-vessels, and became after the war professor of moral philosophy in the State seminary at Alexandria, La. Author of *Service Afloat and Ashore during the Mexican War* (1851), *Campaign of Gen. Scott in the Valley of Mexico* (1852), *The Cruise of the Alabama* (1864), and *Memoir of Service Afloat during the War between the States* (1869). He was in 1867 editor of the Memphis *Bulletin*, and has frequently appeared as a lecturer. D. at Mobile, Ala., Aug. 30, 1877.

Semoli'na [It.], a finely-cracked wheat, or a very coarse meal made from hard wheat. After grinding it is separated into various grades, according to the size of the particles. A series of sieves is employed for this purpose.

Sem'pach, v. of Switzerland, canton of Lucerne, is famous for the battle fought here on July 9, 1386, between the Austrians and the Swiss, in which the Austrian noblemen, in spite of their valor and superior numbers, were butchered like sheep by the Swiss peasants, as they were unable to use their horses, and unable to fight on foot encumbered by their heavy armor. P. 1109.

Sem'per (Gottfried), b. at Hamburg in 1804; studied mathematics at Göttingen, architecture in Munich and Paris; travelled much in Italy, Sicily, and Greece; was appointed professor of architecture at Dresden in 1834; fled to London in 1849 on account of his participation in the revolutionary movements, and taught at the Royal Academy in Marlborough House till 1856, when he became professor at the polytechnic institute of Zurich. His principal buildings are the theatre and new museum of Dresden and the Polytechnicum at Zurich. He wrote *Die vier Elemente der Baukunst* (1851), *Ueber Industrie, Wissenschaft und Kunst* (1852), *Der Stil in den technischen und tektonischen Künsten* (2 vols., 1860–65), etc. He set forth with great decisiveness and defended with many ingenious arguments and acute observations the view that the antique architecture and sculpture were polychromic throughout, and he decorated the antique department of the art-museum of Dresden in accordance with this principle. D. at Rome May, 1879.—His nephew, Karl Semper, b. at Altona July 6, 1832, explored the Philippine Islands; was appointed prof. of zoology at the Univ. of Würzburg in 1868; and published *Reisen im Archipel der Philippinen* (1867–72), *Die Philippinen* (1869), and *Die Palau Inseln im Stillen Ocean* (1873).

Sempervirens. See Evergreen.

Sempervivæ. See Crassulaceæ.

Sem'ple (James), b. in Kentucky in 1799; became a lawyer at Louisville, and subsequently at Edwardsville, Ill., where he settled about 1827; served frequently in the legislature; was Speaker several sessions; became attorney-general and general of militia 1833; was chargé d'affaires to New Granada 1837–41, judge of the supreme court of Illinois 1842, and U. S. Senator 1843–47. D. Dec., 1846.

Semple (Robert Baylor), D. D., b. at Rose Mount, Va., Jan. 20, 1769; received a classical education; studied law, and afterward theology; became pastor of a Baptist church 1790; declined the presidency of Transylvania University 1805; became financial agent of Columbian College, Washington, D. C., 1827; published a controversial treatise against Alexander Campbell, a *History of the Baptists in Virginia* (1810), and other works, and was president of the Baptist triennial convention from 1826 to his death, at Fredericksburg, Va., Dec. 25, 1831.

Sempro'nius, p.-v. and tp., Cayuga co., N. Y., at the head of Skaneateles Lake. P. 1165.

Sen (Keshub Chunder). See Brahmo Somaj.

Senachwine, tp., Putnam co., Ill. P. 801.

Sen'ate. In many of the early states of the world, especially in city-states, besides the meetings of the people entitled to have a share in public affairs—the *ecclesia*, the *comitia*, etc.—there was a preparatory body, or, it might be, more than one, whose function it was to give advice on such matters as might come before the general assembly of the people. This body had also at a very early date the power of judging, together with the kings or supreme magistrates. It formed to a considerable extent at first a superior order, into which persons of lower birth could not find entrance. As usage and old custom, rather than positive enacted law, ruled in the decisions of those times, old men were preferred to younger ones for the members of such bodies, which received some of their names from this source. Such were *γερουσία* (from *γέρων*, "old man"), the senate of Sparta, and *senate* (from *senex*), the corresponding Roman body. In modern times the word senate is retained, although many of the members may be young.

The history of institutions gives us instances of senates selected on principles greatly varying from one another. But *upper houses*, as they may be called, are not necessarily senates according to the idea of the Athenian *βουλή* or council, or the Spartan *γερουσία*. Even the Roman senate's consent was not necessary to the confirmation of a law or rogation of the *comitia*. So, in modern times, senates, while their confirmation is always needed, have sometimes limitations on their power which the popular branches have not, especially those of originating and altering money-bills. The exact legislative competence of a senate or *upper house* must be learned from the constitution of each particular country. T. D. Woolsey.

Senato'bia, p.-v., cap. of Tate co., Miss., on Mississippi and Tennessee R. R., 37 miles S. of Memphis, Tenn., contains 3 churches, a Peabody public school, 1 newspaper, and a fine hotel. Ships annually 8000 bales of cotton. P. about 1100. Ira D. Oglesby, Ed. "Times."

Sen'eca, county of W. New York, extending from Cayuga Lake on the E. to Seneca Lake on the W., drained by Seneca and Clyde rivers, traversed by New York Central and Geneva Ithaca and Athens R. Rs., and by Erie and Cayuga and Seneca canals; has a hilly surface, well adapted for grazing, and a productive soil, and has numerous manufactories and flouring and saw mills. Staples, wheat, oats, Indian corn, barley, potatoes, hay, flax, wool, and butter. Caps. Ovid and Waterloo. Area, 330 sq. m. P. 27,823.

Seneca, county of N. Ohio, intersected by Sandusky River, traversed by Cincinnati Sandusky and Cleveland, Lake Erie and Louisville, Chicago division of Baltimore and Ohio, Cincinnati Sandusky and Cleveland, and Mansfield Coldwater and Lake Michigan R. Rs., has a level and fertile soil, abundant water-power, numerous flouring and saw mills, and manufactures. Stock-raising is an important industry. Staples, wheat, Indian corn, oats, hay, potatoes, apples, wool, and butter. Cap. Tiffin. Area, 550 sq. m. P. 30,827.

Seneca, tp., Plumas co., Cal. P. 400.

Seneca, p.-v., Manlius tp., La Salle co., Ill., on Illinois River and Chicago Rock Island and Pacific R. R.

Seneca, tp., McHenry co., Ill. P. 1027.

Seneca, p.-v., cap. of Nemaha co., Kan., on St. Joseph and Denver City R. R., 77 miles W. of St. Joseph, Mo., has 4 churches, a graded school, 1 newspaper, 2 hotels, 1 bank, a grist-mill, and the usual county-seat buildings. Principal business, stock-raising and farming. P. about 1000. West E. Wilkinson, Ed. "Weekly Courier."

Seneca, p.-v. and tp., Lenawee co., Mich. P. 2396.

Seneca, p.-v., Newton co., Mo., on Atlantic and Pacific R. R. P. 285.

Seneca, tp., Ontario co., N. Y., at outlet of Seneca Lake, includes the flourishing village of Geneva. P. 9188.

Seneca, tp., Monroe co., O. P. 1242.

Seneca, tp., Noble co., O. P. 982.

Seneca, tp., Seneca co., O. P. 1583.

Seneca, p.-v. and tp., Oconee co., S. C. P. 2313.

Seneca, p.-v. and tp., Crawford co., Wis. P. 1233.

Seneca, tp., Green Lake co., Wis. P. 414.

Seneca, tp., Wood co., Wis. P. 293.

Seneca (Lucius Annæus), b. at Corduba in Spain about 8 B. C., belonged to a Spanish-Roman family, but was educated in Rome. His father, Marcus Annæus Seneca, the Rhetorician (b. about 61 B. C. at Corduba, d. at Rome about 35 A. D.), was a teacher of rhetoric and a man of literary studies, wealthy and influential. Almost the whole of his *Suasoriarum Liber* and five books of his *Controversiarum Libri Decem* are still extant, edited by Bursian (Leipsic, 1857), and give a striking aspect of the moral degradation and æsthetic futility to which the oratorical art had sunk in Rome at his time. (See Koerber, *Ueber den Rhetor Seneca und die römische Rhetorik seiner Zeit*, 1864.) Young Seneca was trained in his father's art, and although he afterward left rhetoric for philosophy, he never forgot the lessons of his youth. His style, with all its pompous dignity and brilliant pointedness, is characterized throughout by that absolute preponderance of the form over the contents, of the expression over the thought, which rises from a lack of veracity, and results in mannerism and affectedness. Caligula said of his eloquence that it was sand without lime. After travelling in Greece, he began to practise as an orator in Rome, and achieved great forensic triumphs, but in 41 A. D. Messalina had him accused of entertaining an adulterous connection with Julia, the daughter of Germanicus and the wife of Vinicius, and he was banished to Corsica. Here he lived for eight years, and wrote, among other works, *De Consolatione ad Helviam Liber*, a consolatory letter to his mother, and one of the best of his writings, and *De Consolatione ad Polybium Liber*, a similar letter to Polybius, a freedman and one of Claudius's favorites, who had lost his brother; but this letter is one of his most disagreeable productions on account of its flattery. When Claudius married Agrippina, Seneca was recalled by her influence and appointed tutor to her son, Domitius, afterward the emperor Nero; for which position he showed a rather surprising adaptation. The pupil's vices grew as luxuriantly as the tutor's wealth. Most of Seneca's very prolific authorship belongs to this last period of his life. He wrote moral essays, philosophical letters, physical treatises, and

tragedies. The last mentioned, ten in number—of which, however, three are generally considered spurious, *Hercules, Œtæus, Agamemnon,* and *Octavia*—are the best of his productions. The rhetorical character is predominant here also, but the declamations become rarely entirely hollow, and *Hercules Furens, Phædra,* and *Medea* contain traits of genuine creative imagination. Of his prose essays, some of the most celebrated, *De Ira, De Animi Tranquillitate,* etc., are inexhaustible sources of piquant quotations; others, *De Clementia ad Neronem Cæsarem Libri Duo,* are rather curious on account of the personal character which the author has not been able to conceal under the flourishing representation of his ideas; but the largest portion is vague and trivial—*De Constantia Sapientis, De Brevitate Vitæ,* etc. His 124 *Epistolæ ad Lucilium* have more interest, containing moral observations and aphorisms of practical value. His *Apocolocyntosis* is also worth reading. It is a satire on Claudius, of course written after the death of the emperor, and it is very biting: there is, however, no indignation in it; it is merely written to please Nero. Meanwhile, the emperor began to hint at the millions which the philosopher had amassed. Seneca became alarmed, and offered to repay the whole amount and content himself with a small annuity. Nero refused the offer, and Seneca now retired from the court, gave no levées, was never seen in public, and tried his utmost to sink into oblivion. But in vain. Some one mentioned him as an accomplice in the conspiracy of Piso, and Nero sent him an order to commit suicide, which he immediately obeyed. He opened the veins in his feet and arms, and, discoursing with his friends on the brevity of life and the equanimity of the philosopher, he bled to death in a hot bath 65 A. D. From the revival of letters in Europe, and up to the beginning of this century, the works of Seneca, both the philosophical and the poetical, were much read and much admired. Editions were numerous and translations were made into all European languages. There were, however, always some voices which protested against his fame; and when his admirers tried to prove that he was a Christian and a friend of St. Paul, his adversaries undertook, seemingly with more success, to prove that he was an atheist and a mean hypocrite. In the present century much less attention has been paid to him, though there are editions of his works of quite a recent date—of his prose writings by Fickert (3 vols., Leipsic, 1842–45) and by Haase (3 vols., Leipsic, 1852–53), and of his tragedies by Peiper and Richter (Leipsic, 1867). See Farrar's *Seekers after God;* and Lightfoot's "Essay on St. Paul and Seneca," appended to his *Com. on the Ep. to the Philippians* (1868). CLEMENS PETERSEN.

Seneca Falls, p.-v. and tp., Seneca co., N. Y., on New York Central R. R. and Cayuga and Seneca Canal, at the outlet of Seneca Lake, has fine water-power and beautiful falls of Seneca River, flourishing manufactures of steam fire-engines, machinery, pumps, woollen goods, etc., 2 banks, 7 churches, an academy, and 1 monthly and 2 weekly newspapers. P. of v. 5890; of tp. 6860.

Seneca Lake, in Western New York, bounded by Seneca, Schuyler, Ontario, and Yates counties, is 35 miles long, from 1 to 4 miles broad, with an elevation of 447 feet. Its shores are bold, picturesque, and fertile, and the lake is navigated by steamboats. Its waters reach Lake Ontario by Seneca and Oswego Rivers. Its greatest depth is 630 feet.

Seneca Oil, a local name for PETROLEUM (which see).

Senecas, one of the tribes of the so-called Iroquois, or Six Nations of Indians of Western New York, the most numerous and warlike of that confederacy. Known in their own language as *Nundawa-ono,* or "People of the Great Hill," from one of their original seats at the head of Canandaigua Lake, near Naples, where, according to legend, their ancestors sprang from the ground, they were called by Champlain *Ontouoronons* (whence the name of Lake Ontario); by the Jesuit missionaries *Tsonnontouans;* and by the Dutch, *Sinnekaas*—a word of unknown etymology, which became corrupted into Senecas. They were the westernmost of the original five tribes composing the famous league of the Hodenosaunee or "Long House," of which they were the "doorkeepers," since their geographical position brought them more immediately into contact with hostile nations. Though they seem at all times to have constituted fully one-half of the fighting force of the confederacy, they had, in the distribution of the 50 hereditary sachemships, the smallest number, only 8, while the comparatively feeble tribe of Cayugas, their immediate neighbors on the E., had 10 sachems. This anomaly can best be explained by reference to the probable origin of that complicated system of tribal, clan, and family relationship which, as one of the most remarkable features of aboriginal politics, has received so much attention from writers, while its real nature has usually been totally misunderstood. There can be little doubt that all the "nations" of the confederacy formed but one tribe at a period distinctly within the range of existing traditions, therefore not more than three or four centuries ago. The only original subdivisions were those still subsisting in all the tribes under the name of "clans," eight in number, ranged in two series—Wolf, Bear, Beaver, and Turtle; Deer, Snipe, Heron, and Hawk. All the members of the same clan are regarded as constituting a single family, tracing their descent from a common ancestry; they can therefore only marry in other clans. The clans, being a social, not a political division, were doubtless pretty evenly distributed throughout the tribe at the time when increasing numbers and the progress of colonization led to the recognition of a *geographical* subdivision—first into three, and afterward into the "Five Nations" now known. The seat of government having been at Onondaga, it was natural that a larger number of the sachems remained in that vicinity; hence, the Onondaga "nation," though numerically weak, retained 14 out of the 50 sachemships, while to each of the two original colonies 18 sachems were assigned. The eastern colony was subsequently divided into 2, the Oneidas and Mohawks, each with 9 sachems, and the western colony also into two, the Cayugas and Senecas, the former retaining the disproportionate number of 10 sachems simply on account of greater proximity to the capital of the league. The present "nations" are usually said to speak distinct languages, but they are in reality only dialects, which might readily be differentiated from a common tongue in three or four centuries, the Onondaga retaining a pre-eminence as a sort of "court-language," and the Cayuga and Seneca tongues bearing a resemblance which indicates the recent date of their separation. When first known to the French explorers, the Senecas occupied the region between Lakes Ontario, Cayuga, Seneca, and Canandaigua, but during the seventeenth century they, with their brother tribes, waged incessant and successful wars against their western neighbors, who were more remotely of their own lineage—the Hurons or Wyandottes of Lake Huron, the Jenesasas (Neutral Nation or *Nation du Chat* of the Jesuits) on the Niagara peninsula, the Kahquas, Erikes, or Eries on the S. shore of Lake Erie, and the Andastes, otherwise known as Susquehannocks, Minquas, Mingoes, or Conestogas, on Susquehanna River. Large numbers of the defeated Hurons, and all the survivors of the Jenesasas, Kahquas, and Andastes, as well as captives from many other hostile tribes, were adopted by the Senecas, who were indebted to this resource for their numerical preponderance. At one time captives of eleven different tribes are mentioned as having been thus adopted. Descendants of the Eries are still pointed out among them. The exploits vaguely ascribed by historians to the "Iroquois," of carrying their arms to the Mississippi and Tennessee rivers, were usually true only of the Senecas, among whom resided the two hereditary war-chiefs of the confederacy. The Senecas bore the brunt of the famous battle where Braddock lost his life, as they had previously done of several French invasions from Canada, and were, as allies of the English, the chief sufferers by Gen. Sullivan's famous campaign of 1779. Having made peace at Fort Stanwix (1784), they sold to the U. S. most of their lands in the Genesee Valley and removed to the shores of Lake Erie and the banks of the Alleghany. They rendered good service as allies of the American forces during the campaign on the Niagara frontier 1812–14, and under the influence of Protestant missions have become during the present century prosperous agriculturists, whose religious and educational *status* differs little from that of their white neighbors. Through the advance of settlement in Western New York the ancient territories of the Senecas were rapidly diminished by successive purchases, until about 1847 they were reduced to the three reservations of Cattaraugus, Alleghany, and Tonawanda—some 66,000 acres. Early estimates of their population were much exaggerated, but there is little reason to believe that they were ever more numerous than at present, while it is certain that they have largely increased since 1812. They numbered in 1870, 3060, besides 206 in the Indian Territory, and about 200 with the Mohawks on the Grand River reservation in Canada. The Quakers founded schools among the Senecas before the close of the eighteenth century, and the American Board of Foreign Missions sent missionaries thither early in the present century. To the teachings of Rev. Asher Wright (1802–75) of the Buffalo (subsequently of the Cattaraugus) reservation, Rev. Asher Bliss* and Rev. William Hall of Cattaraugus and Alleghany reservations, and Rev. Anson Gleason of Cattaraugus, the Senecas owe their religious and educational status. The former gentleman, a scholar of culture, translated portions of the Scriptures and several educational works into Seneca, and prepared a hymn-book. PORTER C. BLISS.

* Father of the writer.

Sen'ecaville, p.-v., Richland tp., Guernsey co., O. P. 376.

Se'nefelder (Aloys), b. at Prague Nov. 6, 1771: entered on the stage at Munich, his father being an actor; attempted afterward literature, and engaged finally in the printing business, which led to his invention of Lithography (which see). Lack of money and the imperfection of the invention in its primitive state caused him many difficulties and disappointments, and it was not until 1806, when he settled at Munich and received the support of the Bavarian government, that he was able to carry his invention to perfection and make it of really practical importance. D. at Munich Feb. 26, 1834. He wrote a *Lehrbuch der Lithographie* (1819), which was translated into English—*Complete Course of Lithography* (1819).

Senegal', a river of Western Africa, rises in lat. 10° 30' N. and lon. 18° 40' W., in the Madingo highlands; flows first N. W., then W., and enters the Atlantic in lat. 16° N., after a course of about 1000 miles. It divides into two branches at 35 miles from its mouth, the southernmost of which is deep enough for the largest vessels, but a shifting sandbar at its mouth, having only 10 feet of water, makes its entrance very difficult. Its shores are generally wooded and fertile, but frequent cataracts and shoals obstruct its navigation, and make it of comparatively small commercial importance.

Senegal, the collective name of the French colonial settlements on the river Senegal, including the island of St. Louis, at the mouth of the river, and Gorée, off Cape Verd. They were founded in the seventeenth century, controlled successively by the West India, Senegal, and East India companies, and held by the English from 1758 to 1779 and from 1803 to 1814. A system of military colonization similar to that of Algeria is also applied here, though, as it would seem, not with any great success, as several stations have been abandoned of late. The population was estimated in 1874 at 100,000, and the value of exports at 10,800,000 francs; of imports at 6,400,000 francs. Commerce is exclusively in the hands of the French.

Senegam'bia, a large division of Western Africa, bounded N. by Sahara, E. by Soodan, S. by Guinea, and W. by the Atlantic, and extending between lat. 8° and 17° N., and between lon. 4° and 17° W. Its area is estimated at 400,000 sq. m.; its pop. at about 9,000,000. It derived its name from the Senegal and Gambia, which together with the Rio Grande are the only streams of any importance. The surface of this country presents a belt from 100 to 200 miles wide, of low, flat coastland, generally of a swampy and marshy, though in some places of an arid and sandy, character. Behind these plains the interior rises in terraces until at last it reaches the Kong Mountains, whose highest peaks do not rise more than 3280 feet. The country is very little known, however, on account of the climate, which is often very trying to the natives, and sure death to the European. Senegambia and Nubia are the hottest places on earth. In the dry season the thermometer stands at 102° at six o'clock in the morning, and at 110° at noon, and in the sandy districts, where the rays of the sun are strongly reflected, such a heat is produced that eggs can be cooked by simply burying them in the sand. In the wet season the heat is not diminished, and the rain, which pours down continuously, with a roaring, thundering sound like that of the discharge of musketry, transforms the atmosphere to a real vapor-bath. In the highlands the climate is, of course, cooler, and the air is free from the death-bringing vegetable miasmas with which it is impregnated in the coastland. The vegetation of such a country must necessarily be exceedingly luxuriant wherever the soil is fertile; and it is so, though travellers describe it as somewhat monotonous. In the forests the gigantic baobab, the African teak, and other timber trees alternate with different kinds of palms, the banana, the bread-fruit tree, and the mangrove. Rice, sugar, indigo, tobacco, coffee, and cotton grow wild and are of good quality. Oranges were introduced by the Portuguese, and are cultivated but not eaten by the natives. The inhabitants of Senegambia consist of a great number of different races and tribes, whose descent and relationships involve many intricate complications. N. of the Senegal live the desert tribes of the Moors; S., the Yolofs. The Yolofs are negroes of the very deepest black, and with thick lips and woolly hair, but they are tall, well proportioned, with noble features, and often remarkably handsome. They are Mohammedans, warlike, energetic, and industrious, and their language, which is entirely different from that of the neighboring tribes, has much resemblance to that of the Kaffirs in its grammatical structure. Farther S. live the Foohahs. They have an olive-brown complexion, long, silky hair, eagle nose, and show an apparent relation to the Caucasian race. They call themselves "white men," and are proud, but open, trustworthy, and kind; they are Mohammedans. In the highlands live the Mandingoes, who have all the characteristics of the negroes—woolly hair, thick lips, flat nose, and black complexion—but they are tall, well-proportioned, simple-minded, cheerful, winning, and industrious; some of them are Mohammedans, others are idolaters. Between these tribes, and especially along the coasts, live many other smaller tribes, which are often utterly debased and barbarous, turbulent, and given to intoxication and robbery. Each tribe forms generally a state of its own, but with the lower tribes one tribe is often broken up into several states, each state consisting only of one family: we are here near the bottom of humanity. Of foreigners, the French, the English, and the Portuguese have made settlements or hold possessions in Senegambia—the French on the river Senegal, the English on the Gambia, and the Portuguese on the Rio Grande.

Sen'eka, a drug consisting of the root of an indigenous perennial plant, *Polygala senega*, natural order Polygaleæ. This plant grows throughout most parts of the U. S., frequenting open fields and rocky places. It is a small herb, with small white flowers forming a close spike at the summit of the stem. The roots are of various sizes, tapering, branched, and twisted, with a thick gnarled head from which the several yearly stems arise. The epidermis is dark-colored, corrugated, and is the active part of the root. The dried root has but little smell, but leaves a pungent and acrid impression in the mouth after chewing. Seneka contains a peculiar principle called *polygalic acid*, probably identical with saponine. The drug is an acrid irritant, producing vomiting and purging in overdose. Its first use in medicine was by the Seneca Indians, who employed it as a remedy in cases of rattlesnake-bite, but by physicians it is now used almost exclusively as an ingredient in cough mixtures in the second stage of respiratory catarrhs. Its effects are analogous to those of squill. Seneka is an ingredient of the *compound syrup of squill* of the U. S. Pharmacopœia. Edward Curtis.

Sen'eschal [probably from the old Ger. *sene-scalc*, "senior servant"], an officer of mediæval courts, originally of menial character, but in later times powerful magnates sought the office, which in some instances conferred upon its occupant high military and judicial trusts. Not only monarchs, but many nobles, were attended by a seneschal, sometimes called a bailiff or high steward, for the three terms are nearly synonymous.

Senigallia, Italy. See Sinigallia.

Sen'ior (Nassau William), b. at Uffington, Berkshire, England, Sept. 26, 1790; studied at Eton; graduated at Magdalen College, Oxford, 1811; was admitted to the bar 1818; was professor of political economy at Oxford 1825–30, and again 1847–62; was master in chancery 1835–53, and subsequently examiner in political economy in the University of London. D. at Kensington June 4, 1864. Author of essays upon political economy, philosophy, etc., of narratives of travel in Turkey and Greece (1859) and in France and Italy (1871), and was for forty years a leading contributor to the *Edinburgh Review* and other magazines.

Senise, Italy. See Appendix.

Senlis', town of France, department of Oise, on the Nonette, is surrounded by old walls, and has a cathedral and an extensive trade in corn, flour, and wool. P. 6085.

Sen'na [Arab. *sana*], the leaves of several species of cassia constitute the commercial senna, brought from Southern India and from Alexandria. A senna-plant is indigenous in Egypt and the African deserts, which is called *Cassia acutifolia*, and furnishes most of the Alexandria senna. Great labor has been expended by chemists in endeavoring to isolate the valuable cathartic principle of senna, which has now been known since 1868 to be an acid substance called *cathartic acid*, which was discovered by Dragendorff and Kubly. It is not yet thoroughly well known, but is believed to be a complex compound of the *glucoside* family, and, singularly, contains *sulphur*. Like glucosides generally, it is easily alterable, and hence difficult of isolation and preparation. (For further information reference may be made to Wood and Bache's *U. S. Dispensatory*, under "Senna.") Henry Wurtz.

Sennaar', a state of North-eastern Africa and a part of Nubia, lies between the Bahr-el-Azrek and the Bahr el-Abiad, and extends from lat. 12° to 15° 45' N.; it is subject to Egypt. The surface presents an elevated plain, consisting of a sandy soil strewn with large boulders, but occasionally broken by the presence of large, isolated rocks, rising to the height of 1200 feet, such as Moia, Mandera, and Legadi in the neighborhood of the city of Sennaar. Along the Bahr-el-Azrek, the proper valley of the Nile, the soil is more productive, the sand being mixed with alluvial deposits or altogether supplanted by a rich, stiff marl; and it is only this tract of land which is in-

habited, the whole valley being studded with villages, while there are very few settlements to the E. of the river, toward the Abyssinian Alps, and none at all along the Bahr-el Abiad. The climate of Sennaar is, like that of all Nubia, extremely hot, the thermometer often rising during the dry season to 119° in the shade. The soil then looks like a piece of parchment, bare, naked, cracked, and hard-baked. When the rain comes it is transformed into one vast sheet of mire, and then *durra* is sown without any further preparation of soil than what Nature has done herself. Durra is not only the easiest kind of grain to cultivate, but it is also the most remunerative; and although it is inferior to wheat as a breadstuff, it yields an excellent beer and brandy, which the natives enjoy very freely—too freely indeed, intoxication being a feature of their every day life. The inhabitants are an extremely mixed race, and, like most mixed races, they are indolent and sensual. At one time they were Christians; now they are Mohammedans, but their Islamism does not sit deeper than did their Christianity. They are, however, not without ingenuity. Their houses are often well built, and they possess much skill in gold-smelting, leather-working, and pottery. They have built several cities, of which Sennaar is the capital, in lat. 13° 34′ N., lon. 33° 30′ E. It was a century ago a large and populous city, built of brick and containing several noteworthy edifices, but of late it has declined very much; large portions of it are in ruins, and the number of its inhabitants has decreased from 30,000 to 4000.

Sennacherib. See Assyria, by W. Jacobs, A. M., and Nineveh, by George Smith.

Sen'nett, p.-v. and tp., Cayuga co., N. Y., on New York Central R. R. P. 1748.

Senoi'a, p.-v., Coweta co., Ga., on Savannah Griffin and North Alabama R. R., has 3 churches, 2 academies, 1 newspaper, 2 warehouses, 1 hotel, and planing, merchant, and saw mills. P. about 1000.

J. E. Stallings, Ed. "Senoia Journal."

Sens, town of France, department of Yonne, on the right bank of the Yonne, is surrounded by old walls constructed by the Romans, has a fine cathedral, manufactures of leather, serge, druggets, and glue, and an active trade in corn, wine, flax, and hemp. P. 11,514.

Sensation. See Psychology, by Pres. J. McCosh, S. T. D., LL.D.

Sensa'tionalism, a term in philosophy sometimes used to denote the doctrine that all knowledge is derived originally from the senses. Various other terms are used as its synonyms—viz. "sensism," "sensualism," "sensuism," "empiricism," etc. Hobbes (in 1650) taught that all knowledge grows out of sensations. After sensation there remains behind the memory of it, which may reappear in consciousness. The memory of objects once perceived is aided by words. We therefore connect words to our mental representations of objects. The same word, serving as a sign for numerous similar objects, gives rise to general ideas. Locke held substantially the same views. Condillac (1755) likewise endeavored to explain all mental functions as transformations of sensation (*sensations transformées*). Desire arises from the recollection of a past sensation; the Ego is the totality of sensations. Bonnet (1755), Von Holbach (1770), Buffon (1780), Cabanis (1798), Destutt de Tracy (1815), Laromiguière (1818) held the doctrine of sensationalism. Among recent German writers Czolbe has elaborated a system of psychology that derives all the elements of self-consciousness from sensation. But he has to assume teleological forms—"the sensations and feelings which are hidden in space or the world-soul"—to explain the "fundamental limits of knowledge." His contemporaries, however—Moleschott, Büchner, Vogt—proclaim not only sensationalism, but materialism without reserve. While Cabanis said that thought is a secretion of the brain, Carl Vogt added, "the brain produces thought in the same way that the liver produces bile," etc. John Stuart Mill (1865) defines matter to be "a permanent possibility of sensation," and mind to be "a series of feelings with a background of possibilities of feeling;" thus making sensation the central principle, not only of knowledge, but of being, and apparently reaching the doctrine of Berkeley, *Esse est percipi*. Post-Kantian sensationalism has had to explain away the existence of universal and necessary ideas, such as time, space, causality, etc. Mill holds the geometrical axioms to be "generalizations from observation." Herbert Spencer (1860) holds that knowledge consists in "symbolic conceptions" when it relates to aught else than concrete objects that are not "too great or too multitudinous to be mentally represented." In contrast to this, he holds that "the ultimate truth which transcends experience by underlying it is the persistence of force." Thus, he makes in one instance all general ideas "symbolic," the real being particular things only; and then he makes Force, which corresponds to the most symbolic of our ideas, to be the most real of realities. (See Nominalism and Realism.) William T. Harris.

Senses, individual developments of the general sensibility belonging to the living organism. In the individual senses, hearing, sight, etc., the general sensibility of the organism has become immensely intensified by being concentrated and localized in distinct organs, the ear, the eye, etc., and by being specialized so that each organ transfers from the object to consciousness only a distinct part of that total impression which the object is able to make and the consciousness is capable of receiving—the ear only the audible, the eye only the visible, etc. There are five such senses—hearing, sight, smell, taste, and feeling—but they all rise simply as individual developments of the same fundamental faculty of general sensibility; which is evident from the curious connection existing between them. (See Histology.) But their degree of individualization is very different. In sight it is highest. All sensations, whether they come through the hand or the ear, transform themselves into visions, when they become vivid; while an image never suggests anything to the other senses except through associations. It is feeblest in smell and taste. They both disappear very easily in mere feeling, such as smell in sneezing and taste in nausea. It is apparent, however, that the general sensibility of the human organism covers a much larger ground than its five individual senses. There are sensations which enter into consciousness with great vividness without going through the senses, as, for instance, the feelings of hunger, thirst, suffocation, etc., generally designated as the sensations of organic life; or the feelings of pleasure and pain accompanying rest and fatigue, etc., generally designated as muscular sensations. This observation has given rise to a number of delicate researches which have thrown much new light on the whole question of sensation and sensibility, but it has also caused some physiologists and psychologists (Dr. Thomas Brown, Sir Charles Bell, etc.) to push their zeal for putting life into a thorough system so far as to propound a sixth sense, the muscular sense. Thereby, however, nothing is gained but to throw the definition of sense into confusion. Those sensations result directly from the general sensibility in its unindividualized, unspecialized form; that is their place in the system. Clemens Petersen.

Sen'sitive Plant, a name applied to *Mimosa pudica*, a low leguminous plant of tropical America, now widely dispersed over the world and commonly cultivated, on account of the rapid movement of the leaves when brushed or jarred, appearing to shrink from the touch. This faculty is shared in a less degree by several other species of *Mimosa* and some related plants, such as the sensitive brier (*Schrankia*) of the Southern U. S. (See Vegetable Physiology.)

Senso'rium [Lat.], with earlier philosophers and physiologists, meant the seat of the soul; with Cartesius, the pineal gland; with Boerhaave, the boundary-line between the gray and white substances. It now means the seat of sensation; and as sensation has been proved to take place wherever there exists a ganglionic structure, the term is now coextensive with that of nervous centres.

Sen'tence [Lat. *sententia*], in the law, denotes a judgment or determination pronounced by a court after the trial or hearing of a cause, by which the remedy is granted or the sanction is imposed. In the common-law courts the term is confined to criminal cases, their final decision in civil suits being called a "judgment;" while the corresponding act of a court of equity is usually denominated a "decree." In those tribunals whose procedure is based upon the civil law—in the admiralty courts, the English ecclesiastical courts, and sometimes in the American probate or surrogate's courts—the word "sentence" is used, instead of "judgment" or "decree," to designate all judicial determinations. The sentences in civil causes like judgments are either final or interlocutory—final, when they pass upon all the issues material to the decision, determine the rights and duties of the parties, and terminate the pending controversy; interlocutory, when they pass upon some collateral matter or proceeding in the action, or when they establish some right preliminary to the final adjudication. In criminal trials, according to the common-law methods, the sentences are all from their very nature final. It is the exclusive province of the jury to determine the guilt or innocence of the accused. When a verdict of guilty is rendered, the prisoner is thereby convicted, and it then becomes the duty and function of the court to pronounce upon him the judgment or sentence which the law provides as a punishment for his crime. Previous to this final act in all cases of felony the convict is publicly asked by the judge if he has anything to say why the sentence of the law should not be

pronounced upon him. This proceeding, which was originated at an early period of the English law, when the prisoner could not be defended by counsel, in order that he might have an opportunity to suggest any error that had occurred, is now an empty form, and yet the form must be observed or else the judgment would be illegal. No error being shown, the presiding judge declares the sentence, whereby the court orders the prisoner to be capitally executed on a certain day named, or to be imprisoned for a specified period, or to be fined in a designated amount, as the case may be. This sentence is entered by the clerk, and constitutes a most important part of the judicial record. The doctrines and rules of the law in reference to the nature and effects of judgments apply also to sentences. (See JUDGMENT.) JOHN NORTON POMEROY.

Sen'ter (ISAAC), M. D., b. in New Hampshire about 1755; settled early in life at Newport, R. I., where he studied medicine; was surgeon in Arnold's expedition against Quebec 1775, during which he kept an interesting *Journal*, published in vol. i. of the *Bulletin* of the Historical Society of Pennsylvania; practised his profession with distinguished success at Pawtucket, and afterward at Newport; contributed to the medical and scientific journals; was an honorary member of the medical societies of London, Edinburgh, and Massachusetts, and for many years president of the Rhode Island branch of the Society of Cincinnati. D. at Newport Dec. 20, 1799.

Separate Lutherans of Prussia. When King Frederick William III. of Prussia, by a cabinet order of Sept. 27, 1817, first attempted to introduce, or at least to prepare, a union between the Reformed and the Lutheran churches in Prussia, the attempt was met with much hesitation, not to say aversion, by many earnest Lutherans, who found an eloquent and fearless spokesman in Johann Gottfried Scheibel, professor in theology at the university and minister at the church of St. Elisabeth in Breslau. His two sermons (of Nov. 2, 1817, and Apr. 13, 1821), in which he compared the Reformed administration of the Lord's Supper with the Egyptian Isis-worship, and declared participation in it a deadly sin, set the difficulties of the intended union very forcibly before the eyes of the public, and became the rallying-point of the disaffected. The alterations in the administration of the sacrament, the breaking of the bread, and the introduction of the formula, *Christ, our Lord, says, This is . . .*, he also absolutely refused to adopt, and was suspended; but up to the year 1830 the opposition to the royal plan confined itself mainly to the literary sphere. In this latter year, however, two new cabinet orders, of Apr. 4 and Apr. 30, were issued with the purpose of pushing the cause; and then an open breach took place. Several distinguished men, such as Henry Steffens, Prof. Huschke, and Attorney-general von Haugwitz, many clergymen, and between 200 and 300 families, joined Scheibel. The measures which the government employed were at first rather cautious. Scheibel was driven into exile by chicanery, and died in Nuremberg Mar. 21, 1842; Steffens was removed to Berlin, and negotiations were carried on with Huschke and Haugwitz. The results were not satisfactory, however. The demands became every day louder of entire separation from the state Church and of complete surrender by the state to the congregation of the control of the ecclesiastical government. To suppress the fermentation, first the police and then military force were used. Clergymen were thrown into prison, laymen were fined heavily, assemblies dispersed by dragoons. Many families emigrated to America, but with the martyrdom the enthusiasm rose higher, and the number of the separatists increased. With the accession of Frederick William IV. to the throne in 1840 the situation changed. He restored the imprisoned ministers to liberty, left the congregations undisturbed in their endeavors at organization, and finally recognized the accomplished establishment July 23, 1845. In 1847 a great number of Lutheran congregations joined the separatists, discontented with the continued agitations of the union agenda; and at a synod held at Berlin Oct. 12–14, 1857, one speaker declared all the non-separate Lutheran congregations in Prussia to be the schools of Satan. The zeal of the establishment, however, was soon to be turned against its own bosom. In 1858 the Oberkirchen Collegium of Breslau, the highest administrative authority of the establishment, wanted to be specially mentioned in the official Sunday prayer made by the minister: some objections were made; a discussion of the authority of the Oberkirchen Collegium arose, and it now became apparent that the members of the establishment held very different views concerning church government. In 1861 two parties, a conservative under Huschke, and a radical under Diedrich, were formed, and soon after they entirely ceased to have any intercourse, condemning each other in the harshest expressions. Oct. 28, 1874, a conference was held at Eisenach with the purpose of re-establishing unity.

Sep'aratists, a Christian sect which was organized in 1803 in Dublin, Ireland. They aim at a return to primitive Christianity, and object to taking judicial or other oaths. In 1833, Parliament passed an act permitting them to make use of an affirmation in the place of the oath.

Separatists, one of the chief sects of the Mohammedans; also called MOTAZILITES (which see).

Sepia. See INDIA INK.

Sepiadæ. See CUTTLE FISH.

Sepino, Italy. See APPENDIX.

Se'poy [a corruption of the Indian word *sipahi*, "soldier"], a native soldier in the British service in India. Before the great Sepoy rebellion of 1858 these troops numbered 232,224 men, but in 1871 the force of natives in India proper was given as 102,801. The Sepoys consist of Mohammedans, Rajpoots, Brahmans, and men of other castes, besides Sikhs, Ghoorkas, and hill-men of various tribes. The officers are European.

Sep'sidæ [Lat. *seps*, from σήπω, to "creep"], a family of the order Sauria and group Leptoglossa, including certain small lizards. The body is subcylindrical and elongated, and the tail conical and pointed; the scales smooth; the head conical and regularly shielded, with the rostral plate quite large, and the nostrils in a notch in the hinder edge of the rostral shield; the limbs variable in development, generally all being present, but sometimes (*e. g. Scelotes*) only the posterior two; according to Cope, the temporal fossa is roofed, the premaxillary double, and the palatine maxillary laminæ often dilated. The family is a small one, and is peculiar to the Old World, being chiefly developed in Africa. Two species (*Seps tridactylus* and *Gongylus ocellatus*) occur in Europe. THEODORE GILL.

Septa'rium [pl. *septaria*; Lat. *septum*, "partition"], concretions formed by segregations of calcareous matter diffused through clay, not uncommon in shale-beds of all formations. They are lenticular or spheroidal in form, sometimes attaining a diameter of ten feet or more. In many instances these concretions seem to solidify first and most completely at the surface, and subsequently the interior by shrinkage is divided into a great number of ramified cracks; later, these are filled with calc-spar or some other substance deposited from a solution that has penetrated the mass, and then, when broken or weathered, the sparry lines show septa or partitions, from which the name *septarium* comes. They are also sometimes called *turtle-stones*, the flattened concretions, the surfaces of which are divided into polygonal spaces, having somewhat the aspect of the carapace of a turtle. Septaria frequently form about some organic nucleus, as a leaf, shell, bone, etc., and a great number of interesting fossils have been obtained from them, among which may be mentioned the great Devonian fish *Dinichthys*, of which the bones and plates are frequently found in the central portions of the huge concretions which lie in the Huron shale (Devonian) in Central Ohio. The material composing septaria is usually an earthy limestone, which when calcined often produces good hydraulic cement. J. S. NEWBERRY.

Septem'ber [Lat., from *septem*, "seven"], the seventh month of the old Roman year, but the ninth of the Gregorian. It is the month of the autumnal equinox. (See EQUINOX.)

Septima'nia [so named from its seven cities—Toulouse, Agen, Bordeaux, Poitiers, Saintes, Périgueux, Angoulême], an ancient district in the S. W. of France, was ceded to the Goths in 419. Its name appears in the writings of Sidonius Apollinaris (430–482). It was conquered by the Saracens in 712–719; desolated by Charles Martel in 737; conquered in part by Pepin in 760; became a part of the kingdom of Aquitaine in 778; became a dukedom in 817, a marquisate in 844; and was devastated by the Normans in 859. The Spanish March was set off in 864, and soon after it passed to the house of Toulouse.

Septimius Severus. See SEVERUS.

Septuages'ima [Lat., "the seventieth day"], in the ecclesiastical calendar the third Sunday before Lent. The first Sunday in Lent is termed Quadragesima, the three preceding ones Septuagesima, Sexagesima, and Quinquagesima.

Sep'tuagint, The, or **LXX.** [from the Lat. *Septuaginta*, "the Seventy" (translators)], the name commonly given to the earliest Greek translation of the Old Testament, otherwise called the Alexandrian version. According to the fabulous account of its origin in the letter of the pseudo-Aristeas, repeated by Josephus (*Ant.*, xii. 2) and others, Ptolemy Philadelphus, king of Egypt from 283 (285) to 247 B. C., at the instance of his librarian, Demetrius Phalereus, sent an embassy to Jerusalem to procure from the high priest Eleazar a copy of the Jewish Law, and to make arrangements for a translation of the same into

Greek for the Alexandrian Library. Seventy-two learned men were accordingly selected by the high priest, six from each tribe, and sent to Egypt with a magnificent copy of the Law written on parchment in letters of gold. They retired to the island of Pharos, where they completed the translation in seventy-two days. According to Philo (*Life of Moses*, ii. § 7), they were divinely inspired. The legend appears with embellishments in Justin Martyr and other Christian Fathers, according to whom the translators were shut up in separate cells and worked independently, and at the end of seventy-two days their several versions, being compared, were found to agree *verbatim*. In this later form of the story the translation is made to include the whole Old Testament. All that can be inferred with certainty from this legend is the high estimation in which the translation was held by the Jews as early as the first century of the Christian era. There is, indeed, no improbability in the supposition that Ptolemy Philadelphus may have taken pains to procure a copy of the books of Moses for his universal library. Jews in his time were numerous in Alexandria. On the other hand, a translation of the Old Testament, or at least of the Law, must have become a necessity at that period to the Hellenistic Jews, to most of whom the Hebrew original, long before the Christian era, was a sealed book; and to this necessity alone it may have owed its origin.

The character of the translation proves it to have been the work of many hands. The Pentateuch is best translated. Anthropomorphisms and offensive expressions are, however, often softened; *e. g.* for "they saw the God of Israel" (Ex. xxiv. 10), we read "they saw the place where the God of Israel stood." The translation of Proverbs has considerable merit, and the book of Job was rendered by a man of genius, who was better acquainted, however, with the Greek poets than with Hebrew, and dealt very freely with his text. The speech of Job's wife (ii. 9) is a curious interpolation. Ecclesiastes is rendered with barbarous literalness, so as to be in some places unintelligible; *e. g.* Eccl. vii. 30. The prophets are for the most part poorly translated, especially Isaiah; and the translation of Daniel was so bad that the version of Theodotion was early substituted for it in Christian use, and but a single manuscript of it is known. In some books, particularly Jeremiah, a recension of the text was followed differing from our present Hebrew; to others, as Esther and Daniel, apocryphal additions were made. The version contains all the books commonly printed in the English Apocrypha of the Old Testament, except the second book of Esdras. Some manuscripts and editions add a third, others a fourth book of Maccabees. As to date, the time assigned by the pseudo-Aristeas for the translation of the Pentateuch has nothing against it; and from a passage in the Prologue to Ecclesiasticus, which alludes to a Greek translation of "the Law and the Prophets and the rest of the books," it seems probable that the collection of books had assumed something like its present form before 130 B. C.

In the controversies between Jews and Christians in the second century it was found that the LXX. could not be relied on as an accurate representation of the Hebrew. Other translations were accordingly made, of which the principal were—(1) that of Aquila, in the first half of the second century, slavishly literal; (2) of Theodotion, based on the LXX., but aiming at greater fidelity; and (3) that of Symmachus, distinguished by greater freedom and elegance. These were presented in parallel columns, together with the Septuagint and the Hebrew text (in Hebrew and Greek characters), in the *Hexapla* of Origen in the first half of the third century; in the Septuagint column words and clauses not in the Hebrew were marked with an obelisk or dagger (to stab them as false), and words in the Hebrew not represented in the translation were added from one of the other versions, generally Theodotion, with an asterisk prefixed. Origen's *Hexapla* as a whole was never copied, but probably perished in the destruction of the library of Pamphilus at Cæsarea in Palestine. Copies were taken, however, of his Hexaplar text of the LXX., parts of which have come down to us in various manuscripts, and also in a Syriac version. The best edition of the remains of the *Hexapla* is that by Field (Cambridge, 1867–75, 2 vols. 4to).

The Septuagint has had a wide influence. It was habitually used by Philo and Josephus, and it is very often quoted by the New Testament writers, even where it differs widely from the Hebrew. Most of the ancient versions of the Old Testament were made from it, as the Old Latin, Memphitic, Thebaic, Ethiopic, Armenian, Slavonic, etc. With all its faults, it has been the only representative of the Old Testament to the Greek or Eastern Church from the beginning, and a knowledge of it is essential to one who would understand the language of the Christian Fathers and the history of theological opinions. From no other source is so much illustration to be derived of the peculiar Greek of the New Testament. It has also considerable value as a help in the criticism of the Hebrew text.

The text of the LXX. became early corrupted, and the Hexaplar edition of Origen increased the corruption, his obelisks and asterisks being often omitted or misplaced by copyists. Our existing manuscripts differ considerably, and the correction of the text is a difficult problem. The primary editions of the LXX. are—(1) that contained in the Complutensian Polyglot (1514–17; published 1522); (2) the Aldine (Venice, 1518); (3) the Roman, Vatican, or Sixtine (Rome, 1587, fol.), founded largely on the Vatican manuscript of the fourth century; and (4) that of Grabe (Oxford, 1707–20), the basis of which was the Alexandrian manuscript. The edition of Bos (Franeq., 1709, 4to) exhibits the Roman text with the variations of the other three editions; and the great edition of Holmes and Parsons (Oxford, 1798–1827, 5 vols. fol.) gives the same text, with the various readings of more than 300 manuscripts collated for it at great expense. The text of nearly all the oldest manuscripts of the LXX. (fourth to ninth century), as the Sinaitic, Vatican, Alexandrian, etc., has since been accurately published, but no critical edition exists in which these rich materials have been properly used. Such an edition has, however, been lately undertaken by an eminent English scholar, Dr. F. H. Scrivener. Meanwhile, the most convenient manual editions are those of Tischendorf (5th ed., Leipsic, 1875), the best; and Bagster's *Septuagint, Greek and English* (London, 1870, 4to), giving the Roman text with Brenton's translation in parallel columns. There is an excellent critical edition of the text of the Apocrypha by O. F. Fritzsche (Leipsic, 1871, 8vo). The best concordance to the Septuagint is that of Trommius (Amst., 1718, 2 vols. fol.); there are lexicons by Biel (Hagæ Com., 1779–80, 3 vols. 8vo) and Schleusner (Leipsic, 1820–21, 5 parts, 8vo, or Glasgow, 1822, 3 vols.). Sophocles's *Greek Lexicon* (Boston, 1870) is also valuable; and for the Apocrypha, Wahl's *Clavis* (1853). Among the most important works on the version are Hody, *De Bibliorum Textibus* (1709, fol.); Thiersch, *De Pent. Vers. Alex.* (1841), excellent in regard to the language; Frankel, *Vorstudien* (1841) and later essays; and Geiger, *Urschrift u. Uebersetzungen d. Bibel* (1857). EZRA ABBOT.

Sepul'chral Mound, a tumulus of earth or earth and stones thrown up over the burial-place of the dead. Sepulchral mounds are among the most frequent and interesting monuments of pre-historic ages. Throughout Europe, Asia, and America such tumuli abound; and the name Mound-builders has been applied to the pre-historic race of the present U. S., which left these relics, and a large part of the now remaining mounds are unquestionably sepulchral. The sepulchral mounds of Europe abound in interesting relics of the meagre civilization of early times, and many tumuli long considered Celtic or Scandinavian are of late referred without hesitation to remote ante-historic ages. Some of these are simple barrows of earth; others contain one or more stone chambers or kists.

Sepul'ga, tp., Conecuh co., Ala. P. 1600.

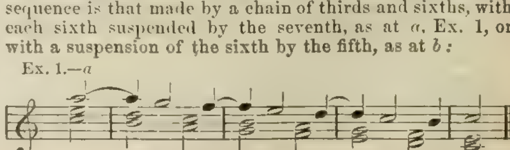
Sepulture. See FUNERAL, by S. SEXTON, M. D.

Sepul'veda, de (JUAN GINEZ), b. at Pozoblanco, near Cordova, Spain, in 1490; became a priest; resided twenty-two years in Italy; assisted Cardinal Cajetan in the revision of the Greek Testament; became chaplain and historiographer to Charles V. 1536; was tutor to Prince Philip. He wrote a *History of Charles V.*, a *Life of Cardinal Albomas*, and engaged in a polemic with Las Casas upon the subject of Spanish cruelties in America. D. near Cordova, Spain, in 1574. His works were edited by the Spanish Academy (4 vols., 1780).

Sequat'chie, county of S. Tennessee, traversed by Sequatchie River and lying between two ranges of the Cumberland Mountains, which have deposits of iron and other minerals. Staples, wheat, Indian corn, oats, tobacco, and wool. Cap. Dunlap. Area, about 300 sq. m. P. 2335.

Se'quence [Lat. *sequens*], in music, a peculiar chain-like progression, in which a short musical figure or group of notes is repeated several times on successive steps or degrees of the ascending or descending scale. As a sequence is thus only a group placed one degree higher or lower at each repetition, it can have (in itself) no proper termination, but may be continued indefinitely or through the whole range of the scale. One of the simplest forms of sequence is that made by a chain of thirds and sixths, with each sixth suspended by the seventh, as at *a*, Ex. 1, or with a suspension of the sixth by the fifth, as at *b*:

Ex. 1.—*a*



b

In sequences the leading trait or figure may lie in the treble, the bass, or one of the middle parts, or in any two or more of the parts together. In Ex. 2 the most forcible expression of the sequential idea is found in the treble at *a*, and in the bass at *b*, while at *c* it appears in the treble and bass combined:

Ex. 2.—*a*

b

c

Sequences are of infinite variety, and occupy an important place in fugues, organ-pieces, and instrumental compositions of almost all kinds, furnishing a grateful relief to the ear, and awakening certain emotions which seem peculiar to progressions of this class. Those we have given in the above examples are founded on the diatonic scale, but many of the richest sequences derive their beauty from the peculiarities of the *chromatic* scale, and are sometimes exceedingly elaborate and complex in their structure.

WILLIAM STAUNTON.

Se′quin [It. *zecchino*, *zecca*, a "mint;" Arab. *sikkah*, "a stamp"], a name applied to various Italian and Levantine coins. The original sequin was a Venetian gold ducat of the thirteenth century. At present the gold Italian sequin is worth $2.301, but it is no longer coined.

Sequoi′a [for derivation of the name see below], a genus of coniferous trees of the sub-order Cupressineæ, or cypress family, remarkable for the great size which they attain, being the redwoods and big trees of California. They are natives of California only, and of two species—one, *S. sempervirens*, the proper redwood, confined to the Coast Ranges; the other, *S. gigantea*, more particularly called big tree or mammoth tree in that State, restricted to the western face of the Sierra Nevada. The Pacific forest-belt is prolific of large trees, but these surpass in girth, if not absolutely in height, the sugar-pines, Douglas spruces, etc. with which they are associated. They are distinguished at sight from other trees by the trunks alone, invested with a peculiar fibrous bark of a rich cinnamon-brown color, and of thickness somewhat in proportion to that of the wood; but the bark of one associated tree, the incense cedar (*Libocedrus decurrens*), is to a certain extent similar. The nearest relative of the genus among existing trees is the *Taxodium*, or so-called cypress (more properly bald cypress) of the Southern Atlantic U. S. and Mexico; but that has deciduous foliage. Both differ from the cypress tribe proper in having the scales of the cone (which is small and oval) arranged on the axis in a spiral order, after the manner of pines, instead of being in pairs or whorls of three. Each of the wedge-shaped scales usually bears five wing-margined seeds. The leaves also, unlike those of the proper cypress tribe, are spirally arranged on the branch. But those of the two species are remarkably different, considering the essential similarity of the rest of the structure.

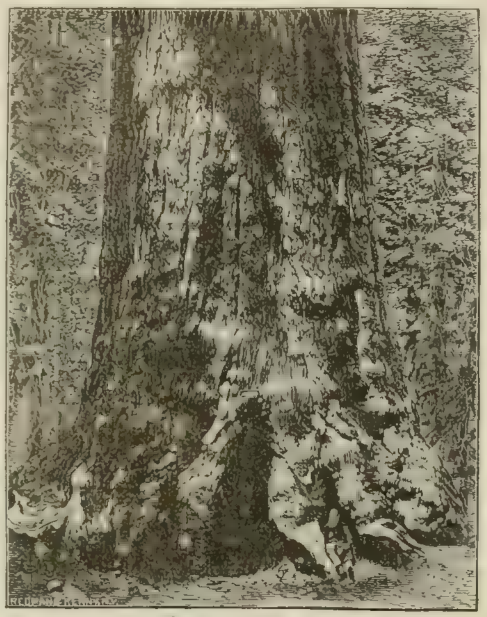
In the coast redwood the bright green foliage, spreading in a two-ranked manner, is very similar to that of yew, forming a graceful spray. The wood answers to its name, being of rich brownish-red; it is light, but firm, free and straight-grained, handsome for wainscoting and the like, although the color fades on exposure without protection, while it is fully as durable as red cedar when used for posts and palings. The tree is tenacious of life, the stumps even of the oldest trunks long retaining their vitality at the circumference, and sprouting into a circle of fresh young shoots. This tree adorns, or till recently adorned, the Coast Ranges from Monterey Bay to the Oregon line, but most abounds northward of the Bay of San Francisco up to lat. 40°. Being by far the most valuable lumber-tree of California, and growing near the coast, the available stock is being rapidly consumed. Where this redwood abounds it naturally forms a forest almost by itself. As Profs. Brewer and Whitney remark: "Let one imagine an entire forest, extending as far as the eye can reach, of trees from 8 to 12 feet in diameter and from 200 to 300 feet high, thickly grouped, their trunks marvellously straight, not branching till they reach from 100 to 150 feet above the ground, and thence forming a dense canopy, which shuts out the view of the sky, the contrast of the bright cinnamon-colored trunks with the sombre, deep, yet brilliant green of the foliage,—let one picture to himself a scene like this, and he may perhaps receive a faint impression of the majestic grandeur of the redwood forests of California." As to size, there are well-known trees with trunks from 50 to over 75 feet in circumference and from 200 to 275 feet in height; and credible accounts are given of still larger ones, equalling perhaps any of the giants of the Sierra species. Archibald Menzies, the surgeon of Vancouver's voyage, was the first botanist to collect specimens of the redwood, but only with old and imperfect cones. This was almost eighty years ago. They remained unpublished until the year 1832, when one of these specimens was figured by Lambert, and described under the name of *Taxodium sempervirens*; that is, it was referred to the bald cypress genus. Soon after, the tree was made known to botanists by Douglas. In 1847, Endlicher founded upon it the genus *Sequoia*. Although the derivation of the name was not explained, there is no doubt that Endlicher, who was a philologist as well as botanist, bestowed the name in commemoration of *Sequoyah*, a Cherokee Indian of mixed blood, who also bore the English name of GEORGE GUESS (which see), and who invented an alphabet (of 85 characters, each representing a syllable) and a written language for his tribe.

S. gigantea, the "mammoth tree" of the Sierra Nevada, now so famous, is of recent discovery. It appears to have been first seen by white men in the spring of the year 1852, when a hunter named Dowd reached the Calaveras grove, and afterward led a company of miners to the spot. Some account of these wonderful trees soon appeared in the California newspapers, and specimens (branches with cones) reached the Atlantic States and Europe in 1853. The earliest scientific account and name of it appeared in *The Gardener's Chronicle* (London), Dec. 24, 1853, by Lindley, who published it as *Wellingtonia gigantea*, and under this name also a figure appeared early in 1854 in the *Botanical Magazine*, edited by the late Sir William Hooker. The Californian botanists and amateurs, with a pardonable patriotism (which was unscientific if they knew that the tree was named and published already), proposed to call it *Washingtonia Californica*, and under this name it was published in the California *Farmer* some time in the year 1854. Meanwhile, the late Dr. Torrey, having obtained flowers of both sexes, determined that this tree was of the same genus as the common redwood—*i. e.* *Sequoia*—notwithstanding the remarkable difference in the foliage; and this conclusion was announced by the present writer in the *American Journal of Science* for Sept., 1854, but without appending the proper specific name. Prof. Decaisne in Paris had already taken the same view, and had assigned the name which the tree now bears as early as in June, 1854 (*Bull. Soc. Bot. France*, i. 70; also *Rev. Hort.* Jan., 1855). This conclusion being now fully adopted by botanists, the name could be regarded as settled were it not that Endlicher, misled by a mistake by Hooker and Arnott of a fir for a new redwood, had already applied the name of *Sequoia gigantea* to that. But Endlicher's second species, being founded upon a nonentity, disappears, the name *Sequoia Wellingtonia*, proposed by Seemann in 1855, has no proper reason, and that of *S. gigantea* stands.

Although attaining in general a vaster size than the coast redwood, this giant of the Sierras is not so handsome a tree, either when young or aged. The branches are short, the spray less graceful, the leaves small, awl-shaped, appressed to the branchlets, and paler. But the cones are three or four times larger. The wood is similar, but of a duller reddish hue. This species nowhere forms a forest by itself, but is intermixed with other coniferous trees, mainly sugar-pines of lordly size, and it generally occurs in detached patches or "groves." Its range in latitude is only between two and three degrees; in longitude very little, being confined to a particular part of the western

slope of the Sierra Nevada; in vertical range it is restricted between 1760 feet (at the northernmost locality) and about 7000 feet. The most northern groves known are the two in Calaveras county, one of which was the first discovered, and is still the most visited and most accessible. It contains some of the tallest trees known. This grove still contains four trees which are over 300 feet high; the tallest, called "the Keystone State," reaches the height of 325 feet, and its girth at six feet from the ground is 45 feet. The tree from which the bark was taken for exhibition and finally consumed in the Sydenham Crystal Palace is not quite so tall, but its stripped trunk measures 61 feet in circumference. The stump of the tree which was cut down was squared off, and a pavilion erected over it, has a diameter of 23 feet, and in one direction of 24 feet. Its annual rings on the section are 1255, besides a small portion in the centre which is imperfect. Its age cannot have exceeded 1300 years. Between this grove and the Merced River are two or three patches of big trees,

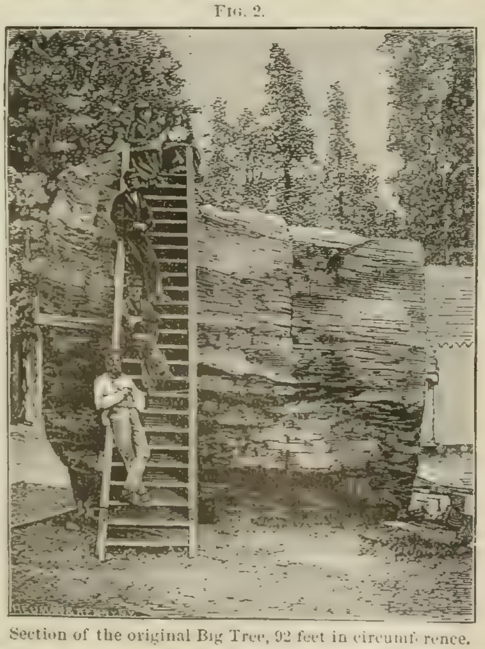
Fig. 1.



The Grizzly Giant.

but none of great note until the Mariposa grove is reached. This is 16 miles S. of the Yosemite Valley, and is

Fig. 2.



Section of the original Big Tree, 92 feet in circumference.

in two patches—the lower one 5500 feet above the sea-level. It contains about 125 trees that are over 40 feet in circumference—one, the Grizzly Giant, which is over 93 feet at the ground and over 64 at eleven feet above—as well as ruins and remains of still larger trees. Many have been sadly injured or destroyed by fire. None equals those of the Calaveras grove in height, the very tallest being only 272 feet. This grove, like the Yosemite Valley, is a government reservation and in charge of trustees. About a dozen miles S. of it is the Fresno grove, which is said to contain about 600 trees, the largest 81 feet in circumference. From this district S. to the Tule River, but at greater elevations, they appear to be more abundant than elsewhere, and more dispersed through the forest. There are probably existing trees of both species of *Sequoia*, and there are doubtless remains of the Sierra species, which have attained the age of over 2000 years; probably there are none which have very much exceeded this. (We learn from Prof. Whitney that a small grove has recently been discovered farther N. than any known before—*i. e.* 50 or 60 miles N. of the Calaveras, in Placer county—and that one of the fallen trees, of no unusual size, gave data indicating an age over 2000 years.)

It appears that neither of these species is adapted for planting in the Atlantic States, although the *S. gigantea* has not rarely survived well for a certain number of years. But it thrives in Europe, especially in England, where it is much planted and grows rapidly. The most full and authentic account of these trees is to be found in Prof. J. D. Whitney's *Yosemite Book*, from which this article is largely abstracted. This genus of trees, now so local and restricted in species, has played a larger part in the forest growth of earlier ages. It can be traced back to the older stage of the Cretaceous period in geology, and was represented by at least seven or eight species in the Tertiary period, during which it occurred all around the Arctic zone—in Europe as far S. as Greece, and in the western part of the North American continent, at least to Oregon. One of the Tertiary fossil species much resembles *S. gigantea*; two or three are very like the coast redwood, or only questionably and provisionally distinguished from it; one is of a type intermediate between the two existing species.

Asa Gray.

Sequoia Gigantea. See Sequoia.

Sequoy'ah, county of S. W. Kansas, formed since the census of 1870, and still unorganized. It is intersected by Arkansas River, traversed by Atchison Topeka and Santa Fé R. R., and consists of high rolling prairies. Area, 720 sq. m.

Sequoyah. See Guess (George).

Seraglio. See Constantinople.

Seraing', v. of Belgium, province of Liege, on the Meuse, has large manufactures of steam-machinery, locomotives, iron goods, and mirrors, and rich coal-mines in its vicinity. P. 21,853.

Serajevo, or **Sarajevo.** See Bosna-Serai.

Serampore', town of British India, presidency of Bengal, on the Hooghly, in lat. 22° 45′ N., lon. 88° 26′ E., is a neat and well-built city, with large manufactures of paper. It was originally a Danish settlement, and was sold in 1845 to Great Britain. P. 15,000.

Sera'peum, a temple dedicated to the god Serapis, of which there were several at Rhacotis, Alexandria, Memphis, and other places of Egypt, Babylon, and elsewhere, 42 temples having been recorded as dedicated to this god. As Serapis was the appellation of the Asar- or Hesar-Api, the Osiris or deceased bull Apis, the term Serapeum was applied to the cemetery of these sacred bulls at Memphis, which lived in the Apeum close by from the seventh century B. C. It was called the Great Serapeum. This subterraneous sepulchre was discovered in 1850 by Mariette-Bey at the western end of a dromos of sphinxes lying N. of the pyramids of Sakkarah, by a series of excavations extending to 7000 feet, and uncovering 141 sphinxes, at the end coming to a semicircle adorned with statues of gods and philosophers, supposed to be the library of the Serapeum. A lateral dromos 360 feet long led to the Apeum or temple of Apis and a naos of the god. This part of the Serapeum was built in the reign of Necht-her-hebi (B. C. 378–360), the mortuary chapel of the bull, however, having been founded by Shaemuas, a son of Rameses II., about B. C. 1300. Another of the shrines was erected during the Ptolemies (about B. C. 300), and the worship continued till the reign of Julian II. (A. D. 360–363). The Serapeum comprised a group of shrines dedicated to Astarte, Anubis, Imouthos, or Æsculapius, and a hospital, and had an organization of different officers, the most remarkable of which were the *didymi* or "twin" priestesses, and those persons who lived as monks (*en katoché*) in the precincts. The mummies of the Apis there buried began with that of a bull which died in the reign of Amenophis III. (about B. C. 1450), and con-

tinued, with some interruption, till the time of Ptolemy Euergetes II. (B. C. 117). They were not all buried with the same honors or in the same manner; those from Amenophis II. to Rameses II. had mortuary chapels, while at a later period they were buried in galleries, the chambers becoming (seventh century B. C.) of considerable size, with magnificent sarcophagi of red granite sixty-four tons in weight, in which portions of the bull were mummied. The tomb of the bulls had attached to outer walls tablets recording the dates of their birth, installation, and death, and the dates of the reigns in which these occurred. Hence, compared with the length of the life of these animals, the inscriptions have thrown great light upon the Egyptian chronology from the nineteenth dynasty downward. About 1200 tablets were discovered, chiefly in hieroglyphic, but a few of the later in demotic characters. Altogether, 7000 different objects were found during the excavations of Mariette-Bey. Besides the worship of the Apis, the sacred cow-mother of the god was also treated with divine honors, and probably buried there; but the place of sepulture of the bulls before the eighteenth dynasty is unknown, and they may have been buried in pyramids. Twenty-four Apis bulls were buried between the reigns of Rameses II. and Psammetichus I.

The other Egyptian Serapeum at Alexandria was erected by the Ptolemies to the god, a modified type or form of Aidoneus or Pluto, brought from Pontus. The building, of magnificent architecture and size, rose 100 feet above the level of the city, and in it was the celebrated Alexandrian library, that burnt by Cæsar having been replaced by the collections of the kings of Pergamus, given by Mark Antony to Cleopatra. The worship of the god was continued after the introduction of Christianity, but the temple and statue of the god of colossal size, made of wood plated with different metals, was destroyed at the instigation of Theophilus, archbishop of Alexandria, about A. D. 390, after the temple had been besieged by the Christians and an edict for the destruction of idols obtained from the emperor Theodosius. The celebrated Alexandrian library was pillaged or destroyed in the tumult, although its loss by fire has been popularly attributed to Amrou, 250 years later—perhaps burnt like the wooden portions of the god in the amphitheatre at the time of Theophilus. The temples of Serapis were supposed to give oracular responses by dreams or visions in which the god appeared, and connected the worship of Greek with Asiatic and Egyptian deities. No representations of the Serapeum have been preserved, but the one at Alexandria was evidently a Greek temple with a quadrangular portico and decorated with statues. One of the shelves of the library which held the works of Dioscorides has been found, but all other portions have been lost or can no longer be recognized. S. BIRCH.

Ser'aph, pl. **Seraphim** [occurring but once in the Bible (Isa. vi. 2, 6), derived by Steudel, Gesenius, Schultz, and others from an obsolete Hebrew root like the Arabic *sharufa*, "to be high," "pre-eminent," but by most interpreters from *saraph*, to "burn," "consume"], regarded by Hävernick, Diestel, and others as symbolical creatures; by Ewald, as of the form of a dragon with fiery eyes; by others identified with the cherubim, of which they are supposed to be another manifestation; but by most interpreters considered to be real creatures in human form, with six wings, ever worshipping at the throne of God, and performing the highest sacerdotal functions, like the twenty-four elders of Rev. iv. 4. CHARLES A. BRIGGS.

Ser'aphim [Heb.], **Order of the,** in Sweden and Norway, a knightly order founded in 1260 or 1285 by Magnus I., king of Swealand, or, as others say, by Magnus II. in 1334. Charles IX. abolished it about 1610, and Frederick I. restored it Feb. 11, 1748. The bishop of the Seraphim, the prelate of the order, belongs to the national Lutheran Church.

Sera'pis, the name of an Egyptian and Græco-Egyptian god. The Egyptian Serapis or Sarapis was the *Asar-Hapi* or Osiris-Apis, the name given to the sacred bull of Memphis, a supposed incarnation or avatar of the god Ptah, and the sepulchral or votive tablets set up in his honor bore that name, the Osor-Apis being supposed to be the son of the god Ptah, and animated by the soul of Osiris. As such he is represented under the type of a man with a bull's head. The Greek Serapis was introduced into Egypt in the reign of Ptolemy Philadelphus (B. C. 284–246), in consequence of a dream of that monarch, and his statue, a form of Hades or Pluto, sent as a present by the people of Sinope. It was placed in the temple on the promontory of Rhacotis, according to one statement, or else transferred from Pontus to Alexandria. As he was not a native deity, great diversity of opinion prevailed as to his significance. He was thought to be Æsculapius, Osiris, Jupiter, or Pluto, but the Greek inscriptions in the temples of Egypt identify him with Zeus or Jupiter and Helios or the Sun. He was also thought to be the ruler of demons and the invisible world. Besides Rhacotis, he had temples at Memphis, Alexandria, and Canopus. His worship was introduced into Rome by Antoninus Pius A. D. 146, and his mysteries celebrated on the 6th of May, but subsequently abolished by the senate. The form of Serapis constantly appears on the Roman coins struck in Egypt as that of a bearded man like Pluto, his hair slightly dishevelled, draped in a full garment, and wearing on his head the cylindrical modius or *polos*. He replaces at this time all the principal deities of Egypt, appearing instead of Osiris in the company of Isis, or else as Chnumis accompanied by Satis and Anucis. The principal site of the worship of Serapis was at Alexandria, and in the Serapeum of that city his type and worship existed till A. D. 379, when, at the instigation of Bishop Theophilus, a colossal figure of the god made of wood, plated with metal, was destroyed and burnt. Several busts and statues of Serapis are known, and small statuettes in bronze of this deity are not uncommon; and he often appears on later and especially Gnostic gems. He was sometimes represented seated with the attributes of Jupiter and Pluto, the eagle and Cerberus, at his side. At other times he is accompanied by the uræus, or even assumes the body of that serpent for his human form. S. BIRCH.

Seregno, Italy. See APPENDIX.

Sere'na, p.-v. and tp., La Salle co., Ill. P. 1076.

Serena, La. See COQUIMBO.

Se'res [Chinese, *see*, "silk"], the Greek and Roman name for a people of Eastern Asia, probably the Chinese, who were the first manufacturers of silk. Arnobius of Northern Africa, who flourished about 300 A. D., speaks of them as having been reached by Christian missionaries. R. D. HITCHCOCK.

Ser'es, town of European Turkey, eyalet of Salonica, in a densely-peopled and extremely fertile plain covered with rice-fields and cotton plantations. It is well built, has many mosques and extensive manufactures of cotton, and carries on an active trade. P. 25,000.

Serf [Lat. *servus*, a "slave"]. The historical origin and development of serfdom were very different in the different European countries. There are, indeed, hardly any two countries in which this institution exhibits exactly the same character, though in them all it at one time during the Middle Ages formed one of the most prominent elements of the existing social order. In many countries its features varied even from province to province; thus, in Denmark there was a great difference in this respect between Jutland and the islands; and in Germany between Mecklenburg and Saxony. Nevertheless, in spite of the innumerable modifications under which serfdom existed, and which make it one of the most difficult institutions of mediæval society to understand, there are several large features which, with some slight qualifications in certain individual cases, may be put down as its general description. It originated from the slavery of the ancient republics, and was transformed by the concurring influences of Christianity and feudalism. It received its final and legally-defined organization from the absolute monarchy, and disappeared with it under the influence of modern liberalism, more especially through the agency of the French revolution.

The slavery of ancient Rome, on which her whole civilization depended, was not a thing entirely unknown to the barbarians who invaded her territory and finally overthrew her empire. The Germanic nations had their thralls. Wherever they settled they employed the native population—that is, that part of it which was not killed and did not flee—to perform all menial labor for them, treating them nearly as we treat our domestic animals; and when they moved they generally carried along with them a multitude of such helpers, probably at the rate of ten thralls to one freeman. Such was the relation in England between the Anglo-Saxons and the Celts, and in Scandinavia between the Goths and the Finns and Lapps. But in the Roman slavery there was something absolutely unintelligible to the man of Germanic descent. In Rome the poet, the philosopher, the man skilled in science and art, the tutor of the children, and the ornament of the house was often, not to say generally, a slave. In the Germanic nations a man possessed of eminent wisdom or skill could never become a thrall. He might be sold, when captured, to a foreign market as a slave, but the individuals kept as thralls in the household were always inferior to their masters, both in natural capacity and in training; and whenever a thrall gave proofs of eminence in any respect, in some kind of workmanship or in noble courage, he was immediately made free. Furthermore, the Roman law had established a very subtle gradation in civil freedom, from

the slave just bought in the market to the patrician just become independent by the death of his father. But these subtleties the barbarian did not understand: he despised them, evaded them, and judged each single case according to his individual feeling; which, as society around him was far superior to him in refinement and general civilization, led him naturally toward the acknowledgment of freedom rather than toward the establishment of slavery. Thus, although the Germanic nations kept thralls themselves, their conquest of the Roman empire acted as a powerful agent in breaking up and transforming the ancient institution of slavery; and at the same time the Christian Church succeeded in enforcing laws which forbade Christian masters to keep Christian slaves: that is, they forbade slavery. But of course it was only the form which changed: the thing itself, the dependence of one individual on another, could not be abolished. In time of famine—and famines were frequent—the monasteries, or rather the ecclesiastical establishments, the bishops' sees, were the only places where provisions were found stored up, and the inhabitants of large districts were often compelled to buy relief here by selling a part of their independence. In time of war—and wars and feuds were perpetual—the agricultural population of whole provinces or of smaller circuits was often compelled to buy in the same manner protection for their corn-fields, vineyards, cattle-herds, and huts from the commander of an army or the lord of a castle. And still more general causes were at work. It was as impossible in the period between the sixth and the eleventh century to realize any kind of aspirations without belonging to the retinue of some lord or the court of some prince as it would be in the nineteenth century to achieve a success in any line of business without acquiring first the elements of the corresponding education. Thus, ancient slavery arose again in mediæval society, but in a much milder and more alleviated form—as a serfdom only; and it is probable that the mastership which the feudal and ecclesiastical lords exercised over their serfs was for centuries felt as a blessing rather than as a burden; for the feudal system was indeed, up to the tenth century, the main support of social order, the condition of life. In countries in which feudalism did not penetrate, such as Italy, no serfdom was developed: here the peasants, the population of the agricultural districts, entered the armies of the city-republics to which they belonged, and their position as citizens was not very different from that of the burghers.

The serfdom of the early Middle Ages was a very vague organization, and by no means regulated. But after the victory of absolute monarchy over feudalism it was defined by law in all its particulars; and however hard and repulsive it might formerly have been in many cases, on account of the arbitrariness and violence of the lords, it now became a general curse, an organized misery. The serf was not exactly a slave: the lord could not sell him, though it was quite common among noblemen in the seventeenth century, when playing at cards, to stake a certain number of peasants. But he was tied to the soil; he could not move, and if he fled he was hunted like a wild beast. He could hold property, said the law, but the law did not give him any means of protecting his property. The nobleman could arbitrarily increase the rent of the farm, from which the peasant was not allowed to move, and when the rent became due, but was not paid, the lord was his own court and sheriff; and in some countries he could even employ torture to enforce payment. The reasons why absolute monarchy thus delivered up one part of its subjects to the greediness and violence of another were different in different countries, but generally they bore the character of being a sort of compromise; the king had usurped the rights of the nobility, and, as a sort of compensation, he thus surrendered the rights of the peasants. In Russia, Peter the Great introduced feudalism and serfdom together in a very summary manner. His favorites were presented with a certain number of square miles and with all the people living on the land; he was to be lord, and they serfs; which practice was continued up to the time of Alexander I. In England, where absolute monarchy never became a fixed establishment, serfdom gradually disappeared during the fifteenth and sixteenth centuries. It is mentioned for the last time in 1574 by a commission issued by Queen Elizabeth for its abrogation in the counties of Cornwall, Devon, Somerset, and Gloucester. In France, where both Louis IX. and Louis X. had sought support in the serfs against the feudal counts, serfdom was maintained, often in very harsh forms, up to the Revolution. In Denmark it was abolished in 1784 by Frederick VI., at that time heir-apparent only, but actually governing instead of his insane father; in Prussia in 1808 by Von Stein; in Hungary in 1848 by the revolutionary anti-Austrian Diet; and in Russia in 1861 by Alexander II. CLEMENS PETERSEN.

Serge [from the Lat. *sericeus*, "silken"], a name applied to various twilled fabrics. Silk serge is a coarse and strong material used for lining coats, making light shoes, etc. Woollen or worsted-and-woollen serges are made for ladies' cloaks and other uses. Some kinds of coarse serge are employed for making the garments of certain ecclesiastics.

Ser'geant, a non-commissioned officer (*i. e.* an enlisted soldier holding an appointment from the colonel authorizing him to exert a limited authority over his fellow-soldiers) in the army and marines, of a rank higher than that of corporal. Bardin (*Military Dict.*) derives the word from the Low Latin *servientes*, men discharging a military service, and hence *soldiers*; while *servientes armorum* referred to armed knights, and hence our SERGEANT-AT-ARMS (which see). Each infantry company has a certain number of sergeants, one of which is of higher rank and pay than the rest, and is called first sergeant. Each battalion (or regiment, if as in the U. S. it has but one battalion) has a sergeant-major, who is the highest non-commissioned officer of the battalion. He is the executive officer of the adjutant, and superintends the making out of details and the performance of other camp duties for the adjutant. There are also quartermaster and commissary sergeants to each battalion. In the U. S. service *ordnance sergeants*, whose duty relates to the care of ordnance, arms, ammunition, and military stores at the posts to which they are attached, are provided for by law, to be selected from sergeants of the line who have served eight years, four of which as non-commissioned officers. J. G. BARNARD.

Sergeant, tp., McKean co., Pa. P. 119.

Sergeant (JOHN), b. at Newark, N. J., in 1710; graduated at Yale College 1729; was tutor there 1731–35; began to preach to the Indians at Housatonnuc, in Western Massachusetts, Oct., 1734, and translated portions of the Bible into their language. D. at Stockbridge July 27, 1749.—His son JOHN, b. at Stockbridge about 1747, was pastor to the same Indians at New Stockbridge, N. Y., from about 1768 until his death, Sept. 8, 1824.

Sergeant (JOHN), LL.D., son of J. D. Sergeant, b. at Philadelphia, Pa., Dec. 5, 1779; graduated at Princeton 1795; was admitted to the Philadelphia bar 1799; was appointed a commissioner of bankruptcy 1801; was subsequently deputy attorney-general of Pennsylvania; sat several times in the Pennsylvania legislature; was member of Congress 1815–23, 1827–29, and 1837–42; was the leading representative of the Northern States in advocating the passage of the Missouri Compromise act 1820; was minister to the Panama congress 1826; Whig candidate for the Vice-Presidency on the ticket with Clay 1832, in which year his *Select Speeches* were published; president of the Pennsylvania constitutional convention 1830; declined the mission to England 1841; was appointed by Secretary Marcy arbitrator to determine a controversy of long standing between the U. S. and the State of New Jersey; was president of the Philadelphia House of Refuge and of the Apprentices' Library Company, and for half a century was regarded as one of the leaders of the Pennsylvania bar. D. at Philadelphia Nov. 23, 1852.

Sergeant (JONATHAN DICKINSON), b. at Newark, N. J., in 1746; graduated at Princeton 1762; became a lawyer; was a member of the Continental Congress 1776–77, having taken his seat a few days after the Declaration of Independence; was attorney-general of Pennsylvania 1777–80; was afterward an eminent member of the bar of Philadelphia, where, in consequence of his benevolent efforts as a member of the board of health, he caught the yellow fever, and d. in Oct., 1793.

Sergeant (THOMAS), son of John, b. at Philadelphia, Pa., Jan. 14, 1782; became a lawyer; sat in the legislature 1812–14; was judge of the district court 1814–17; secretary of state 1817–19; attorney-general 1819–20; postmaster of Philadelphia 1824–32; associate justice of the supreme court of Pennsylvania 1834–46, having been reporter of the decisions of that court 1814–28; was long president of the Historical Society of Pennsylvania; wrote several professional works, and was a frequent contributor of prose and verse to the literary periodicals. He married Sarah Bache, a granddaughter of Benjamin Franklin. D. at Philadelphia May 5, 1860.

Sergeant-at-Arms, originally an officer who attends the English lord chancellor and also the House of Lords. He acts as executive officer for the Lords and for the chancery court. The House of Commons has another sergeant-at-arms.

The sergeant-at-arms of the U. S. Senate assists in the preservation of order, serves processes, arrests persons, and holds them in custody when so directed by the Senate, etc. He has $2000 a year, and large fees, in the aggregate,

for the serving of processes. The sergeant-at-arms of the House of Representatives performs duties corresponding to the above, and also keeps the pay and mileage account of the House, and, if required, pays money to the members for the pay-checks prepared by him and endorsed by the Speaker and the member to whom the check is issued. His pay is $4320, without fees.

Sergi'pe, province of Brazil, bounded N. by the province of Alagoas, from which it is separated by the river São Francisco, W. and S. by the province of Bahia, and E. by the Atlantic; comprises an area of 31,958 sq. m., with a population estimated at from 250,000 to 300,000. The coastland is mostly sandy and extremely hot; the interior is high, though not mountainous, and in many places very fertile. Agriculture is the principal branch of industry, sugar and cotton the common crops. Coffee, for which the soil is well adapted, is not cultivated. Cattle-rearing is mostly neglected. There is a little shipbuilding.

Seriation, in chemistry. See SERIES, IN CHEMISTRY.

Sericine. See SILK, CHEMISTRY OF.

Sericulture. See SILK.

Se'ries [Lat.], an infinite number of terms following one another in regular order, each of which is deduced from one or more of the preceding terms by a fixed law, called the law of the series. A certain number of leading terms being given, and the law of the series being known, the series may be written out to any number of terms. Sometimes the law of the series is given by means of a *general* term, from which any term may be derived by making proper suppositions on the arbitrary constants that enter it. A series is said to be *increasing* when the numerical value of each term is greater than that of the preceding term; it is *decreasing* when each term is less than the one preceding. A series is said to be *converging* when the sum of any number of terms approximates more nearly to a fixed quantity the greater the number of terms that are taken. The fixed quantity is called the *sum of the series*, and the operation of finding this quantity is called summation.

The following are some of the more important series: (1) The *arithmetical series*, in which each term is derived from the preceding one by the addition of a constant quantity; (2) the *geometrical series*, in which each term is equal to the preceding one multiplied by a constant quantity; (3) the *recurring series*, in which each term is the algebraic sum of the products obtained by multiplying two or more preceding terms by certain fixed quantities: these quantities taken in order constitute the scale of the series; (4) the *logarithmic series*, which may be deduced by the development of a logarithmic function; (5) the *exponential series*, which may be deduced by the development of an exponential function; (6) the *trigonometrical series*, which may be deduced by developing a trigonometric function in terms of its arc, or an arc in terms of one of its trigonometric functions; (7) the *series of figurate numbers*, whose terms may be deduced from the general expression

$$\frac{n(n+1)\,.\,.\,.\,(n+m)}{1\,.\,2\,.\,3\,.\,.\,.\,(m+1)},$$

by assigning to m a particular numerical value, and then making n in succession equal to 1, 2, 3, etc. To these may be added the *series of powers* of natural numbers, the *series of reciprocals of powers*, and many others.

W. G. PECK.

Series, in Chemistry. The word *series* is Latin, and means a "succession," a "chain," or a "train" of things *of like derivation*. Its Latin meaning is precisely applicable in chemical and chemi-physical science, in which it is destined to be in the future a most important word. The prevalent notions of the chemical schools of the present day rest mainly upon the assumption of the derivation of all the infinite variety of bodies from a certain small number of so-called *types*. These typical bodies are selected so as to represent the different known degrees of "atomicity" or *equivalence*, and need therefore be only equal in number to these degrees of equivalence. (See TYPE-THEORIES.) They are conceived to represent types of *completed* or "saturated" *molecular structure*, made up of atoms, which atoms, while admitted by some to have probably some sort of *motion* in a way no one has attempted clearly to explain, yet must nevertheless have, according to the hypothesis, in the mean and relatively, *fixed positions*. Every other body is then derived from one or other of this small number of saturated types by the *substitution*, according to the known laws of equivalence, of one or more of these atoms by an equivalent number of atoms of either elements or radicals. The attempts to apply this hypothesis exhaustively, so as to cover the whole field of chemistry —though it seems at first to possess to some degree those elements of beauty and simplicity which we expect to find in nature—have not been very encouraging. Instead of enabling us to rid ourselves of any of the vast cloud of assumptions which overshadowed the science of Berzelius and his contemporaries, it has been found necessary to retain the *alcohol-radicals*, and even some of the *ternary* organic radicals, and to invent, in addition, new classes of these mystical "residues;" as will be found partly explained under the head of SALT-RADICALS. The invention also of *hydroxyl*, *carboxyl*, or *oxatyl*, and their analogues has been found necessary. Even with all this, we must have also "mixed types" and "condensed types" to cover all the facts. Briefly, a survey of the field of theoretical chemistry shows convincingly that we have been following a track which, to say the least, is doubtful, and can be but a by-road or side-track at the best. The inductive philosophy requires that we should "try back," and follow up, in a tentative way at least, other experimental paths of classification and derivation of compounds.

The *serial system* of building up and deriving chemical compounds from each other has heretofore been distinctly recognized only in organic chemistry, as it was first proposed in 1842 by James Schiel, a German chemist who was long a resident of America. His original memoir on what he named "progressive series" in organic compounds is in Liebig and Wöhler's *Annalen der Chemie* (July, 1842). A *résumé* of the subject, by Schiel himself, with a reclamation of priority against Gerhardt, will be found in the *American Journal of Science and Arts* (July, 1861). In this latter paper he claims two kinds of seriation as occurring in organic compounds, one being the homologous seriation—so called by Gerhardt, whose term he adopts—which is based upon successive additions of H_2C to a nuclear group of atoms (see HOMOLOGY), and another based upon successive additions of HC, which he calls "hemilogous series," though he did not indicate any very satisfactory example of a known series of the latter kind.

According to the views of constitution of chemical compounds most in vogue at present, the existence of homologous series—which are generally admitted to run throughout the whole range of organic chemistry, as was claimed by Schiel, their discoverer—is attempted to be explained by calling H_2C a "residue," derived from the *typical* saturated compound H_4C, or marsh-gas, by the abstraction of two atoms of hydrogen, and that this residue is therefore unsaturated, having two affinities or units of equivalence unsatisfied. It is therefore regarded as a dyad or diatomic group of atoms, and is compared and virtually classed with the electro-negative dyads, oxygen, sulphur, selenium, and tellurium, the *amphigen* group of Berzelius, which stand alone by themselves in being able to combine in varying proportions with almost if not all the other elements, without regard to atomicity. Oxygen and sulphur are themselves derivable just in the same way from the saturated compounds *water* and *sulphuretted hydrogen*, by the abstraction of two atoms of hydrogen in each case. It is represented—and easily justified by the graphic system of notation—that dyadic atoms or groups, by virtue of their two "bonds of affinity," may be introduced *ad libitum* into saturated groups without disturbing the balance of atomicity. *In fact*, however, it is only dyadic *negatives*, like oxygen and sulphur and the like, that can in reality be thus introduced; and hence, as aforesaid, the group H_2C thus assimilates itself, even according to the type theories, through the analogies of its derivation, and by its relations, with oxygen and sulphur. The present writer has proposed to give this group a name, *Homologen*, and to regard it as having, like *ammonium* and *cyanogen*, a real individual existence, as being a true *compound radical*, and not a mere imaginary "residue," merely representing so much atomicity. In following out this view, the molecular volumic relations of H_2C, or homologen, have been investigated by the writer. (See *American Chemist* for March, 1876.) These volumic relations have been found to demonstrate in every way the reality of homologen as a real compound radical, like ammonium.

Homologous series are found, however, to have a quite different basis and mode of derivation from that which is apparently deduced, as above, from the prevailing views; homologen turning out to be, in its analogies and relations, an *electro-positive* radical or group, and to diverge probably as far as possible from oxygen in its combining relations. Certain universal *geometric* principles have been discovered which govern the volumes of chemical equivalents of all the elements and radicals when entering into *liquid* and *solid* combinations; and it is found that electro-positive elements and radicals have the general property of varying in molecular volume within compound molecules that they help to make up, this variation being according to a certain simple geometric law, the volumes varying *in the ratio of even cubes of whole numbers*. In this manner series of *isomeres* are constituted. When to an existing

group a molecule is added, either of an element or a radical which is already present, the new molecule, if negative, always assumes the same volume as that already present: but if positive, is liable to vary to the next even cube above or below that already present. It is this latter mode of derivation that rules in the formation of homologous series, each new molecule of homologen added being either in the same cubical volume or the next cube below the previous one. Hence it is that homologen assimilates itself, *in fact*, with the electro-positive elements and radicals, and not with oxygen.

We have here two modes of derivation *in series*—series of homologues and series of isomeres (the latter pertaining not merely to organic, but to mineral chemistry also)—both now seen to be dependent upon the addition of molecules having certain geometrical relations to *space*, and not merely to weight or centripetal force, the only relation heretofore ascertained. It is also found that in the case of *elementary* bodies similar laws govern, and that the known elemental forms are generally congeries of molecules, one or more of which may vary according to the same geometric law; and thus is formed another kind of series, series of *elemental allotropes*. As several other compound radicals exist besides homologen which have been also newly recognized as forming extensive and varied kinds of series, it has become possible—indeed inevitable—that all known chemical compounds, as regards their *modes of derivation*, the determination of which is the chief end of the science of chemistry, shall fall naturally into *series*, which follow certain simple geometric volumic laws, instead of being derived from the supposed few simple *types*, which, when followed up, evolve complexity instead of simplicity. Hence, there has dawned the reasonable expectation of a *serial system* of chemistry. (Under VOLUMES, MOLECULAR, these new principles will be made clearer.) HENRY WURTZ.

Serinagur′, or **Srinagar,** capital of Cashmere, situated in a broad, marvellously beautiful valley at an elevation of 5276 feet, and with a mean temperature of 56.8° F. It is built on both sides of the navigable river Jhylum, from which numerous canals, spanned with light wooden bridges, branch off, the lively traffic by boat reminding one of Venice. The most remarkable building is the palace of the maharaja, a Rajput by descent, but a Hindoo by religion; it is called the Shergarh ("citadel"), and a large, beautiful flight of stairs leads from it down to the river. Close by the city is Lake Dal, which boasts of the far famed isle Chinars (*Platinus orientalis*). Vegetables are raised here on floating rafts called gardens. About 21 miles N. W. of the city is Wular Lake, which covers 103 sq. m. In 1875 the maharaja was presented by Queen Victoria with a small steamboat, which plies between the two lakes. Europeans, provided with Indo-English passports, are allowed to take up their residence here, and 399 persons, among whom were 63 ladies, spent the summer here in 1873. The village of Sonamarg has become very popular among the English, who have here a club and boarding schools. A police force, organized after the Indo-European fashion, is stationed here. E. SCHLAGINTWEIT.

Seringapatam′, city of Southern India and formerly capital of Mysore, on an island in the Cavery, in lat. 12° 25′ N., lon. 76° 48′ E. Under Hyder Ali and Tippoo Sahib its fortifications were strengthened, and although unhealthy it had 300,000 inhabitants. In 1799 it was conquered by the English, and now it has barely 13,000 inhabitants.

Serino, Italy. See APPENDIX.

Sermide, Italy. See APPENDIX.

Sermon. See HOMILETICS and HOMILY, by W. ADAMS.

Sermone′ta (MICHELANGELO CAETANI), DUKE OF, belongs to one of the most ancient and illustrious of the patrician families of Rome, that of Pope Boniface VIII. He was b. in 1804, and received an accomplished literary and artistic education; made a profound study of Dante, and his three essays on the eighth and ninth cantos of the *Inferno*, on the Matilda of the *Purgatorio*, and on the image of the eagle in the *Paradiso*, have excited great admiration. His illustrations of the *Divina Commedia* are original in conception and of great excellence in the drawing: *La Materia della Divina Commedia di Dante Allighieri dichiarata in Sei Tavole* (Rome, 1865–72). The marble *Cupid Bound* of the duke of Sermoneta has been many times reproduced, and Castellani, the great Roman jeweller, is indebted to this distinguished man for many a beautiful design. In 1865 the duke had the great misfortune to lose his sight. In 1870 he was chosen president of the Roman commission appointed to convey to the king of Italy the result of the *plébiscite* of the Romans, and on that occasion he was honored with the order of the Annunziata. The daughter of the duke of Sermoneta, the Countess Ersilia Lovatelli, is a learned archæologist, as well as a Latin, Greek, and Sanskrit scholar.

Se′rous Flu′ids. The term *serum* designates the homogeneous fluid of the blood deprived of the blood-cells and coagulable fibrine. All the translucent, homogeneous fluids of the body, resembling blood-serum, are called serous fluids. In health the inner walls of the large cavities of the body—the arachnoid which envelops the brain and spinal cord, the pleural cavities, the pericardium and peritoneum, as well as many lesser serous tracts—are bathed with a variable quantity of serous fluid. The presence of an excess of serous fluid in these cavities constitutes disease: such excess is due in some instances to hypersecretion of the surface or the unloading of its nutrient blood-vessels when actively congested or inflamed: in other cases it is a passive, dropsical transudation of the serum of impoverished blood. Thus, serous fluids at the base and within the ventricles of the brain are effused in subacute meningitis; larger quantities in the same locations or within the arachnoid are the result of transudation, constituting the hydrocephalus or "dropsy of the brain" in strumous, ill-nourished children. The pleural cavity may be filled with many pints of serous fluid, either of inflammatory origin, as in pleurisy, or a transudation, "hydrothorax." Pericarditis, with effusion, and hydropericardium, or "dropsy of the heart," are similarly produced. Abdominal dropsy, known technically as "hydroperitoneum" and "ascites," is a collection of serous fluid in the peritoneal cavity consequent upon obstructed portal circulation, and chiefly secondary to disease of the liver. Serous fluid may accumulate in large quantity in cystic tumors, as in ovarian dropsy. Serous fluid may escape from the blood-vessels when the blood is impoverished or perverted, as in Bright's disease, and infiltrate the meshes of the subcutaneous connective tissue, producing a swollen, puffed appearance of the surface, which pits when pressed—a condition styled "œdema." Fluid of serous consistency is often discharged from the mucous lining of the nose, throat, and air-passages, either in recent or chronic inflammation; serous diarrhœa frequently occurs in gastro-enteric disorders; in Asiatic cholera, the copious evacuations of serous fluid ("rice-water" stools) completely drain the blood, leaving it of a pasty, tarry consistency. Serous fluid in all such cases originates from overloaded, congested capillaries. Serous fluid is often discharged from granulating wounds when the healing process is feeble. Bloody serum escaping from the ear is a guide to diagnosis of fracture at the base of the skull.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Serous Membrane, in the human body the membranous walls of the arachnoid, pleural, pericardial, and peritoneal cavities, and the investing membrane of the testis. Serous membranes in all instances, save the peritoneum in women, are closed sacs, with their opposed walls collapsed in contact, but lubricated by secreted serous fluid, so as to permit of free motion. The serous membrane is therefore a contrivance of nature to ensure the freedom of the large organs of the body in the limited movements incident to their functional activity. The brain is congested by mental action; is anæmic during sleep; it pulsates synchronous with the heart; the arachnoid surfaces permit these movements. The lungs of adults expand and collapse, in health, between eighteen and twenty times per minute, more often in the child, and with greater frequency in certain pulmonary and febrile diseases. The heart of the adult undergoes marked movements between seventy and eighty times per minute; such constant movements of the lungs and heart are rendered easy, with a minimum of friction, by the smoothness of the gliding surfaces of the pleural and pericardial sacs by which they are surrounded. The variable conditions of the intestines as to distension by food, flatulence, or fæces, and the intestinal peristaltic action by which the contents of the bowels are moved onward, are guarantied by the reduplicated structure of the closed peritoneal sac. The serous membrane is composed of a delicate layer of "tessellated" (tile-like) epithelial cells upon a thin basement membrane of dense, impacted, inelastic fibrous tissue. It is often closely adherent to adjacent structures. In the sub-serous tissues, or elastic connective tissue which unites the membrane to contiguous parts, capillary vessels freely ramify, but nerves and lymphatics have not been demonstrated. The diseases of serous membranes are chiefly inflammatory, and often involve the underlying invested organs. Hence, they are usually very grave. Acute meningitis, acute pleuritis when involving the lung also—pleuro-pneumonia—pericarditis, and peritonitis, all are attended with danger, and often are fatal.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Ser′pent, a musical wind instrument of brass invented by Edme Guillaume of Auxerre in 1590, has a curvilinear form, is composed of a mouthpiece, a neck, and a tail, and has six holes stopped with the fingers, with a compass from B flat below the bass staff to G, the treble clef line.

Ser′pentine, a metamorphic rock, essentially a hydrous silicate of magnesia, which takes its name from its mottled colors, chiefly yellow and green, thought to resemble those of the skins of certain serpents. It is so soft as to be readily cut or sawed, is also susceptible of a fine polish, and is frequently manufactured into vases and other ornamental articles. Serpentine rocks occur in a great number of places through New England and down the Alleghany belt; very beautiful varieties are found at Deer Island, Me.; Newburyport, Mass.; Montville, N. J.; Chester co., Pa., etc. Serpentine also is an important constituent of the Coast Mountains, Cal. "Verde antique marble" is composed largely of serpentine (green), mingled with carbonate of lime (white); this is a highly-prized ornamental stone, well adapted to internal decoration, but losing its polish and rapidly decomposing on exposure. One variety of serpentine (chrysotile) is made up of flexible fibres of more than silky fineness and lustre; this is sometimes called amianthus, though that name was originally applied to the finer varieties of asbestos. J. S. Newberry.

Serpents. See Appendix.

Serpents, Poison of. See Poison of Serpents.

Serpent-Worshippers. See Ophites.

Serpookhov′, town of Russia, government of Moscow, on the Nara, has a fine cathedral of the fourteenth century, and manufactures of linen fabrics of different descriptions, mostly coarse. It is one of the oldest towns of Russia. P. 12,196.

Ser′pula, a genus of annelides, worms with red blood, and inhabiting a tubular shell, which much resembles that of some mollusks. They belong to the family Serpulidæ. There are two beautiful ctenoid gills, which may be protruded from the tube; and, though eyes are wanting, the animal appears to have a sense highly analogous to sight. Each tube is fitted with an exactly-fitting stopper, often of very beautiful color.

Serracapriola, town of Southern Italy, province of Foggia, on a rugged height commanding magnificent views of the adjacent country, has suffered often and severely from earthquakes. P. 5300.

Serradifalco, town of Sicily, province of Caltanisetta, at the foot of Monte Calvario, N. E. of Girgenti, was long a fief of the family of the same name, and the late duke of Serradifalco has during the present century illustrated the antiquities of Sicily with great taste and learning. P. 6948.

Serrano y Dominguez (Francisco), Duke de la Torre, b. at San Fernando, near Cadiz, Spain, Nov. 10, 1810, son of Gen. Serrano y Cuenca, distinguished in the Spanish war of independence; entered the army as a cadet 1825; rose rapidly in military rank during the Carlist wars, attaining through the favor of Queen Christina the grade of general of division before he was thirty years of age; sat in the Cortes as deputy for Malaga and vice-president of the chamber 1843; became minister of war in the "nine days' administration" of Lopez May 11; joined Narvaez in effecting the overthrow of the regent Espartero July 24; was again minister of war for ten days (Nov. 19–29) under Olozaga, but withdrew and successfully intrigued with Narvaez against the government; became lieutenant-general and senator 1845; obtained such influence over the young queen after her marriage (1846) as to give rise to much scandal; was appointed captain-general of Granada 1847; took part in several short-lived ministries and in equally numerous revolutions, figuring ultimately as a "liberal" at the head of the senatorial opposition; was exiled Feb., 1854, for participation in an insurrection at Saragossa; returned to power in July of the same year as an ally of Espartero and O'Donnell; became captain-general of New Castile; espoused the cause of the latter at the rupture of the "Liberal Union," which culminated in the *coup d'état* of July, 1856; went as ambassador to Paris 1857; received the appointment of marshal; was captain-general of Cuba 1860–62, signalizing his administration by the reannexation of Santo Domingo to Spain, which procured his elevation to a dukedom as a grandee of the first class; became captain-general of Madrid June, 1865; was president of the senate 1866, in which year he suffered a brief imprisonment at Alicante for having signed a protest against the illegal prorogation of the Cortes; was exiled to the Canary Islands July, 1868, when he took part with Prim and Topete in effecting the revolution which drove Isabella from the throne, landing with those generals at Cadiz Sept. 19, 1868; became thereupon the ostensible head of the government as president of the council of ministers and commander-in-chief of the army; was elected regent June 16, 1869; negotiated the acceptance of the Spanish crown by Prince Amadeus of Italy, by whom he was made premier Jan., 1871; resigned that post in July of the same year; took the field as commander in-chief against the Carlists Apr., 1872; concluded with them the convention of Amorevieta in May; returned to office as premier for a few months; fled to France soon after the proclamation of the republic (Apr., 1873), but shortly returned; was made "chief of the executive" after the *coup d'état* of Gen. Pavia Jan., 1874; again took the field against the Carlists with varying success, and privately arranged with Martinez Campos the details of the restoration of the monarchy in the person of Alfonso XII. Jan., 1875. Porter C. Bliss.

Serra San Bruno, town of Southern Italy, province of Catanzaro, about 20 miles S. E. of Monteleone, was almost totally destroyed by an earthquake in 1783. P. in 1874, 5050.

Serrastretta, town of Southern Italy, province of Catanzaro, on the right bank of the Corace, about 9 miles S. of Nicastro. P. 5380.

Serravalle Pistojese, town of Italy, province of Florence, on a hill E. of Lucca and about 4 miles from Pistoja. The old castle and two towers are still standing, and recall the fierce conflicts for the possession of this town between the rival republics of Florence, Lucca, and Pistoja. P. 5574.—Serravalle is the name given, from their geographical position, to several other smaller Italian towns.

Serravezza, town of Italy, province of Lucca, about 22 miles W. of the city of Lucca, at the confluence of the two branches of the Serravezza or Versilia. The fine marble of the neighboring mountains, especially that from Monte Altissimo, is here sawed and sent in various directions to market. Though good white marble was quarried from these mountains as early as the time of Michelangelo, yet the superior quality now in such great demand was only discovered at the beginning of the seventeenth century. The town contains an active and industrious pop. of 8900.

Serto′rius (Quintus), b. about 121 b. c. at Nursia in the country of the Sabines; distinguished himself highly in the battle of Aquæ Sextiæ (102 b. c.) under Marius, whose fortunes he afterward followed. He fought with Cinna at the Colline gate in 87 b. c. against Pompeius Strabo, but he did not participate in the bloody massacre which Marius instituted after the capture of Rome; on the contrary, he surrounded and put to death a gang of about 4000 slaves whom Marius had let loose on the city, and who had perpetrated the most horrible cruelties. In 82 b. c. he was sent to Spain as proprætor, but in the same year Sulla returned to Rome from Asia, and the power of the democratic party came to a sudden end. Sertorius was outlawed. Nevertheless, although he had only a small army, he took up the contest against the oligarchs in Spain, and carried it on for several years with steadily-increasing success. He gained the favor of the natives, especially the Lusitanians, who became his faithful allies. Fugitives from Rome gathered in his camp; in 77 b. c. Perperna joined him with fifty-three cohorts. In 74 b. c. he formed an alliance with Mithridates. Metellus Pius, whom Sulla first sent against him, was repeatedly defeated, and even Pompey, who came to Spain in 76 b. c., achieved nothing, and was driven back across the Ebro. But intrigues and jealousies arose in Sertorius's camp, and in 72 b. c. he was invited to a banquet by Perperna and treacherously assassinated at the festival. His biography by Plutarch is very interesting, though more full in its description of his personal character than in its narrative of his exploits.

Sertularia′dea [pl.], a sub-order of hydroid acalephs which are attached by a peduncle and protected by a horny case, which forms a cup about the head. It includes the sertularians proper and the campanularians. The genus *Sertularia* is a typical one. There are a great many species, some of them extremely beautiful.

Se′rum [Lat.], a word applied in two different senses having little real resemblance or analogy, as *serum of milk* and *serum of blood*. Serum of milk is Whey (which see), containing no albuminous matter; whereas serum of blood, the fluid part left after the separation of the *coagulum* from Blood (which see), is a strong solution of albumen in a liquid containing certain salts, neutral and alkaline. The total amount of saline matter in the serum of a healthy man is somewhat over 10 per cent., and there are present carbonates and phosphates of soda, potash, lime, and magnesia, with considerable chloride of sodium, some chloride of potassium, and sulphates of soda and potash. The amount of albumen is in the neighborhood of 7 per cent. Both the saline matter and the albuminous matter prevent the solution of the blood-globules, which are very soluble in water itself, and are attacked at once on addition even of a very little water to blood. In disease, changes of composition of the serum occur, and rapid methods of analysis of blood, applicable to small quantities, appear likely to be hereafter, when perfected, of great value in pathology. H. Wurtz.

Ser'val, an animal of the Felidæ or cat family, having a slender body, small head, long legs, long and shaggy hair, body spotted with dark brown, the general color being ochrey yellow, and the lower parts white. It is mild and docile, and is about three feet long exclusive of the tail, which is tipped and ringed with black. It is found in the southern part of Africa.

Servant. See MASTER AND SERVANT, by PRES. A. L. CHAPIN, S. T. D.

Serve'do (MIGUEL), usually known by the Latinized form of his name, SERVETUS, b. at Villanueva, near Saragossa, Spain, in 1509, son of a notary, who sent him at the age of nineteen to study law at the University of Toulouse, France; gave his attention principally to theology, in which he became very proficient; visited Italy, and was present at the coronation of Charles V. at Bologna 1530; travelled in Germany and Switzerland; became acquainted with many of the Reformers, and partially adopted their doctrines; resided some months at Bâle, where he discussed theology with the celebrated Johann Hussgen (Œcolampadius), and broached for the first time his conclusions adverse to the doctrine of the Trinity; proceeded to Strasbourg 1531; acquainted himself with the teachings of the Protestant divines Kuhhorn (Bucer) and Capito; went thence to Hagenau, Alsace, where he published his *De Trinitatis Erroribus* (1531) and *Dialogorum de Trinitate Libri duo: de Justitia Regni Christi Capitula quatuor* (1532), works which embroiled him with both Roman Catholics and Protestants; took up his residence at Lyons under the name of "Michel de Villeneuve" about 1533; studied medicine, and supported himself by working as a corrector of the press; was at the University of Orleans 1534; settled at Paris 1535; studied medicine under Sylvius and Fernel; took the degree of M. D. with high honors 1536; became an eloquent and popular lecturer at the university on medical science and mathematics; published a treatise, *Syruporum Universa Ratio* (1537), attacking opinions of Galen and of the Paris faculty of medicine; had about this time several conferences on theology with Calvin, whom he challenged to a public discussion on the Trinity, which was agreed to, but, distrusting the consequences, left Paris secretly before the appointed day; proceeded to Charlieu, near Lyons, 1538; lived some time at Avignon; published at Lyons editions of Ptolemy's *Geographia* (1541) and of the Bible (1542) with Latin notes, which were condemned as heretical by the Roman Catholic Church; took up his residence in 1543 at Vienne, Dauphiné, living in the palace of the archbishop, Pierre Palmier, a former pupil; carried on with Calvin, then at Geneva, an active theological correspondence, which resulted in a bitter quarrel; published anonymously his chief work, *Christianismi Restitutio* (Vienne, 1553), the authorship of which was discovered by Calvin and made known by him to the Roman Catholic archbishop of Lyons, Cardinal Tournon. Arrested and imprisoned by the Inquisition at Vienne at the instance of that prelate, Servedo would probably have been acquitted for lack of evidence had not Calvin supplied portions of his correspondence as proofs against him. Not being vigilantly guarded, Servedo escaped from prison in disguise Apr. 7, crossed the frontier into Piedmont, and remained in concealment several months. Meanwhile, his trial went on; he was condemned for heresy, and burnt in effigy at Vienne June 17, 1553. He now resolved to go to Naples, but by a strange fatality went first in disguise to Geneva, when, his presence having become known to Calvin, he was arrested, brought to trial (Aug. 14) before the municipal court on charges of heresy, sedition, insult to the Fathers of the Church, and calumny against Calvin and other Protestant divines; was forced to discuss doctrinal points with Calvin, who appeared as prosecutor and drew up the final articles of accusation, thirty-eight in number; was condemned to the stake, and, notwithstanding the desire of Calvin for a milder form of death, was burned alive on a hill near Geneva Oct. 27, 1553. *Lives* of Servedo have been published by Mosheim (1750), Trechsel (1839), W. H. Drummond (London, 1848), and Brunnemann (1865).

PORTER C. BLISS.

Servetus. See SERVEDO.

Ser'via [Slavonian, *Serbia*; Turk. *Syrp*], principality of Europe, tributary to Turkey, bounded N. by the Austrian empire, from which it is separated by the Save and Danube; E. by Wallachia and Bulgaria; S. by Macedonia, from which it is separated by the Balkan Mountains; and W. by Albania and Bosnia. Area, 16,817 sq. m. Pop. 1,338,505, of which 140,000 are Wallachs, 25,000 gypsies, and 15,000 Turks. The surface is very mountainous, being covered W. by the Dinaric Alps and S. by the Balkan Mountains, which latter meet the Carpathian Mountains on the eastern frontier at Orsava, separated from them by a narrow cleft, called the Iron Gate, through which the Danube rushes along. The average height of these mountains is only from 2000 to 3000 feet, and toward the N. they open into broad valleys sloping toward the Danube and the low, level plains which extend along its shores. The climate, though rigorous in the highlands, is generally mild and healthy. Extensive forests of oak and walnut trees cover the mountains—that is, more than one-half the surface—but the excellent timber which these forests contain is as yet unavailable on account of the total lack of means of transportation. Immense herds of swine are fed in the forests, and millions of hogs are annually exported. In the valleys and in the plains of the Danube rice, maize, and wheat, flax, hemp, and tobacco, wine and fine fruits, grow abundantly, but agriculture is as yet in a backward state. Iron, copper, lead, and coal are found, but no mines are worked; all manufactures are confined to articles for home use. Cap. Belgrade.

In the early Middle Ages, Servia formed an independent kingdom, powerful and flourishing. But in 1385 it was conquered and subjugated by the Turks, and they soon brought it into a miserable state. The first rising of the Servians against their oppressors, in 1806, under Czerny, was successful, but not lasting, and the Turks took bloody revenge when they again came into possession of the country. The second rising, in 1814, under Milosch, proved lasting, and the country is now rapidly progressing as an hereditary monarchy under the Obrenovitch dynasty, paying an annual tribute of 2,300,000 piasters to Turkey, but with a free constitution and an independent government. The strong sympathy which the Servians show for the Russians, their co-religionists, the inveterate antipathy they feel against the Turks, and the constant intermeddling in all Turkish affairs from the Russian side, led finally, in 1876, to a new and bloody war, still pending. The Servians are a Slavonic tribe, and belong to the Greek Church. They are a strong, well-built, and handsome people, enthusiastic but industrious, energetic but benevolent, and deeply devoted to their fatherland, their freedom, and their Church. In the present war, however, they have won no laurels as soldiers. There is no nobility and no proletariat. Each family, the father, the sons with their wives, the children, etc., remains together, forming a community of which the oldest member is the chief. The estate is the property of the family, and cannot be sold. The range of personal property is very limited.

The Servian language, which is spoken by about 7,000,000 people, living partly under Austrian, Russian, and Turkish rule, partly independent, is the richest, softest, and most melodious of all Slavonian languages, and has received considerable literary development, both in Servia proper and in Dalmatia. It contains a great treasure in its ballads, which in translations have traversed Europe, and charmed all with the nobleness of their feelings and the beauty of their imagery, at times simple and distinct, with an almost Greek plasticity, at times dazzling and alluring, with an almost Oriental mysticism. (See W. Denton, *Servia and the Servians* (London, 1862); Elodie Lawton Mijatovics, *History of Modern Servia* (London, 1874); Talvi, *Historical View of the Languages and Literature of the Slavic Nations* (New York, 1850); St. René Taillandier, *La Serbie au XIXe. Siècle, Karah George et Milosch* (Paris, 1875).)

Service-Berry. See JUNE-BERRY.

Serv'ice Tree, the *Pyrus domestica*, a tree of Europe, Asia, and Africa, of the order Rosaceæ, much resembling the MEDLAR and SORB (which see). Its fruit, when over-ripened and bletted, is soft and pleasant to eat. It is considerably cultivated. The wood is very hard and valuable, and is used as a substitute for box. In parts of North America the shad tree is called the service, and in others the mountain-ash.

Servites, a community of Augustinian friars, called Servants of the Virgin Mary, founded at Florence in 1233. One Monaldi was their first general and one of their founders. They were confirmed in 1255 by the pope, and in 1493 a part received a reformed rule. There is also a congregation of Servite Tertiaries, and there are a few houses of Servite nuns. The Servites are mostly found in Europe.

Serv'itude [Lat. *servitus*], the generic name given by the civil law to the class of rights which may be held in the lands or other things of another person, and virtually synonymous with the "easement" of the American and English law. A prædial servitude is a burden imposed upon one piece of land, called the servient estate, in favor of and attached to another tract, called the dominant estate. The right accompanies the latter and the burden follows the former in their transfers from one owner to another, until terminated in some legal manner. Among the most common species are the servitudes of way, of aqueduct, of light, of prospect, of support for walls or beams, of drip from

eaves, and of pasture. Prædial servitudes are divided into rural and urban, depending upon the situation of the lands in the country or in a town. A personal servitude differs from the prædial in not being appurtenant to any dominant estate, but in being attached to and held by a person who exercises the right unconnected with the ownership of any particular land. By some modern text-writers the name is used interchangeably with "easement." (See EASEMENT.) JOHN NORTON POMEROY.

Ser'vius Tul'lius, the sixth king of Rome (578–534 B. C.). His history is full of fables and wonderful traditions—his birth by a female slave of the queen's and the god Vulcan; his education in the royal household under the special care of the queen Tanaquil; his marriage with the king's daughter, and his accession to the throne by the stratagem of his mother-in-law; his death in Vicus Sceleratus, thrown down by Tarquin himself from the stone steps of the senate-house, then overtaken and stabbed by Tarquin's servants on his way home, and finally driven over by the chariot of his unnatural daughter, Tullia, the wife of Tarquin. But amidst the many mythical elements which cling to his name there are several facts, well established at least in their general outlines, which show that his reign must have been one of the most important periods in the history of Rome. He gave a new constitution, by which the plebeians became an independent part of the nation equally with the patricians, and part of that political influence which hitherto had been attributed to birth alone was transferred to property. He completed the city by incorporating with it the Quirinal, Viminal, and Esquiline hills, and surrounding the whole with a wall five miles in circumference, which remained the legal boundary of the city up to the time of the emperors. Finally, he formed an alliance with the Latins, by which Rome and the cities of Latium became the members of one great league, which was consecrated by the erection of a temple of Diana on the Aventine, where the Romans and the Latins worshipped in common.

Ses'ame [Gr. σησάμη; Arab. *simsim*], the **Benne-Plant** of our Southern States (*Sesamum Indicum*), belonging to the order Pedalineæ, sometimes annexed to the Bignoniaceæ. There are several varieties, which have been regarded as species. They are annual Oriental plants, now naturalized in most warm climates. Sesame was probably brought to the U. S. by slaves from Africa. Its rich oily seeds are prized by the negroes, who also make a thick gelatinous drink of the leaves, which is very bland and useful in diarrhœas. The seeds can be made to yield half their weight in oil, which is in some respects better than olive oil. It is locally known as tilseed and oilseed. The oil is called oil of Benne and Gingilie oil. Sesame fully deserves attention as a regular crop in this country. It does well about Philadelphia.

Sesame-Grass, the *Tripsacum dactyloides*, a large grass of the Atlantic U. S., from New Jersey southward, with broad leaves and a solid stem, like that of Indian corn or sugar-cane, which it somewhat resembles. It is very coarse, and in the North is not valued, but in parts of the South and in the West Indies and Mexico is used as fodder.

Ses'amoid Bones [so called from their supposed resemblance to a sesame-seed], bones developed in the tendons of muscles, and found both in man and the lower animals. The most familiar example is the patella or knee-pan. They do not belong to the vertebral appendages proper, but to the sclero-skeleton.

Se'sia, an interesting genus of hawk-moth (Sphingidæ) of a mimetic type, resembling the bees in form. The U. S. have several species, called clear-wings or bee-moths.

Sesos'tris, the name of a king of Egypt, according to Manetho the third monarch of the twelfth dynasty. According to popular tradition, all the boys born on the same day as Sesostris were brought up with him, and he grew to the great size of four cubits three palms and two digits, or more than seven and a half feet high. The youths educated with him became afterward his most devoted friends and ministers. On his accession to the throne he divided Egypt into thirty-six nomes, and then departed with a vast army for the conquest of the world, and is said in nine years to have conquered the whole of Asia and Europe as far as Thrace. In the S., Libya, Æthiopia, and Arabia were subdued by his arms. To record his exploits he placed *stelæ* or tablets to mark his power, and on those of the warlike nations were engraved emblems of the male, and on those of effeminate countries of the female sex. Some of these tablets, according to Strabo, existed at the Bab-el-Mandeb, recording his victories over the Ethiopians and Troglodytes. He did not, however, advance so far S. as the so-called Cinnamon Land. After his wars he devoted his attention to the protection and improvement of Egypt, which he intersected with canals to prevent the incursions of cavalry, partitioned the country into fields, and imposed a land-tax on all except those belonging to the temples. He also raised the great wall on the E. of Egypt, along the edge of the desert by Heliopolis, 1,500 stadia, or 187 Roman miles. It was built of sun-dried bricks. Sesostris is also said to have had a fleet of 400 sail in the Mediterranean and the Arabian Gulf. The temples of Egypt, 100 in number, he is said to have built, and to have erected obelisks about 180 feet high, and made a boat 280 cubits long to the god of Thebes. His public works were said to have been executed by prisoners of war reduced to slavery for the purpose. His triumphs were signalized by making the captive monarchs drag his car, but his life was embittered by the treason of his brothers, who endeavored to burn him in a house, from the blazing chambers of which he only escaped by the sacrifice of two of his children thrown on the burning embers, and by walking over their bodies. In his old age he became blind, and finally, in disgust of life, put an end to his existence, and was honored by the priests as second only to Osiris. The name of Sesostris is that of no Egyptian monarch hitherto discovered on the monuments, and the exploits attributed to him do not agree with those of any monarch of the twelfth dynasty, the power of which did not extend beyond the peninsula of Sinai. It is, however, evident that the scenes represented on the temples and the exploits of Rameses II. and other monarchs of the eighteenth and nineteenth dynasties had become interwoven into the legendary history of Sesostris, and that the monarch most like him was Rameses II. In some papyri the name of Rameses has been found shortly written as *Sesu*, the root of the name Sesosis or Sesoosis, sometimes given by the Greeks as the equivalent of Sesostris. Rameses II. also boasts on the monuments that he had constructed public works by means of his prisoners of war, and captive chiefs are seen ignominiously tied under his chariot, which files of prisoners appear to drag along. The name of Rameses II. is also found on the great wall of the eastern frontier attributed to Sesostris, and tablets recording his campaigns in Northern Syria are found in the passes of the Nahr-el-Kelb, as mentioned by Herodotus. Even the lion which is said to have accompanied Sesostris in his campaigns is found on the monuments following Rameses II. Although the exploits of this monarch, elevated to the rank of a hero by the Egyptian scribes, did not extend beyond the Orontes, the more extended campaigns of Thothmes III. gave rise to the reported conquest of the whole of Asia, while the monuments found at Nymphi, near Smyrna, and elsewhere, had been attributed by popular report to Sesostris, although they were not of Egyptian origin. The legendary height of the monarch is also said to correspond with the proportions of some of the figures of these slabs, and to have given rise to the traditionary but by no means impossible stature of the Egyptian hero. The conquest of Libya may have been derived from the defeat of the Libyans in the reigns of Meneptah and Rameses III. by these monarchs, and the incorporation of the vanquished people in the Egyptian territory. S. BIRCH.

Ses'sa Aurun'ca [anc. *Suessa*], town of Southern Italy, province of Caserta, on the crater of an extinct volcano about 6 miles from the Tyrrhene Sea. Suessa was a conspicuous city of the Auronians or Auruncians as early as 418 B. C., and, judging from the position of important architectural remains of a very remote period, antiquarians and geologists are of opinion that the town was, in part at least, buried by a volcanic eruption. Medals, bronzes, and inscriptions of interest have also been found here. Tradition says that St. Peter laid the foundation of the Christian church here, but there is no certain account of a bishop of Suessa before the beginning of the fifth century. The present town is poorly built, but is furnished with cafés and tolerable inns. The weekly market is very animated. P. 20,708.

Sester'tius [Lat. for *semis tertius*, "two and one-half;" it was once worth two and a half *asses*; see As], in ancient Rome, a silver or bronze coin worth one fourth part of a denarius. Originally, it was worth two and a half asses, but in later times four asses made one sestertius, and the coin, originally of silver, was struck in fine bronze. The SESTERTIUM was a money of account equal to 1000 sestertii, but it was never coined. The value of the sestertius, roughly stated, was from one and a half to five cents of our money, for the value declined greatly after the downfall of the republic.

Ses'to Fiorenti'no, town of Italy, province of Florence, about 5 miles from the city of Florence. This town is formed of several fractions or parishes, the most con-

siderable containing about 6000 inhabitants. In the parish of Colonnata is the famous manufactory of porcelain known as the Doccia or *Manifattura Ginori*. This establishment was founded by the marquis Carlo Ginori in 1735, and is therefore coeval with the celebrated manufactory of Sèvres. The ceramics produced here are very beautiful. P. of commune, 13,137.

Ses'to San Giovan'ni, or **Sesto di Monza,** town of Italy, province of Milan, about halfway between the city of Milan and the town of Monza. It is a favorite site for villas, and the land here sells at very high prices. P. 5000. SESTO (Lat. *Sexto ab urbe lapide*) is a name common to many other small towns in Italy.

Ses'tri Levan'te [anc. *Segesta Tigullorum*], town of Italy, province of Genoa, on a tongue of land about five miles from Chiavari. The views from this point are almost unrivalled in beauty even on this coast, so famed for its scenery, and the climate is no less charming. The harbor is well protected, and receives about 500 coasting-vessels annually, besides the many employed in fisheries. P. of entire commune, 8800.

Ses'tri Ponen'te, town of Italy, province of Genoa, beautifully situated on the sea-shore about 5 miles W. of Genoa. It enjoys a delicious climate, and is a favorite summer resort of the Genoese aristocracy, many of whom have superb villas here. The inhabitants of Sestri Ponente are extensively engaged in shipbuilding, and are otherwise very industrious. P. of commune, 9600.

Sestus, or **Sestos.** See ABYDUS.

Set, or **Typhon.** See TYPHON, by S. BIRCH, LL.D.

Se'te Lago'as ["seven lakes," so-called from their number], a collection of lakes in Brazil, situated on the N. top of the Serra da Melgueira, province of Matto Grosso, and the sources of the PARAGUAY (which see).

Set-Off, in law, is a cross-demand existing in favor of a defendant which in certain actions and under certain conditions may be interposed as a defence, and either partly or wholly defeat a recovery by the plaintiff, or even result in a recovery against him. This species of defence was unknown to the common law, and was first authorized by the English statutes 2 Geo. II. ch. 22, § 13, and 8 Geo. II. ch. 24, § 4, which have been substantially re-enacted in the several States of this country. The original statute only permitted a set-off in the case of mutual "debts." The use of this technical word restricts the set-off to actions brought for the recovery of a fixed, certain sum of money due upon a contract, and the demand in favor of the defendant must be of the same nature. There can be no set-off of unliquidated damages resulting from the breach of contracts, but only of those claims the amount of which has been ascertained and settled by the promise itself, whether that promise be express or implied. The debts must also be mutual, and due to the parties in the same right. Under the American statutes a set-off may be interposed in two different cases: (1) Where the cross-demands accrued in favor of the actual parties, the plaintiff and the defendant; and in such an action, if the defendant's claim is the greater of the two, he will not only defeat the plaintiff's recovery, but will recover a judgment for the excess. (2) Where the cross-demands originally accrued in favor of persons who are not both the parties to the action, as, for example, where the plaintiff is an assignee of the demand in suit, and the defendant's claim is against the assignor. Under these circumstances, the set-off can only avail as a partial or total defence; no judgment for any excess can be recovered by the defendant, since the plaintiff is not his debtor. Judgments held in the same right may also be set off, sometimes on motion, in the discretion of the court. Courts of equity, acting upon the analogies of the statute, have created an "equitable set-off" broader and more comprehensive than that administered by the courts of law. The reformed American procedure has greatly expanded and liberalized the doctrine of set-off by the "counter-claim" which it has introduced, and which has also been adopted by the new English procedure. JOHN NORTON POMEROY.

Se'ton [Fr. *séton*, from the Lat. *seta*, a "bristle"], in surgery, a twist of silk or a piece of leather, india-rubber, or other material passed through a fold of skin and beneath the subcutaneous tissue for the purpose of exciting suppuration. Its action may be derivative, or it may tend to promote a salutary adhesive inflammation. The use of setons is less common than formerly, but they nevertheless often serve a very useful purpose. They are much employed in veterinary practice.

Seton (ELIZABETH ANN **Bayley**), b. in New York City Aug. 28, 1774; married William Seton about 1794, and on his death at Pisa 1804, returned to New York; joined the Roman Catholic Church Mar. 14, 1805; conducted a school at Baltimore 1805–08, and with her sisters-in-law, Harriet and Cecilia Seton, took the veil as Sisters of Charity Jan. 1, 1809, at Emmittsburg, Md., being the first members of that order in the U. S. A conventual establishment was opened at Emmittsburg July 30, 1812, with "Mother Seton" as superior-general. The new order took charge of orphan asylums at Philadelphia 1814, and at New York 1817, in which year it was incorporated by the legislature of Maryland. At the death of the foundress, at Emmittsburg Jan. 4, 1821, there were 50 members. In 1869 there were in the U. S. 95 houses and more than 1000 Sisters of Charity.

Seton (SAMUEL WORTHINGTON), b. in New York City Jan. 23, 1789; engaged in mercantile life, and was teller of a bank when in 1827 he was chosen agent of the Public School Society, and thenceforward devoted himself to the promotion of popular education. Upon the establishment of the board of education (1853) he was appointed assistant superintendent, and retained that position through life. He was also zealous in the organization and management of Sunday schools. D. in New York Nov. 20, 1869.

Set'ta, town of West Africa, dominion of Dahomey, in a very fertile and well-cultivated district, has about 9000 inhabitants.

Settembri'ni (LUIGI), b. at Naples in 1812; was appointed professor in the lyceum of Catanzaro at the age of twenty-three, but becoming compromised in political affairs, was arrested in 1839 and imprisoned at Naples. Being set at liberty in 1842, he gave private lessons in literature until 1848, publishing in the mean time his bold *Protesta de' Popoli delle Due Sicilie*. In 1848 he held an important post in the ministry of public instruction; May 16, 1849, the reaction having triumphed, was arrested and thrown into the prison of San Stefano, where he occupied himself in translating the works of Lucian into Italian. On his release he devoted himself wholly to literature, and published in 2 vols. his course of *Lezioni di Storia della Letteratura Italiana*, a work very popular in Southern Italy, notwithstanding many defects. In 1873 he was appointed senator of the kingdom of Italy. D. Nov. 4, 1876.

Set'ter, a hunting-dog of a breed apparently intermediate between the pointer and the spaniel. This dog was formerly trained to sit or drop when marking down game, but at present it stands at its work like a pointer. There are several distinct strains, as the Irish, the Russian, and the English setters, and of late there are several new stocks which are highly prized. Notable among these are the Macdona and the Laverack setters. The colors vary, but a liver color is a favorite one.

Setting-Machines for Type. See PRINTING, by W. S. PATERSON.

Set'tlement, in law, the right which an individual acquires to parochial assistance in that parish or district to which he legally belongs, and in which he is said to have the settlement. (See PAUPERISM.)

Settlement of Property. See MARRIAGE, by PROF. J. N. POMEROY, LL.D.

Setu'bal, town of Portugal, province of Estremadura, on the Bay of Setubal, 20 miles S. of Lisbon, has an excellent harbor, lined with broad and convenient quays and defended by five forts. It is an old town, surrounded by walls, but it is well built, airy, and clean. It is the chief seat of the Portuguese salt-trade, and has also a very extensive trade in wine. Considerable pilchard fisheries are carried on. P. about 15,000.

Sevasto'pol, or **Sebastopol,** near the S. W. extremity of the Crimean peninsula in the Black Sea, *was* the great naval station of Russia in that sea. The roadstead and the harbor, and the extensive establishments connected with them, formed the most important features of the place. It was a Tartar village (*Akhtiar*) until 1780, when the Russian government commenced the work of establishing here its naval arsenal. The great harbor-fortifications which existed at the period of the siege were planned in 1834, and simultaneously land defences; which latter, however, had not been constructed when (Sept., 1854) the allied armies of England and France established themselves before the place and the memorable siege commenced. Every effort was then made to increase the strength of existing intrenchments, and the process continued *pari passu* with the siege. The "bastions" (of earth) mentioned in accounts of the siege had been previously thrown up. The connecting lines had not the strength of ordinary field fortification, the scarcity of earth preventing the excavation of ditches except about the bastions and other points of support (*e. g.* the "Malakoff," originally a stone tower; the Redan, an earthwork, etc.). To compensate for want of ditches every imaginable and practicable expedient to render access difficult was resorted to. These defences, based upon a matured plan of permanent

fortification, and having some of its features, combined therewith the characteristics of lines of fieldworks and those of the siegeworks always resorted to by a besieged garrison, but yet differed from all these and from all others previously employed, owing to peculiarities of site and circumstances, to the skill of the engineer, and to the indomitable resolution of the defenders. Though compressed into comparatively small linear space, their real magnitude was enormous, 5000 or 6000 men being at some periods daily engaged on them, and the labor being unintermitted during the eleven months of the siege. The garrison during this period (always in free communication with the external forces by which it was replenished) was usually about 30,000 men; the number of guns mounted at the final assault is said to have been 800, several times that number having been rendered unserviceable in the course of the siege, which lasted eleven months (Oct., 1854–Sept., 1855). The Russian loss in the defence was 84,000 men. (*Todleben.*) The forces *actually engaged* were, during the later months of the siege, about as follows: French, 120,000; English, 27,000; say, 147,000 men. The Sardinians (5000) and Turks are not included, as they were not directly engaged in the siege. The former, however, and a portion of the Turkish force, were indirectly "engaged," inasmuch as they helped to hold the base (Balaklava) and communications of the besiegers. The French loss was 44,500 (*Niel*); hence the total loss of allies must have been about 60,000. The total loss of besieged and besiegers must have been nearly 150,000 men.

The fortifications and naval establishments were, after the capture, destroyed by the allies, and by the Treaty of Paris, which terminated the war, Russia was debarred from maintaining a naval force in the Black Sea beyond a fixed and very limited magnitude. By the stipulations on this point of that treaty Russia in 1870 asserted her intention no longer to be bound. P. before the siege, 40,000; now about 10,000. (See Todleben.) J. G. Barnard.

Sevastopol, p.-v. and tp., Door co., Wis., on Green Bay. P. 326.

Seven Dolors of the Virgin Mary, Festival of, the Friday next preceding Palm-Sunday. This celebration was fixed by Benedict XIII. in 1725. The Seven Dolors were—the prophecy of St. Simeon; the journey to Egypt; the losing of Jesus at Jerusalem; the sight of the Lord bearing the cross; the Lord upon the cross; the piercing of his side with the holy lance; and the burial.

Seven Mile, p.-v. and tp., Butler co., O., on Cincinnati Richmond and Chicago R. R. P. 229.

Seven-Mile Creek, tp., Juneau co., Wis. P. 825.

Seven Pines, Battle of. See Fair Oaks.

Seven Sages (or **Wise Men**) **of Greece, The,** according to most authorities, were Bias, Chilon, Cleobulus, Periander, Pittacus, Solon, and Thales, but the names are variously given. In fact, the selection of seven names from among the sages of ancient Greece is a purely arbitrary one. Many aphorisms in prose and verse, chiefly practical observations for the regulation of life, have come down to us as the work of these and other wise men of the antephilosophic period of Greece. These have been collected in Orelli's *Opuscula Græcorum Veterum Sententiosa et Moralia* (vol. i. pp. 138 *seq.*).

Seven Sleepers, The, according to an old tradition, were seven Christian brothers of Ephesus who in 251 A. D., during the persecution of Decius, took refuge in a cave, the entrance of which was walled up by the heathens in order to starve the young men. They, however, slept 200 years, or till 447 A. D., when they awoke. They were finally brought to Ephesus, to the great edification of the faithful. The Roman Catholic Church commemorates them on July 10, but the legend is older than the Church itself, and is found in various forms in the folk-lore of the East.

Seventeen-Year Locust. See Cicada, and also Locust.

Seventh, in music, an interval comprising six degrees of the diatonic scale. (See Interval.)

Seventh-Day Adventists. See Adventists.

Seventh-Day Baptists, a denomination of Christians formerly called *Sabbatarians*. They hold to the immersion of adult believers, and also to the observance of the seventh day of the week as the Sabbath. Traces of this peculiar practice among some of the early Reformers are not few. The Sabbatarians began to attract attention in England about the time of the Commonwealth. In 1650 they assumed a denominational form in that country. The first Sabbatarian church in America was organized at Newport, R. I., in 1665, under the care of Stephen Mumford. In 1671 they left the Baptist denomination. In 1818 they assumed their present name. In the U. S. they number about 10,000 members, support one university (at Alfred, N. Y.), a number of academies and periodicals, a tract and publication society, and a missionary organization. In England they are at present few in number.—Seventh-Day Baptists (German), a small sect which in 1728 seceded from the Dunkers of Pennsylvania, and established at first a solitary, and then a conventual, life at Ephrata, Lancaster co., Pa. They hold a part of their property in common, adopt the Capuchin habit and a system of monastic names, and recommend, but do not absolutely require, celibacy. At present their leading establishment is at Snowhill, Franklin co., Pa. They are few in number. Their founder was Conrad Beissel. (See *A General History of the Sabbatarian Churches*, by Mrs. Tamar Davis (1851).)

Seventy-First, tp., Cumberland co., N. C. P. 1184.

Seventy-Six, tp., Muscatine co., Ia. P. 959.

Seventy-Six, tp., Washington co., Ia. P. 419.

Seven Wonders of the World, The, are variously given, but more generally as follows: the Colossus of Rhodes, Diana's temple at Ephesus, the Mausoleum at Halicarnassus, the Pyramids, the Pharos at Alexandria, the Hanging Gardens at Babylon, and the Olympian Zeus. Each is noticed under its alphabetical head.

Seven Years' War (1756–63). Maria Theresa could not forget the loss of Silesia. It had been taken from her by an insignificant power, to which the house of Austria was not used to pay any regard, and her attempts at rebuking this audacity had failed signally in the first and second Silesian wars. She was fully determined on crushing—or at least humiliating—the house of Brandenburg, and since the Peace of Aix-la-Chapelle (1748) her generals had been busy in reorganizing and increasing the Austrian armies and her diplomats in forming alliances against Prussia. The czarina of Russia, Elizabeth, was willing; she knew that Frederick II. used to make her amorous aberrations the favorite subject of his sarcasms. But with respect to France, the hereditary enemy of Austria and just now at war with England, the former ally of Maria Theresa, the difficulties seemed almost insurmountable. Nevertheless, when George II. concluded an alliance with Prussia Jan. 16, 1756, in order to secure his Hanoverian possessions against a French invasion, and when Maria Theresa stooped to write a letter to Madame de Pompadour, calling her *Ma chère cousine*, Prince Kaunitz succeeded in forming an alliance between France and Austria (May 1, 1756). With other powers also the negotiations were promising and nearly ripe. Sweden, whose possessions in Northern Germany were now confined to Stralsund and the island of Rügen, demanded only money to make a descent upon Pomerania, and France declared herself willing to pay; and in Saxony the elector was found so exasperated at Prussia that he even came forward with a proposal of playing the traitor—of alluring the Prussian king into Bohemia by a feigned neutrality, and then throwing an army into his rear to cut off his lines of retreat and communication. Frederick II. knew of all these plans, and when he saw that war was unavoidable he fell at once, without any declaration of war, upon Saxony with an army of 60,000 men (Aug., 1756), took Dresden Sept. 10, shut up the Saxon army of 18,000 men in its camp between Pirna and Königstein, defeated the Austrian army under Browne, who from Bohemia hastened to the support of Saxony, at Lobositz (Oct. 1), compelled the Saxon army to surrender Oct. 15, and placed the whole country under Prussian control, treating it very severely. The exploit was brilliant on account of its rapidity and completeness, but Frederick II. knew very well that no single exploit, however dazzling, would finish the game this time; and he conquered Saxony, not because he thirsted for a sip of revenge, but because the country formed the necessary basis for his future operations. His situation in the spring of 1757 was almost overwhelming. At the N. 22,000 Swedes gathered in Stralsund ready to cross the Peene; in the E. 100,000 Russians under Apraxin pushed onward to Memel; in the S. E. two Austrian armies approached through Bohemia—the one, of 76,000 men, under Charles of Lorraine, destined for Silesia, the other, of 46,000 men, under Daun, destined for Saxony; in the S. W. two French armies marched toward Prussia—the one, of 100,000 men, under D'Estrées, through Hanover, the other, of 36,000 men, under Soubise, through Hesse-Cassel; in the S. an army was organized from the contingents of the South German states, and was destined to manœuvre in connection with the Western Austrian and Eastern French armies. In the centre of this circle, which drew nearer and nearer every minute, on the Brandenburger heath, where there grows little corn and no iron, stood Frederick II. with an army of about 200,000 men, trim and in good repair like his country, quick and undaunted like himself. But he was alone. England, his only ally, promised and paid him for several years a handsome subsidy, but her representative

at the theatre of war, the duke of Cumberland, commanding an army of 40,000 English-Hanoverian troops in Hanover, was the sorest point in Frederick's position. In Apr., 1757, he broke into Bohemia; attacked the Austrian army under Charles of Lorraine before Prague, May 6; split it in two, of which the one part retired into Prague, and the other retreated to the S. W. to join Daun; invested and besieged Prague; marched with one division of his army against Daun, who came to reinforce the city; met him at Kolin June 18; was completely defeated, and retreated with his whole force into Saxony, slowly followed by Daun, while Charles of Lorraine marched onward to Silesia. In Hanover the duke of Cumberland was totally defeated by D'Estrées at Hastenbeck, July 26, and compelled to conclude the capitulation of Kloster-Seven, Sept. 8, by which his army was dissolved. D'Estrées' successor, the duke of Richelieu, was too much occupied with plundering Hanover to do anything serious, but in the mean time Soubise, with the second French army, had conquered Hesse and penetrated into Saxony. Frederick II. met him at Rossbach Nov. 5, and literally scattered his army to the winds. With incredible rapidity he then turned to Silesia, which had fallen into the hands of the Austrians; routed Charles of Lorraine at Leuthen Dec. 5, and reconquered the whole province with the exception of Schweidnitz. In the N. the Swedes had been driven back into Stralsund, and the Russians, although victorious at Grossjägerndorf, Aug. 30, and still occupying Memel, suspended all hostilities on account of the illness of the czarina, which changed the whole policy of the country. Thus, when winter set in and stopped all military operations, the actual loss which Frederick II. had sustained was not great, and the prestige he had gained was enormous. The capitulation of Kloster-Seven was not ratified by the English Parliament. On the contrary, a new English-Hanoverian army was organized and placed under the command of Duke Ferdinand of Brunswick, and during the subsequent campaigns he succeeded by his vigilance, energy, and shrewd tactics, and by several brilliant victories—at Crefeld June 23, 1758, over Clermont, and at Minden Aug. 1, 1759, over Contades and Broglie—in keeping the French on the other side of the Rhine. In the sea-war between England and France, Spain joined the latter in 1761, but England was so successful in North America, the West Indies, the African coast, and India, and showed herself so superior to France in all their great naval encounters—at Quiberon, 1759, and Belleisle, 1761—that she then laid the foundation of her great maritime empire, while France became utterly exhausted. The attempts of the Swedes in the N. and of the German army in the S. were of no great consequence, but along the eastern and south-eastern frontier, in the provinces of Prussia and Silesia, and in Saxony, the struggle against the Russians and Austrians was at times desperate. In 1758, Frederick II. defeated the Russians under Fermor at Zorndorf Aug. 26, but he was himself defeated at Hochkirch Oct. 14, by the Austrians under Daun. He nevertheless kept both Silesia and Saxony, but in 1759 was so completely routed at Kunersdorf, Aug. 12, by the Russians under Soltikow and the Austrians under Daun, that the morning after the battle he could hardly gather 5000 men. Dresden and a large part of Saxony fell into the hands of the allies, and although he reconquered it in 1760 by the brilliant victories at Liegnitz, Aug. 15, over Landon, and at Torgau, Nov. 3, over Daun, his ruin seemed, nevertheless, unavoidable. On Oct. 25, 1760, George II. died, and the English subsidies stopped. The Russians under Todtleben took Berlin and plundered it for three days. In large districts, especially of the eastern part of his kingdom, the houses were burnt, the animals driven away, the men killed, and the women and children left on the naked ground to starve. His army, mostly foreigners and young recruits, numbered only 50,000, and with this force he had to face three hostile armies at once, each superior in numbers to his own. But, fortunately, the czarina died Jan. 5, 1762, and her successor, Peter III., was an enthusiastic admirer of Frederick II. Peace was concluded with Russia May 5, and with Sweden May 22, and although the projected Russian-Prussian alliance was frustrated by the assassination of Peter III., Catharine II., his successor, declared herself neutral; Austria felt too weak to carry on the war alone; France also had lost its warlike enthusiasm; all seemed sunk in sheer exhaustion. During the many years of fruitless exertions the angry passions and haughty demands had vanished, and given room for a longing after peace. There was only one man who still seemed wide awake, who did not ask for peace, who would yield nothing; and as the alliance between the three greatest powers of the world, seconded by several minor ones, had not been capable of putting him down, they determined to let him stay. Almost without any preliminary negotiations peace was concluded between Prussia and Austria at Hubertsburg Feb. 15, 1763, by which "all should remain as it had been before the war," with the exception of the million of lives and the millions of property which had been destroyed. (See Frederick II., *Histoire de la Guerre de Sept Ans* (6 vols., 1794–1801); Carlyle, *Frederick the Great*; Ranke, *Ursprung des siebenjährigen Krieges* (1871).) CLEMENS PETERSEN.

Sev'erance, p.-v., Wolf River tp., Doniphan co., Kan., on St. Joseph and Denver City R. R.

Sev'ern, a river of England, rises in Montgomeryshire at an elevation of 1500 feet above the level of the sea, flows in a southern and south-western direction, and falls into the Bristol Channel after a course of about 200 miles. It is navigable for a distance of 180 miles, and the tide, which in its estuary assumes the character of the *bore* or *eagre*, is perceptible 120 miles from its mouth.

Severus (ALEXANDER). See ALEXANDER SEVERUS.

Seve'rus (LUCIUS SEPTIMIUS), Roman emperor from 193–211, b. at Leptis Magna, on the northern coast of Africa, Apr. 11, 146 A. D.; studied jurisprudence at Rome; held the highest offices under Marcus Aurelius and Commodus, and commanded the legions in Pannonia when tidings came that the prætorian guard at Rome had murdered Pertinax in 193 and sold the imperial purple to Didius Julianus. The legions immediately proclaimed Severus emperor, and on June 2, 193, he appeared at their head before the walls of Rome. Julianus was deposed, sentenced to death, and executed, and the prætorian guard was dissolved, while a new guard was formed of the legions, which received great dotations. Meanwhile, the Roman legions in Asia had proclaimed their general, Pescennius Niger, emperor. Severus marched against him and defeated him in several battles, finally, at Issus in 194; made successful campaigns against the Parthians, and returned to Rome, where he entertained the people in a most magnificent way, and gave the army new and still larger dotations. Another rival, Clodius Albinus, appeared at this time in Gaul, but in the battle of Lugdunum (197) Severus was victorious, though only after a protracted struggle and a horrible massacre. New campaigns in the East followed, and resulted in the capture and plunder of the Parthian capital, Ctesiphon. Then the emperor spent several years (202–208) at Rome, occupied with reforms of the internal administration of the empire, but in 208 a rebellion broke out in Britain, and Severus again took the field. His campaigns in Britain were difficult, bloody, and without any decisive or lasting result. He was just planning a new campaign against the Caledonians when he d. at Eboracum (York) Feb. 4, 211. His last years were much disturbed by the dissensions and dissipations of his sons, Caracalla and Geta. The discipline of the army was greatly deteriorated by the large dotations he at different times conferred on the soldiers. The surname *Severus* he received from the cruelty with which he treated the families and partisans of Pescennius Niger and Clodius Albinus.

Severus (SULPICIUS). See SULPICIUS SEVERUS.

Severus, Wall of, a wall of stone erected by the emperor Severus in 208 A. D. to protect Roman Britain from the Caledonians. It extended from the Solway to the Tyne, immediately N. of that of Hadrian, and consequently far S. of that of Antoninus. Considerable portions of the wall still remain.

Sevier', county of S. W. Arkansas, on Little River, adjoining Indian Territory. Staples, Indian corn, cotton, sweet potatoes, tobacco, and wool. Cap. Lockesburg. Area, about 850 sq. m. P. 4492.

Sevier, county of E. Tennessee, adjoining North Carolina, from which it is separated by the Unaka, Iron or Great Smoky mountains, is watered by French Broad and Little Pigeon rivers, has bottom-lands of extraordinary fertility, and valuable beds of limestone and iron ore. Staples, Indian corn, wheat, oats, tobacco, sorghum-molasses, honey, wool, and butter. Cap. Sevierville. Area, 500 sq. m. P. 11,028.

Sevier, county of E. Utah, adjoining Colorado, intersected by Green and Grand and Sevier rivers, and traversed by the Wahsatch Mountains. Cap. Richfield. Area, about 7000 sq. m. Settled since 1870, when the pop. was only 19.

Sevier (AMBROSE H.), b. in Middle Tennessee in 1802; received a scanty education; removed to Arkansas Territory when eighteen years of age; studied law; was admitted to the bar two years later; became clerk to the Territorial legislature; was elected to that body 1823 and 1825; delegate in Congress 1827–36; U. S. Senator 1837–48; was many years chairman of the committee on Indian affairs, and afterward of that on foreign relations, and was a commissioner to negotiate peace with Mexico 1848. D. at Little Rock Dec. 21, 1848.

Sevier (JOHN), b. on Shenandoah River, Va., in 1740, of French parents originally named XAVIER; emigrated to

the Holston River country, in what was then North Carolina, in 1769, and with an exploring-party built the first fort on Watauga River, which he defended against the Indians, and in 1772 was delegate to a convention at Halifax, N. C. In 1773, Lord Dunmore, then governor of Virginia, commissioned him as captain of an expedition fitting out against the Shawnees and other tribes of Indians; took part in the battle of Point Pleasant, 1774; sat in the North Carolina colonial assembly 1777; procured the erection of the Tennessee region into a district under the laws of North Carolina, and the establishment of courts of justice; was commissioned lieutenant-colonel, and defeated the Indians at the battle of Boyd's Creek 1779. As colonel of a regiment raised by himself in Tennessee, he participated in the signal victory over the British at the battle of King's Mountain, N. C., Oct. 7, 1780, and for his distinguished bravery on that occasion was presented with a sword and a vote of thanks by the legislature of North Carolina. He was foremost in almost all the battles and skirmishes, as well as treaties and negotiations, with the Indians during many years, and was regarded by the settlers as their father, friend, and protector; was chosen in 1785, without opposition, governor of the anomalous State of Frankland, which was formed by the settlers out of a portion of what is now Western North Carolina and Eastern Tennessee. He received from Pres. Washington the commission of brigadier-general of the territory S. of Ohio River. In 1796 the State of Tennessee was erected and admitted into the Union, and Sevier was chosen governor, served for two consecutive terms, and re-elected in 1803; was elected a Representative in the U. S. Congress in 1811, and re-elected in 1813. During the war with Great Britain (1812–15) he served with honor as a member of the military committee, and in 1815, against the advice of friends who regarded his age and impaired health, accepted an important mission to adjust difficulties with the Creek Indians in Alabama Territory. While thus engaged he was taken sick, and d. at an encampment on the E. side of Tallapoosa River, near Fort Decatur, Sept. 24, 1815. A handsome monument to his memory stands in the city cemetery at Nashville, Tenn. JAMES D. PARK.

Sevier Lake, a body of salt water lying in Western Utah, 120 miles S. S. W. of Great Salt Lake, N. lat. 39°, lon. W. from Greenwich 113° 10′; altitude above the ocean 4600 feet. Its length N. and S. is 20 miles, its width 10 miles, and its area 140 sq. m. Its surface is not interrupted by an island. It has no outlet, and its sole tributary is Sevier River, which enters the N. end. The valley which contains the lake is an arm of the Sevier desert, and is uninhabitable by reason of the absence of fresh water. It is walled at the W. by the House range of mountains, and at the E. by the Beaver Creek range, and it opens northward to the desert. The shores of the lake are low and treeless, and desolate in the extreme. The soil is saline and pulverulent, and sustains only a scanty growth of low bushes. A few wading-birds haunt the beach, and a flock of gulls hover about the mouth of the river feeding on the fish that stray into the lake and are poisoned by its brine. In the lake are found the forms of life that usually inhabit strong brines—namely, *Artemia* and the larvæ of certain insects. The brine has been found by analysis to contain 62.3 parts in 1000 of chloride of sodium, 13.4 of sulphate of soda, 10.3 of chloride of magnesium, and 0.4 of sulphate of lime. It is needful to note that the facts contained in this description were gathered in the year 1872, for, like all salt lakes, Sevier Lake is subject to fluctuations. Having no outlet, but disposing of its surplus by evaporation, it oscillates with every change of climate. When the weather is unusually dry, the accession of water from the river becomes less and the loss by evaporation greater; the surface falls, the dimensions shrink, and the brine becomes stronger. When the weather grows more moist, the opposite result is produced. All about the lake are abandoned beaches, which record its former extent. At some time in the past the water was expanded over a large portion of the Sevier desert, and discharged northward into Great Salt Lake. The channel through which this discharge took place is still to be seen on the watershed between the Sevier and Salt Lake deserts, 50 miles N. of the present shore of Sevier Lake. It is known as the "Old River bed," and may well excite the wonder of the traveller, for it is the trace of a broad stream where now there is perpetual drought and one must journey 50 miles from spring to spring. At a time still more remote Great Salt and Sevier lakes rose so high that their waters joined, and the combined lake, to which the name "Bonneville" has been given, overflowed to the ocean through Snake and Columbia rivers. The sediments and shore-lines of Lake Bonneville are well preserved, and show that it covered Great Salt Lake, Sevier, and Escalante deserts, and sent arms into Utah, Juab, Rush, Skull, Preuss, Snake, and Cedar valleys. It had an extreme width of 125 miles. Its water-level was about 575 feet above the present level of Sevier Lake (1872), and 968 feet above Great Salt Lake (1873). Its sediments abound in fresh-water shells. In its phenomena is the record of a climate far less arid than that which now prevails in Utah. The epoch of moisture was not, however, of great duration as geologists reckon time, and it was preceded by a long period of dryness. It was probably coincident in time with the Glacial epoch.

G. K. GILBERT.

Sevier′ville, p.-v., cap. of Sevier co., Tenn. P. 159.

Sévigné′, de (MARIE DE RABUTIN CHANTAL), MARQUISE, b. at Paris Feb. 6, 1626; was left an orphan very early, but received an excellent education from her uncle, Abbé de Coulanges, and married in 1644 the marquis Henri de Sévigné (d. 1651), to whom she bore two children, a son and a daughter. Her social position was very elegant; she was rich, spirited, beautiful, one of the most prominent members of the literary circle of the Hôtel Rambouillet, and intimate with all the principal actors in the civil war of the Fronde. In 1669 her daughter, to whom she was passionately attached, was married to the marquis de Grignan, governor of Provence; the consequent separation occasioned a correspondence which, although not intended for publication, appeared after the death of the authoress, and has made her name celebrated, the letters being at once of great historical interest and of the highest literary merit. D. Apr. 18, 1696. The first edition of her *Letters* appeared in 1726; the last and best are those by Silvestre de Sacy (11 vols., 1860–63) and by Regnier (14 vols., 1862–66). (See Walckenaer, *Mémoires touchant la Vie et les Écrits de Madame de Sévigné* (1842); *Madame de Sévigné*, by Countess de Puliga (London, 1872).)

Sev′ille, city of Spain, capital of a province of the same name, on the left bank of the Guadalquivir, 70 miles from its mouth. Under the Romans, Goths, and Moors it was the capital of wealthy and powerful empires. The earlier kings of modern Spain also resided here; and although Charles V. removed the royal residence to Valladolid, Seville rose to a still higher degree of splendor and prosperity when America was discovered, as it became the mart of the new colonies. During the French invasion (1810–13), and by the subsequent loss of the Transatlantic possessions, it suffered very much, but recovered rapidly, and is to-day not only a city of great and brilliant remembrances, but also a lively and enterprising modern town. It is surrounded by old Moorish walls, 5 miles in circuit, pierced by fifteen gates, and surmounted by sixty-six towers; as fortifications these walls are of little consequence, but their ramparts afford beautiful public walks. Across the city runs the Alameda, a broad, open street lined with palaces, planted with magnificent elms, and adorned with numerous fountains, which, like the city in general, are provided with water by several great aqueducts, of which that built by the Moors in 1172 is a magnificent structure resting on 410 high arches. The rest of the city, with the exception of the numerous public squares and promenades, consists mostly of narrow streets lined with high, sombre-looking, but substantial houses of Moorish construction, and eminently well adapted to keep the sun out and give a cool, healthy, and comfortable abode. Among its many splendid edifices the cathedral is the most remarkable. It is one of the greatest Gothic structures in the world, 431 feet long, 315 feet wide, and 145 feet high under the transept dome, and it is most magnificently adorned with paintings by Murillo, the Herreras, and other masters of the school of Seville, besides being almost overloaded with the most elegant sculptures. Unique of its kind is the Giralda, a belfry 350 feet high; and most interesting on account both of their elegant architecture and beautiful ornamentation are the Alcazar or royal palace, and the university, founded in 1579. Besides the university, which is generally attended by about 1200 students, and to which several fine scientific establishments are attached, Seville has many other good educational institutions, and several valuable libraries and art collections. Among its manufactures are a tobacco-factory, in which about 5000 persons are employed, a cannon foundry, several manufactories of muskets and other firearms, powder, saltpetre, soap, leather, cotton thread, etc. Of its exports, oranges, olive oil, wine, wool, and cork, together with copper, lead, and quicksilver, form the principal items. P. of city proper, 81,546; with suburbs and surroundings, 152,000.

Seville, tp., Gratiot co., Mich. P. 575.

Seville, p.-v., Medina co., O., on Lake Shore and Tuscarawas Valley R. R., 36 miles S. of Cleveland, has 4 churches, excellent schools, 2 banks, 1 weekly and 1 monthly newspaper, a cheese-factory, 2 flouring-mills, flax

and vinegar factories, a planing-mill, 1 wagon and carriage establishment, and a town hall. P. 597.

MRS. M. A. COULTER, ED. "SEVILLE TIMES."

Sèvres, town of France, department of Seine-et-Oise, on the Seine, is celebrated for its manufactures of porcelain, which are generally acknowledged to be the most elegant ever produced, both in design and painting. P. 7096.

Sèvres, Deux, department of Western France, has received its name from two rivers—the Sèvre-Niortaise, which flows into the Bay of Biscay, and the Sèvre-Nantaise, which joins the Loire. Area, 2315 sq. m. P. 331,243. The northern part is hilly, even mountainous; the southern, level, but the soil is everywhere very fertile; it produces more wheat than necessary for home consumption, and affords excellent pastures. Cattle, horses, mules, and asses are extensively reared. Iron, marble, and granite are found, and considerable manufactures are carried on. Of 33,992 children of school age, 11,181 received no school education in 1857. Cap. Niort.

Sewage. See SEWER, by GEN. Q. A. GILLMORE.

Sew'all (JONATHAN), LL.D., b. at Boston, Mass., Aug. 24, 1728; graduated at Harvard 1748; taught school several years at Salem; began the practice of law at Charlestown about 1758; became attorney-general of Massachusetts 1767; gained a suit by which the slave James recovered his freedom at common law 1770; resided several years in the Vassall House at Cambridge; went to England early in 1775; was included among the sufferers by the penal act of Apr. 30, 1779, against the loyalists or "Tories;" settled at St. John, New Brunswick, 1788, and was judge of the court of vice-admiralty until his death, Sept. 26, 1796. He was long, but incorrectly, reputed the author of the letters signed "Massachusettensis" published in defence of British policy, and replied to by John Adams over the signature of "Novanglus," it being now known that they were written by Daniel Leonard. His son, JONATHAN SEWALL, LL.D. (1766–1839), was chief-justice of Lower Canada 1808–38.

Sewall (JONATHAN MITCHELL), b. at Salem, Mass., in 1745, was adopted and reared by his uncle, Chief-Justice Stephen Sewall; was a distinguished lawyer; became register of probate for Grafton co., N. H., 1774; removed some years later to Portsmouth; was noted as a wit and writer of popular Whig and Federalist lyrics, which were collected into a volume 1801. D. at Portsmouth, N. H., Mar. 29, 1808.

Sewall (SAMUEL), b. at Bishopstoke, England, Mar. 28, 1652, grandson of Henry, a pioneer resident at Newbury, Mass.; was brought by his parents to that town 1661; graduated at Harvard 1671; studied theology; preached for a short time; acquired a fortune by his marriage (Feb. 28, 1676) with Hannah, daughter of John Hull, the celebrated master of the mint at Boston; was assistant governor 1684–86 and 1689; visited England 1688–89; was annually chosen a member of the executive council from 1692 to 1725; was judge from 1692 to 1718, when he was made chief-justice, being at the same time judge of probate for Suffolk county; presided at the trial of some of the victims of the witchcraft delusion of 1692, but was soon convinced of his error, for which he publicly asked pardon of God and man in a paper read to the congregation on Fast Day, Jan. 14, 1697, by his pastor, Rev. Samuel Willard; was noted for his charity and philanthropy, having been perhaps the first American writer against slavery, on which theme he published a tract, *The Selling of Joseph* (1700); was secretary and treasurer of the society for the maintenance of Indian missions, and was author of *An Answer to Queries respecting America* (1690), *Accomplishment of Prophecies* (1713), *A Memorial relating to the Kennebec Indians* (1721), and *A Description of the New Heaven* (1727). He resigned his judicial offices 1728, and d. at Boston Jan. 1, 1730. His *Diary* and other papers are in the possession of the Massachusetts Historical Society.—His son, JOSEPH, b. Aug. 15, 1688; graduated at Harvard 1707; studied theology; was ordained colleague pastor of the Old South Church Sept. 16, 1713; declined the presidency of Harvard College 1724; received the degree of D. D. from the University of Glasgow 1731; gave to that institution a fund for the education of indigent students; was a friend of learning and a man of great benevolence and worth. D. at Boston June 27, 1769. Author of *Four Sermons* (1741) and of twenty-three other sermons separately printed.

Sewall (SAMUEL), LL.D., grandson of Dr. Joseph, and great-grandson of Chief-Justice Samuel, b. at Boston Dec. 11, 1757; graduated at Harvard 1776; became an eminent lawyer at Marblehead; frequently sat in the legislature; was a member of Congress 1797–1800; judge of the supreme court 1800–13, and chief-justice of Massachusetts from 1813 to his death, at Wiscasset, Me., June 8, 1814.—His son, SAMUEL, b. at Marblehead June 1, 1785; graduated at Harvard 1804; studied theology; was long pastor at Woburn and Burlington, Mass., and d. at the latter place Feb. 18, 1868, leaving a MS. *History of Woburn*, which, together with a *Memorial Sketch* of the author, prefixed by his brother, Rev. Charles Chauncey Sewall, was published the same year by the town.

Sewall (STEPHEN), b. at Salem, Mass., Dec. 18, 1704; graduated at Harvard 1721; was tutor there 1728–39; was judge of the superior court 1739–52; chief-justice and member of the council from 1752 to his death, Sept. 10, 1760.

Sewall (STEPHEN), b. at York, Me., Apr. 4, 1734; graduated at Harvard 1761; taught the grammar school at Cambridge; became Hebrew tutor at Harvard 1762 and Hancock professor of Hebrew 1765–85; published a *Hebrew Grammar* (1763); wrote seven of the Greek and Latin poems in *Pietas et Gratulatio* (1761), and left several MSS., now in the library of Harvard, including a *Chaldee and English Dictionary*. D. July 23, 1804.

Sewa'nee, p.-v., Franklin co., Tenn., on Tennessee Coal R. R., is the seat of the University of the South, and has 2 monthly periodicals.

Sew'ard, county of S. W. Kansas, adjoining Indian Territory, and watered by tributaries of Cimarron River. It is still unorganized. Area, about 720 sq. m.

Seward, county of S. E. Nebraska, on Big Blue River, traversed by Midland Pacific R. R., has a rolling prairie surface. Staples, wheat, Indian corn, oats, hay, and butter. Cap. Seward. Area, 576 sq. m. P. in 1870, 2953.

Seward, tp., Kendall co., Ill. P. 944.

Seward, tp., Winnebago co., Ill. P. 997.

Seward, Kosciusko co., Ind. P. 1353.

Seward, p.-v. and tp., cap. of Seward co., Neb., on Midland Pacific R. R., has fine water-power, a weekly newspaper, and a growing trade. P. 1207.

Seward, p.-v. and tp., Schoharie co., N. Y., on Albany and Susquehanna R. R. P. 1765.

Seward (ANNA), b. at Eyam, Derbyshire, England, in 1747; obtained some celebrity as a poet, chiefly by her elegies upon her friend Major André (1781), and upon Captain Cook; resided most of her life at Lichfield, where she was intimate with Dr. Erasmus Darwin, of whom she published a *Life* (1804), in which she laid claim to the authorship of the first fifty lines of the *Botanic Garden*. D. at Lichfield Mar. 25, 1809, bequeathing her MSS. to Sir Walter Scott, who published her *Poetical Works and Correspondence* (3 vols., 1810), with a prefatory memoir, but the collection met with little favor.

Seward (JAMES L.), b. in Georgia; studied law; was elected to the State legislature in 1836, serving several years; was Representative in Congress 1853–59; resides in Thomasville, Ga. ALEXANDER H. STEPHENS.

Seward (WILLIAM HENRY), LL.D., b. May 16, 1801, in the retired town of Florida, Orange co., N. Y., where resided his father, Dr. Samuel S. Seward, at that time a practising physician. With such facilities as the place afforded he was made ready for entrance to Union College, Schenectady, at the age of fifteen, and in regular course took his degree, with signs of promise, in the year 1820. He then addressed himself with diligence to the study of the law under competent masters, who introduced him to practice in the year 1823. He selected his place of abode at Auburn in Cayuga co., and there soon found in the family of Judge Elijah Miller of that place a partner, Miss Frances Adelaide Miller, with whom he appears to have enjoyed a happy home for the whole of their joint career. This union took place in the year 1824, when he was twenty-three years old. He began by practising law, a profession for which he was in some respects tolerably suited, and wherein he might certainly have counted upon distinction had he confined himself to it exclusively. But little time intervened when circumstances presented to him inducements to enter the more tempting field of national politics. The year after his marriage he acceded to the call of his fellow-townsmen to address them on the national anniversary, and then enunciated opinions singularly prophetic of the conflicts of his later days. The year 1828 found him presiding in a convention of young men of New York, having for its purpose the election of Mr. John Quincy Adams as President for a second term, and the year 1830 brought him forward as a prominent leader in the uprising of the population of all Western New York against the audacious and successful conspiracy of certain lodges of Freemasons, which had combined to visit upon the person of William Morgan secret and summary vengeance for his disclosure of their formulas. The consequence to Mr. Seward was his election to a seat in the New

York senate, and from that date he may be said to have been, with few intervals, in one form or another, an effective and prominent leader in the councils which framed the policy both of the State and nation.

The political history of the most populous and powerful State of the Union, considered separately, has already been partly written by a competent hand; but as time moves on, events continually occur which tend more and more to supply materials for philosophical speculation far wider than has ever been attempted yet. For this immediate occasion it will be enough to point out as briefly as possible the precise nature of the influences which had prevailed in that State down to the time of Mr. Seward. The two individuals of prominence who had as statesmen contributed the most to give a tone to politics had been Aaron Burr and Martin Van Buren. Their policy had chiefly been the narrow one of manipulation of measures and men to the main object of securing the control of place. Neither of them can ever rank in the list of great men, but both materially contributed to establish habits and practices the bitter fruits of which will probably be gathered to the latest days of expiring freedom. With these men and their school Mr. Seward was little able to sympathize at any time of his life, for the reason that his mind dwelt far more in a region of abstract generalization, from which he studied to deduce just practical conclusions for the useful development of the public interest. The nature of his philosophy was to lead the public mind through maxims, spreading a useful influence over the welfare of the State. Men to him were mainly instruments to promote the public welfare, and not that of a few leaders. It is this tendency which sets him in a degree apart from the common run of politicians of the century. Hence it appears that in all the high positions which he ultimately occupied his aim was always to move in advance of and not after the public sentiment. His mind was remarkably clear and prompt in action, and the result rarely failed to justify his judgment. Yet he strove to exercise a decisive power, not simply over the adoption of a policy, but likewise upon the selection of the right agents to carry it out. Events not to be foreseen by human ken happened more than once utterly to demolish his best-devised conceptions, but they never impaired the organizing energy which formed his most characteristic feature. The difference between Seward and Burr or Van Buren is the difference between Sir Isaac Newton and a gamester—the clear perception of great results drawn from abstract philosophical deductions, and the sharp calculation of chances applied to the management of dice.

The political action of Mr. Seward was mainly directed through three channels laid open to him pending his career. The first was his election by the people to be governor of New York; the second, his election by the legislature of that State to a seat in the Senate of the Union; the third, his appointment by Pres. Lincoln to the post of secretary of state. His services in these forms absorbed twenty-four years of the best part of his life, during which he was steadily exercising a direct healthy influence over the movement of great events. At times the part which he chose to take needed for success courage of the highest kind, yet qualified by calmness and prudence to make it truly effective. It was his fortune to enter into debate with several of the most distinguished statesmen of the period; and, although not by nature so well gifted to shine in the mere externals of oratory as they, he never failed to maintain himself as quite their equal in the strategy of every conflict. In reviewing the proceedings of that period it is worth while to note at this day the haughty, dictatorial style of discussion habitually used by the exponents of what was then the ruling power in the national legislative bodies, as if their word was equivalent to law, to be obeyed everywhere. And for a long while it must be confessed this style remained potential over the larger number of the elect from the free States, who were content to submit for the sake of the strength derived from combinations with them to hold the central citadel of power. Yet in his various conflicts Mr. Seward studiously preserved all proprieties of deportment toward his antagonists without sacrificing any portion of his convictions. One of their favorite modes of assault was to pick out some one of his most pungent propositions, to which they assiduously labored with some success at the moment to attach popular odium. The later result is that they have invested him with the imperishable mantle of a seer. One strong feature of his character seems not to have been yet fully explained in the various notices taken of his life. This was his promptness and decision in action when required in an emergency. While he remained a member of the so-called Whig party it was chiefly his energy which prompted the success secured to them in the selection both of Gen. Harrison and Gen. Taylor, the only two candidates for the Presidency who ever secured a popular majority to their side. Yet this good fortune in these cases never inured either to his own or their benefit. In each of the three instances in which the party to which he attached himself gained the supremacy it was his fate to witness, by the sudden interposition of a higher law, the blight of his own hopes of personal influence for the public good at the very instant of fruition.

Mr. Seward in 1860 had been himself a candidate for the nomination to the Presidency, with every prospect of success. He lost it by the force of certain bargains which are apt in this country to defeat the just expectations of the majority of the nation. The successful candidate, Mr. Lincoln, however, was not slow to recognize the value of his long public services by immediately placing him in what then was undoubtedly the most difficult position in the cabinet. For the four years following he underwent an extent of labor and care in the maintenance of the country's influence upon foreign nations which it is difficult to describe in adequate language. All the powers of Europe had fixed their attention upon the catastrophe in the U. S., and, with perhaps the exception of Russia, they scarcely disguised their satisfaction at witnessing the temporary check administered to the steadily-expanding power of the great republic. Plenty of traitors had been sent out to do whatever they might to win sympathy for their cause, and most of the then existing envoys, if not secretly co-operating with the enemy, certainly bore small good-will to assist the struggling republic. In other words, the entire organization of the foreign office needed reconstruction, both in spirit and in substance, throughout the world. There have been in this department many statesmen who have merited the reputation which they earned by their effective direction of this branch of service, but there never was before Mr. Seward a case when not one, but every, nation of importance needed to be impressed with the expediency of neutrality as the safest line of policy. Much the larger portion of the labors of Mr. Seward in this field may probably remain for centuries unseen and unread, and yet it may be preserved hereafter to testify to the patriotism, the energy, and the wisdom of him who bore up the honor and safety of his country through five long years of as critical diplomatic intercourse as ever was carried on in any responsible hands.

In the whole career of Mr. Seward one element appears steadily predominant—the firmness of his spirit and his presence of mind in the face of difficulties. Few public men of any note have been subjected to more sudden and desperate reverses, and none ever bore them with more fortitude or set to work more energetically to recover from them. His rivals and opponents often vied with each other in their efforts to deride him—efforts which did not escape his attention, though they seldom were permitted to affect his deportment. He had very little of the peculiarity so common to jealous politicians of damning with faint praise, or yet of insinuating calumny under the phase of sympathy. He was not always prudent in his own speech, nor sensible of the foul uses to which his rather grotesque efforts at humor were sometimes put to injure him. The whole atmosphere of political contention is always fetid with the vile gases exuded from the bad passions of swarms of actors, especially those of inferior grades of character. He passed through it all, catching as little of the stain as possible. His enemies only hated him the more bitterly the less he permitted them to spoil his temper. It is the law of public life that the more of power a great mind applies in action the stronger is the wave of resistance which he is sure to carry before him. For conflicts of this kind Mr. Seward was by temperament peculiarly well fitted. Only in a very few instances did he lose his self-command, and these were very naturally bruited with more industry from the very reason of their rarity.

In Mar., 1865, the great conflict at arms was over, but the labors of the state department continued to involve questions ominous to the peace of the country. Mr. Seward had a just right to expect relief from the strong pressure upon him during the preceding four years, and some return for his long services in the grateful homage of the sovereign people. In point of fact, his fatality in reverses followed him to the end. The second term of Pres. Lincoln found him completely in harmony with his chief, and ready to co-operate with vigor in the arduous task of redintegration of the old and fondly-prized institutions under which the people had prospered as no other had ever done for a continuous period of three-quarters of a century. The imagination of a miserable wretch, inflamed by familiarity with histrionic effects, prompted a conspiracy that in the very hour of triumph laid low the heroic martyr President, and but just failed to involve Mr. Seward in the awful catastrophe. It admits of some question whether, historically considered, it would not have

been more dramatically fortunate for him had the assassin succeeded. The consequence would have been a sanctification of the two martyrs together in the memory of all later generations, and a corresponding execration of the miscreants who perpetrated both crimes. As it is, Mr. Seward survived to continue his labors under a successor to the Presidential chair who, with the best of intentions, possessed none of the conciliatory spirit of his predecessor, and stirred up strife instead of establishing harmony. The consequence was domestic dissension instead of peace, alienation instead of union. The whole policy of restoration, which had been carefully matured for adoption, and was really a wise one, sank under the unpopularity attached to its official source, and Mr. Seward, who would not desert his chief, took his full share of the odium attending the failure. Blows fell thick and fast upon him, more severe than those of the assassin or the loss of public favor. His wife, who had always been to him an angel of mercy, deeply sympathizing in his alternations of fortune, and a highly-cherished daughter in the flower of her age, successively withered under the shadow of the destroyer, and left him to return to his old home at Auburn, so strongly associated with the bright promise of his earlier life, to find himself bereft of all the attractions that had once adorned it. The shattered old man had not, however, the disposition even then to sink without a struggle against all these disasters. The threatening progress of disease, and the obstacles suggested to deter him, only stimulated him the more to persevere at every hazard in fighting for life. Surrounded by his remaining family and multitudes of personal friends, who held to him to the last, he yet calmly determined upon a final measure singularly indicative of his resolute will. Feeble as he seemed to others, and conscious of the progress of the enemy within him, he decided to struggle to the last by undertaking nothing less than a voyage and journey around the world. When finally he got back safely to his own home at Auburn, he even then would not sink into the abyss of indolence. Action was indispensable to him. He directed the preparation of a volume to contain his observations upon all that he had seen in the regions he had so painfully traversed. It was accordingly published under his supervision, and will remain as a final illustration as well of his keen observation to the last as of the unflinching tenacity of his will. He d. at Auburn Oct. 10, 1872, in the seventy-second year of his age. CHARLES FRANCIS ADAMS.

Sew'ell, tp., Fayette co., West Va., on Chesapeake and Ohio R. R. P. 1333.

Sewell (ELIZABETH MISSING), sister of William, b. in the Isle of Wight in 1815; became well known as the authoress of novels of the so-called "High-Church school of fiction," among which were *Amy Herbert* (1844), *Gertrude* (1845), *Laneton Parsonage* (1846), *Margaret Percival* (1847), which were republished in the U. S. She also wrote works of travels, poems, many volumes of a devotional character, and histories of Greece, Rome, and Egypt for the young. She was associated with Miss C. M. Yonge, another well-known writer of "High-Church fiction," in the preparation of a volume of *Historical Extracts* (1868).

Sewell (WILLIAM), b. in the Isle of Wight, England, about 1805; educated at Harrow School; graduated at Merton College, Oxford, 1827; became fellow of Merton, tutor of Exeter College, public examiner at Oxford (1836–41), principal of St. Peter's College, Radley (1852), and incumbent of Carisbrooke. D. at Leachford Hall, near Manchester, Nov. 14, 1874. Author of *Horæ Philologicæ* (1830), *An Introduction to the Dialogues of Plato* (1841), *Popular Evidences of Christianity* (1843), and of many other religious and literary treatises, and translated into verse portions of Æschylus, Virgil, and Horace.—His brother, RICHARD CLARKE, b. 1803, was a graduate and fellow of Magdalen College, Oxford, a distinguished barrister in London, and subsequently at Melbourne, Australia, where he d. Nov. 7, 1864. Author of several legal works.

Sewellel, a rodent of the genus *Aplodontia*, which unites some of the characteristics of the beaver with those of the squirrel family and of the prairie dog, is noted for its rootless molars; has a reddish-brown color, with very small eyes and a short tail; is about the size of a muskrat, and has very strong jaws and a plump heavy body. One species only (*A. leporina*) is known to exist. It is found on the Pacific coast in California, Oregon, and Washington Territory, is gregarious, and lives in burrows. Its skin is employed by the Indians as an article of dress.

Sew'elsville, p.-v., Kirkwood tp., Belmont co., O. P. 84.

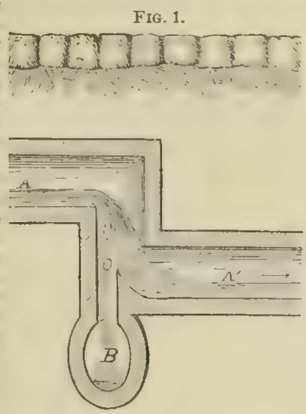
Sew'er [O. Fr. *sewiere*], an underground drain or channel for conveying away sewage, such as refuse and filthy liquids and fæcal matter. The construction of sewers and the discharging of water, etc. by sewers, as well as the system or plan of sewers for carrying off the sewage of a locality, are denominated sewerage. Technically speaking, a town or city provided with sewers is said to be sewered.

Sanitary works and regulations for the promotion of the public health have been the accompaniments of civilization in all ages of the world, and most ancient cities had their systems of sewerage and water-supply, and their elaborate public baths or temples of health, the ruins of which, having been less exposed to the action of the elements than those more elegant structures which rose higher above the earth's surface, bear testimony by their magnitude to the liberal views which inspired their construction. The waterworks and sewerage systems of Carthage, Alexandria, Rome, and Jerusalem were both extensive and complete. In Jerusalem the water-supply was so abundant that the gardens were irrigated with the overflow, and it was made to flush the whole temple, and convey away the blood and offal from the numerous sacrifices. The Cloaca of Rome has been continuously performing its present duties for about twenty centuries, and there is other abundant proof that at one time in the history of the human race both art and science had attained, in respect to sewerage, in the East a high state of excellence. This was followed by a period of decline and general neglect of the laws of health among the masses of the people. The present century has witnessed a revival of the spirit of sanitary reform, especially in thickly-populated districts, and some of the ablest minds of the age have been enlisted in its behalf. Carefully-kept statistics show that in England a reduction of the death-rate invariably follows the construction of works of sewerage and water-supply, even in towns having a low death-rate. In twelve towns selected by Mr. Baldwin Latham, from data collected by the medical officers of the privy council, with populations running from 7818 to 68,056, and with average death-rates before the improvements were made varying from $19\frac{1}{10}$ to $33\frac{2}{10}$ per 1000, the average death-rate after the sanitary works were completed ranged from $18\frac{6}{10}$ to $26\frac{2}{10}$ per 1000, with a reduction in the several towns of from 10 to 75 per cent. in typhoid-fever cases, and from 11 to 49 per cent. in phthisis cases. It must be conceded that the amount of value or wealth which a community can produce by its labor, both mental and physical, depends upon the health of the people, and among two or more communities similarly circumstanced and following the same pursuits it will commonly, like the death-rate, vary directly with their sanitary condition. Dr. Lyon Playfair estimates that there are 28 cases of sickness for every unnecessary death. To the loss in wealth-producing power caused by every death there must be added, therefore, not only the expense of burial and the cost of mourning in one or more entire households, and the interruption of industry in many others imposed by custom, but the additional loss arising from the sickness of 28 other members of the community, and the physicians' fees consequent thereon. By following out this line of thought, it will be found that the present or current value of works of water-supply and sewerage can even be estimated in dollars and cents. Moreover, as sickness of long standing may result in diseases transmissible to posterity, this current value is largely increased in the future, in the comparative freedom of the people from inherited diseases. The estimated money-value of sanitary works is therefore capital invested at interest, triply or quadruply compounded.

The requisite sanitary works of a town should provide (1) for a daily supply of pure water at the rate of not less than 20 gallons per capita of the population; (2) for the thorough drainage of the surface and subsoil; and (3) for conveying away all the liquid waste and fæcal refuse produced by the community. Only the second and third of these specified objects come properly within the scope of this article. Some authorities claim that the surface and subsoil drainage should always be kept distinct from the sewers, to the extent of providing for them a separate system of channels; and there doubtless are many cases where they should be so treated. This question, like many others likely to arise, may very properly be regarded as one to be decided upon its merits for each locality. In the general case the considerations which should govern the engineer, in fixing the essential features as well as the details of his project, will depend on (1) whether the subsoil water ordinarily stands so near the surface as to require tapping and draining off to a lower level; (2) whether the surface drainage, loaded with silt and soil not soluble in the water, and too heavy to be carried off by it and deposited in the final outfall, shall be provided with a separate set of channels, or be passed, in whole or in part, directly into the sewers which convey away the fæcal refuse from the habitations; (3) whether the less offensive sullage, arising from the domestic use of the water-supply, shall be conveyed from the houses in the same pipes which carry the animal excreta;

(4) whether the sewers shall be ventilated directly into the streets, and if not, then the best method of securing their ventilation; (5) the most effectual and certain, and therefore the best, method attainable for excluding the sewage-gases from the houses; (6) whether the sewage is needed for manurial purposes, and if so, the best method of adapting the works to that end; and (7) whether, if not required as a fertilizer, the sewage can properly be passed into the natural water-courses. In districts where the sewage is to be used for enriching the land the question of keeping it separate from the rainfall—the surface and subsoil drainage—is an important one, as the expense of handling it will generally be in proportion to its volume. The surface drainage of streets that are closely built up and subjected to heavy traffic is nearly if not quite as impure, in time of moderate and during the first stage of a heavy rainfall, as any sewage; and even if kept separate from the sewage, it might be unwise to allow it to flow into and corrupt the natural water-courses of the neighborhood in localities where it is a matter of grave importance to preserve the purity of these streams. Under these circumstances it seems necessary to deal with the foulest part of the surface drainage as sewage, so that even when the question of the manurial value of the latter is to be considered, it will not always be judicious "to convey the rainfall to the rivers and the sewage to the land," which is advocated by some sanitary writers as an unexceptionable rule. The best arrangement for providing that no portion of the surface drainage except that most heavily charged with street soil shall pass into the sewers, while the rest flows by a separate drain into the natural water-courses, is the method by storm-overflow sewers, by which the rainfall drain, which naturally lies nearer to the street surface than the sewer, is made to cross and discharge into the latter all its contents when the flow from the street is small and the velocity consequently low, while on the other hand the sewer will not intercept any of the water from the surface when the volume in the rainfall drain is great and its velocity proportionally high. This is done where the two channels cross each other by placing an opening in the sole of the drain, directly over a corresponding opening in the crown of the sewer, and by making at that point a vertical fall or step in the drain, of such height that with a high velocity in the drain its contents will overleap the opening in the sewer, and with a low velocity will drop into it. This arrangement is shown in Fig. 1, in which A A′ is the rainfall drain, B the sewer, and O the vertical opening between them. The velocity in a drain or sewer diminishes rapidly with the depth of its contents. The transverse form and the inclination of the drain A A′ being once established, the velocity of its flow, and therefore the horizontal distance to which it will leap in falling from the level A to the level A′, will depend on the depth of its contents; and the difference between these levels, or the height of the fall, can be so arranged at the time of construction, that all the surface drainage for a moderate rainfall, and for the early stages of a heavy one, when the flow is loaded with street filth, will fall through the opening O into the sewer. For a large rainfall there will be a greater depth, and therefore a greater velocity, in the drain A A′, and the stream will leap farther in falling from A to A′. For example, suppose the drain A A′ to be circular and 2 feet in diameter, and laid at an inclination of 1 in 550, and the opening O to be 1 foot wide. With a flow 6 inches deep in the drain the velocity will be $2\frac{1}{4}$ feet per second, and the stream will require a fall of $3\frac{1}{4}$ feet to enable it to overleap an opening 1 foot wide. If we suppose this fall to have been fixed at 2 feet in height, all this flow will be intercepted and pass into the sewer. If the drain runs half full, the velocity will be 3 feet per second. The contents will then overleap the opening in a fall of 2 feet, and be passed off by the rainfall drain into the natural water-courses.

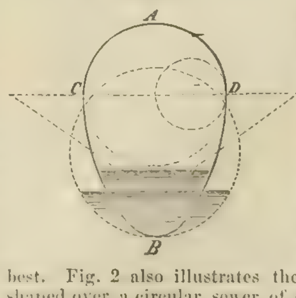
FIG. 1.



With respect to the subsoil drainage, inasmuch as sewers are or should be watertight, as otherwise the contamination of the surrounding soil, and consequently of the atmosphere, by leakage, would be the certain result, they in no sense, when properly constructed, act as drains by lowering the subsoil water-level. In well-paved streets very little of the rainfall is absorbed into the soil, but finds its way into the sewer or other channels provided for it; and were it not for the unpaved areas, including back yards and unimproved lots, the question of draining the soil in built-up streets would not perhaps possess great importance, especially if the soil be of a sandy or gravelly character. It has been shown in Great Britain, from carefully-prepared statistics, that the death-rate from pulmonary diseases was reduced 50 per cent. by sewering certain towns in such manner as to lower the subsoil water by drainage, while in other towns sewered with impervious pipes throughout, with no provision for drainage, there was no decrease in the death-rate from consumption. Some provision for subterranean drainage should therefore be made without using the sewers for that purpose, although the laying of sewers alone, by cutting through the various impervious strata, invariably results in the drainage of the surrounding earth to a greater or less degree. It is easy, when constructing the sewers, to arrange an effective system of subsoil drainage, generally at a moderate cost. There are several ways of doing this, among which are—*First.* The method by perforated inverts, giving, when the invert-blocks are laid, a series of continuous channels in the lower portion of the sewer. The joints between the invert-blocks are left open on the sides and bottom, but are closely filled and pointed with mortar between the sewer and the longitudinal channels, to prevent the escape of sewage into the latter. This manner of securing drainage of the soil is not easy of successful application, and is not therefore recommended for general adoption. *Second.* To make the foundation of the sewer itself serve the purpose of a blind drain, by forming it of well-compacted broken stone of various sizes. Between the broken stone and the earth on either side a vertical layer of straw, hay, or fine brush may be placed, to prevent the choking of the drain with soil. *Third.* To make a blind drain on each side of the sewer, by filling in with broken stone, or a mixture of stone and coarse gravel, instead of ordinary soil. *Fourth.* An ordinary drain of brick, or a tile drain, on each side of the sewer foundation will answer as well as any other, and can easily be laid at less cost than a blind drain of stone. Whatever method be adopted, it should be such as will secure a thorough drainage of the soil to the level of the floor of adjoining cellars. The areas in rear of the houses may be drained by either tile, brick, or blind drains, connected by a single pipe with the house drain, and thence with the sewer.

The transverse form of sewers is a detail of capital importance, more especially if they are required to provide for an intermittent flow, as when the surface drainage passes into them in whole or in part; for in order that they may be self-cleansing the minimum velocity should never fall below 2 feet per second in large sewers, and 3 feet per second in those of 6 to 9 inches diameter, even when the volume of flow is smallest. The greater the sectional area of the stream in proportion to the wetted perimeter of the channel in which it flows, the greater will be the mean hydraulic depth, and therefore the greater the velocity. Sewers should therefore be narrow on the bottom, or invert, in order that the mean hydraulic depth for a small flow may be as great as possible. They should also be broad across the middle and upper portion, to give the requisite capacity for a large flow. A transverse section of the shape of an egg with the smallest end down secures these conditions better than any other form. A good form of such a sewer is shown by the full line in Fig. 2, in which the vertical diameter A B is equal to once and a half the transverse diameter C D, the sides being described with a radius equal to the vertical diameter, and the invert or lower arc with a radius equal to one-fourth the transverse diameter. The circular form is stronger than the egg-shaped, and where the amount of sewage is pretty nearly uniform is generally considered to be the best. Fig. 2 also illustrates the advantage of the egg-shaped over a circular sewer of equal capacity, the latter being indicated by the larger dotted circle. The volume of water flowing, as indicated by horizontal lines, is supposed to be the same in each case, yet the depth, and consequently the velocity, is very much the greatest in the egg-shaped sewer.

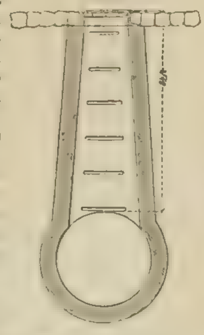
FIG. 2.



In order to afford the requisite facility for inspecting and

repairing a system of sewerage, and keeping it free from obstructions, man-holes are constructed. (See Fig. 3.) These are shafts, usually circular in horizontal section, and placed in a vertical position, constructed with brick, reaching from the street surface through the crown of the sewer. They are large enough for a man to pass through them, and are closed on the top with an iron cover of such strength and so fitted to the opening as to resist the traffic of the street without injury or displacement. They are located at every point where the sewer deviates from a straight line laterally or vertically, so that if a light be displayed in the sewer at any man-hole, a man at the next one on either side can readily see if any stoppage exists between them.

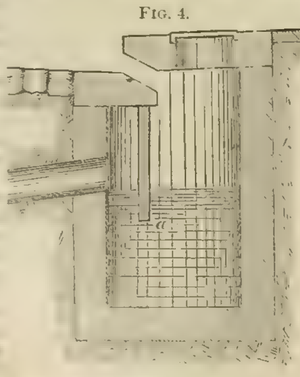
Fig. 3.



When the man-holes are used for purposes of ventilation, the covers are perforated. The practice of placing catch-basins directly underneath the man-holes, which is followed by some engineers, in order to prevent the sewer becoming obstructed by deposits, is a bad one, for they become cesspools for the constant generation of noxious gases, which are discharged into the streets when the man holes are used for ventilating flues, or find their way in a greater or less degree into the houses. There should be no dead angles and spaces in the sewers, but a constant flow of all the contents until they are discharged at the outlet; and this should take place before putrefactive fermentation can set in. In the summer the time occupied in flowing from the house to the outlet should not exceed ten to twelve hours. In a long stretch of sewer without change in direction or grade man-holes should be placed at intervals of 100 to 150 feet. A small shaft, just large enough to allow a lamp to be lowered through it, may replace some of the man-holes.

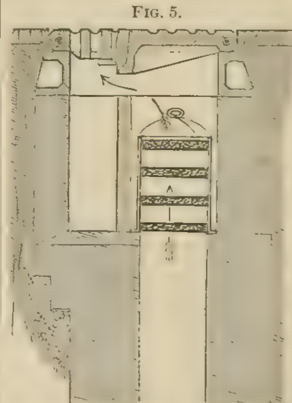
The drainage of the street first flows through openings in the curb or gutter into street-gullies, provided usually with catch-basins which retain the sand, gravel, and heavy detritus, while the water, carrying the lighter street-soil in suspension, flows into a pipe from 8 to 12 inches in diameter, which issues from the catch-basin at a point some feet above the bottom, and leads to the sewer. These catch-basins may be circular or rectangular in plan, and are placed at intervals of 150 to 200 feet apart on each side of the street. They should also be placed in valleys where descending and ascending grades meet. They should be well trapped to guard against the escape of sewer-gases into the street. As often as the basin gets filled with silt up to the mouth of the pipe, it should be removed, and an opening in the covering stone is provided for that purpose. The traps should be so designed that they will not be opened by the leaking of the catch-basin, or by the lowering of the water-level therein when the silt is removed. Many of those in common use in this country are open to these objections. One of them is shown in Fig. 4, in which, whenever the water from any cause gets below the level of the point *a*, a free passage for the gases will be opened from the sewer to the street. As a remedy for this, a siphon-trap may be placed in the gully-drain, so near to the gully that it can be readily cleaned out in the event of its becoming choked. As a security against untrapping by leakage or evaporation, the gullies and traps are sometimes made of cast iron, and frequently of earthenware.

Fig. 4.



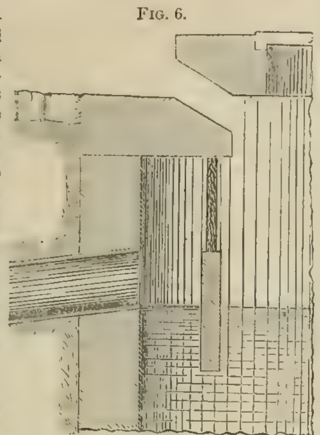
The most perfect system of street sewers will fail in performing its most important function, the protection of the health of the population, unless the sanitary requirements of house-drainage are carefully and skilfully established. House-drains should promptly convey to the sewers all the fæcal matter and liquid refuse produced by the inhabitants, and they should accomplish this in such manner that sewer-gases are effectually excluded from the houses. Glazed stoneware pipe of 5 to 6 inches bore are suitable for house-drains, and they should be laid with tight joints at an inclination that will produce a velocity not less than 3 to 4 feet per second, and provided with a good siphon-trap. Into this drain, which is placed below the level of the cellar floor, and may be carried through to the back-yard to receive its surface and sub-soil drainage, all the pipes in the house usually lead, whether from water-closets, bath-tubs, wash-bowls, or kitchen sinks. The soil-pipe may be of lead or iron of 3½ to 4 inch bore; the sink-pipes of lead 1¾ to 2 inch bore; and those from bath-tubs and wash-bowls of lead of ¾ of an inch to 1 inch bore. All these pipes should be trapped near their opening in the house. The drain-pipe, if leading into the back-yard, should terminate at a catch-basin to hold the silt, and be trapped near it. But all these traps, in the absence of other precautions, cannot be relied upon with confidence to prevent the escape of sewer-gases into the house by blowing through the traps in times of extraordinary compression of the air in the sewers, as when a high wind blows into the main sewers at their outlet, or when an obstruction occurs at any point and the sewage is banked up behind it. Increased pressure in the sewers may also result from an elevation of temperature of the sewage, and consequently of the air and gases in contact with it, produced by the warm refuse-water entering from the kitchens. Sewers discharging into tidal waters between high and low water have their outlets sealed twice a day, during which periods the sewage fills up to a higher level, causing increased and increasing compression of the gases, which continues until the tide falls and the outflow is resumed. There are therefore a variety of causes against which precautions must be taken to prevent the gases when under abnormal compression from forcing the traps and permeating the habitations of the people. In this connection it is well to remember that the sense of smell furnishes no sure evidence of the presence or absence of a dangerous gas, for some of the most pernicious gases are free from odor, while strong-smelling gases may be innocuous. The gases may be rendered harmless either by diluting or by disinfecting them. Dilution naturally ensues when sewers are ventilated through the man-holes into the street; and if we assume that the gases are homogeneously dissipated into the atmosphere, their dilution is in the ratio of the cubes of the distances from the man-hole covers, so that at the distance of 20 feet they are only one-eighth as strong as at the distance of 10 feet. In wide streets, therefore, provided with sewers in which there is a constant current and no deposits, the ventilation secured by simply closing the man-holes with perforated covers will generally suffice. In narrow streets the gas should be deprived of its hurtful properties before it is allowed to mix with the surrounding air; and when this is done by the introduction within the man-holes of an efficacious disinfecting absorbent, like wood-charcoal placed in shallow layers or pans, so arranged that it will remain dry and not choke the draught, while the gas must necessarily pass through it in its passage to the street, the result is an excellent if not, indeed, the best system of sewer ventilation yet devised. The absorbing powers of charcoal are very great. Liebig says the pores contained in a cubic inch of beech-wood charcoal are equivalent to an area of 100 superficial feet. When kept dry, and its pores are not allowed to become choked up by dust, its efficacy does not appear to diminish with continued use. Many methods of using it have been tried, but none of them appear to be entirely free from objections, the difficulties being to so interpose the charcoal as not to obstruct the natural draught too much, to keep it dry, and to prevent the escape of any gas that has not passed through the charcoal. Fig. 5 shows a man-hole fitted up with a charcoal air-filter of very simple design. The pans have perforated bottoms, are each 2½ to 3 inches deep, and will each hold 1½ to 2 pounds of the coal. The man-hole cover should fit so as to be water-tight, the purified air passing up through a catch-basin on one side covered with a grating. Holes left in the bottom of this basin will promptly carry off into the adjacent soil the small amount of water which finds its way into it. The cylinder holding the nest of pans is made of sheet metal, and is entirely open at both ends. It should fit very closely to the ledge on which it rests, so that no gas can escape upward around the outside. For a 20-inch man-hole, 5 to

Fig. 5.



6 pounds of charcoal will be sufficient. It should be renewed about once a month, and may be used again and again by being reburnt a short time at a cherry-red heat in iron retorts from which the atmospheric air is excluded. The cost of maintaining these ventilators, inclusive of labor, new charcoal, and reburning the old, should not exceed $1.50 per man-hole per year. Charcoal ventilators may be introduced into the catch-basins which receive the surface drainage in its passage to the sewer, as shown in Fig. 6.

FIG. 6.

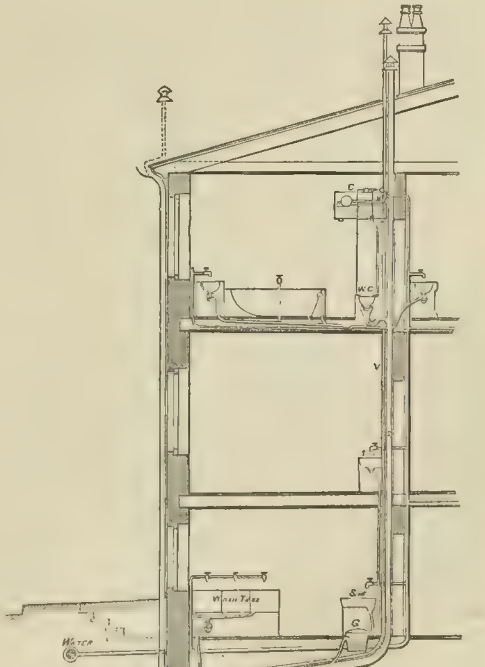


It is now an established rule that all drains and branch sewers should discharge their contents into the mains in the direction of, and with a velocity at least equal to, the current in the mains, in order to avoid a reduction of velocity and the formation of a deposit at the point of junction. Junctions should be formed with curves, and the axis of the branch ought to be approximately tangent to the axis of the main, and the rate of fall in the curve should be increased sufficiently to compensate for the increased friction in the bend. Branch pipes from street catch-basins should join below the average water-level in the sewer. House-drains should join above that level if they are expected to perform any function in sewer ventilation, as they would be effectually sealed if their opening into the sewer be habitually submerged. House-drains, however, cannot, in connection with the rain-water pipes from the roofs, perform effective service in any system of house or sewer ventilation where the public sewers receive the surface drainage; for in time of rainfall, although the drains would or might be sealed at the sewers, the sewer-gases would be compressed, and the water-pipes, already engaged in carrying down the rainfall, might be entirely inadequate to furnish an avenue of escape upward. The consequences might be, first to blow through the drain-trap, and then through all the traps in the house in succession. Moreover, if used for this purpose, the rainfall pipes would, in the ratio of their value as sewer ventilators, discharge the poisonous gases at the eaves, which might be in such dangerous proximity to the windows of sleeping-rooms as to render them unfit for occupancy. Mr. Baldwin Latham states that "at Croydon it was found that the more rigorously the system of ventilation by rain-water pipes was pursued, the more unhealthy the district became." Another danger to be guarded against is the unsealing of the traps in the house by a sudden and rapid rush of water through the pipes in the lower portion of a house, as when a simultaneous discharge into the pipes takes place from bath-tubs, water-closets, wash-bowls, and kitchen-sinks. The tendency then is to create a vacuum in the upper portions of the pipes and suck the water from the siphon-traps, leaving the sewer in free communication with the various rooms until the traps are again filled in the ordinary routine of domestic life. The remedy for this evil is to prevent the formation of the vacuum, by providing for a free ingress of air behind the down-rushing water in the pipes. This may be done by carrying the principal pipe—the soil-pipe—in its full size up through the roof, and leaving it open to the air. It should not terminate near a ventilator nor a chimney-top, nor near any of the windows of adjoining houses. When the circumstances will safely admit the escape of the gases at the eaves, the rain-water pipe may lead directly into the house drain, between the drain-trap and the house, so that gases after forcing the trap can pass into the upper air through either the rain pipe or soil-pipe. In every other case the rain-pipe should be disconnected from the house-drain, and discharge into a catch-basin at the ground-level provided with an efficient trap, from which a pipe carries the water to the house-drain. If this trap is forced by the gases, they escape at the catch-basin; and it is therefore a preliminary question whether they had better be set free at the ground or allowed to ascend the rain-pipe and make their exit at the eaves. Where there are necessarily a number of branches leading into a house-drain, the efficient ventilation of the one next the head of the drain will not always afford ventilation to the others. The head of each branch should therefore be carried up and put in direct communication with the open air. They may be drawn together, if thought best, inside the house, so as to show but one top above the roof.

When water is distributed through a house from a cistern locate l on one of the upper floors, its overflow-pipe, even if trapped in the best manner, should not, in any event, be directly connected with the house-drain, for the reason that as the overflow may be brought into use but seldom, the trap is liable to become unsealed by evaporation, and the cistern thereby placed in open communication with the sewer, or the trap may be forced by the sewer-gases in any of the cases of exceptional pressure already noted. In either event, the danger would be that the water in the cistern would become so tinctured, if not saturated, by the absorption of the poisonous constituents of the gases, as to be entirely unsuitable for domestic use. The overflow-pipe should be treated, with the difference specified below, in all respects like the rain-water pipe when the latter is not used for ventilating the sewers; that is, it should discharge in the open air, generally into a grated catch-basin at the ground-level, from which it flows through a trapped pipe to the house-drain. It may even enter and form a junction with the rain-water pipe at the nearest convenient place. The difference referred to consists in placing a trap at the cistern, intended simply to prevent wind blowing into the house through the overflow-pipe. For this purpose an ordinary siphon-trap within or just below the cistern will suffice.

One of the most difficult kinds of waste material to provide for is kitchen grease, which, so long as it is conveyed along in warm water, is fluid and flows freely. Whenever and wherever it cools, it solidifies and adheres to the object with which it happens to be in contact at that moment. Greasy water should not be allowed to reach the house-drain except through a capacious and well-trapped catch-basin, conveniently located with reference to easy and frequent cleansing. Mr. J. H. Shedd recommends a cast-iron grease-trap of the form shown at G, Fig. 7. The top may

FIG. 7.



be made to fit closely by setting it on a layer of plastic clay every time it is replaced after removal for cleaning out the basin. In houses not provided with the water-closet system all the waste liquids from bath-tubs, wash-basins, kitchen-sinks, etc. can safely be led outsi le to a ventilated and trapped catch-basin, having an outflow-pipe leading to the sewer. Sewer-gases entering this pipe will escape into the open air as soon as they reach the catch-basin, and the house will not become contaminated by them. The offensive discharges from water-closets cannot, however, be disposed of in this manner, but must be conveyed in a tight house-drain directly to the sewer. It is of vital importance, therefore, to maintain

such control over the poisonous gases which enter this drain that they cannot in any event or under any circumstances permeate the house. It is admitted that under a very slight abnormal pressure they can force their way through the house-drain trap, and reach the various traps at the several openings throughout the building. If these traps remain permanently sealed, and the soil-pipe in full size extends upward to the external air, the gases would doubtless escape in that direction. But the emptying of any one of these traps would ensure its entrance into the house: and there is no doubt that they may and do become emptied from various causes, among which are evaporation of the sealing water during prolonged disuse, and ordinary suction where there is a rush of water in large volume down the soil-pipe. I have no confidence in the efficacy of these traps, nor in any of the usual methods of preventing the escape of sewer-gases into houses, nor indeed in any method hitherto adopted or recommended, so far as I know, for attaining this end. I deem it of vital importance that no sewer-gas whatever should be allowed to enter the soil-pipe. This accomplished, it cannot, as a matter of course, come in contact with any of the inside traps or reach any avenue of escape into the house. This object can be attained by the device shown in Fig. 7, which indicates one method of so arranging the plumbing and draining of a dwelling-house as to render it absolutely secure against infection from poisonous gases. The sewer-gases in their passage up the house-drain will be arrested by the siphon-trap T, and can only force that trap under the existence of two conditions, one of which is a sufficient degree of pressure from behind, and the other the absence of an unobstructed avenue of escape. But such an avenue is purposely furnished by the ventilating pipe V, which issues from the house-drain below the trap, and passes up through the house, terminating above the roof, preferably at some distance from the end of the ventilating shaft of the soil-pipe, in order to avoid all danger that the sewer-gas, after having issued from the pipe V, will be sucked into the main shaft. The pipe V may pass through the roof at some distance from the main shaft. Indeed, it need not enter the house at all, but may discharge through an opening in the sidewalk near the curbstone, provided with a charcoal filter, or it may pass up on the outside of the house and terminate above the eaves, as shown by the dotted lines. There is no doubt that with this arrangement, the sewer-gas, having once ascended the house-drain as far as the trap T, will not exert any serious, or even appreciable, pressure on that trap, but will pass off through the ventilator V.

The proper dimensions of sewers will of course be governed by the proportion of the rainfall they are intended to carry off and the quantity of sewage produced by the population: and this last will depend to some extent on the volume of the water-supply and the methods of its consumption. When no provision except the sewers is made for carrying off the rainfall, the ratio of the total rainfall to the quantity received by the sewers will depend greatly upon the character of the surface-soil, and to some extent on the kinds of pavement used and the area of roof-surface. Very nearly all the water which falls upon the roofs, and upon streets covered with asphalt or other monolithic pavement, finds its way into the sewers within thirty minutes after its fall, while only a small portion of that received upon sandy or gravelly soil, unless the fall be excessive or is repeated at short intervals, will reach the sewers at all. In 1858 a board of distinguished experts in London stated on the subject of Metropolitan drainage that they felt "warranted in concluding as a rule of averages that one fourth of an inch of rainfall will not contribute more than one-eighth of an inch to the sewers, nor a fall of four tenths of an inch more than one-fourth of an inch." It was found that of a rainfall of $2\frac{8}{10}$ inches in 26 hours the Savoy street sewer received $64\frac{1}{2}$ per cent., the Ratcliff Highway sewer 52 per cent., and the London Bridge sewer 53 per cent. of the quantity which fell upon their respective drainage areas. The London Bridge sewer drained an area of 2.250 acres. On another occasion a rainfall of $\frac{24}{100}$ths of an inch in $1\frac{1}{2}$ hours delivered 74 per cent. to the sewers. At Croydon, where the surface soil is gravel overlying chalk, Mr. Latham found that a rainfall of $\frac{72}{100}$ths of an inch in 12 hours contributed but one-tenth of it to the sewers. Prolonged rainstorms are a greater strain upon the capacity of a sewer than those of shorter duration but of greater hourly amount: for the percentage of the fall which reaches the sewers increases with the degree of saturation of the soil. Mr. Roe found that a rainfall of $\frac{1}{2}$ an inch in 3 hours produced its greatest depth in the sewer half an hour after the fall had ceased; that this greatest depth lasted an hour and a half: and that the effect of the storm had ceased in the sewer at the end of twelve hours from its commencement. On another occasion a rainfall of $1\frac{11}{100}$ inches in 1 hour, followed by another of $\frac{33}{100}$ of an inch in the next 2 hours, produced its maximum effect in the sewer about the time the storm began to slacken, and its effect had ceased in sixteen hours. In the district of Warwickshire, where the surface is an almost impervious red marl formation, Mr. Baldwin Latham made provision for leading off by the sewers a rainfall of 1 inch in 24 hours, together with one-half the maximum quantity of sewage in 6 hours, estimated at 5 cubic feet per head every 24 hours; and he states that the sewers were by no means too large: while in the city of Dantzic, where the surface is flat and sandy, the sewers were proportioned to carry off one-fourth of an inch rainfall in 24 hours, together with 2 cubic feet of sewage per head in eight hours. Rain-water overflows were provided for excessive storms. It is generally considered safe to provide for carrying away one-half the daily sewage production in 6 hours, or two-thirds of it in 8 hours. The sewers of the city of Brooklyn are designed to carry off a rainstorm of 1 inch per hour, upon the assumption that only one-half of it would reach them within the hour. During the excessive rainstorms of the summer of 1872 it was found that the sewers became surcharged in certain localities, and some shallow storm-overflow sewers became necessary. Mr. Shedd states that "the sizes of the sewers in the city of Providence have been based on the supposition that $30\frac{1}{4}$ cubic feet per minute per acre would need to be carried away in the sewers without entirely filling them," which is equivalent to carrying off one-half of a 1-inch rainfall per hour during the time of falling.

The natural drainage-area should always be taken into account in adjusting the sizes of sewers, in order that the question whether the rain which falls upon the higher levels and flows through the district to be sewered shall go into the sewers in whole or in part, or be kept pure in natural or artificial channels, may receive intelligent consideration. It will rarely occur that this outlying rainfall can be passed through the sewers as economically as by separate channels of a more simple and less costly character. If the surface-drainage or rainfall to be passed into the sewers is restricted to that which belongs to the district embraced by them, it will generally suffice to give them such capacity and inclination that they can discharge, without running quite full bore, a rainfall of 1 inch per hour, presuming that only half that volume will reach the sewers within the hour. The ordinary house-sewage is so small a percentage of this discharge that no additional provision need be made for it. In exceptional cases, where manufactories discharge large quantities of water into the sewers, account must of course be taken of it, but ordinarily a capacity adapted to convey away the rainfall will fix the maximum dimensions. For example, take the isolated and simple case of a street 60 feet wide and half a mile long, compactly built up on both sides upon lots 25 feet wide and 100 feet deep, with a sewer in the street to carry off the rainfall and house-sewage of this area of $\frac{1}{2}$ mile $\times$ 260 feet. One-half a rainstorm of 1 inch per hour is 28,600 cubic feet, equal to 477 cubic feet per minute. If the population be estimated at 1000, or 5 persons to each house, and the daily water-supply is 100 gallons per head, one-half of which flows off as sewage in 6 hours, the sewers would receive during the time of greatest flow only 22 cubic feet per minute from this source. As this is only about $4\frac{1}{2}$ per cent. of the rainfall which they should be proportioned to carry off without running quite full bore, they may be safely trusted to carry the sewage in addition. An egg-shaped sewer of $1' 8'' \times 2' 6''$ at the lower end, running with a velocity of $2\frac{7}{10}$ feet per second, would carry off the water from both sources without running quite full.

Sewers should be laid at such an inclination that the velocity maintained in them when the volume of flow is small will be sufficient to move the heavier materials along, even should they subside to the bottom, in order to prevent obstructing the flow by the formation of deposits. Small sewers should have a greater inclination and a greater velocity than large ones, because they have a greater frictional area in proportion to the volume of flow. It has been found from observation that a velocity of 4 feet per second will prevent deposits in small sewers or drains of 4 inches to 6 inches diameter, while in those of 8 inches to 10 inches diameter a velocity of $3\frac{1}{2}$ feet per second will suffice. For diameters of 1 to 2 feet the velocity should not be less than 3 feet per second; and for larger dimensions not less than $2\frac{1}{2}$ feet. Baldwin Latham suggests 2 feet per second as the lowest admissible velocity for large sewers. Hence, several sewers set to different inclinations may be of such varying sizes that the velocity will be the same in all of them. For example, circular sewers of 1 foot, 3 feet, 6 feet, and 8 feet, diameters, running full or half full, if laid with inclinations respectively of $17\frac{1}{10}$ feet, $5\frac{8}{10}$ feet, $2\frac{9}{10}$ feet, and $2\frac{2}{10}$ feet per mile will

run with the same velocity, the rule being that *for equal velocities the lengths corresponding to a fall of 1 foot vary directly as the diameters of the sewers.*

TABLE I.—*Inclinations and Corresponding Velocities for Circular Sewers 1 foot in diameter, running full or half full, $h = v$.*

Velocity in feet per second.	Inclination.	Velocity in feet per second.	Inclination.
2	1 in 583	$4\frac{1}{2}$	1 in 127
$2\frac{1}{2}$	" 386	5	" 103
3	" 275	$5\frac{1}{2}$	" 86
$3\frac{1}{2}$	" 205	6	" 72
4	" 159		

From the foregoing table for 1-foot sewers the inclination of any circular sewer running full or half full can be ascertained by the rule that for equal velocities the lengths corresponding to a descent of 1 foot vary directly as the diameters of the sewers. For example, a 6-inch sewer running full or half full must have a descent of 1 foot in $291\frac{1}{2}$ ($583 \div 2$) in order to run with a velocity of 2 feet per second, while a 4-foot sewer with a descent of 1 foot in 2332 feet (583×4) will maintain the same velocity. The inclination and velocity obtained by the foregoing table and rule are applicable to a length of sewer of which $h = v$—that is, in which the total fall in feet is equal to the velocity per second in feet. To find this length, multiply the length for a descent of 1 foot by the total descent—*i. e.* by the velocity. For example, the 6-inch sewer, with a descent of 1 foot in $291\frac{1}{2}$ feet ($583 \div 2$), in order to run with a velocity of 2 feet per second, should have a total length of 583 ($291\frac{1}{2} \times 2$). A 4-foot sewer, to run with a velocity of 6 feet per second, should have an inclination of 1 foot in 288 (72×4), and should be 1728 feet long (288×6). When the total fall in feet of a given length of sewer to be constructed is either less or greater than the velocity in feet per second, a correction in inclination is necessary. This correction can be made by using the following formula, which is applicable to all lengths of sewer, from which may be deduced the value of either one of the four quantities h, l, d, or v, when the other three are known:

$$h = \left(1 + e + c\frac{l}{d}\right)\frac{v^2}{2g}, \qquad (1)$$

in which h = head of water or total fall in feet;
l = length of pipe in feet;
d = diameter of pipe in feet;
v = velocity in feet per second;
c = coefficient of friction in pipe;
e = coefficient of resistance for entrance of water into pipe.

The value of e is generally averaged at 0.505, but it may be reduced to 0.08 by rounding off the edges of the inlet. The coefficient of friction c is not quite constant, but varies slightly with v. It may be calculated for each velocity by the formula

$$c = .01439 + \frac{.016921}{\sqrt{v}}. \qquad (2)$$

For example, What should be the length of a circular sewer of which the total fall from source to outlet is 10 feet, diameter 4 feet, and velocity per second 2 feet? In this case $c = 0.0263$, and the equation becomes

$$10 = \left(1 + .505 + .0263\frac{l}{4}\right)\frac{4}{64.38};$$

from which $l = 21250$. The inclination therefore is 10 in 21250, equal to 1 in 2125. Similarly, by assuming the length, total fall, and velocity, the equation would give the diameter of the sewer.

Although it is the velocity on the bottom which is effective in keeping a sewer clear of deposits, v in the foregoing discussion represents the mean velocity. Prony's formula for mean velocity is

$$v = V\frac{V + 7.776}{V + 10.335},$$

in which v = mean velocity, and V = surface velocity. The mean velocity is a mean proportional between the velocity at the surface and the velocity at the bottom. For practical use it may be assumed that the mean velocity is equal to four-fifths the superficial velocity. The sectional area of the stream divided by the wetted perimeter or rubbing surface is called the mean hydraulic depth. The discharge of a sewer in cubic feet per second is equal to the transverse section of the stream in feet multiplied by the velocity in feet per second.

The foregoing discussion applies to circular sewers of any size, running full or half full, with any total fall from source to outlet, and with any velocity. When the velocity does not exceed 6 feet per second, and the total fall in feet equals the velocity, the inclination is calculated directly from Table I. by the rule there given. For greater velocities, and for cases where $v \gtrless h$, recourse can be had to formulas (1) and (2):

TABLE II.—*Inclinations and Corresponding Velocities for Egg-shaped Sewers 1.0′ × 1′ 6″, running full, $h = v$. (The proportions of the Sewer are those shown in Fig. 2.)*

Velocity in feet per second.	Inclination.	Velocity in feet per second.	Inclination.
2	1 in 676	$4\frac{1}{2}$	1 in 147
$2\frac{1}{2}$	" 448	5	" 120
3	" 318	$5\frac{1}{2}$	" 100
$3\frac{1}{2}$	" 238	6	" 84
4	" 185		

From the foregoing table the inclination of any sized egg-shaped sewer, and of the same proportions, running full, may be deduced from the rule that for equal velocities the lengths corresponding to a descent of 1 foot vary directly as the transverse diameters of the sewers. *Example.*—A 2-foot × 3-foot sewer running 3 feet per second should have an inclination of 1 in 636 (318×2), and the length of sewer to which this calculation applies is that corresponding to a height of 3 feet ($h = v$). The total length is therefore $3 \times 636 = 1908$ feet.

TABLE III.—*Inclinations and Corresponding Velocities of Egg-shaped Sewers 1.0′ × 1′ 6″, running two-thirds full, $h = v$.*

Velocity in feet per second.	Inclination.	Velocity in feet per second.	Inclination.
2	1 in 737	$4\frac{1}{2}$	1 in 160
$2\frac{1}{2}$	" 488	5	" 131
3	" 347	$5\frac{1}{2}$	" 108
$3\frac{1}{2}$	" 259	6	" 91
4	" 201		

From the foregoing table the inclination of any sized egg-shaped sewer of the same proportions running two-thirds full may be deduced in the manner already described. Thus, a 4′ × 6′ sewer running 3 feet per second should have an inclination of 1 in 1388 (347×4), and the length of sewer to which the calculation is applicable corresponds to a height of 3 feet. This length is therefore $3 \times 1388 = 4164$ feet.

TABLE IV.—*Inclinations and Corresponding Velocities of Egg-shaped Sewers 1.0′ × 1′ 6″, running one-third full, $h = v$.*

Velocity in feet per second.	Inclination.	Velocity in feet per second.	Inclination.
2	1 in 482	4	1 in 132
$2\frac{1}{2}$	" 319	$4\frac{1}{2}$	" 105
3	" 227	5	" 85
$3\frac{1}{2}$	" 170	6	" 60

The inclination of any sized egg-shaped sewer of the same proportions, running one-third full, may be deduced from the above table in the manner before described. *Example.*—An egg shaped sewer 3′0 x 4′6 inches, running with a velocity of 3 feet per second, must have an inclination of 1 in 681 (227×3), and this velocity and inclination apply to a length of 2043 feet (681×3).

Tables II., III., and IV. afford the means of calculating the inclination of egg-shaped sewers of any size, provided they have the proportions shown in Fig. 2, for velocities up to 6 feet per second, and for lengths in which the fall in feet equals the velocity in feet per second. When the total fall in feet from source to outlet differs from the velocity in feet per second, we may use, as in the case of circular sewers, the equation

$$h = \left(1 + e + c\frac{l}{d}\right)\frac{v^2}{2g}, \qquad (1)$$

in which d represents the diameter of a circular sewer having the same inclination, velocity, and mean hydraulic depth as what may be termed the corresponding egg-shaped sewer. The mean hydraulic depth of egg-shaped sewers of the form under discussion (Fig. 2) is found by multiplying the transverse diameter by 0.2897 when running full, by 0.3157 when running two-thirds full, and by 0.2066 when running one-third full. The mean hydraulic depth of a circular sewer when running either full or half full is one-fourth of the diameter. If t = transverse diameter of the egg-shaped sewer, we have for corresponding or equivalent sewers—

when running full, $\frac{d}{4} = t \times 0.2897$;

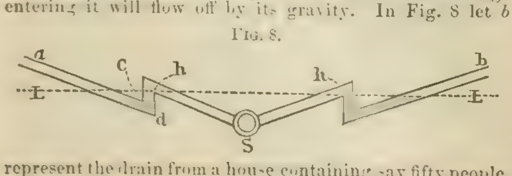
when running two-thirds full, $\frac{d}{4} = t \times 0.3157$; and

when running one-third full, $\frac{d}{4} = t \times 0.2066.$

Hence the diameter of a circular sewer is equal to four times the mean hydraulic depth of the corresponding egg-shaped sewer; and by substituting in Eq. (1) the value of d thus obtained, we shall obtain the value of either one of quantities h, l, or v, knowing the other two. *Example.*—What is the proper inclination of an egg-shaped sewer 3.0 × 4 feet 6 inches, running full, with a velocity of 2 feet per second, the total fall being 2 feet? In this case $d = 4 \times 3 \times 0.2897 = 3.4764$ feet, and as $v = h$, we have only to go to the rule under Table I. and multiply the length for a fall of 1 foot by 3.4764, to get the length for the same descent in the given sewer. Answer, 583 × 3.4764 = 2028, or 1 in 2028, applicable to a length of 4056 feet (2028 × 2). *Example.*—What is the proper inclination for an egg-shaped sewer 4 feet × 6 feet, running two thirds full, with a velocity of 3 feet per second and a total fall from source to outlet of 6 feet? $d = 4 \times 4 \times 0.3157 = 5.0512$, which, substituted in Eq. (1) with $c = 0.0242$, gives the total length, $l = 8640$ feet in a fall of 6 feet, or 1 in 1440. *Example.*—What is the proper inclination of an egg-shaped sewer 2 feet 6 inches × 3 feet 9 inches, running one third full, with a velocity of 4 feet per second, and a total fall from source to outlet of 2 feet? $d = 4 \times 2.5 \times 0.2066 = 2.066$, which, put in Eq. (1) with $c = 0.0229$, gives for total length, $l = 589.57$ feet, or 1 in 294.78.

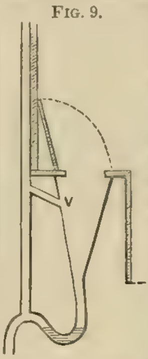
The Pneumatic System.—In all the foregoing discussion the faecal and other waste and refuse matter produced by the inhabitants of a district or town is supposed to be carried away through the agency of the liquid portions thereof, moving under the laws governing the flow of water. This method of carrying off sewage is known as the water-carriage system. In Amsterdam, Leyden, and some other towns in Holland the movement of atmospheric air has been applied to secure the same results, according to a method devised by Capt. Liernur, civil and military engineer, and generally designated the "pneumatic system." Its efficacy has not yet been thoroughly tested, and some of its important and essential details are still confined to the field of experimental research, but its merits have been set forth in such a positive manner, and by advocates of such acknowledged ability and experience, as to entitle it to some notice. In order to understand the principle of this system, suppose that an air-tight iron tank or reservoir occupies some central point of a town or district. From this tank an air-tight main issues, having branches through the several streets to different points in the district. These branches in turn branch off into the several house-drains, and these latter are connected respectively with the soil-pipes of the houses, the latter being open to the external air at their upper end above the highest closet. If the air be pumped out of the central tank, creating a vacuum therein more or less complete, there will ensue a downward rush of air in each and all the houses, and thence through the branches and main into the tank, carrying with it, under a suitable arrangement of the details, all the refuse matter which finds its way into the soil-pipes and house-drains. In this manner the tank may be filled with sewage. It is emptied by a similar process. A pipe with one end inside the tank, and reaching to the bottom, has its other end connected with an air-tight receiver, which may be a portable tank on wheels for carrying the sewage away. When this receiver is exhausted of air by the use of the air-pump, the sewage flows up into and fills it from the main tank. A single stopcock, near the tank, in the main sets the system to work. When this is opened, the pneumatic power of the vacuum in the tank begins to act, and a downward rush of air in the houses, branches, and main sets in with a more or less sudden shock, which puts the sewage in motion. In order to adapt this system to districts where there are differences of level, and therefore different rates of inclination in the branches, and also where the volumes of sewage supplied by the several house-drains vary within wide limits, a water-trap or vertical step is made in each house-drain, something like an ordinary siphon-trap. When this trap is full, all additional sewage entering it will flow off by its gravity. In Fig. 8 let b

Fig. 8.



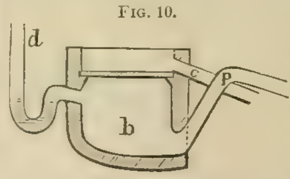
represent the drain from a house containing say fifty people, and a that from a small residence in which only two or three persons live, both in communication through their respective traps with the sewer s; also suppose that the drain b carries enough sewage into the trap to fill it up to the level L L in an hour, and that the flow in a requires twenty-four hours to fill its trap to the point of overflow. After the first hour the sewage in b will flow directly into the sewer s and toward the central tank by its own weight, while in a it will remain in the angle d for a whole day. Suppose, after it has risen above the sealing angle c, that the pneumatic power is applied by opening the stopcock in the main. The liquid at d will rise up some distance toward the overflow angle h under the effect of atmospheric pressure in the drain a, while in b it will begin to flow at once over the ledge and toward the central tank. If the vertical steps in the two drains are of the same height (say one foot), the flow over the ledge in the drain a will not begin until the liquid in b is so much reduced by its flow that were the pressure to be removed by closing the cock it would assume the same height in the two traps. A condition of equality of barometric resistance would then be established, and the two drains will flow simultaneously on a reproduction of the vacuum. It is claimed that by this device of traps or steps the pneumatic power, applied by means of the vacuum in the central tank, operates equally and simultaneously upon all the house-drains in a single district, causing an immediate flow wherever the traps are full, and at a later period in those where the level of the sewage is between the sealing angle and the overflow angle. In the houses the closets on the different floors should, for convenience and economy, be placed as nearly as possible over one another, in order that the faecal and liquid refuse may reach the house-drain through a single soil-pipe. Each closet-pan is provided below with a siphon-trap, as shown in Fig. 9, and the soil-pipe is carried up through the roof from a point outside the siphon of the highest closet. The pan is also ventilated into this main shaft, as seen at V in Fig. 9. The closet room should preferably be next to an exterior wall, and be provided with a window or otherwise ventilated. The soil-pipes, house-drains, and street-sewers in the works constructed under Capt. Liernur's supervision are all of cast iron, 5 inches in diameter, with the joints calked in the manner usually adopted with gas-pipes.

Fig. 9.



This method of sewerage necessitates a separate system of drains for carrying away the surface and subsoil waters, and into this supplemental system all the refuse waters of the houses flowing from kitchens, bath-tubs, wash-basins, etc. are conveyed. These latter pass through a siphon-trapped pipe into a catch-basin having an overflow near the top for conveying off the liquids to the water-drain pipes, while the more solid matter which has a manurial value sinks to the bottom and is conveyed by another pipe to the pneumatic sewer. This will be understood by a reference to Fig. 10, where the drain d carries the house-sullage through a trap into the basin b. The fluid portions pass off through the pipe c to the water-drains, the solid portions being kept back by a screen placed just below the upper outlet-pipe. From the bottom of the basin the pipe p connects with the pneumatic sewer. It has a sudden rise near the basin of, say, one foot, designed to place it under the same barometric resistance with the sewage house-drains. When the vacuum-power is applied, the basin b is emptied of its contents in the same manner as the other parts of the system.

Fig. 10.



During the construction of the works, and before the street-tanks in the several sub-districts are brought into connection with the main reservoirs at the central pumping-station, the tanks are emptied by means of a portable steam-engine and air-pump, accompanied by a portable iron tank or tender. By attaching the pump to the top opening of the street-tank the latter is exhausted of air to about a three-quarter vacuum. The stop-cocks in the mains are then opened, and the sewage of the district flows into the tank, which is then closed. The portable iron tank is next exhausted of its air, and closed, and then connected by its supply-pipe with a pipe reaching to the bottom of the street tank. Air is then admitted at the top of the street tank, and the valves of the portable tank opened, when the contents of the former are forced or sucked into the latter, to be transported away. The portable engine and tender-tank are dispensed with as soon as the sub-district or street tanks are placed in communication with the great central reservoir or reservoirs, which, whether one or more in number, are capacious enough to receive the

contents of the tanks in all the surrounding districts. The sewage is transferred from the small tanks to the central reservoir by the same process of pneumatic pressure already explained. It is then treated by a poudrette apparatus, and converted into a fertilizer by a process which it is deemed unnecessary to describe in this article. It generally requires thirty-six hours for the sewage to pass from the houses to the central reservoir, undergo the necessary treatment, inclusive of desiccation, and be packed up and made ready for sale and shipment. Mr. Adam Scott in describing this system says: "The air-pump is set in motion, and maintains during the day a three-quarter vacuum in certain central reservoirs placed below the floor of the building, and at the same time in the central pipes. Workmen perambulate the town, visiting each tank once a day. To drain the houses commanded by one tank, they alternately open the connecting cock of the central pipe and the stopcock of any main pipe; the first to obtain a vacuum in the tank, the second to utilize this by emptying the closet-pipes connected with that particular main. After all the mains of the tank in question have been operated upon, and their contents collected in the tank, the workman turns the discharging cock to send the whole mass to the central building for immediate conversion into poudrette. He then proceeds to the next tank, there to repeat the operation."

There is no doubt that the pneumatic process has a strong prejudice to overcome in communities long accustomed to the visible cleanliness of the water-closet system, but it certainly possesses this advantage, that it prevents the escape of sewer-gases into the houses, for during those intervals when the vacuum-power is not in operation the gases are hermetically enclosed and free from pressure in the mains and branches, and at other times flow away from the houses toward the central reservoir. The total cost of the Amsterdam works, for engineering, plant, machinery, royalties, and the requisite alterations in the houses, is stated to have been a little under £2 10*s.* per inhabitant. Mr. Scott estimates that in an English town with a population of 18,750, covering an area of 250 acres, the cost should for safety be placed at £4 per inhabitant, with a total working expense per annum of £5430, and a yearly credit from the sale of poudrette of £9375, leaving nearly £4000 annually as clear profit after deducting every charge.

The disposal of the sewage of large communities, where it cannot be safely passed into the natural water-courses, is admitted by all who have given any intelligent thought to the subject to be a most serious and vexatious question. In England large sums of money have been expended in more or less fruitless attempts at its solution. All the schemes have attached more or less manurial value to the sewage, upon which their success was predicated. After years of effort the conclusion seems to be that any method by which the sewage of large towns can be harmlessly got rid of is preferable to the best-known devices for utilizing it for fertilizing purposes. In small towns the difficulty is encountered in less unmanageable proportions, and examples are cited where the system of irrigation, as well as that of downward filtration through the soil, has been successfully applied. Artificial purification by chemicals has also been successful in some instances. The limits assigned to this article will not admit of any discussion of this branch of the sewerage question. (For further information see Baldwin Latham's *Sanitary Engineering*; George E. Waring on *The Sanitary Drainage of Houses and Towns*; William Eassie on *Healthy Houses*; J. H. Shedd's *Report on the Sewerage of Providence City*.) Q. A. GILLMORE.

Sewers and Drains. See SEWER, by GEN. Q. A. GILLMORE.

Sew′ickley, p.-b. and tp., Allegheny co., Pa., on Ohio River and Pittsburg Fort Wayne and Chicago R. R. P. of b. 1472; of tp. 443.

Sewickley, tp., Westmoreland co., Pa. P. 2372.

Sew′ing-Machines. The sewing-machine is one of the mechanical triumphs of the nineteenth century, and in its practical application to manufacturing and household purposes belongs to the last half of that century. Yet the idea of attempting by a machine to relieve woman from the "drudgery of the needle" had suggested itself to more than one of the inventors and mechanics of the eighteenth century. The first sewing-machine of whose patenting there is any record was intended rather for embroidering than plain sewing. It was patented in 1755, and had a needle with two points, and an eye at mid-length. This form of needle was called for many years a tambour-needle. In 1790, Thomas Saint invented in England a sewing-machine for "quilting, stitching, and sewing, making shoes and other articles by means of tools and machines." This machine was made mostly of wood; it had an overhanging arm, a needle-bar or needle-carrier, into which was fastened by set screws not only a vertically reciprocating straight needle, with a notch at its lower end, but a straight awl also to make the holes through which the thread was to pass. On the top of this needle-bar was a thread-spool, giving out its thread continuously; it had also an intermittent automatic feed between the stitches, and thread-tighteners above and below. It made the chain or tambour stitch—*i. e.* a loop being first made by thrusting the eye-pointed needle, armed with a thread, through the material to be sewed, the second thrust of the needle carried the bight of the thread through this loop, forming in its turn another loop through which the next thrust of the needle carried the bight of the thread to form still another loop, while the first loop was drawn up close by the descending needle. This *tambour stitch* is in use in several machines at the present day. The next machine in the order of time was Duncan's, also English, and patented in 1804. It made the tambour stitch, using for the purpose a number of hooked needles to catch the loop. About this time, and perhaps earlier, several machines were patented making the *running stitch*, usually by crimping or fluted rollers, which crimped or plaited the cloth, and then forced the needle through it horizontally. These used needlefuls of thread, and were not fed from a spool giving out its thread continuously. The next machine was an American invention, and, though not patented, was a decided advance on those which had preceded it. In 1818, Rev. John Adams Dodge of Monkton, Vt., invented and (with the assistance of John Knowles, an ingenious mechanic of the same town) constructed a sewing-machine which made the *back stitch* and sewed a perfect seam. Mr. Dodge was deterred from continuing the manufacture of the machine, and from endeavoring to introduce it to the public or securing letters patent for it, by two causes: first, the exigencies of his professional duties as pastor of two and sometimes three churches, which left him no time for other pursuits; and second, by the bitter opposition of the journeymen tailors, who denounced the machine as an invasion of their rights. There exists, however, ample evidence that it was a machine capable of doing good and practical work. Lye's machine, patented in the U. S. in 1826, exists only in name. The patent-records of that year are burned, and it is not known what were its claims or what stitch it made. The next machine was invented in France, and patented there in 1830, and, after some modifications, in the U. S. in 1850. The inventor was Barthélemy Thimonnier, and his machine is worthy of notice as having been the first, except Saint's, which came into practical use. It made the chain or tambour stitch, but of such strength that it was used near the close of Charles X.'s reign, early in 1830, for manufacturing army clothing. Eighty of these machines, made of wood, were destroyed by a mob, on the plea that they were depriving the journeymen tailors of their daily bread. Thimonnier himself escaped with his life, and again set to work. In a few years he had other machines ready, made of metal, but again they were destroyed by a mob. He died in poverty in 1857. This machine was driven by a treadle and cord. It made the chain stitch, with the successive loops on the upper surface of the cloth. It had the overhang arm, the flat cloth-plate, the vertical post, vertically reciprocated needle, the continuous thread, and a nipple sleeved upon the stem of the needle acted as a presser-foot. Between 1832 and 1834, Walter Hunt, an ingenious and highly-educated mechanic of New York City, invented, manufactured, and sold a number of sewing-machines, which were operated successfully by several persons. These machines had a curved eye-pointed needle at the end of a vibrating arm, used two threads, the lower being on a bobbin and enclosed in a shuttle, and made the *lock stitch*—*i. e.* a stitch in which the two threads, that from the needle and that from the shuttle, interlock by a single turn or twist as nearly as may be in the centre of the goods or fabric which is being sewn. Like many other inventors, he was improvident, and neglected to patent his inventions. In 1834 a Mr. G. A. Arrowsmith, who had seen these machines working, and who desired to introduce them into the market, purchased of Walter Hunt for a small sum two or three of the machines and the right to procure a patent and manufacture them. While the application for a patent was pending Mr. Arrowsmith became involved in pecuniary disaster, and was unable to perfect his patent. Mr. Hunt, about 1852, repurchased his invention from Arrowsmith, and applied for a patent. The commissioner of patents decided that he had made a good working machine, but held that he had forfeited his right to a patent by his neglect and the sale of his invention. In 1841, Newton & Archbold patented the eye-pointed needle in England, though it had been used certainly for eight, and possibly for more than twenty, years in this country. In 1842, J. J. Greenough patented a sewing-machine intended for leather and other heavy work. This machine had the double-pointed needle, with the eye in the

centre; the needle was preceded by an awl, which made the hole through which the needle passed, and the needle was passed through and through the material, being drawn through by pincers acting automatically on either side. It made at the option of the operator either the *back stitch* or the *shoemaker's stitch*, which went continuously forward. The needle used lengths of thread, and required refilling often. The feed was automatic and regulated by the length of stitch required, and was continuous for the length of the rack bar of the machine, when it had to be set back. The machine was very little used. The next year (1843) the Corliss machine was invented; its general character was similar to that of Greenough's, but it used two eye-pointed needles, which reciprocated in horizontal paths through holes previously made by awls in the material fastened between clamps and fed in front of the needles. The feed was automatic, the length of the holding-clamps. The motions were derived from peculiarly-shaped cams on a revolving shaft. Except Bean's, and possibly one or two other small machines making the running stitch, there is no other machine on record as patented until 1846, when a patent was issued to Elias Howe, Jr. Howe was but an indifferent mechanic—his inventive genius was far inferior to that of Walter Hunt or Thimonnier, or many other inventors who have done much toward perfecting the sewing-machine—but he possessed great persistence and determination; and though at first the outlook was gloomy in the extreme, yet in the end fortune favored him even beyond his deserts. He first attempted to solve the problem of making a practical sewing-machine in 1843; in 1844 he claimed to have devised the eye-pointed needle and interlocking shuttle, and in May, 1845, had a machine which worked fitfully and intermittently. In Sept., 1846, he obtained his patent. As we have seen, the curved eye-pointed needle, in combination with the shuttle, had been used by Hunt eleven or twelve years before. The eye-pointed needle had been patented in England in 1841.

The original Howe machine is thus described by Dr. E. H. Knight in the *American Mechanical Dictionary*: "It had a curved eye-pointed needle attached to the end of a vibrating lever and carrying the upper thread. The shuttle carrying the lower thread between the needle and the upper thread was driven in its race by means of two strikers carried on the ends of vibrating arms worked by two cams. The cloth was suspended by pins from the edge of a thin steel rib called a baster-plate, which had holes engaged by the teeth of a small intermittingly moving pinion. This was the feed." When the machine was patented it was found to be impossible to sell it. The tailors and seamstresses all opposed it, and the few who were willing to try it found it impossible to make it work satisfactorily. Aside from the defects resulting from imperfect mechanism and badly-adjusted parts, there seems to have been some inherent difficulty in Howe's original plans for a sewing-machine. Several parties who took out licenses from him and attempted to make sewing-machines under his patent and models, though they were greatly his superiors in mechanical ability and genius, found themselves unable to make machines of any practical value. Among other difficulties, two seemed insuperable: the baster-plate did not answer any good purpose as a *feed*, and the vertical suspension of the material was both awkward and objectionable; the *tension* was not regulated, so that the machine would skip stitches, make large loops at some places, and draw the thread too tightly at others. Several eminent machinists undertook in 1848, 1849, and 1850 to produce sewing-machines which might be of more practical value. Messrs. Blodgett & Lerow made a machine which was used to a moderate extent in the manufacture of clothing, but it retained Howe's baster-plate and was otherwise imperfect; Messrs. Morey & Johnson and John Bachelder produced single thread machines making the loop or *chain stitch*, and having new devices both for feed and tension. Bachelder's feed had a rotating-pin surface moving about a horizontal axis and carrying the material over a horizontal cloth-supporting surface. Johnson's needle-feed possessed considerable merit, and has been lately revived with some modifications. These machines were the first which attempted the *chain* or *loop stitch* in this country. In 1849, Mr. Allen B. Wilson, now the Wilson of the Wheeler & Wilson Manufacturing Co., made, and in 1850 patented, a sewing-machine with a vibrating shuttle, and containing the germ of his two-motioned feed (afterward improved and repatented as the four-motioned feed); this had a considerable sale, and was greatly superior to the Howe machine; but it did not satisfy the inventor, and was eventually abandoned. In Sept., 1850, Isaac M. Singer, an ingenious mechanic of New York City, who had interested himself in the sewing-machine experiments, and was familiar with Blodgett & Lerow's machine, made a contract to invent an improved sewing-machine and have it built for forty dollars. He accomplished this for the specified price within twelve days. His machine was found to be a practical working machine. This machine was the first which had the rigid overhanging arm to hold the vertical needle, in combination with a shuttle, and the double-acting treadle, also Mr. Singer's invention, but which he did not patent, and was the first which had proved satisfactory to manufacturers. A patent was applied for at once, but was not issued until Aug. 12, 1851. The wheel-feed was one of Mr. Singer's improvements in this patent. At about the same time Mr. William O. Grover, afterward of the firm of Grover & Baker, a skilful mechanic of Boston, was attempting the solution of the sewing-machine problem in another direction. On Feb. 11, 1851, Messrs. Grover & Baker patented a sewing-machine making what has since been known as the *double-loop* (or Grover & Baker) stitch by means of a circular under-needle reciprocating with a curved eye-pointed needle above, and doing away with the shuttle entirely. This machine was subsequently improved by a feed device invented by Mr. Grover, substantially similar to Mr. Wilson's (the four-motioned feed), Mr. Grover having at the time no knowledge of Mr. Wilson's invention; the difficulties growing out of this were compromised between the two parties. These machines were very popular, and from 1854 to 1858 took the lead of all others.

We have already spoken of Mr. Wilson's shuttle-machine, and of his dissatisfaction with it. Mr. Wilson, however, possessed what Howe lacked—a high order of inventive genius, as well as the quality of persistence which characterized Howe. He had set himself resolutely to work to produce a machine which would give satisfaction. The result was the invention and patenting (Aug. 12, 1851) of the rotating or revolving hook, which carried within its concavity a double-convex circular bobbin, and a concave ring which held it in place. This hook caught the loop from the descending eye-pointed needle, which was slightly curved, and passed it around the bobbin, thus dispensing with the shuttle. Subsequently, Mr. Wilson perfected the four-motioned feed and various other devices tending to perfect his machine. Thus, these three machines, which for many years led the market (as two of them yet do), started nearly abreast of each other in the race. The Grover & Baker machine was the first patented, but the Singer machine had been most largely manufactured after its patent was applied for, and from 1852 to 1854 made the largest sales. From 1854 to 1858 the Grover & Baker took the lead; from 1858 to 1868, the Wheeler & Wilson; and from 1868 to 1876 the Singer again took the first place in the amount of its sales. For the first five years all of these companies were greatly annoyed and embarrassed by Howe's claims. His patent had been so skilfully drawn as to include the forming of a seam by means of a curved needle and shuttle under a combination of parts and arrangement substantially the same with that described. Under this claim, which arose from the fatal *laches* of Hunt in neglecting to secure a patent for the same combination, he held several points essential to the construction of a successful sewing-machine; and, though he had never constructed one which would work, he demanded from all the manufacturers a royalty of $25 for every machine made. The demand was resisted, but one of the courts having sustained his claim, he enforced it until 1853. After long negotiations an arrangement known as the "Albany agreement" was entered into by Elias Howe, the Singer Manufacturing Co., the Wheeler & Wilson Manufacturing Co., and the Grover & Baker Manufacturing Co., by which the three parties agreed to pay a royalty of $5 to Howe on each machine manufactured by themselves, except those exported, and to exact $15 of those under license from them.* From this royalty a litigation fund of $10,000 was to be accumulated, and the remainder divided between Howe and the three companies, the licensing company receiving the larger share. This arrangement was continued till 1860 (Mr. Howe's patent having been extended for seven years in 1860). Howe applied for a second extension in 1867, although he acknowledged that he had received between $1,000,000 and $2,000,000 for his invention; but his application was denied. Under the extension Howe received but $1 on each machine, and the licensees paid $7, divided as before. For some years but few new machines were invented: the Weed (1854, and subsequently improved in 1868), the Parham (also in 1854), the Finkle & Lyon (the same year), and the Florence (1855), were the principal new-comers. These were all shuttle machines. Mr. Singer, Mr. Wilson, and Mr. Grover were all intensely active during the years 1851–60 experimenting in every direction to perfect their machines. Mr. Singer in particular seems to have gone

* This royalty of $15 included the permission to use specified patents taken out by these companies, such as the feed, form of the needle and of the shuttle, etc., as well as the fee to Mr. Howe.

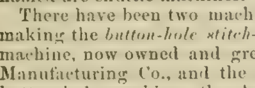
through the entire range of devices which were capable of being applied to the purpose of machine-sewing—reciprocating, vibrating, and rotating shuttles, and various forms of these, latch-takers for chain-stitch machine, feeds of all kinds, tension devices, sewing-machine attachments of all sorts, etc.

In June, 1857, Mr. James E. A. Gibbs of Millpoint, Va., took out his first patent for a machine with a rotating hook, to be used with a single thread, and making the *twisted-loop stitch*, a variety of the chain or tambour stitch which possesses much merit. This, with some additions of other devices by Mr. James Willcox of Philadelphia, and his son, Mr. Charles H. Willcox, became the Willcox & Gibbs sewing-machine, the most popular and approved of the single-thread machines. The Empire (since, we believe, consolidated with the Remington) was put upon the market about 1858, and the Slote or Elliptic, a machine having a hook with elliptic motion, involving the Wheeler & Wilson patent, and subsequently owned by them. The two Howe machines (the Elias Howe and the Amasa B. Howe) came in about the same time, and the American Button-hole and Sewing Machine Co., the Ætna, and the original Domestic under Mack's patents, between 1860 and 1864. The last five were all shuttle machines. The Beckwith machines, driven by hand or by treadle, but without stand, and one making the loop or chain stitch, and the other the double loop or Grover & Baker stitch, were first patented in 1865, and have since been considerably improved. They have a peculiar feed invented by Mr. Beckwith, and combining a smooth plate with a vibrating needle-bar. At the expiration of Howe's patent in 1867 a large number of new machines were put upon the market, but few of them now survive. The Victor (the successor, with considerable improvements, of the Finkle & Lyon machine), the Remington (consolidated with the Empire), and which, as now made, is a popular machine, are the most prominent of the new-comers. The Domestic, with its successive improvements and its easy motion, has also greatly increased its sales. The Davis machine, the Secor, Blees, and J. E. Braunsdorff's (the old Ætna revived) have been the most conspicuous of the minor machines. All of those last named are shuttle machines.

There have been two machines and two attachments for making the *button-hole stitch*—viz. the Union button-hole machine, now owned and greatly improved by the Singer Manufacturing Co., and the House or Wheeler & Wilson button-hole machine; the American button-hole and the Wheeler & Wilson button-hole attachments. As these machines are only used by manufacturers of clothing and leather goods, and from their construction are necessarily costly, the only machine now in use to any extent is the Singer Manufacturing Co.'s, which makes a very perfect and strong button-hole. The attachments are mostly employed on white goods, ladies' dresses, etc., and are in considerable demand. They do not make the circular eye of the button-hole, but have a provision for staying it at the ends, and are also useful in making the button-hole stitch used instead of a binding upon shoes and upon the scalloped edges of cloaks, dresses, etc. In all, about 2000 patents have been issued since 1846 on sewing-machines and their different parts and sewing machine attachments.

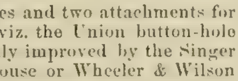
In looking back at this history of the sewing-machine enterprise, it will be seen that the best classification of sewing-machines is by the kind of stitch produced, the only machines now operated making one or other of the following stitches: the *running stitch*, now nearly abandoned; the *lock stitch*, used by not less than four-fifths of all the machines made; the *Grover & Baker or double-loop stitch*; the *twisted-loop or Willcox & Gibbs stitch*, and its congener, the *chain or loop stitch*; and, for a special purpose, the *button-hole stitch*. We give these in their order of development in this country. The *back stitch*, formerly made by the Dodge, the Greenough, and the Corliss machines, is not now made on any machine in operation. The *over-and-over stitch* is only produced on a machine used for sewing carpets by A. T. Stewart & Co. The *running stitch*, or its congener, a stitch made with a spiral eye-pointed needle and holding the thread in a groove of the spiral, is only used in sewing bags by Garland's spiral-needle sewing-machine.

FIG. 1.



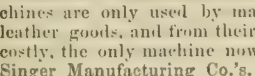
The Lock stitch.

FIG. 2.



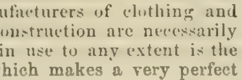
Grover & Baker stitch.

FIG. 3.



Twisted Loop stitch.

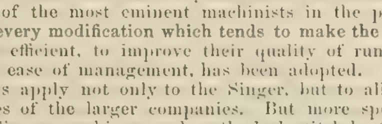
FIG. 4.



Button-hole stitch.

There remain, then (I.), the LOCK-STITCH MACHINES, which are properly divided into two sub-classes—those making the lock stitch by means of a shuttle, and those effecting the same result by a rotating or revolving hook. The first of these sub classes is a very prolific one; it includes about thirty kinds of sewing-machines, and of the 5,680,000 machines manufactured in the last twenty years, not less than 3,500,000 were shuttle machines. Of course we have not room to describe all of this promising family, but, taking the Singer machine as the type or representative of the whole, we propose to point out in the others their several points of difference. The Singer Manufacturing Co. makes several kinds of sewing-machines, one or two for manufacturing purposes, one for family use, and a button-hole machine. They are made, of course, in all the different styles of cases or stands and of ornamental finish to satisfy different tastes, and have the various attachments which in these days are regarded as indispensable for fancy work. One thing impresses the expert on looking at the working specimens of these, as well as those of the other large sewing-machine manufacturers: there is nothing done for display; the parts are as simple as possible, and as few in number as is consistent with the objects to be accomplished; they are all made on the "assembling principle," every piece, even to the smallest screw or washer, being duplicated thousands of times, and each so exactly alike that the machine is put together by the assembling of these pieces taken at random from their hundred or more drawers or bins. Every part of the machine is and has been for years under the constant scrutiny of the most eminent machinists in the profession, and every modification which tends to make the machines more efficient, to improve their quality of running and their ease of management, has been adopted. These remarks apply not only to the Singer, but to all the machines of the larger companies. But more specifically: the Singer machines produce the lock stitch by the reciprocal action of a straight eye pointed needle and a long and rather narrow shuttle, opening on its lower face and carrying a fixed bobbin traversing longitudinally a straight race. The machine is operated either through the treadle

FIG. 5.

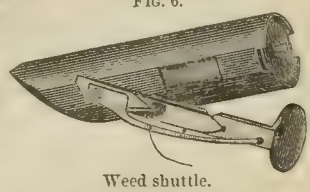


Singer shuttle.

or other power by means of a horizontal and a vertical shaft, engaged with each other by the action of two bevel-wheels; a pin on the end of the rotating horizontal shaft, entering a heart shaped groove in a block attached to the needle bar, communicates motion to the needle-bar, while a crank at the lower end of the vertical shaft connects by a link with the shuttle-driver or carrier. Some of the manufacturing machines for heavy work have the wheel-feed invented by Mr. Singer in 1851; others, and all the family machines, the four-motioned feed of Mr. Wilson. This feed is operated through the horizontal lever actuated from the vertical shaft. The feed is adjusted through a movable fulcrum controlled by a set-screw. A take-up lever controls the thread between the tension device and the eye of the needle. The tension of the under thread is regulated by slots and holes in the shuttle. The upper tension is not professedly automatic, but has as much claim to be considered so as that of some other shuttle machines, the thread passing between two elastic disks of thin steel so arranged that they admit coarse or fine thread without changing the tension. It has its action transmitted mainly by means of cams, though in some instances there is a resort to crank movements. The Singer manufacturing machine cannot be described as noiseless, but the Family machine is as quiet as most of the shuttle machines, and is easy running. The manufacturing machine has always been a great favorite with tailors and the clothing trade. The two Howe machines, now both manufactured by the Howe company, bear a very strong general similarity to the Singer machines, but have an additional cam-movement for bringing the stitch home without a sudden jerk, thus lessening the liability of breaking the thread at that point. The Howe machines are properly manufacturing machines, and in some descriptions of manufacturing, particularly in leather-work, have no superior in the beauty and certainty of their stitching. As family machines they run too heavily and are somewhat noisy, though they do good work. The Weed machines are also of two

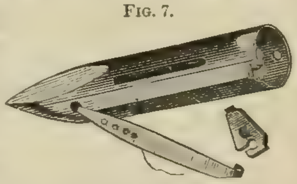
kinds—the General Favorite or manufacturing machine, and the Family Favorite. Both have been greatly improved since 1868 by inventions and changes made by Mr. G. A. Fairfield, their present superintendent. The former machine, usually styled "G. F.," is now, from recent improvements, very popular among the manufacturers of leather goods, not only for its good work, but for its quiet action, its rapidity of motion, and its durability. It has no cams and no long bearings, all the movements being by short cranks and eccentrics so arranged as to have very little wear, and that so uniform that it can be compensated by simply tightening the screws. Their family machine (F. F.) is now receiving some modifications which will doubtless improve it. The shuttle of these machines differs from that of the Singer in opening at the end to receive the bobbin; in having the bobbin loose in the shuttle; in having the lower tension pass through a large slot and under two long steel springs, instead of through holes in the shuttle, thus, it is claimed, diminishing the wear of the thread; and in having the shuttle in a cradle without motion, the only motion being that of the cradle, which reciprocates instead of the shuttle. This, it is claimed, greatly diminishes the clatter of the machine. The Remington machine, remodelled and improved from the old Empire machine, claims to have made several improvements on other shuttle machines. It dispenses with rotary cams except in moving the needle-bar, and claims, from its peculiar construction and the longer amount of revolution of its shaft, to run lighter and with less wear and noise than other shuttle machines. It also claims that its feed is positive, silent, and automatic, and that its tension is so easily and effectually controlled that it can be run at a higher rate of speed than any other shuttle machine. As to quietness of running, there is no appreciable difference between it and the Singer Family or some of the other shuttle machines. The "Domestic" sewing-machine, originally made under Mack's patents of 1863, etc. at Norwalk, O., has been greatly improved since 1870. It has a straight needle, a peculiarly-formed and very simple shuttle, which is supported at the end of a horizontally vibrating shuttle-lever, which is forked at one end to receive the ball-like end of a vertical lever which is itself vibrating from a pivot in the standard of the machine, and which is forked to embrace an eccentric on the horizontal shaft. The shuttle, like that of Weed's G. F., opens at the end, and the bobbin is loose in the shuttle. The thread passes out of the slot through two holes and under a single spring. The bobbin carries 80 to 100 yards of thread. The four-motioned feed is used, but with some adaptations which are claimed to make it more precise and powerful than most others. The upper tension has some claims to be considered as automatic. It is obtained by a spring accommodating itself perfectly to the size of the thread, maintaining a constant, equal, and regular hold, and, when once adjusted, remaining so without the least variation. From several particulars in its construction the Domestic is a light-running and not a noisy machine. The Wilson sewing-machine makes its stitch by a vertically reciprocating straight needle and a longitudinally reciprocating shuttle. The needle is moved by the action of a vibrating arm pivoted to an upright rising from the bed-plate. The lower end of the bent arm is slotted, and receives a pin projecting from a crank or disk on a short cross-shaft located directly under the upright. The shuttle-driver is connected by link with the disk or crank that actuates the needle-arm. In other respects this machine differs very little from other shuttle machines. The "Florence" machine is made under the Langdon patents. It is somewhat complicated in construction; it uses a curved needle carried by a vibrating arm or lever on a shaft which has a backward extension yoke embracing an eccentric on the main shaft. The shuttle-driver is actuated by the shaft by means of a link. The needle and shuttle have constant motion, not having periods of rest, like other machines. By an attachment to the feed-bar when the feed-bar is at a stand the machine can be made to produce a knotted stitch, of no great use. The shuttle has a latch-plate to regulate its tension and distribute the unwinding of the thread from the bobbin. Its reversible feed is regarded as one of its strong points, and its hemming attachment as another. It is said to be more easily handled than some other machines. The "Victor" (the successor of the Finkle & Lyon machine) is manufactured at Middletown, Conn. It also claims an automatic tension, but in its general construction presents few noticeable points of departure from its type, the Singer family machine.

Fig. 6.



Weed shuttle.

Fig. 7.



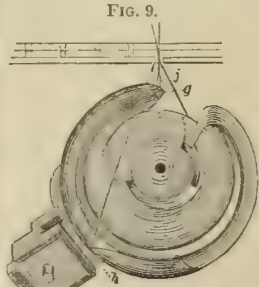
"Domestic" shuttle.

Fig. 8.

"Florence" shuttle.

We come next to the second sub-class of lock-stitch machines—those with a revolving hook instead of a shuttle—of which the Wheeler & Wilson Co.'s machines are now the only representatives. We have already spoken of Mr. Wilson's inventions, and especially of the rotating hook and the four-motioned feed. In Mr. Wheeler, Mr. Wilson found an able and energetic coadjutor, and the two partners and their associates who afterward joined them have conducted their enterprise with great ability and wonderful success. From the first they had a difficult task to perform; the traditions, such as they were, of the sewing-machine interest were all in favor of the shuttle, and have continued so to the present day; and in adhering to the rotating hook, and demonstrating by their work their ability to do all descriptions of sewing, both on heavy and light goods, in every respect equal to that done by the shuttle machines, and with no more expenditure of labor, trouble, or difficulty of working than that of other machines, they have shown what resolute and intelligent manufacturers can accomplish even under adverse influences. They have sold nearly 1,200,000 of their machines—a greater measure of success than has attended any other company except the Singer. Except a single infringement on their patents, they have had no imitators in this country in the use of the rotating hook. They now make four classes of machines: (1) The old Wheeler & Wilson machine, invented by Mr. Wilson, and improved by him at different times, a machine of great capacity for work, and, for very fine work, perhaps the best of their machines; (2) and (3) Nos. 6 and 7 machines, invented by Mr. James A. House, but including some of the devices of the old machine. These are adapted to heavy work, especially in leather and cloth goods. These machines have the straight needle instead of the curved one of the old machines; and (4) the No. 8 machine, intended for family use and light manufacturing, which is also Mr. House's invention, and carries a straight needle. The most characteristic feature of all these machines is the rotating hook and its adaptation to the other parts of the machine. We give below a cut of this hook. Dr. E. H. Knight in his *Mechanical Dictionary* gives the following description of the old machine: "It makes a lock stitch by means of a curved eye-pointed needle carried by a vibrating arm, projecting from a rock-shaft connected by link and eccentric strap with an eccentric on the rotating hook-shaft, this shaft having at its outer end the hook provided with a point adapted to enter the loop of needle-thread. As the hook *g* rotates, it passes into and draws down the loop *i* of needle-thread, which is held by means of a loop-check *h*, while the point of the hook enters a new loop *j*. Then the old loop *i* is cast off, the face of the hook being bevelled for that purpose, and is then drawn upward by the action of the hook upon the loop through which it is then passing. During the rotation of the hook each loop is passed around a disk-bobbin *k* (lying in the concavity of the hook) provided with a second thread, and serving the part of a shuttle. The four-motioned feed (Mr. Wilson's invention) is actuated by means of a cam on the hook-shaft." In the old machine the lock of the stitch is perfected while the point of the needle is in the material; there being some objection to this in some classes of fine leather goods, Mr. House has remedied it in his Nos. 6, 7, and 8 by his "independent take-up," which completes each stitch before another is begun, and while the point of the needle is out of the cloth, dispensing with the loop-check of the old machine. Other changes in the new machines are—the straight needle; the deeper concavity of the hook to allow of a larger and thicker disk-bobbin to hold more thread; the

Fig. 9.



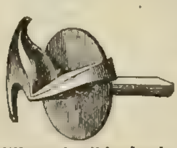
Rotating hook of Wheeler & Wilson.

overlapping tail of the hook, which acts as a guard in keeping off the bobbin-thread while the hook enters the loop of the needle-thread; the eccentric or cam to drive the needle; and the method of giving motion to the rotating hook through the two shafts and their flanges and the differential disk. This differential disk seems to be a new departure in its method of producing a varying velocity without a long crank. The disk revolves freely in a yoke secured rigidly to the frame of the machine, and is revolved by means of two pins in the flanges of the shafts on either side of it, these flanges being set eccentrically to it, and working in slots extending from the circumference of the disk to its axis, in such a way as to give the rotary hook a very quick motion through two-thirds of its revolution, and a slower motion through the other third. There are also minor modifications in the automatic tension of the lower thread and the upper tension. A greater possible rate of speed is claimed for these machines than for the shuttle machines. An improvement in the finishing of the stands and cases by the application of a preparation for filling the pores of the wood without changing the appearance of its grain has been recently patented by Mr. Wheeler. In their preparation of specimens of work for the Centennial Exposition this company have surpassed everything heretofore attempted on the sewing-machine, and are entitled to the credit of having demonstrated its wonderful capacity in directions hitherto deemed only possible to the most skilled of hand-workers.

II. *The Double-loop or Grover & Baker Stitch.*—There are, so far as we can learn, only three machines making this stitch—viz. the Grover & Baker machines, with which it originated; the Gold Medal Machine Co.'s machine in Boston, which produces from 12,000 to 18,000 machines per year, nearly all of which are exported; and the $25 Beckwith machine, which is a hand or treadle machine, but has no stand. The Grover & Baker Co. manufacture also a shuttle machine which comes under a previous head. The Grover & Baker double loop-stitch machine uses a curved eye-pointed needle and a rotary reciprocating curved eye-pointed hook or needle, called a thread-carrying looper, which works horizontally, and thrusts its own loop through that from the descending vertical needle. The next thrust of the vertical needle puts its loop through that from the under needle or looper, thus making a strong yet elastic stitch. The needle is carried at the upper end of a ⊃-shaped arm, slotted at its lower forward end to receive an actuating pin upon a disk connected with the main shaft. The vertical looper-shaft has a spiral portion embraced by a slotted plate at the end of the ⊃-shaped arm, and as the latter vibrates it acts upon the spiral portion of the looper-shaft and imparts to it a reciprocating rotary motion. The feed is the usual four-motioned feed of the Wilson patent. Both the upper and under threads are supplied from the ordinary commercial spools, as there is no necessity for a bobbin. The double loop makes a ridge on the under side, but if the under thread is materially finer than the upper—as, for instance, the upper 60 and the under 120—the ridge is not very noticeable. The machine undoubtedly uses more thread than the lock-stitch machines or the single-loop stitch, but it makes a very strong and elastic stitch, and for some purposes, as in some descriptions of embroidery, it is well adapted. As we have already said, this machine led the others from 1854 to 1858, but of late years its sales have somewhat fallen off. The aggregate sales of the machines making this stitch to Jan., 1876, are probably somewhat more than 600,000 machines. We have been unable to learn the points of difference in construction between the Grover & Baker and the Gold Medal Co.'s machine, which makes the same stitch. The Beckwith double-loop stitch machine uses a sickle-shaped thread-carrying looper and the vibrating needle-bar and smooth plate-feed invented by Mr. Beckwith, which is a material improvement on the Johnson needle-feed. It is claimed for this that it does not injure the finest fabric, and that it avoids the danger of drawing the different folds or thicknesses of the material unequally.

III. *The Twisted Loop and Chain or Single-loop Stitches.*—The twisted-loop stitch is made by only one machine, the Willcox & Gibbs; the chain stitch, tambour, or single loop by several machines past and present. One of these was invented and patented by Mr. Singer in 1854, but is not now made; another is the Beckwith single-thread machine. The Willcox & Gibbs machine, first patented by Mr. Gibbs in 1857, and since improved and perfected by Messrs. James and Charles H. Willcox, is by far the best of the single-thread machines, and is an example of what may be accomplished by resolute and determined men of high mechanical ability when working against popular prejudices. The impressions of the great mass of buyers of sewing-machines in regard to single-thread machines were decidedly adverse to their use. To remove this prejudice, and obtain a foothold of anything like equality with other machines, was a difficult task, and one which other prominent inventors had undertaken and in which they had failed. The Willcox & Gibbs Co. attempted it by making the details of their machine as perfect as possible, producing the most silent and swift-running machine in the market—one easily learned, readily managed, and capable of executing with great facility all descriptions of ordinary work, and from its simplicity of construction not liable to get out of order. Then, availing themselves of the twist in the loop necessarily made by their method of forming the stitch, they set themselves to the task of convincing the public that the chain or twisted-loop stitch, as made by them, was strong, not liable to rip, and at the same time more elastic than other stitches in use. They have not fully succeeded, for the prejudices of men and women are strong and very difficult of removal, but they have made a gallant and protracted fight, have raised up a host of advocates for their stitch, and have sold since 1858 over 270,000 machines. They use a short, straight needle, carried by a reciprocating bar actuated by a vibrating lever, connected by link with an eccentric on the main shaft. At the forward end of the shaft is a hook of peculiar construction, which as it rotates carries the loop of needle-thread, distends and holds it expanded while the feed moves the cloth and until the needle at the next stroke descends through the loop so held. When the needle descends through the first loop, the point of the hook is again in position to catch the second loop, at which time the first loop is cast off and the second loop is drawn through it, the first loop being drawn up against the lower edge of the cloth, forming a chain. An eccentric on the main shaft, back of the rotating hook, actuates the feeding device, and gives it the usual four motions of the Wilson patent. By a succession of improvements made from 1864 to 1872, Mr. Charles H. Willcox has greatly modified this machine, giving it a really self-acting automatic tension, capable of operating without change, and entirely without any interference of the operator, on goods from the thinnest of fabrics to the bulkiest and most difficult, going forward without hesitation, drawing of material, breaking of thread, or defect of stitches. He has connected with this a graduated lever and self-register, which enables the operator to adapt the number of stitches to the inch to the fineness of the thread or silk and the grade of the needle, and fixes it there. The feed surrounds the needle, and by the addition of teeth on the throat-plate causes seams and inequalities to enter and feed through under the presser-foot at regular speed, without assistance. Another of these improvements is the "take-up," which has no moving parts and no joints, the thread itself making all the needed motions, and being kept constantly moving on the staples so as not to wear any part. Other improvements are—that the spool does not revolve, but the thread is drawn off as needed over a disk; that the provision of compensation for wear is perfect and self-adjusting; that the bearings are all globular and smoothly turned, so as to produce the least possible friction; and that while the speed can be increased to 3000 or more stitches per minute, the machine is absolutely silent. The problem of single or double thread and of loop stitch or lock stitch is still unsolved, but it would be difficult to produce a sewing-machine more perfect in all its details than the Willcox & Gibbs. The Beckwith single-loop stitch machine does not differ greatly in its principle from the Willcox & Gibbs. It has a reciprocating instead of a rotating hook or loop-taker, and is generally of very simple construction. Its feed, etc. are similar to those of the $25 machine.

Fig. 10.

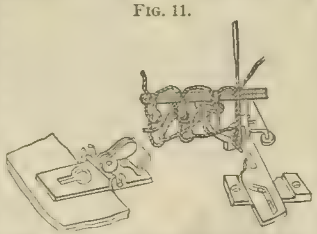


Willcox & Gibbs hook.

IV. *Button-hole Stitch.*—This specialty of sewing-machines is now represented by the Singer button-hole machine, the Wheeler & Wilson machine being nearly or quite withdrawn from the market, by the Wheeler & Wilson button-hole attachment, and the American button-hole and sewing-machine attachment. The Singer button-hole machine, a material improvement on the Union button-hole machine, which it succeeds, is a very complicated machine. For the full comprehension of its construction drawings in detail are needed, but as we have not room for them, we must give a general idea of its action without them. A hole is cut in the cloth or leather for the button-hole, having at one end the nearly circular space which is to form the eye of the button-hole; the machine uses two threads and a cord of gimp or large twist (one spool of thread and the gimp being underneath, and the other spool above). The gimp by an ingenious contrivance is put around the edge of the incipient button-hole to stay or stiffen it after the material has been placed under a dilating clamp which

spreads it: the whole is now moved under the needle, which makes a circuit of the button-hole a short distance from its edge, the needle descending alternately through the material back from the edge and then over the edge: the loop formed by the first descent is interlocked by the loop formed at the second descent, the first loop being by a skilful device brought forward and spread for this loop to enter it: and this second loop is then secured by a thread from the eye pointed looper, which moves horizontally below. As the needle approaches the eye of the button-hole, where the stitches along the curved edge must be set thicker, a most ingenious combination of cams and slides causes the needle and the looper to turn around it and to increase their speed, the distance traversed by the cam-lever being shorter than in the other part of the button-hole. Its operation is perfect, and the button-hole thus made is much more durable than those made by hand, and the purl edge more beautiful. The button-hole attachments do not attempt to make the eye of the button-hole in this way, and in that of the Wheeler & Wilson Co. the stitching is done first, and the button-hole is cut after the stitching is completed. These attachments also make the button-hole stitch on the edges of garments, shoes, etc., which the button-hole machine cannot do. Its office is to make button-holes, and button-holes only, and this it does well. The button-hole attachments are very ingenious and useful, performing their work with great certainty and beauty, but their office is somewhat different.

FIG. 11.



Method of making button-hole stitch.

There are still other sewing-machines for special purposes—as the cylinder sewing machine, with its cylindrical work-holder, for sewing seams on sleeves, trousers, water-hose, boot-legs, leather buckets, and other tubular forms; the shoe-sewing machine, for stitching the soles of shoes; the carpet-sewing machine, for making up carpets; and the book-sewing machine, for bookbinders—but lack of space forbids our going into details concerning these.

From 1856, at which time the record of sales under license from the parties to the "Albany agreement" was commenced, to 1869, the number of sewing-machines sold was about 1,500,000, divided about as follows: Wheeler & Wilson Co., 450,000; Singer Co., 350,000; Grover & Baker Co., 235,000; Howe Machine Co., 140,000; Willcox & Gibbs S.-M. Co., 105,000; Weed S.-M. Co., 70,000; Florence S.-M. Co., 60,000; all others, 90,000. The aggregate sales to Jan. 1, 1876, are about 5,800,000 machines. The following table shows the sales of such companies as paid royalty to the associated companies during the last seven years. With the expiration of the several patents, only one or two of which are now in force, there is and will be a dropping off of the companies reporting. Some have also withdrawn from business or have been consolidated:

Sewing-machine companies.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
Singer Manufacturing Company	86,781	127,833	181,260	219,758	232,444	241,679	249,852
Wheeler & Wilson Manufacturing Co.	78,866	83,208	128,526	174,088	119,190	92,827	103,740
Howe S.-M. Co.	45,000	75,156	34,010*	est. 145,000	est. 90,000	est. 35,000	est. 25,000
Original Howe S.-M. Co.	....	....	20,051				
Grover & Baker S.-M. Co.	35,288	57,402	50,838	52,010	36,179	est. 20,000	est. 15,000
Weed S.-M. Co.	19,687	35,002	39,655	42,444	21,769	20,495	21,993
Willcox & Gibbs S.-M. Co.	17,201	28,890	30,127	33,639	15,881	13,710	14,522
Wilson S.-M. Co.	....	500	21,153	22,666	21,247	17,525	9,508
Florence S.-M. Co.	13,655	17,660	15,947	15,793	8,960	5,517	4,892
B. P. Howe S.-M. Co.	....	....	....	14,907	13,919		
Domestic S.-M. Co.	....	....	10,397	49,554	40,114	22,700	21,452
Gold Medal S.-M. Co.	....	8,912	13,562	18,897	16,431	15,214	14,262
American Button-hole and S.-M. Co.	7,792	14,573	20,121	18,930	14,182	13,529	14,406
Victor S.-M. Co.	....	....	....	11,901	7,446	6,292	6,103
Finkle & Lyon Manufacturing Co.	2,339	2,420	7,639				
Remington S.-M. Co.	....	....	....	4,982	9,183	17,608	25,110
Empire S.-M. Co.	8,700	3,560	2,965				
Davis S.-M. Co.	....	....	11,568	11,376	8,861		
Blees S.-M. Co.	....	....	4,557	6,053	3,458		
Elliptic S.-M. Co.	....	....	4,555				
J. E. Braunsdorff & Co., Ætna	4,548	5,806	4,720	4,262	3,081	1,866	1,447
Parham S.-M. Co.	1,141	1,766	2,056				
Bartram & Fanton S.-M. Co.	....	470	1,004	1,000	1,000	250	
Bartlett Reversible S.-M. Co.	....	496	614	1,000			
Secor S.-M. Co.	....	....	....	311	3,430	4,541	1,307
Keystone S.-M. Co.	....	....	....	2,665	217	37	
J. G. Folsom	....	....	280				
McKay S.-M. Association.	....	129	218	....	....	128	161
C. F. Thompson	....	100	147				
Centennial S.-M. Co.	....	....	....	....	514		
Leavitt S.-M. Co.	771						
Union Button-hole Machine Co.	....	....	124				
Total reported.	322,769	464,254	606,094	851,236	667,506	528,918	528,755

Of the companies not reporting, such as the Beckwith, Williams & Orvis, Home Shuttle, Hamilton, etc., the entire annual production probably ranged from 25,000 to 50,000 machines, not exceeding the higher amount, in any year. The production of the Beckwith in ten years has been a little more than 35,000 machines. A portion of the large annual production shown in the table has gone to foreign markets, the Singer Co. and Howe Co. having manufactories in Europe; and they, as well as the other companies, export many machines to Europe, Mexico, Central and South America, and other countries. L. P. BROCKETT.

Sexages'ima [Lat., "sixtieth"], in the calendar the eighth Sunday, nearly sixty days, before Easter.

Sex'tans, or **Sex'tant,** in astronomy, one of the constellations formed by Hevelius. It is placed across the equator and on the S. side of the ecliptic.

Sex'tant [Lat. *sextans*], a portable astronomical instrument, invented by Newton, and re-invented by T. Godfrey of Philadelphia in 1730, using for the measurement of an angle a graduated arc of the sixth part of a circle, and employing in its construction the following theorem of optics: If a pencil be reflected by each of two plane surfaces, the deviation of the axis of the pencil is double the inclination of the reflecting planes, supposing its course to be in one plane perpendicular to the intersection of the surfaces. To show the application of this theorem to the sextant in Fig. 1, let I be the index-glass, H the horizon-glass, S the star, S I H E the pencil of light from the star S as it suffers the two reflections at the index and horizon glasses. The star will be seen by the eye projected in the horizontal line E S′. Since $SIr = rIH$ by the law of reflection of light,

$$\therefore SIa = HIA;$$
$$\therefore EIA = HIA.$$

In a similar manner $EHA = PHA$,

$$HEI + AIE = AHE + IAH,$$
$$HEI + HIA = PHA + IAH,$$
$$= HIA + 2IAH;$$
$$\therefore HEI = 2IAH.$$

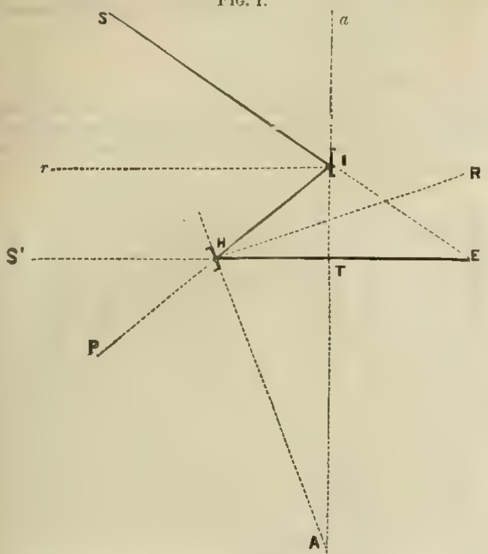
But H E I is the deviation of the pencil produced by the double reflection, and we see this angle is twice the angle of the inclination of the mirrors. So long as the line of sight E S′ is directed to any fixed point the angular distance to any other point may be determined by the revolution of the mirror at I: the angle through which this mirror is moved may be indicated by the revolution of the line *a* A, which carries at some part of it an index sweeping over a graduated arc, which is graduated to twice as many degrees as it measures in its own circumference.

The following description of the instrument is taken from Chauvenet's *Astronomy*, vol. ii. art. 81: Fig. 2 represents the most common form of the sextant constructed upon these principles. The frame is of brass, constructed so as to combine strength with lightness; the graduated arc, in-

* Six months.

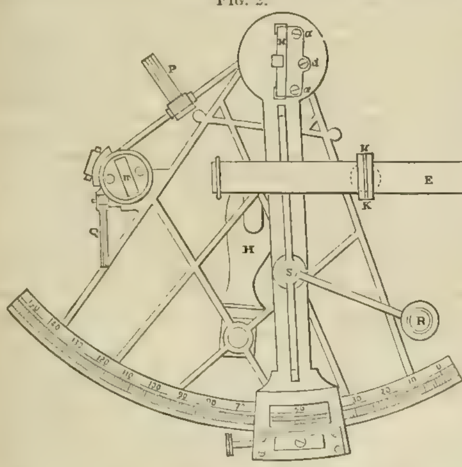
laid in the brass, is usually of silver, sometimes of gold or platinum. The divisions of the arc are usually 10′ each, which

FIG. 1.



are subdivided by the vernier to 10″. The handle H, by which it is held in the hand, is of wood. The mirrors M and *m* are of plate glass, silvered. The upper half of the

FIG. 2.



glass *m* is left without silvering, in order that the direct rays from a distant object may not be intercepted. To give greater distinctness to the images, a small telescope E is placed in the line of sight *m* E. It is supported in a ring K K, which can be moved by means of a screw in a direction at right angles to the plane of the sextant, whereby the axis of the telescope can be directed either toward the silvered or the transparent part of the mirror. This motion changes the plane of reflection, which, however, remains always parallel to the plane of the sextant, the use of the motion being merely to regulate the relative brightness of the direct and reflected images. The vernier is read with the aid of a glass R attached to an arm which turns upon a pivot S, and is carried upon the index-bar. The index-glass M, or central mirror, is secured in a brass frame, which is firmly attached to the head of the index-bar by screws, *a, a, a*. This glass is generally set perpendicular to the plane of the sextant by the maker, and there are no adjusting screws connected with it. The fixed mirror *m* is usually called the horizon-glass, being that through which the horizon is observed in taking altitudes. It is usually provided with screws, by which its position with respect to the plane of the sextant may be rectified. At P and Q are colored glasses of different shades, which may be used separately or in combination, to defend the eye from the intense light of the sun.

In a theoretically perfect sextant the four faces of the index and horizon glasses are plane and perpendicular to the sextant-plane; the two faces both of the index and of the horizon glass must be parallel to each other. The axis of the telescope must be parallel to the sextant-plane. The arc of the sextant should be accurately centred. The following methods may be used to test and make the above adjustments: (1) To adjust the index-glass, bring the vernier near the centre of the arc. Hold the sextant with its face up and the arc away from you. Look into the index-glass, and the arc to the right of the vernier will be seen reflected, and the arc to the left will be seen direct. If these two arcs are apparently continuous parts of the same circle, the index-glass is in adjustment, but if the reflected arc is lower than the true, turn the small adjusting-screw to the back of the index-glass *inward*; if higher, turn it *outward*. This adjustment is performed by the makers by filing down one of the metallic points against which the glass bears when secured in its frame. (2) To adjust the horizon-glass, screw the telescope into its collar, and observe whether the direct and the reflected image of a star, preferably of about the third magnitude, can be made to coincide by moving the index-arm; if so, the adjustment is made: if not, cause the two images to coincide by altering the proper screws of the horizon-glass. Another method is to observe whether the direct and reflected images of the sea-horizon are continuous when the plane of the sextant is vertical, and then whether they remain so when the sextant-plane is inclined to the horizon. (3) To adjust the telescope axis, make two of the lines in the focus of the eyepiece parallel to the plane of the sextant. Select two objects over 90° apart, and bring their images into contact on the wire nearest the sextant-plane. Move the sextant very slightly, so they may be brought to the other wire. If both images still remain in contact, the adjustment is made; but if they separate, the object-glass end of the telescope is inclined to the sextant-plane. Make the necessary adjustment by means of the two small screws in the collar which carries the telescope.

It is but seldom that the zero of the vernier and the zero of the arc coincide when the horizon and index glasses are parallel to each other. The index and horizon glasses may be so adjusted that this will be the case, but the instability of this adjustment makes it a better plan to determine the reading-arc when these two glasses are parallel, and apply this reading as a correction to an observed angle. We can determine whether the two surfaces of the index-glass are plane and parallel by examining the reflected image of a star when the vernier is set to about 120°. The image of the star will be distorted and indistinct. There are no means of adjusting this error outside of the instrument-shop. We may determine its amount by measuring a large angle after having made the other adjustments very carefully, and then remeasuring the same angle after having turned the index-glass so that the end which was before toward the vernier is now away from it, and carefully re-adjusting the instrument. Half the difference of the two measures will be the error of a single measure at that angle. It may be determined in the same manner for a number of angles, and hence for any particular angle, by interpolation. Should the two surfaces of the horizon-glass be inclined to each other, all angles will be affected alike, the index error included. We may determine whether the instrument is properly centred by measuring a number of known angles with the sextant, and comparing the observed with the true results. These angles may be terrestrial and determined by a theodolite, or the angular distances between two heavenly bodies at any given time computed from their right ascensions and declinations. This error is called the error of eccentricity.

In the following description of the methods of observation we shall assume that the amount of the errors arising from eccentricity, want of parallelism between the surfaces of the index-glass, the inclination of the telescope axis, and the inclinations of the horizon and index glasses respectively to the plane of the sextant, are all either zero, or else have been determined.

To measure the Altitude of a Heavenly Body.—When at sea, mariners use the sea-horizon. The telescope is directed toward the horizon, the index is swung forward until the image of the heavenly body, seen by reflection from the horizon-glass, is brought into contact with the horizon, seen directly. The exact instant of time when this contact takes place is noted, and this constitutes a single observation. When the sun is observed, a number of observations are taken, preferably half with the lower limb of the sun brought tangent to the horizon, and the other half with the upper limb of the sun brought tangent to the horizon. If these observations are all comprised within a few minutes of time, it is sufficiently accurate to consider the mean of the observed altitudes as being the observed altitude of the sun's centre at the mean of the times. The index error should be the mean of a number of contacts of the sun's limbs taken first on one side, and then causing the reflected image to move across the direct image, and noting the sextant reading with the contact of the sun's limbs in this po-

sition. For convenience, the graduation of the sextant may be supposed to commence 5° beyond the 0° mark. Thus, what would ordinarily be read as *minus* 1°, can be read as *plus* 4°. This point will be illustrated subsequently. To observe an altitude on land, however, an artificial horizon must be substituted for the sea. Various forms have been suggested to obtain a truly horizontal surface. One artificial horizon consists of a plate of glass, darkened and having its upper surface ground truly plane. It is supported on three delicate screws, and is levelled by a sensitive level placed on the upper surface of the glass. An addition to this form of apparatus consists of a graduated arc by which it may be inclined to an angle with the horizon, and thus larger angles may be observed than with the ordinary sextant and horizon. This form, however, does not seem to meet with much favor among observers. A modification of this method consists in floating the glass plate upon mercury; but by far the best method, and the one almost universally employed, is to use a surface of mercury direct in some such contrivance as shown in Fig. 3, where $f\,g\,h\,i$ represents a wooden trough about four inches long and three wide, so constructed that a funnel being screwed into an aperture at h, and mercury being admitted, the mercury flows through a narrow channel till it comes to the outlet at i, when it rises and overflows the bottom of the shallow basin $k\,i\,l$. The object in sending it through the funnel at h and the channel $h\,i$ is to get rid of the oxide of mercury, which clouds the surface after standing in an ordinary bottle for some time. This scum is left in the funnel, and the surface is left clean and bright at $k\,i\,l$. Owing to its extreme sensitiveness, a slight current of air or tremor of any kind renders observation extremely difficult. Currents of air are guarded against by the cover $a\,b\,c\,d\,e$, which consists of a frame holding two windows of plane glass at $b\,c$ and $c\,d$. This form of horizon cannot be used where there is the least tremor; but if, instead of using the wooden trough above described, we form a vessel of flat copper turned up at the edges to about one-eighth of an inch, and then amalgamate the copper vessel by the friction of mercury with water and rotten-stone, and then carefully wash with an abundance of water and dry it by means of a piece of very clean linen, and pour mercury into such a vessel until it overflows, we may skim off all impurities, and have left a brilliant surface which is particularly stable. The quantity of mercury in this case need not be more than a fourth as much as in the ordinary artificial horizon. To an observed altitude of the sun or moon at sea the following corrections must be applied, which will be illustrated in their order: (1) index error, which may be positive or negative; (2) dip of the horizon, which is always negative; (3) refraction, which is also negative; (4) semi-diameter of the body observed, which may be positive or negative; (5) parallax, which is always positive. The *index error* was determined at the time of the observation. Suppose the following observations had been taken by placing the limbs of the sun as shown in the two following figures, where Fig. 4

FIG. 3.

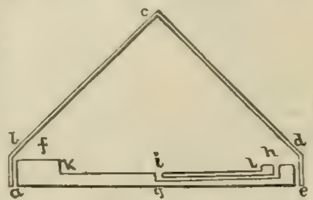
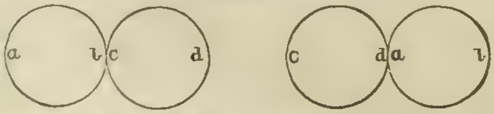


FIG. 4.



represents the two solar images in contact in the first instance, and Fig. 5 represents the same images after the vernier has been moved so as to bring the opposite edges in contact. We thus virtually measure the sun's diameter *on* and *off* the arc, and the mean of the two readings will be the reading of the sextant when the horizon and index glasses are parallel.

Suppose the reading to be in Fig. 4 = 360° 29′ 40″
" " " " " " 5 = 359° 25′ 50″
Mean = 359° 57′ 45″

Consequently the index correction will be + 2′ 15″. The advantage of this method is that it does away with the use of the computed semi-diameter of the sun, and the observations are symmetrical. The index error may be determined by noting the reading of the sextant when the direct and reflected images of any distant, well-defined point are made to coincide in the field of view of the telescope. The correction for dip of the horizon is necessary, because, as the observer at sea is elevated some feet above the surface of the water, the distant horizon is projected to a lower point on the celestial sphere. It may be computed by the following formula, where

d = dip in minutes of arc;
h = height of observer's eye above the level of the sea;

$$d = \sqrt{h} \times 3437.75 \times \sqrt{\frac{2}{20888761.5}},$$
$$= 1.064\sqrt{h}, \text{ very nearly.}$$

Expressed in a convenient rule, the dip in minutes very nearly equals the square root of the height of the eye in feet. The following table gives its amount for various heights in feet:

Height.	Dip.	Height.	Dip.	Height.	Dip.	Height.	Dip.	Height.	Dip.
1	0′ 59″	10	3′ 3″	19	4′ 13″	28	5′ 2″	65	7′ 48″
2	1 22	11	3 12	20	4 20	29	5 13	70	8 06
3	1 40	12	3 21	21	4 26	30	5 18	75	8 23
4	1 56	13	3 29	22	4 32	35	5 43	80	8 39
5	2 10	14	3 37	23	4 39	40	6 07	85	8 55
6	2 21	15	3 45	24	4 45	45	6 29	90	9 11
7	2 33	16	3 52	25	4 51	50	6 51	95	9 26
8	2 43	17	3 59	26	4 56	55	7 11	100	9 41
9	2 54	18	4 06	27	5 02	60	7 30	110	10 09

The correction for refraction presents too intricate a problem to be followed out in the limits of this article. Usually, the mean refraction is sufficient for the accuracy of sextant-work, and this may be taken directly for any given altitude from some table. The following is an approximate formula for the mean refraction at the sea-level:

$$r = 57.''538 \tan. z;$$

where z = zenith distance of the observed body.

The correction for semi-diameter is the addition of the semi-diameter of the body observed to the observed altitude of its lower limb, or its subtraction from the observed altitude of its upper limb to obtain the altitude of its centre. In the case of the sun it is better to observe a certain number of altitudes of the lower limb and the number of the upper limb. The means will then give the altitudes of the centre of the sun, providing the lower and upper limbs have been observed alternately.

The Correction for Parallax.—Since all astronomical observations are referred to the centre of the earth, an altitude observed from its surface will be less than the true altitude until the body reaches the zenith, when its displacement as seen projected on the celestial sphere is zero. This correction becomes insensible in the case of the fixed stars. It may amount to about 9″ in the case of the sun, to about 19″ in the case of Mars, and to about 2″ in the case of Jupiter. In the case of the moon it is a large and varying quantity. The following table shows its amount at various altitudes of the sun:

Altitude	° 0	° 12	° 15	° 30	° 33	° 39	° 42	° 48	° 51	° 57	° 60	° 66	° 69	° 72	° 75	° 78	° 81	° 84	° 90
Parallax	″ 9	″ 9	″ 8	″ 8	″ 7	″ 7	″ 6	″ 6	″ 5	″ 5	″ 4	″ 4	″ 3	″ 3	″ 2	″ 2	″ 1	″ 1	″ 0

Of the above corrections, those for dip of the horizon, semi-diameter, and parallax vanish in the case of a star observed on land and with an artificial horizon. The true altitude of the observed object is obtained by summarizing the above corrections and applying the result to the observed reading of the sextant. It is to be observed that a source of error sometimes exists in the dark glasses used to modify the sun's light. Should such an error exist, it may be eliminated by making half of the observations with the shade-glasses in one position, and the other half with the shade-glasses reversed in their supports. It is, in fact, a common precaution with the best observers to make half the observations with the shade-glasses and artificial horizon-roof in one position, and the remaining half with both reversed.

Mounted on a stand, and all the errors carefully estimated, the sextant gives results much more accurate than is commonly supposed. Thus, Prof. William Harkness from the discussion of 930 observed altitudes of the sun adopts as the probable error of the mean of a set of six altitudes of the sun, ± 3.″00. He also finds that the weights to be given to a series of observations sustain the following relations to the number of observations in each series:

No. of observations.	Weight.	No. of observations.	Weight.
1	1.00	8	2.91
2	1.60	16	3.37
4	2.29	100	3.88

The prismatic sextant by Pistor and Martin by the arrangement of prism is enabled to measure angles up to

180°. Its adjustments are the same as those of the ordinary sextant. The box sextant is merely a miniature one.

For a discussion of the sextant generally see Wm. Chauvenet, *Manual of Practical and Spherical Astronomy* (Philadelphia, 1874); Dr. C. M. Bauernfeind, *Elemente der Vermessungskunde* (Munich, 1872); Merrifield and Evers, *Navigation and Nautical Astronomy* (London, 1868); E. Loomis, *Practical Astronomy* (New York, 1855). For special problems and capacity of the sextant for scientific purposes see *Monthly Notices R. A. S.*, 1853, January; 1873, November; *Washington Astron. Obs.*, 1867, App. ii.; 1869, App. i.; *Pogg. Ann.*, vol. lxxix. p. 136; *Astron. Nach.*, vol. vii. p. 262; vol. xxiii. p. 321. LEONARD WALDO.

Sex'tus Empir'icus, a Pyrrhonic or skeptical philosopher, flourished in the first half of the third century A. D. Beyond the facts that he was an African and a physician of the empirical—or, as he preferred to say, the methodical—school, nothing is known of his personal history. He is known chiefly as the author of three works, setting forth, in principle and detail, the skeptical, or, as we should say, critical philosophy: (1) *Institutiones Pyrrhoniana* (Πυῤῥώνειαι Ὑποτυπώσεις), dealing with the principles of skepticism; (2) a work on philosophy in its three divisions, of which two books, entitled Περὶ Φιλοσοφίας, are devoted to logic, two to physics, and one to ethics; (3) *Against the Mathematicians* (Πρὸς τοὺς ἀπὸ τῶν μαθημάτων Ἀντίῤῥησις), in six books, devoted respectively to grammar, rhetoric, geometry, arithmetic, astronomy, and music. Sextus undertook to prove that there is no criterion of truth either in the subject man, or in his faculties of apprehension, or in his mode of apprehension (κριτήριον ὑφ' οὗ, δι' οὗ, καθ' ὅ). He argued, further, that even if we had a criterion, it would be of no use unless we were sure that there existed truth to which it could be applied. And even if this were admitted, he said, it would be of no use, inasmuch as we should not know whether to look for it in that which appears or in that which is hid. Even if we knew this, by what sign or mark, he asks, should we know the truth? As there is no such sign, there is, of course, no proof and nothing certain. All that men can reach is a certain amount of probability, derivable from the observation of phenomena, and sufficient to enable us to conduct life and attain that calm (ἀταραξία) which the mind naturally craves. Sextus might be called the Hume of ancient philosophy. He differs from Hume, however, in this, that he regards our notions and concepts objectively, not psychologically. He deals with the notions themselves, not with their mode of production. (*Works* edited by Fabricius (Leipsic, 1718; reprinted, 2 vols. 8vo, 1842), by Bekker (Berlin, 1842). Cf. McColl, *The Greek Sceptics* (London and Cambridge, 1869).) THOMAS DAVIDSON.

Sey'bert (ADAM), M. D., b. at Philadelphia, Pa., in 1773; went to Europe 1793; studied at London, Edinburgh, Paris, and Göttingen, giving special attention to chemistry and mineralogy; was member of Congress 1809–15 and 1817–19; visited Europe 1819, and again 1824, and d. at Paris May 2, 1825. Author of scientific papers *On Putrefaction of the Blood* (1793) and *Experiments and Observations on Land and Sea Air*, and *On the Atmosphere of Marshes* (in *Philos. Trans.*, iv.) and of *The Statistical Annals of the U. S.* (1818)—a work which gave occasion to the famous article (*Edinburgh Review*, Jan., 1820) in which Sydney Smith asked, "Who reads an American book?"

Seychelles', a group of thirty small islands in the Indian Ocean, between lat. 3° 30′ and 5° 45′ S., and between lon. 55° 20′ and 56° 20′ E., belonging to Great Britain. They are rocky and high, but very fertile and covered with a luxuriant vegetation, especially of palms. Cotton is cultivated with some success. The largest is Mahé, 16 miles long and 4 miles broad. The Seychelles Islands were discovered by the Portuguese early in the sixteenth century; they were first settled by the French in 1756, and became an English possession in 1794.

Seychelles Cocoanut, the double cocoanut, the fruit of *Lodoicea Seychellarum*, a noble palm tree, now becoming rare in its native islands. The Orientals ascribe great and mysterious virtues to this curious nut, and in mediæval Europe it was sold for fabulous prices. The ancients believed that it grew at the sea-bottom. Practically, it is far less valuable than the true cocoanut.

Seyf'farth (GUSTAV), PH. D., D. D., b. at Uebigau, Saxony, July 13, 1796; was educated at Leipsic University, where he was professor of archæology from 1825 to 1855; professor in a Lutheran seminary at St. Louis, Mo., 1855–71, and afterward took up his residence in New York City. Author of numerous works in German and Latin upon theology, Oriental philology, mythology, history, and chronology, chiefly notable for their extreme advocacy of the literal school of biblical interpretation and their entire rejection of the system and results of the Egyptian researches of Champollion and Bunsen.

Sey'mour, p.-v., New Haven co., Conn., on Naugatuck River and R. R., 10 miles N. W. of New Haven, has 4 churches, a public library, 1 newspaper, 3 hotels, and paper, rubber, woollen, cutlery, pin, and nail factories, run by water-power from the falls of Naugatuck, Bladen, and Little rivers. P. 2122. W. C. SHARPE, ED. "RECORD."

Seymour, p.-v., Jackson co., Ind., at the junction of Ohio and Mississippi and Louisville and Indianapolis R. Rs., 59 miles S. of the latter place, contains 9 churches, good schools, 1 bank, 3 newspapers, spoke and cradle factory, a rolling-mill, 1 woollen-factory, foundry, a carriage-factory, and 3 planing-mills. P. 2372.
A. A. DAVISON, ED. "DEMOCRAT."

Seymour, p.-v., Wayne co., Ia., on South-western R. R., has 3 churches, excellent schools, 1 newspaper, 1 bank, 2 hotels, 1 steam-mill, and a coal-shaft. P. about 750.
C. W. BOLSTER, ED "REPORTER."

Seymour, tp., La Fayette co., Wis. P. 419.

Seymour, p.-v. and tp., Outagamie co., Wis. P. 251.

Seymour (EDWARD), duke of Somerset. See SOMERSET, DUKE OF.

Seymour (GEORGE FOX), D.D., b. in New York City in 1829; graduated at Columbia College in 1850 and at the General Theological Seminary in 1854; had charge of a mission-station at Dobbs Ferry for six years; became first head of St. Stephen's College, Annandale, 1860, and in 1861 rector of St. Mary's church, Manhattanville, N. Y.; in 1863 went to St. John's church, Brooklyn, N. Y., and was in 1865 elected professor of ecclesiastical history in the General Theological Seminary; in 1874 was chosen bishop of the diocese of Illinois, but the General Convention refused to confirm him; in 1875 elected dean of the General Theological Seminary. In 1877 chosen bishop of Springfield, Ill., and consecrated June 11, 1878. J. B. BISHOP.

Seymour (Sir GEORGE HAMILTON), grandson of the first marquis of Hertford, b. in England in 1797; graduated at Merton College, Oxford; entered the diplomatic service 1817; served as secretary of legation at Frankfort, Berlin, and Constantinople; became minister at Florence 1830, envoy at Brussels 1835, at Lisbon 1846, and at St. Petersburg 1851; was approached by the czar Nicholas with proposals to England for the partition of Turkey 1853—a scheme which resulted in the Crimean war; was recalled on the proclamation of that war, Mar., 1854; made envoy to Vienna Dec., 1855, and retired from the service on a pension Mar., 1858. D. Feb. 3, 1880.—His cousin, Sir GEORGE FRANCIS (1787–1870), was a distinguished admiral.

Seymour (HORATIO), LL.D., b. at Litchfield, Conn., May 31, 1778; graduated at Yale College 1797; studied law under Judge Gould at Litchfield; settled at Middlebury, Vt., 1799; was a member of the executive council of Vermont 1809–17; U. S. Senator 1821–33; was Whig candidate for governor 1836, and became judge of probate 1847. D. at Middlebury Nov. 21, 1857.

Seymour (HORATIO), LL.D., nephew of Senator Horatio, b. at Pompey, Onondaga co., N. Y., May 31, 1810; removed in childhood to Utica; studied at Oxford and Geneva academies, N. Y., and at Partridge's Military Institute, Middletown, Conn.; was admitted to the bar at Utica 1832, but soon withdrew from its practice to devote himself to the management of the large estate he inherited by the death of his father; was a member of the staff of Gov. Marcy 1833–39; was elected to the State assembly as a Democrat 1841, and three times re-elected, serving as Speaker in 1845; was chosen mayor of Utica 1842; was an unsuccessful candidate for governor 1850; was governor 1853–55; vetoed a prohibitory liquor law Mar., 1854; was defeated in the election of that year by the prohibitionist candidate, Myron H. Clark; was again elected governor as a War Democrat 1862; aided in suppressing the riots in New York City, and forwarded efficient co-operation to the national government in the war for the Union; was defeated in the election of 1864, in which year he presided over the national Democratic convention at Chicago, as he did again at New York 1868, when he was himself nominated for the Presidency much against his will, and received 80 electoral votes. He resides at Deerfield, near Utica, and is president (1876) of the National Dairymen's Association and of the American Prison Association.

Seymour (Lady JANE), third queen of Henry VIII., sister of Protector Somerset, and daughter of Sir John Seymour, b. in England about 1510; became maid of honor to Queen Anne Boleyn; married Henry May 20, 1536, the day after the execution of Anne, and d. shortly after giving birth to a prince (Edward VI.) Oct. 24, 1537. She was chiefly notable for her sympathy with the Protestant Reform.

Seymour (MICHAEL HOBART), b. in Ireland in 1802; graduated at Trinity College, Dublin, 1825; took orders in the Church of England; held several curacies in Ireland; distinguished himself in the pulpit and on the platform as a controversialist against Roman Catholicism, and officiated many years as afternoon and evening lecturer at Blackfriars and Southwark, London. D. June 19, 1874. Author of several effective works upon Roman Catholicism, of which the best known was *Mornings among the Jesuits at Rome* (1849).

Seymour (THOMAS), BARON SEYMOUR OF SUDELEY, brother of the Protector Somerset, b. in England about 1508; was ennobled and made grand admiral of England Jan., 1547; privately married Catharine Parr, widow of Henry VIII., the same year; was given the custody of the princess Elizabeth and of Lady Jane Grey; projected a marriage with the former 1548; intrigued against his brother, the Protector; was accused of treason; refused to obey a summons to appear before the council; was committed to the Tower Jan. 19, 1549; was shortly after attainted, and beheaded Mar. 20, 1549.

Seymour (THOMAS HART), b. at Hartford, Conn., in 1808; educated at Partridge's Military Academy at Middletown; became a lawyer at Hartford, and editor of the *Jeffersonian* (1837), a Democratic newspaper; was some time judge of probate; sat in Congress 1843–45; served in the Mexican war as major of the 9th regiment; became lieutenant-colonel Aug. 12, 1847; commanded the 9th Infantry after the death of Colonel Ransom at Molino del Rey; was brevetted colonel for services at Chapultepec Sept. 13, 1847; was governor of Connecticut 1850–53, and minister to Russia 1853–57. D. at Hartford Sept. 3, 1868.

Seymour (TRUMAN), b. at Burlington, Vt., Sept. 24, 1824; graduated at West Point 1846; entered the 1st Artillery; was brevetted lieutenant and captain for gallantry in the Mexican war; was professor at West Point 1850–53; served under Maj. Anderson at Fort Sumter Apr., 1861; became chief of artillery of McCall's division in the Army of the Potomac Mar., 1862; was commissioned brigadier-general of volunteers Apr. 28, 1862; was distinguished in the Virginia and Maryland campaigns; was severely wounded at Fort Wagner July 18, 1863; commanded an expedition to Florida Feb., 1864; was taken prisoner at the Wilderness; commanded a division in the Shenandoah Valley Oct., 1864, and became major-general 1865.

Seyne, La, town of France, department of Var, opposite Toulon, has a good harbor and carries on considerable fishing and shipbuilding. P. 11,700.

Sez'ze [anc. *Setia*], town of Italy, province of Rome, on a hill overlooking extensive marshes toward the W. The remains of a triple cyclopean wall prove its great antiquity, if they do not confirm the tradition that it was founded by Hercules—a tradition still preserved in the municipal arms in the figure of a lion. The foundations of many ancient temples of great extent may still be seen. The present walls are from the time of the Lower Empire; the mediæval history of the town is closely connected with the fierce feuds of the great Roman houses. The wines of Sezze have always had a good reputation, and the traffic of the place is now confined to this and other agricultural products of the vicinity. Both the costume and the dialect of the inhabitants still retain some striking peculiarities. P. 9367.

Sforz'a, the name of an Italian family which ruled Milan as a dukedom in the fifteenth and sixteenth centuries and exercised considerable influence on the politics of Italy by their ambition, which was generally accompanied with violence and faithlessness, and by their talent, which was not always accompanied with education, though several members showed interest for and gave much protection to science, poetry, and art. The founder of the family was (1) GIACOMUZZO ATTENDOLO, a peasant-boy from Cotignola in the Romagna, b. 1369. He distinguished himself by his bodily strength, and received the surname *Sforza*, "the forcer;" became chief of a band of condottieri, and entered the service of Queen Joanna II. of Naples, who made him grand constable; served afterward Pope Martin V., who made him a count, and d. in 1424.—(2) His son, FRANCESCO, b. in 1401, was chief of a large troop of mercenaries, and served the highest bidder. He invented a new tactical trick which made his troop very effective in battle; entered the service of Visconti, duke of Milan, and was very successful in his undertakings; received Visconti's daughter, Bianca, in marriage, and Cremona as her dowry; took Ancona from the pope, and began to settle down in fixed purposes. In 1447, Visconti died without any male heirs, and Milan instituted a republican government. But in 1450, Francesco seized the ducal crown, defeated his adversaries both in Milan and among the other states in Northern Italy, reigned well, and d. in 1466, much beloved by his subjects.—(3) His son, GALEAZZO MARIA, b. in 1444, was a monster of debauchery and ferocity, and was assassinated in 1476.—(4) He was followed by his son, GIOVANNI GALEAZZO, b. in 1468, during whose minority the government was carried on by his mother, Bona of Savoy.—(5) But in 1470, LUDOVICO THE MOOR, a brother of Galeazzo Maria, b. in 1451, banished Bona and assumed the regency, and in 1494 he poisoned his nephew and ascended the ducal throne himself. As Galeazzo Maria was married to a Neapolitan princess, Naples remonstrated very seriously against the usurpation, and in order to avert the impending danger Ludovico induced Charles VIII. of France to assert his claims on Naples. But the success of the French alarmed him more than the threats of Naples, and he now formed a league between all the North Italian states against France. To punish him, Louis XII. invaded his country, which he claimed as a grandson of Valentina Visconti, captured him in 1500, and confined him in the castle of Loches in the present department of Indre-et-Loire, where he d. in 1510.—(6) His son, MASSIMILIANO, b. in 1491, was made duke in 1512 by the Holy League, but expelled by the French in 1513; reinstated in the same year by Charles V. after the battle of Novara, but was again driven out by Francis I. after the battle of Marignano, and finally sold his claims to the dukedom to France for a pension.—(7) His brother, FRANCESCO II., b. in 1492, was made duke of Milan by Charles V. in 1522 after the battle of Pavia, and at his death (Oct. 24, 1535), he being the last representative of the main line of the house, the country was incorporated with Austria. Collateral branches of the family, the counts of Santa Fiora and the dukes of Sforza-Cesarini, are still flourishing in Italy.

'S Gravesan'de, van (WILLEM JAKOB), b. at Herzogenbusch (Bois-le-Duc), Holland, Sept. 27, 1688; studied first law, then mathematics, physics, and philosophy at Leyden and Leipsic; edited 1714–22 the *Journal Littéraire*, and attracted much attention by both his mathematical and his philosophical essays, and was appointed professor, first of mathematics and astronomy in 1717, then of philosophy in 1734, at the University of Leyden, where he d. Feb. 28, 1742. His principal works are *Physices Elementa Mathematica* (1720), *Philosophiæ Newtonianæ Institutiones* (1723), *Introductio ad Philosophiam* (1736); his *Œuvres philosophiques et mathématiques* were published in 2 vols. in 1774.

Shabbo'na, tp., De Kalb co., Ill. P. 1205.

Shabonier, p.-v., Kaskaskia tp., Fayette co., Ill., on Illinois Central R. R. P. 143.

Shackle'ford, county of N. W. Texas, on Clear fork of Brazos River, has a rolling surface and a productive soil. Cap. Albany. Area, about 500 sq. m. P. 455.

Shad [Ger. *Schade*], a name applied to several species of the family Clupeidæ, agreeing in the possession of an oblong-fusiform and rather high and compressed body, with trenchant and serrated belly, the preoperculum and suborbital higher than long, a deep re-entering notch in the upper jaw, and the roof of the mouth and tongue at least toothless; these are by some naturalists combined in a peculiar genus, *Alosa*, but by others with them are associated species of the groups *Pomolobus*, *Brevoortia*, etc., and by others still they are all regarded as constituents of the enlarged genus *Clupea*, and thus confounded with the salt-water herrings, etc. The shads are all inhabitants of the northern hemisphere, and anodromous, like the salmon, living for the greater portion of the year in the sea, but in the spring ascending the rivers in large schools for the purpose of spawning. The time of ascent is determined by the temperature, and the point is only limited by insurmountable obstacles in the form of dams or falls which cannot be overleaped, although the larger portion spawn at intervals far below this final point. The eggs are moderate in size, the ovaries of a single female having generally, it is said, about 25,000 eggs, although sometimes as many as 100,000 to 150,000. They are discharged near the surface, and slowly sink to the bottom. The time between impregnation and hatching depends on the temperature, and varies from about three to six days; thus, when the temperature is about 75° to 80° F. they hatch in about seventy hours or little more, while at a temperature of 62° to 67° they are delayed to about six days. The shads are the largest and most esteemed, at least in America and China, of the Clupeidæ. The best-known species are four—viz. *Alosa vulgaris* and *Alosa finta* of Western Europe, *Alosa sapidissima* of the Eastern U. S., and *Alosa Reevesii* of China, which last especially ascends the Yang-tse-Kiang River. The European species are held in much less esteem than the American and Asiatic. The last are esteemed among the best, if not the finest, of fishes in their respective countries, and their ovaries are also regarded as special objects of luxury. The capture of these fishes gives rise to

a large industry, and in the early spring months the fishermen are to a large extent engaged in their capture by means of fixed nets as well as seines, and to a small extent by dip-nets. The shads eat little or nothing when in fresh water, but sometimes rise to the fly, although not enough to constitute them generally-recognized game-fishes. In the salt water and estuaries they feed chiefly on small crustaceans, such as species of *Mysis*, etc. Within the last few years attempts have been made by the U. S. commissioner of fish and fisheries to introduce the shad into the waters of California and those emptying into the Gulf of Mexico, in which last they had, however, already been to some extent acclimated. It has also been sought to introduce the American species into German waters, but the shortness of the period of hatching and the tenderness of the young have hitherto rendered futile the attempt. The fish commissioners of several Atlantic States, especially the U. S. commissioner and the commissioners of the States of Connecticut, New York, and Maryland, have for several years past endeavored, by artificial fecundation, to increase the supply of this species, which had been overfished, and, it has been claimed, success has rewarded their exertions. THEODORE GILL.

Shad'dock [called **Pompelmoose** in the East Indies], the large fruit of *Citrus decumanus*, a small tree of the orange family (Rutaceæ). It has a watery pulp, cooling, acid, aromatic, and somewhat bitter. It is used for preserves. It was named from one Shaddock, who carried it from India to Jamaica. Risso describes six varieties. The fruit sometimes weighs fifteen pounds.

Shade, tp., Somerset co., Pa. P. 1287.

Shade'ville, p.-v., Hamilton tp., Franklin co., on Scioto River, O. P. 124.

Shad'ine, the *Alosa sadina*, a little spotted shad about a foot long, caught, but not abundantly, off the New York and New Jersey coasts.

Shad Tree, or **Bush,** the *Amelanchier Canadensis* of the order Rosaceæ. It is remarkable for its numerous and strongly-marked varieties, some of them very small shrubs and others larger shrubs, and it occasionally grows to be a tree, 50 feet high or more. Its wood is hard, white, and very fine-grained. Its flowers appear in early spring in loose white racemes. The fruit is a juicy and savory berry, abundant in the North-west, where it is called service-berry. It is there collected as food, and is one of the ingredients of the native pemmican.

Shad'well (THOMAS), b. at Stanton Hall, Norfolk, England, about 1640; educated at Caius College, Cambridge; studied law at the Temple, London; travelled on the Continent; acquired considerable reputation by his comedy, *The Sullen Lovers*, produced in 1668; devoted himself thenceforth to literature, chiefly dramatic; was author, among many other plays, of *The Virtuoso* (1676), *Lancashire Witches* (1682), *The Squire of Alsatia* (1688), and *Volunteers, or The Stock-Jobbers* (1693); became poet-laureate and royal historiographer 1688, succeeding Dryden in both posts, and thereby incurring a resentment which led to his unjust impalement by that poet as the hero of *Mac Flecknoe* in the character of "monarch of dulness." D. Dec. 6, 1692. His collective *Works* appeared in 4 vols., 1720.

Shady Spring, p.-v. and tp., Raleigh co., West Va. P. 1686.

Shaef'ferstown, p.-v., Heidelberg tp., Lebanon co., Pa. P. 636.

Shaftes'bury (ANTHONY ASHLEY **Cooper**), FIRST EARL OF, b. at Wimborne St. Giles, Dorsetshire, England, July 22, 1621, son of Sir John Cooper of Rockbourne, Hampshire, and grandson on the mother's side of Sir Anthony Ashley, secretary of war to Queen Elizabeth; entered Exeter College, Oxford, 1637, and Lincoln's Inn 1638; was elected for Tewkesbury to the Short Parliament Apr., 1640, though but nineteen years of age; sat in the Long Parliament as a supporter of the king; went over to the popular party Feb., 1644; commanded forces in Dorsetshire; stormed Abbotsbury and relieved Blake at Taunton in the same year; was a member of the "Barebones" Parliament July, 1653, and of Cromwell's council of state Dec., 1653; separated from the cause of the Protector Dec., 1654; was excluded from the Parliament of 1656; took his seat in that of Jan., 1658; was a member of the council of state May, 1659; co-operated in the restoration of Charles II.; was one of the commissioners sent to the new king at Breda Apr., 1660; was made a privy councillor in May, and a commissioner for the trial of the regicides Oct., 1660; was raised to the peerage as Baron Ashley Apr., 1661; became chancellor of the exchequer May, 1661; opposed the Act of Uniformity 1662; supported the Dispensing bill 1663; was one of the grantees of the province of Carolina 1663 and 1665; secured the services of John Locke as private secretary 1666; prepared with Locke the famous aristocratic constitution for the government of the Carolinas; was a joint commissioner of the treasury 1667; a member of the "Cabal" 1670; created earl of Shaftesbury Apr. 23, 1672; was president of the council of trade and plantations from Sept. 27, 1672, to Apr., 1676; was lord chancellor Nov. 17, 1672, to Nov. 9, 1673; refused a bribe offered by the French ambassador Dec., 1673; was dismissed from the privy council May 19, 1674, on account of having gone over to the opposition; was imprisoned by order of Parliament for aiding the king in asserting the prorogation of that body 1677–78; procured the passage of the Test bill 1678; became president of the council Apr., 1679; procured the passage of the Habeas Corpus act 1679; was dismissed from office Oct., 1679; presented the duke of York before the court of king's bench as a "Popish recusant" June 26, 1680; attended the Parliament at Oxford Mar., 1687; was thrown into prison by order of the council on a charge of high treason July 2, but released Dec. 1, 1681, the grand jury having refused to find a true bill; went to Amsterdam Nov., 1682, and d. there Jan. 22, 1683. He was the Achitophel of Dryden's satire, is brilliantly sketched by Macaulay in his *History*, and gave name to Ashley and Cooper rivers in South Carolina. (See his *Life*, by W. D. Christie, 1871; also Fox-Bourne's *Memoir of John Locke*, 1876.)

Shaftesbury (ANTHONY ASHLEY **Cooper**), THIRD EARL OF, grandson of the first earl, b. in London Feb. 26, 1671; was educated under the supervision of Locke; entered Parliament 1673; resided in Holland 1698–99; succeeded to the peerage 1699; supported the administration of William III., and retired from public life on the king's death; was noted as a philanthropist and stigmatized as a free-thinker; published a *Letter on Enthusiasm* (1708) in defence of the rights of the "French Prophets," *The Moralist, a Philosophical Rhapsody* (1709), *Sensus Communis* (1710), *A Soliloquy, or Advice to an Author* (1710); spent much of his time on the Continent, and was preparing a work upon the arts of design when he d. at Naples, Feb. 15, 1713. His principal work, *Characteristics of Men, Matters, Opinions, and Times*, was posthumously published (3 vols., 1713–23; often reprinted), and enjoyed great popularity for its elegant and thoughtful style.

Shaftesbury (ANTHONY ASHLEY **Cooper**), SEVENTH EARL OF, b. in England Apr. 28, 1801; graduated at Christ Church, Oxford, 1822; entered Parliament 1826; supported the administrations of Liverpool and Canning; was made a commissioner of the board of control by the duke of Wellington; was a lord of the admiralty under Sir Robert Peel 1834–35; succeeded to the peerage 1851; has labored zealously to improve the condition of the working-classes; has been president of the Bible Society, the Pastoral Aid Society, the Protestant Alliance, and other organizations for the propagation of evangelical doctrines, and has been long regarded as the head of the so-called "Exeter Hall" school of Low Churchmen.

Shafts'bury, p.-v. and tp., Bennington co., Vt., on Harlem Extension division of Central Vermont R. R. P. 2027.

Shagreen. See LEATHER, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Shah [Pers., "king"], the title of the ruler of Persia and of certain other Asiatic princes. The sons and other male relatives of the Persian shah also assume this title, the full title of the monarch being *shah-in-shah*, "king of kings."

Shahjehanâbâd. See DELHI.

Shahjehanpoor', town of British India, presidency of Bengal, in lat. 27° 52′ N., lon. 79° 28′ E., on the Gurrah, has 62,875 inhabitants.

Shairp (JOHN CAMPBELL), LL.D., b. at Houstoun House, Linlithgowshire, Scotland, about 1830; educated at Edinburgh Academy, Glasgow University, and Baliol College, Oxford; was for some years assistant master of Rugby School; became professor of humanity at the United College, St. Andrew's, 1861, and principal of that institution 1868. Author of *Kilmahoe, a Highland Pastoral* (1864), *Studies in Poetry and Philosophy* (1868), *Lectures on Culture and Religion* (1870), and of numerous contributions to magazine literature.

Shakerag, v., Fayette co., Ga. P. 1010.

Shakerag, v., Henry co., Ga. P. 428.

Sha'kers [so called from certain rhythmical movements of the arms which form a part of their ceremonial], a sect called by themselves the United Society of Believers in Christ's Second Appearing. They claim descent from the French Camisards, and were founded by Mrs. Stanley, better known by her maiden name as Ann Lee. (See LEE, ANN.) She was a member of a society founded in 1747 at

Manchester, England, by Jane Wardlaw, a visionary and professed prophetess, whose followers were named Shaking Quakers. Of these people Mother Ann (as she was called) became in 1770 the acknowledged head. She called herself "Ann, the Word," and professed to be the bride of the Lamb, the queen of Mount Zion, and the second appearing of Christ. In 1774 she emigrated with her leading followers to the U. S. In 1776 they settled at Watervliet, N. Y., but the society did not thrive until after 1780. The Shakers lead a celibate life, hold their property in common, believe that they communicate with the spirits of the departed, that the millennium has come, and teach that for those who are not Shakers marriage, if entered into for the perpetuation of the human race, is not sinful. They hold that the millennium has come, make use of the song and dance in worship, wear a peculiar dress, and devote themselves to agriculture, horticulture, the raising of medicinal herbs, and engage in a few simple manufactures. They are a thrifty, cleanly, and industrious people. They teach a system of doctrine which is founded partly on the Bible and partly on the supposed revelations of Mother Ann Lee and their other inspired leaders. They are opposed to war and the use of pork as food, and believe in the exercise of miraculous gifts. The U. S. census for 1870 reports 18 communities of Shakers, with 8850 sittings, and $86,000 in church property, but their whole common property is worth over $10,000,000. Their establishments are at New Gloucester and Alfred, Me.; Canterbury and Enfield, N. H.; Harvard, Hancock, Shirley, and Tyringham, Mass.; Enfield, Conn.; 2 in Canaan, N. Y., and 1 each in Groveland, Mount Lebanon, and Watervliet, N. Y. (those in Canaan are dependent on that at Mount Lebanon, which is indeed a kind of mother-house to all the others); at North Union, Union Village, Watervliet, and Whitewater, O., and Pleasant Hill and South Union, Ky.

Shakers, or **Whitewater Village,** v., Crosby tp., Hamilton co., O. P. 123.

Sha'kerstown, v., Van Buren tp., Montgomery co., O. P. 54.

Shake'speare (William), b. in Stratford-on-Avon, Warwickshire, England, in Apr., 1564—on the 23d of that month, it is supposed. His father, John Shakespeare, was of the yeoman class; his mother, Mary Arden, was of a family of the minor gentry. John Shakespeare seems to have been a man of character and ability. He became a landholder, and rose rapidly through all the grades of office in Stratford until he became chief alderman and *ex-officio* justice of the peace. Misfortune, however, befell him, and he was reduced to comparative poverty, and was even subject to arrest for debt. Of Shakespeare's early life until he married we know nothing; but it is probable that he was educated at the grammar school of Stratford, and that he acquired there a little Latin and some Greek. Passages in his works showing more than ordinary familiarity with law-terms have been regarded as indicating that he was for a time in an attorney's office. The fact that he was the third child and the eldest son of the eight children of a man who suffered heavy losses may give us assurance that he was early set at work of some kind; and we may well believe that it was rather that of an attorney's clerk than that of a helper to his father in the trade of a butcher —a story which has only the flimsiest traditional foundation. Whatever his occupation in Stratford, however, he soon left it, and under very depressing circumstances. While but a lad of seventeen he had become entangled with a woman of twenty-five, Anne Hathaway, the daughter of Richard Hathaway, who lived at Shottery near Stratford. He married this woman, in another parish and by special license, when he was but eighteen, while she was twenty-six years of age, and her first child, as far as our knowledge goes, was born in May, 1583, between four and five months after her marriage. How long he lived with her, and where, we do not know, but it was probably in Stratford, and for not more than three years. She bore him twins, a boy and girl, in Feb., 1584, which were named Hamnet and Judith, her first child having been named Susanna. Shakespeare at twenty-one, with a wife eight years his senior, whom he married under such circumstances, with three children on his hands and his father in distress, was driven to seek some change for the better; and he left Stratford to seek his fortune in London. Tradition says that he himself had led a somewhat wild although not a vicious life, and that, having killed some of the deer of Sir Thomas Lucy of Charlecote, near Stratford, and having written a rhyming lampoon upon him and affixed it to his gate, Sir Thomas made Stratford too hot to hold him. The story of the deer-killing is not well authenticated, but it is very probable, as it also is that the knight's vindictiveness was one of the causes of his leaving his native village. How Shakespeare lived during his first year or two in London we do not know, but it is probable that he sought employment in the office of a cousin who was an attorney in that city. However this may be, ere long we find him engaged as an actor and as a playwright. This became his profession, and he remained in London practising it for almost all his life. There is no evidence that he returned to Stratford more than once or twice, and then on business, until he withdrew from active connection with the theatre. But tradition says that he visited the home of his wife and children once a year. It may as well be here said that to this evidence of his indifference to the former there is to be added that of his will, in which he gave her only his second-best bed, and this as an afterthought and by an interlineation of the bequest, without which her name would not even have appeared in that instrument. In regard to her, it is also important to remark that she met with similar negative evidence of disregard in the will of her father, although her sisters were kindly and considerately remembered therein. Shakespeare was led to adopt the dramatic profession not only by strong native impulse, but by his acquaintance with some young dramatists of his native town who were living in London, and also by his memories of dramatic performances in Stratford during his father's prosperity and under his patronage. It is not improbable that, with his strong poetical and dramatic instincts, he may have made some attempts at play-writing before he went up to London, and still more probable that at that time he had written his first poem, *Venus and Adonis*. However this may be, he went upon the stage as an actor of minor parts, and seems never to have risen higher than a position of what is known as "general utility." We know that he was one of the original performers of Ben Jonson's *Every Man in his Humour;* that he appeared in the same author's *Sejanus* (but we do not know in what part); and there is a tradition that he played the Ghost in his own *Hamlet*, and that his brother Edward saw him play the part of an old man, which was probably that of Adam in his own comedy *As You Like It*. As a dramatist he began his career by rewriting old plays in conjunction with others, his seniors in years and as playwrights. At the time of his leaving Stratford the drama was rising rapidly in favor with all classes in London, where actors were made much of in a certain way, and where there was a constant demand for new plays. Ill-provided younger sons of the gentry, and others who had been bred at the universities and at the inns of court, sought to mend their fortunes by supplying this demand; and it was the custom of the various companies of players to have several playwrights in their pay, who, working together, produced new plays and patched up old ones. These plays were not regarded as literature, but were produced and used only as attractions to the theatres. There is good reason for believing that Shakespeare, in accordance with this practice, wrote at first in conjunction with Marlowe, Greene, Peele, and other playwrights of less note. His superiority to all his contemporaries, however, soon asserted itself, and he began to write alone or with little assistance. His first wholly original play was probably *Love's Labour's Lost;* for in *Titus Andronicus*, a revolting tragedy characteristic of a kind of drama then in vogue, there are but slight traces even of his 'prentice hand. He probably also in his earliest dramatic days wrote, in conjunction with Marlowe, Greene, and Peele, the first and the second parts of *The Contention between the Houses of York and Lancaster*, his own contributions to which he afterward embodied in Part I. and Part II. of his *Henry VI*. His success provoked the jealousy and excited the enmity at least of one of those whom he eclipsed—Robert Greene, a gifted but dissolute man, who died in wretchedness, and who, in a pamphlet written during his last illness, attacked Shakespeare as a pretentious plagiarist. This enmity was probably heightened by the respectability of Shakespeare's character, and the favor in which he seems to have been held by all with whom he was brought into contact. Henry Chettle, who was one of the knot of writers to which both Greene and Shakespeare belonged, speaks, in a pamphlet, of the latter as in his demeanor "no less civil than he was excellent in the quality he professes:" adding that "divers of worship have reported his uprightness of dealing, which argues his honesty, and his facetious grace in writing which approves his art." In the phraseology of that day "facetious" meant, not humorous and whimsical, but skilful and of a delicate fancy, and "of worship" meant of social rank and consideration. Among the friends that Shakespeare won among the latter class was the earl of Southampton, a nobleman of taste and culture, who took great interest in literature and the drama. To him the poet dedicated his first published poem, which was his first purely literary effort: he calls it "the first heir of his invention." Whether this dedication was an acknowledgment of substantial service from the earl, or whether it led to such an exhi-

bition of friendliness, we do not know. But there is a tradition that Southampton gave Shakespeare a large sum of money—£1000, quite equal to $30,000 in this day and country—and the story is probable. Such munificence was not unknown in those days among English noblemen; and when Shakespeare published *Lucrece*, his second poem, he dedicated this also to Southampton, saying, "The love I dedicate to your lordship is without end. . . . What I have is yours; what I have to do is yours; being in part all I have devoted yours." This at least, is evidently the acknowledgment of a great service; and there is therefore good reason to believe that to the nobleman's generosity the poet-dramatist owed his ability to become a very considerable sharer in the Black Friars' Theatre, at which the company with which he was connected was in the habit of performing. Having attained this advantageous position, Shakespeare soon reached the utmost height of success, both as to reputation and profit, possible to one of his profession. The notion long prevalent that he was neglected during his life, and that his plays rose into popularity only a long time after his death, is entirely unfounded. We know from contemporary evidence that he was the most admired of all the dramatists of his day, and that when the productions of the best of his contemporaries—Ben Jonson included—failed to pay the expenses of their representation, his plays filled the house to overflowing. He now entered upon a career of dramatic production which is without a parallel in the history of literature, and which soon placed him—its chief value in his eyes—in independent circumstances. It cannot be too strongly insisted upon, or too constantly remembered in reading his plays, that he produced them only in the way of business. He was a theatrical proprietor and an actor; and his object in writing was not fame, or even literary exertion, but to get money by his professional labor. He rose rapidly, however, both in fame and in fortune. He had money to spend and money to lend; and he used it to place his father in comfort and to acquire landed property and other wealth in his native town. The object of his life appears to have been to return to Stratford—which he had left hardly a man, and almost in disgrace—a man of property, and to take a position as a gentleman of consideration. The Heralds' College made his father a gentleman by coat-armor; and there is reason to believe that this was done at the instance and the request of the successful playwright, who thereby became a "gentleman" by descent both on his father's and his mother's side. He invested a part of his money in the tithes of Stratford, and he bought "New Place," a large house which had been built by the Cloptons, a Warwickshire family of wealth and position. To this house he retired on his withdrawal from the theatre about A. D. 1611, and there he died Apr. 23, 1616, leaving behind him only one child, his daughter Judith, who was married to Thomas Quiney, a vintner. His family, even through her descendants, soon became entirely extinct.

Of Shakespeare's life in London we know very little, almost nothing except the successive production of his plays. Fuller says that he and Ben Jonson used to have many "wit-combats," in which he compares Jonson to a heavy Spanish galleon and Shakespeare to a light English man-of-war. Jonson was his junior, but was one of those who knew him intimately: and jealous, hot-tempered Ben loved him well and honored his memory after his death. He supports Fuller's comparison by saying, with a classical allusion, that Shakespeare was distinguished by great copiousness and facility of thought and language—so great as to be almost oppressive to his hearers. There was a sort of club of which Raleigh, Jonson, Beaumont, Selden, and Donne were members, and which met at the Mermaid Tavern; and it has been assumed that the wit-combats took place at these meetings. It is not improbable that Shakespeare met with this club, but there is not the least evidence of the fact. Tradition says that Jonson owed to Shakespeare's influence the performance of his first comedy, *Every Man in his Humour*, which had been offered and rejected. But we only know that the story agrees with Shakespeare's reported kindliness of nature, and with the gruff and cynical scholar-dramatist's love for him. Traces of Shakespeare's personal character and experience are found rarely in his works, if at all, unless we are to accept his *Sonnets* as an expression of personal feeling. These very remarkable compositions, 154 in number, were published in 1609, and were dedicated to a Mr. W. H. as their "only begetter," but by the publisher, not by the poet, who seems to have had no agency in the publication of any of his works except *Venus and Adonis* and *Lucrece*, the two poems before mentioned. The *Sonnets* remain a literary puzzle to this day. A few of the first in the collection are addressed to a very beautiful young man, and entreat him to marry; two of them are avowedly the expression of Shakespeare's own feeling, and show that his spirit was galled by the nature of his profession and the low estimation in which it was held. But the most of them were written as an expression of the feelings and the experience of a man who loved and suffered deeply. It is almost impossible to believe that Shakespeare, even with all his powers of dramatic simulation, wrote these strong utterances of deep emotion in an assumed character, although it is to be remarked that such performances were rather the fashion in his day, and also that poets were employed to use their art in this way vicariously for others. If, on the contrary, we are to regard these *Sonnets* as the result of Shakespeare's own experience—which seems most probable—we learn from them that he passionately loved and was loved by a beautiful dark-eyed "black"—that is, brunette—woman, who nevertheless tortured him by being false to him with his best friend. This theory agrees with what we know of Shakespeare's character, and with his long residence in London, neglectful, if not entirely forgetful, of his wife. The *Sonnets* are worthy to be the utterance of such an experience by such a man. Although inferior to the plays, they are far superior to the other poems. But who was the Mr. W. H. whom the publisher styles their "only begetter"—whether he was connected in any way with their production, or only with their collection for publication—is only a subject of vague and unsatisfactory conjecture.

Shakespeare's dramas are unlike those of his predecessors, his contemporaries, and his successors, but their unlikeness is not in form or in purpose. He assumed the forms of comedy and tragedy, and of history or historical play, which had been established before he began to write, and he conformed in every external respect to the fashion of his time and the needs of the theatre. His difference from other dramatists consists in his thought and his language, and in his power of dramatic characterization; in all of which he is unapproached by any writer who ever lived. No other writer ever united imagination, fancy, humor, knowledge of human nature, worldly wisdom, psychological insight, and creative power, as all these were united in him. The fertility of his mind appears to have been inexhaustible, the profundity of his thought illimitable. He throws away upon a minor personage and an unimportant situation poetical thoughts and philosophical reflections which other writers, if they could have originated them, would have carefully reserved for elaboration upon great occasions. His dramatic isolation from his creations appears to have been perfect; once evoked from his mind, they exist independently and altogether outside of it, and act and speak altogether according to the laws of their own being, not of his. He may be almost said to have had, as a dramatist, no sympathy either with good or with evil, for he elaborates a human devil and a human angel with an equally loving hand; and he does not hesitate to show us that even both good and bad may, and often do, act from mixed motives, good and evil. It is in this inflexible justice, characteristic of only the very highest quality of intellectual and moral nature, that we find one of the chiefest evidences of his superiority.

Such of his plays as were published during his lifetime seem to have been given to the press entirely without his agency. Indeed, his interest was against their publication. They were written not to be read, but to be performed; and it was to the interest of all concerned in the theatre, whether as proprietors or only as actors, or, like himself, as both, that the theatre should have the entire benefit of whatever favor they enjoyed with the public. But the publishers—or stationers, as they were then called—eagerly sought copies of them for publication, and obtained them surreptitiously; sometimes, it would seem, by corrupting persons connected with the theatre, and sometimes, as the text which they printed shows, by sending short-hand writers to the performance. It is not improbable that in case of great and injurious misrepresentation of the text of a play by the latter method fair copies were furnished by the theatrical people, at the author's request, in self-defence. The first and second editions of *Hamlet* (1603 and 1604) appear to have been the result of such manœuvres on the part of the pirates and the author. However this may be, twenty of Shakespeare's plays were published by various stationers during his lifetime. They are known as "the 4tos" from the form in which they are printed. They are, most of them, full of errors, and, with one or two exceptions, they are all more or less imperfect. Some of them seem to have been put in type from stage-copies, or not improbably from an aggregation of the separate parts which were in the hands of the various actors. But they are nevertheless of great value in the formation of the text, and they have been freely used for that purpose by all the editors except Mr. Charles Knight. For the text of the remaining seventeen of the plays we are entirely dependent upon the folio edition of the whole thirty-six, which (not including *Pericles*) was published by Isaac Jaggard and Edward Blount

in 1623, under the authority—and, in some sort, the editorial supervision—of John Heminge and Henry Condell, who describe themselves as his friends and fellows. This edition, known as the "first folio," although greatly superior, as to the text of almost all the plays, to the quarto copies of the twenty plays before mentioned, is yet marred by so many and so great errors, and even by such important omissions in some of the plays, that it has required the labors of a numerous body of editors and commentators during 150 years to produce the text as it is now accepted, if indeed there is a text which can be regarded as accepted. As Shakespeare had no hand in the publication of his works, and as we know so little of his life, the very interesting question of the order in which the former were produced is left to inference from external evidence and critical opinion upon the evidence in the plays themselves. The *Stationers' Register* (a sort of contemporary record of copyright), the remarks of a critical writer named Francis Meres, whose book, *Palladis Tamia*, appeared in 1598, and one or two diaries written at the time furnish the external evidence upon this question; and the language, the style of thought, and the versification of the poet the internal. All this evidence unites in showing that the poems and plays were produced in the following order, and at about the following dates: *Venus and Adonis*, 1584–85; *The Passionate Pilgrim*, 1584–86; Part I. of *The Contention of the Two Houses of York and Lancaster*, *The True Tragedy*, etc., *The Taming of a Shrew* (in which old plays Shakespeare had a share), 1587–79; *Love's Labour's Lost*, 1588–89; *The Comedy of Errors*, 1589; *Love's Labour's Won* (probably an early form of *All's Well*, etc.), 1589; *The Two Gentlemen of Verona*, 1589–90; *King Henry VI.*, Parts I., II., and III., 1590–91; *Sonnets*, 1590–1605 (?); an early form of *Romeo and Juliet*, 1591–92; *Lucrece* and *Richard III.*, 1593; *A Midsummer Night's Dream* and *The Merchant of Venice*, 1594; *Richard II.*, 1594–95; *Romeo and Juliet*, *King John*, and Part I. of *King Henry IV.*, 1596; Part II. of *King Henry IV.*, 1597; *Much Ado About Nothing*, 1598–99; *Twelfth Night*, *Henry V.*, and *As You Like It*, 1599; *Hamlet*, 1600; *The Taming of the Shrew*, 1601; *Pericles* (Shakespeare's part), 1602; *The Merry Wives of Windsor*, 1603; *Measure for Measure*, 1603–04; *All's Well that Ends Well*, 1604; *A Lover's Complaint*, 1605 (?); *King Lear*, 1605; *Timon of Athens*, 1605–07; *Macbeth*, 1605; *Julius Cæsar*, *Antony and Cleopatra*, and *Troilus and Cressida*, 1606–08; *Cymbeline*, *Coriolanus*, and *Othello*, 1609–11; *The Winter's Tale* and *The Tempest*, 1611; *Henry VIII.*, 1613. To these should be added *The Two Noble Kinsmen*, in the writing of which there is hardly a doubt that he had a part, and which has a better right than *Titus Andronicus* or *Pericles* to a place among his collected works. In this order of production we see evidence that although Shakespeare was a miracle, like the sun and the stars in their daily rising and setting, his mind developed and his power grew like that of any ordinary mortal. His great tragedies, *Hamlet*, *King Lear*, *Macbeth*, and *Othello*, were produced between his thirty-seventh and his forty-seventh year, during which rich and fruitful decade he also produced his most beautiful comedies, with *Antony and Cleopatra*, and his wisest play, *Troilus and Cressida*. After 1611 he ceased to write—probably because he was weary of his profession and had accumulated money enough to live upon handsomely—and retired to Stratford. But he retained his interest in the theatre, and at Stratford he probably wrote his last play, *Henry VIII.*, to supply a pressing need of his company for a show-piece. It bears marks of great maturity of mind, but of great haste in production, and parts of it are plainly not his. They were supplied, according to the custom of the time, by other writers connected with the company. *Cymbeline*, which contains some of his finest thoughts and most beautiful creations, bears also in some scenes the marks of another hand. There are no traces, even in tradition, of any intercourse between Shakespeare and any of the eminent men of his time except Ben Jonson, and, if we may call him eminent, Southampton. Bacon was his contemporary; and it is an impressive and a somewhat saddening fact that these two intellects, probably the two greatest the world has known—certainly two such never existed together at any other time before or since—had, so far as we know, no communication. Shakespeare and Bacon lived at the same time in the same city, then not a large one, passed each other in the street, and yet probably never interchanged one word. The reason was that one was a player and a poet, the other a statesman and a philosopher, and that each was absorbed in his own affairs. The notion that Shakespeare's plays were written by or in conjunction with Bacon—which has found two or three ingenious advocates—is unworthy a moment's consideration by any reasonable creature.

Shakespeare did not long enjoy that for which he had longed so much and worked so hard—the life of a gentleman of substance and leisure in his native place. He died in Apr., 1616, and was buried on the 25th of that month in front of the chancel of Stratford church. There is a stone over his grave on which there is this inscription:

"Good frend for Iesus sake forbeare
To digg the dust encloased heare:
Blest be ye man yt spares thes stones,
And curst be he yt moves my bones."

These lines, which may embody a wish expressed by Shakespeare, but which are hardly of his writing, have prevented the removal of the remains of the greatest Englishman to Westminster Abbey. Against the wall of Stratford church there is a monument to Shakespeare, with a laudatory inscription in Latin. But of far greater interest is the bust of the poet which forms part of the monument. It is coarse and rude in execution, but there is no reason for doubting that it gives at least a general idea of his personal appearance. According to this, he was at fifty-eight a portly but not at all corpulent man, with a high forehead, a head somewhat bald, a small aquiline nose, and a well-formed mouth and chin. Aubrey, the antiquarian, who lived two generations after him, had heard that he was "a handsome, well-shapt man." An engraved portrait upon the title-page of the first collected edition of his works, which Ben Jonson, in some verses almost as hard and expressionless as the engraving itself, assures us was a good likeness, has a general conformity in the features and the form of the head to the bust. The latter is supposed by some persons to have been modelled from the poet's face after death. But a close examination of it shows this to have been impossible. The bust was originally colored after life, and had hazel eyes and auburn hair and beard. These traits were afterward obliterated by a coat of white paint. The bust and the engraved portrait in the Folio are the only portraits of Shakespeare which are of undoubtable authenticity; but one known as the Chandos portrait has tradition of very respectable antiquity in its favor. There is a very slight and vague tradition that Shakespeare "died a papist," but this is very improbable. His works show very little religious sentiment, and favor no religious form, sect, or dogma. There was also a tradition in Stratford fifty years after his death that he, Drayton, and Ben Jonson had "a merie meeting, and it seems drank too hard, for Shakespeare died of a feavour there contracted." The event is not absolutely impossible, but this tradition has probably as little foundation as the other.

Although Shakespeare was acknowledged as the greatest dramatist of his time, his reputation rather diminished than increased during the century after his death. He had no followers or imitators; he established no school. Dramatic taste and dramatic writing steadily declined after the Elizabethan age (about 1575 to 1625), and by the beginning of the eighteenth century Shakespeare was lightly thought of by the literary critics, and much neglected by the actors. But there had been among the reading public a steady although not a large demand for his plays. The folio of 1623 was succeeded by another folio in 1632, and a third edition was called for and published in 1664. In the last *Pericles*, and six spurious plays which had been published in quarto in Shakespeare's lifetime, with his full name or his initials upon the title-page, were included. A fourth edition, also in folio, appeared in 1685. Upon these four folios, and upon the existing old quarto edition of twenty of the plays, the readers of Shakespeare depended for their supply. They did not meet the demand, and in 1709 the first edited edition of Shakespeare's plays appeared, in 7 vols. 8vo. The editor was Nicholas Rowe, himself a poet and dramatist of considerable merit. Rowe, however, did little for his author more than the correction of the most obvious typographical errors in the old copies, the division of the plays into acts and scenes, the addition of stage directions, and the writing of a biography, for which the materials were mostly collected by Betterton the actor, and to which, after a century and a half spent in investigation, little has been added. Rowe's edition has an engraved frontispiece to each play, and these are of interest as contemporary evidence of stage costume, action, and "business" at the end of the seventeenth and the beginning of the eighteenth century. From the time of the appearance of this edition the fame of Shakespeare steadily grew until about the beginning of this century he was acknowledged to be the first of poets and of dramatists, the most creative mind, the greatest master of imagination and of language, that the world has known. The number of mere impressions of his works, even in the English language, is quite out of all reckoning; and the real editions, those formed by a careful collation and collection of the text, are many. Among the editions of this character the following are the most worthy of note: Alexander Pope's (1725), Louis Theobald's (1733), Sir Thomas Hanmer's

(1744), Bishop Warburton's (1747), Dr. Samuel Johnson's (1765), Edward Capell's (1767), Edmund Malone's (1790), Boydell's illustrated edition, 9 vols. folio (1802), Alexander Chalmers's (1805), Heath's illustrated edition, 6 vols. 4to, Reed's, 21 vols. 8vo, known as the "first variorum" (1813), Rev. William Harness's (1825), S. W. Singer's, known as "the Chiswick" ed. (1826), Charles Knight's "Pictorial" (1838), J. P. Collier's (1841), Gulian C. Verplanck's (1847), Rev. H. N. Hudson's (1852), J. O. Halliwell's, 15 vols. folio, with illustrations (1853), Rev. Alexander Dyce's (1857; 2d ed. 1864; 3d, 1875), Clark and Wright's, known as the "Cambridge" (1863), R. Grant White's (1857–64). In 1852, Mr. John Payne Collier published *Notes and Emendations to the Text of Shakespeare's Plays from early Manuscript Corrections in a copy of the Folio 1632.* The very numerous readings which appeared on the margins of this now notorious copy were at first received with enthusiastic welcome by a large class of the readers of Shakespeare, and even by some critics and editors; and it was for a time supposed that they would be generally accepted, and produce great changes in the received text. But their soundness, and even their genuineness, were soon disputed. A critical controversy arose upon them which is one of the most remarkable in the history of literature. It continued for years, the result being that nearly all of the readings were rejected, with damage to Mr. Collier, not only as a Shakespearian critic, but even to his reputation for literary good faith; for on both internal and external evidence it was shown that the volume was not what it professed to be. See *The Text of Shakespeare*, by R. Grant White, in *Putnam's Magazine* (Oct., 1853); *The Text of Shakespeare Vindicated*, by S. W. Singer (8vo, 1853); *Shakespeare's Scholar*, by R. Grant White (8vo, 1854); *An Inquiry into the Genuineness of the MS. Corrections in Mr. J. Payne Collier's annotated Shakespeare Folio, 1632*, etc. (4to, 1860); *A Complete View of the Shakespeare Controversy*, by C. M. Ingleby (8vo, 1861); and *The Shakespeare Mystery*, by R. Grant White, in the *Atlantic Monthly* (Sept., 1861). The number of Shakespeare's commentators has much exceeded that of his editors. His text was left in such a condition by the printers of the old quartos and folios that, although it may be read even in those impressions with pleasure and with a full comprehension of its general meaning, there is to its perfection need of more critical labor than is required by most old manuscripts; and of such we have none to consult, for of Shakespeare's writing not a line has come down to us—not even a word, except his own signature. The number of those who have rushed to the correction of Shakespeare's text and the explanation of his meaning is so large that it is not surprising that among them there should have been some weak-minded and ignorant persons altogether unfitted for a task the nature of which they did not even understand. And among those better qualified for their work, some have been narrow-minded, over-precise, and captious. But notwithstanding the reproach which such persons have brought upon Shakespearian criticism, it must be admitted that more critical ability and learning has been displayed upon this subject than upon any other in the whole range of literature, the poems of Homer perhaps excepted; the reason for the excess being the remoteness of the age when those poems were produced, the uncertainty of their origin, and the fact that their language is foreign to all their critics—very important circumstances which do not apply to the works of Shakespeare. The works written upon Shakespeare form a library in themselves, and the reader desirous of becoming acquainted with their titles must consult the catalogues of *Shakespeariana*, of which the best is Franz Thimm's (Lond., 1865; 2d ed. 1872). This, however, is imperfect, and sometimes erroneous; while the next best, that in Bohn's ed. of Lowndes's *Bibliographer's Manual*, is not without important errors in names, dates, and titles. Among the foreign students of Shakespeare the Germans have been the most laborious and steadily enthusiastic. There is no department of Shakespearian criticism in which they have not exerted themselves, and to which they have not brought their habits of patient and systematic inquiry. But it may be questioned whether, except for themselves, they have increased pleasure in his writings or made them more thoroughly understood; while as to the text there can be no doubt that their labors have been entirely fruitless. The best German translation of Shakespeare's plays—and it is admirable in every respect—is that of Schlegel and Tieck. The best contemporary discussion of Shakespearian subjects is to be found in the *Jahrbuch* of the German Shakespeare Society, published since 1865 yearly at Berlin.

Shakespeare, like so many other men of great eminence, left little trace of his personality behind him. His only son, Hamnet, died at the age of eleven years. His two daughters were married and left children, but the family, even on the female side, became extinct in the third generation. "New Place," his residence upon his retirement from the theatre, after passing through several hands, was in 1759 razed to the ground by its last owner, the Rev. Francis Gastrell, who was exasperated by a quarrel with the town authorities and by the persecution of prying visitors to the home of the great poet. John Shakespeare's house, which stands in Henley street, and in which it is reasonably supposed that William was born, is still standing. In the poet's time it was a pretty, comfortable dwelling for that age, with gable ends and pargetted walls. After falling into decay, it was a few years since bought by an association and restored, but in so unskilful and tasteless a manner that it gives very little idea of its appearance when he lived in it as a boy who has brought pilgrims to it from all quarters of the earth.

RICHARD GRANT WHITE.

Shakopee′, city and tp., cap. of Scott co., Minn., on Minnesota River and St. Paul and Sioux City R. R., has 6 churches, 2 academies, and 3 public schools, an orphan asylum, 1 steam flouring-mill, 1 newspaper, 2 wagon manufactories, 1 bank, and the repair-shops of the above railroad. P. of v. 1349; of tp. 1263.

HENRY HINDS, ED. "ARGUS."

Shale [Ger. *Schale*, "shell"], a name commonly given to soft laminated argillaceous rock formed by the induration of clay stratified in water. When containing much carbonaceous matter it is called bituminous shale. When hardened by metamorphism, shales are converted into slates. (See PETROLEUM, GEOLOGY OF.)

J. S. NEWBERRY.

Shale Oil. See PETROLEUM, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Sha′ler, tp., Allegheny co., Pa. P. 1173.

Shaler (NATHANIEL SOUTHGATE), S. B., b. in Campbell co., Ky., Feb. 20, 1841; graduated at Lawrence Scientific School 1862; became director of the State geological survey of Kentucky, in which capacity he has published various *Reports;* professor of palæontology at Harvard, and assistant at the Museum of Comparative Zoology at Cambridge, and is author of above sixty papers and memoirs on geological and palæontological subjects.

Sha′lersville, p.-v. and tp., Portage co., O., on Cuyahoga River. P. 977.

Shallot′, the *Allium ascalonicum*, an onion-like plant which grows in cloves somewhat like the garlic. The cloves are set in the ground early, and become large enough for market two months before seedling onions are ripe. In the U. S. they are sold as onions by market gardeners. They much resemble the onion in taste. The tops and bulbs are both eaten.

Shal′lotte, p.-v., Brunswick co., N. C. P. 1035.

Shama′ka, or **Kooneshur**, town of Asiatic Russia, in Transcaucasia, is a rising place, especially celebrated for its silk manufactures, which are said to equal those of Lyons. P. 25,609.

Sha′manism [Per. and Hind. *shaman*, "idolater;" Sans. *sramana*, an "ascetic"], the religion of a large number of primitive North Asiatic tribes, blended in Central Asia with Lamaism. It has no idols, save perhaps some fetiches and charms and rude ancestral images. It is a mixture of pretended sorcery and ceremonies for the propitiation of evil spirits. The priests or shamans offer sacrifices and perform grotesque and tumultuous ceremonies upon all extraordinary occasions. (See E. B. Tylor's *Primitive Culture* (2 vols., 1871).)

Sham′burg, p.-v., Oil Creek tp., Venango co., Pa.

Shamo, Desert of. See GOBI.

Shamokin, p.-b., Coal tp., Northumberland co., Pa., on Shamokin division of Northern Central R. R., and on Shamokin branch of Philadelphia and Reading R. R., in the centre of an important anthracite coal-field, which produces annually 1,250,000 tons; contains 3 foundries and machine-shops, 3 banks, 2 weekly newspapers, 10 churches, 1 large public schools, is well built and lighted, and supplied with water from Shamokin Creek. P. 4320.

Shamokin, tp., Northumberland co., Pa. P. 2282.

Shamong, p.-v. and tp., Burlington co., N. J., on New Jersey Southern R. R. P. 1149.

Sham′rock, the national badge of Ireland, as the thistle is that of Scotland, the rose of England, and the lily of France. The shamrock is a three-leaved or trifoliate plant, which was used by St. Patrick to illustrate the doctrine of the Trinity. There is some dispute as to whether the wood-sorrel (*Oxalis acetosella*), the common white clover, or the black medick or nonesuch (*Medicago lupulina*) is the true and original shamrock.

Sham'yl (*Samuel*), b. at Aul Himry, Northern Daghestan, about 1797; became a zealous disciple of the fanatic but sagacious and energetic Mohammedan reformer, Kasi-Mollah, whom he assisted in reconciling the feuds of the various Caucasian tribes and uniting them into a furious hatred of the "heretic" Russians. In 1834 he was unanimously chosen chief of the sect, and for more than twenty years he maintained, often with brilliant success, a continuous war with Russia. The culmination of his power falls between 1844 and 1852, when he succeeded in organizing a considerable number of tribes into a well-ordered state, which he governed from his capital, Dargo. But after this time the religious enthusiasm subsided, the Russian attacks became more comprehensive and energetic, one tribe after the other fell off, and the great opportunity which the Crimean war afforded him he was unable to avail himself of. After the Peace of Paris, Russia resumed the war with redoubled energy, and on Sept. 6, 1859, Shamyl was captured on the plateau of Gounib and carried to St. Petersburg, and the Caucasian tribes were finally pacified. In St. Petersburg, Shamyl was treated with much regard by Alexander II. He received a pension and resided in Kaluga, afterward in Kiev, and finally in Mecca, where he d. in 1871.

Shanda'ken, p.-v. and tp., Ulster co., N. Y., on Esopus Creek and on New York Kingston and Syracuse R. R. P. 2751.

Shane's Crossings, p.-v., Dublin tp., Mercer co., O. P. 246.

Shanes'ville, p.-v., Sugar Creek tp., Tuscarawas co., O. P. 360.

Shanghai', or **Shanghae,** city of China, province of Kiang Su, situated in lat. 31° 10′ N., lon. 121° 30′ E., on the left bank of Wusung River, 12 miles above its junction with the southern portion of the mouth of the Yang-Tse-Kiang. It consists of the city proper and numerous suburbs. The city proper is surrounded with a wall 3 miles in circumference, but it is generally poorly built, though it contains a very fine Chinese temple and several elegant tea and ice houses. Of the suburbs, that inhabited by the foreign merchants is the most remarkable. It sprang up after 1843, when by the treaty between England and China the port was opened to foreign commerce. It is laid out like a European city; was inhabited in 1873 by 80,367 persons, of whom a little more than 2000 were foreigners—English, French, and Americans; and contains many elegant residences, magnificent warehouses, manufacturing establishments, dockyards, etc. The manufactures of Shanghai are flourishing, and comprise silks, glass, paper, and articles of gold, silver, and ivory. But its commerce is still more important, on account of its favorable situation at the mouth of the Yang-Tse-Kiang. Between 7000 and 8000 river and coast junks put it in communication with the interior and other parts of the empire, and the number of vessels engaged in the foreign trade which visited its harbor in 1873 amounted to 2111, with a burden of 1,165,967 tons, of which 940 vessels were English, 741 American, 135 Chinese, 127 German, and 47 French. The total value of its foreign imports amounted to $82,169,694; of native imports, to $61,549,673; of exports of native produce, to $45,504,851; of re-exports of foreign produce, to $50,880,627. The principal articles of exportation are tea, of which the U. S. took in 1874 the value of $13,869,522, silk, oil, porcelain, and straw goods; of importation, opium, treasure, grain, and coal. P. estimated at between 250,000 and 320,000.

Shanghai', v., Knox tp., Jefferson co., O. P. 76.

Shan'non, a river of Ireland, rises in the county of Cavan at an elevation of 345 feet above the sea, flows first S. to Limerick, then W., and enters the Atlantic through an estuary 10 miles wide after a course of 224 miles. It is navigable throughout nearly its whole course, though at several places it has been necessary, on account of rapids, to transfer the navigation to canals. Vessels of 400 tons burden can ascend to Limerick.

Shannon, county of S. E. Missouri, traversed by Current River, has a broken surface, with some deposits of copper and iron, and extensive pine forests. Staples, Indian corn, tobacco, and butter. Cap. Eminence. Area, about 1150 sq. m. P. 2339.

Shannon, p.-v. and tp., Carroll co., Ill., on Western Union R. R., 136 miles W. of Chicago, has 5 churches, a public school, 1 bank, 1 newspaper, and a mill. P. of v. 635; tp. 1102. MASTIN & SANFORD, EDS. "GAZETTE."

Shannon, tp., Atchison co., Kan. P. 1301.

Shannon, tp., Pottawattamie co., Kan. P. 812.

Shannon, v., Muskingum tp., Muskingum co., O. P. 44.

Shannon (WILSON), b. in Belmont co., O., Feb. 24, 1802; studied at Athens College, O., and at Transylvania University, Ky.; became a lawyer; was prosecuting attorney for the State of Ohio 1835; governor 1838–40, and again 1842–44; minister to Mexico 1844; member of Congress 1853–55; Territorial governor of Kansas 1855–56. D. at Lawrence, Kan., Aug. 30, 1877.

Shan'nonville, port of entry of Hastings co., Ont., Canada, on Salmon River, 1½ miles from the Bay of Quinté, and on the Grand Trunk Railway, 120 miles E. of Toronto. Its chief trade is in lumber and railroad ties. P. about 700.

Shan'ny, a marine spiny-rayed fish of the genus *Pholis*, family Blenniidæ (see BLENNY) and natural order Teleostea, is usually about 5 inches long, is found in shoals on the coasts of England and France, and is remarkable for the habit of creeping, by means of its ventral fins, out of the water into the crevices of the rocks, and there remaining until the return of the tide. It has been known to live thirty hours away from salt water, but soon dies in fresh water. The American radiated shanny (*Pholis sub-bifurcatus*) is found, though rarely, on the coasts of Massachusetts and New York.

Shanonshaw, tp., Watauga co., N. C. P. 328.

Shan-See', province of China, bordering W. and S. on the Hoang-Ho, and bounded N. by Mongolia or the desert of Shamo, comprises an area of 55,278 sq. m., with 20,166,072 inhabitants. It is mountainous, and yields the purest iron ore in China; also marble, crystal, salt, and building-stone, and the most extensive coal-fields in the world. Wine is extensively cultivated; silk, carpets, iron and steel goods are the principal manufactures. Cap. Tai-Yuan-Foo.

Shans, The, occupy the central part of Farther India, N. of Siam and E. of Burmah, and form states which are tributary, partly to Siam and partly to Burmah. Their rulers levy no taxes, but support themselves exclusively from the proceeds of their hereditary estates and from a part of the fines. They are under the supervision of a royal commissioner from Burmah or Siam, who in his turn has left his family as hostages at the royal court.

Shan-Toong', province of China, bordering on the Yellow Sea, comprises an area of 65,100 sq. m., with 41,700,621 inhabitants. It is mountainous. Wheat, millet, and indigo are produced; silk, hempen cloths, and felt are manufactured. In Yen-Chow-Foo, a department of this province, Confucius was born. Cap. Tsee-Nan-Foo.

Shap'leigh, p.-v. and tp., York co., Me. P. 1087.

Shapoor' [anc. *Sapores*], the capital of the Sassanian dynasty, in lat. 29° 50′ N., lon. 51° 40′ E., in the Persian province of Fars. Its ruins, which cover vast fields, contain the finest and most interesting specimens of Persian or Oriental antiquities.

Shark, the English name applied to most of the species of the order or sub-order Squali, and to some extent synonymous with it. Inasmuch, however, as the word is used rather vaguely, and a number of species agreeing in structure with the so-called sharks are called by other names—*e. g.* dog-fish (*Squalus* or *Acanthias* sp., *Scyllium* sp.), sea-fox (*Alopias vulpes*), etc.—the forms will be most advantageously considered under the scientific name, SQUALI.

THEODORE GILL.

Sha'ron, p.-v. and tp., Litchfield co., Conn., on Housatonic R. R. P. 2441.

Sharon, p.-v., Taliaferro co., Ga.

Sharon, tp., Fayette co., Ill. P. 1663.

Sharon, tp., Appanoose co., Ia. P. 661.

Sharon, tp., Clinton co., Ia. P. 1152.

Sharon, tp., Johnson co., Ia. P. 1120.

Sharon, p.-v. and tp., Norfolk co., Mass., on Boston and Providence R. R. P. 1508.

Sharon, tp., Washtenaw co., Mich. P. 1087.

Sharon, tp., Le Sueur co., Minn. P. 924.

Sharon, tp., Hillsborough co., N. H. P. 182.

Sharon, p.-v. and tp., Schoharie co., N. Y., on Cherry Valley branch of Albany and Susquehanna R. R. P. 2648.

Sharon, tp., Mecklenburg co., N. C. P. 2197.

Sharon, tp., Franklin co., O. P. 1480.

Sharon, tp., Medina co., O. P. 1131.

Sharon, p.-v. and tp., Noble co., O. P. 1227.

Sharon, tp., Richland co., O. P. 2762.

Sharon, p.-b., Mercer co., Pa., on Erie and Pittsburg and Cleveland and Mahoning branch of the Atlantic and Great Western R. Rs., 14 miles W. of Mercer, contains 7 churches, 3 large graded schools, 2 banks and 2 banking companies, 2 newspapers, 2 extensive rolling-mills and nail-factories, 5 blast furnaces, 2 foundries and machine-

shops, 4 hotels, and a fire department. Principal business, mining and manufacturing. P. 4221.
RAY & MORRISON, EDS. "HERALD."

Sharon, tp., Potter co., Pa. P. 968.

Sharon, p.-v. and tp., Windsor co., Vt., on White River and Central Vermont R. R. P. 1013.

Sharon, p.-v. and tp., Bland co., Va. P. 939.

Sharon, tp., Portage co., Wis. P. 948.

Sharon, p.-tp., Walworth co., Wis., on Chicago and North-western R. R., 71 miles from the former place, has 3 churches, an academy, graded and common school, 1 bank, 1 newspaper, 1 steam flouring-mill, cheese-factory, 2 produce-houses, and 2 hotels. Excellent farming lands in the vicinity. P. 1865. J. C. KEENEY, ED. "INQUIRER."

Sharon (WILLIAM), b. in Smithfield, O., Jan. 9, ——; studied law, but never practised; engaged in banking; removed to Nevada, where he followed the same business, residing much of the time in San Francisco, where he was a trustee of the Bank of California; acquired enormous wealth by judicious investments in Nevada silver-mines, and took his seat in the U. S. Senate 1875.

Sharon Springs, p.-v., Sharon tp., Schoharie co., N. Y., on a branch of Albany and Susquehanna R. R., is a noted place of summer resort, having four mineral springs—chalybeate, magnesia, white sulphur, and blue sulphur—has 10 hotels and numerous boarding-houses, and is annually visited by above 10,000 persons. P. 520.

Sharp. See MUSIC, by REV. WILLIAM STAUNTON.

Sharp (GRANVILLE), grandson of Archbishop John, and son of Thomas Sharp, D. D., archdeacon of Northumberland, b. at Durham, England, Nov. 10, 1735; was bound apprentice to a London linen-draper 1750; was for some time a law-student, and for several years a clerk in the ordnance office; was the chief patron of the slave Somerset in suing for his freedom (1769), which resulted in the famous decision against the legality of slavery in England, pronounced by the court of king's bench May, 1772; resigned his post in the ordnance office on account of opposition to the American war Apr., 1777; devoted himself thenceforth to philanthropic objects, especially the overthrow of slavery and the slave-trade; was the first chairman of the Association for the Abolition of Negro Slavery May 22, 1787; was the principal promoter of the colony of Sierra Leone; opposed the impressment of seamen; advocated parliamentary reform, and favored the claims of Ireland. D. in London July 6, 1813. Author of sixty-one publications, chiefly pamphlets, in advocacy of the causes to which he devoted his life, philological tracts in favor of trinitarianism, and millenarian interpretations of biblical prophecies. (See his *Memoirs*, by Prince Hoare (1820) and by Charles Stuart (1836).)

Sharp (JAMES), D. D., b. in the castle of Banff, Scotland, in May, 1618; educated at the University of Aberdeen, where he figured among the students who declared against the Solemn League and Covenant 1638; took orders in the Scottish Church; became professor of philosophy at St. Leonard's College, St. Andrew's, 1640; was the representative of the Presbyterians sent to Cromwell 1656, to Monk and to Charles II. 1660; was appointed king's chaplain for Scotland and professor of divinity in St. Mary's College, St. Andrew's; consecrated archbishop of St. Andrew's and primate of Scotland upon an Episcopalian foundation Dec., 1661; was regarded as a tool of Charles in the persecution of the Covenanters, and consequently assassinated by "a band of nine enthusiasts" on Magus Muir, near St. Andrew's, May 3, 1679.

Sharp (JOHN), D. D., b. at Bradford, Yorkshire, England, Feb. 16, 1644; educated at Christ's College, Cambridge, on leaving which he became chaplain to Sir Heneage Finch, then attorney-general, through whom he obtained the archdeaconry of Berkshire 1672, a prebend at Norwich, 1675, the rectorship of St. Bartholomew, London, 1676, of St. Giles-in-the-Fields 1677, and the deanery of Norwich 1681. He became chaplain to Charles II. and James II., by whom he was deposed from his preferments for preaching against his church policy 1686; became dean of Canterbury 1689 and archbishop of York 1691. D. at Bath Feb. 2, 1714. Seven volumes of his *Sermons* were published 1709.—His son THOMAS, b. 1693, became archdeacon of Northumberland, and was author of various theological, philological, and philosophical works. D. at Durham Mar. 6, 1758.

Sharp Creek, p.-v. and tp., McPherson co., Kan. P. 199.

Sharpe, county of N. E. Arkansas, adjoining Missouri, intersected by tributaries of Black River, consists of high land broken by several ridges, in which iron, lead, and zinc are found. Cap. Evening Shade. Area, about 650 sq. m. P. 5400.

Sharpe, tp., Alexander co., N. C. P. 825.

Sharpe (DANIEL), D. D., b. at Huddersfield, England, 1783; emigrated to New York 1805; became pastor of the Baptist church at Newark, N. J., 1809; was from 1812 till his death in 1853 pastor of the Charles street Baptist church, Boston, Mass.; published about twenty sermons, of which the most significant is one on the *Recognition of Friends in Heaven.*

Sharpe (DANIEL), F. R. S., nephew of Samuel Rogers the poet, b. in London, England, in 1806; educated at Walthamstow; was interested in natural history and geology from boyhood; became a wine-merchant; made several visits to the wine-growing districts of Portugal; presented to the Geological Society several memoirs on the rocks and fossils of Portugal, and of Wales and England and Scotland, and several other memoirs on special subjects; contributed to the Palæontological Society an important monograph *On the Fossil Remains of the Mollusca found in the Chalk Formation of England*; reduced to system the fragments of the Lycian language preserved in the inscriptions discovered by Sir Charles Fellows; was an eloquent and keen debater in scientific associations; became president of the Royal Geological Society, and was noted for his munificence in private life. D. in London May 31, 1856.

Sharpe (SAMUEL), b. in England about 1800; author of a translation of the New Testament from the text of Griesbach (1846), and of a revision of the authorized version of the Old Testament (3 vols., 1865), of a *History of Egypt* (1846; new ed. 1860), of many works on Egyptian chronology and hieroglyphics, embracing editions of the Rosetta Stone and the Decree of Canopus, of *Texts from the Bible explained by Ancient Monuments* (1866), *Chronology of the Bible* (1860), *History of the Hebrew Nation and Literature*, and of a work claiming to decipher the mysterious Sinaitic inscriptions (1876).

Sharpes'burg, tp., Iredell co., N. C. P. 947.

Sharps (CHRISTIAN), b. in New Jersey in 1811; became a machinist, thoroughly conversant with every branch of his art, and invented the "Sharps rifle," which has proved so serviceable a weapon to the hunters on the Plains. In 1854 he settled at Hartford, Conn., to superintend the manufacture of this rifle, and subsequently invented other fire-arms of great value, and patented many ingenious implements of other kinds. D. at Vernon, Conn., Mar. 13, 1874.

Sharps'burg, p.-v., Bath co., Ky. P. 319.

Sharpsburg, p.-v. and tp., Washington co., Md., on Potomac River and Washington co. branch of Baltimore and Ohio R. R. P. of v. 1001; of tp. 2478.

Sharpsburg, p.-b., Indiana tp., Allegheny co., Pa., on Allegheny River, Allegheny Valley R. R., and Western Pennsylvania division of Pennsylvania R. R. P. 2176.

Sharps Rifle, on the breech-block principle, has a calibre of 0.500 inch, rifled, the breech-action being confined to three parts—the lever, the slide, and the extractor. The lever forming the trigger-guard opens the breech. The breech-slide is spheroidal, permitting the use of cartridges with varying thickness of base. The cartridge is rim-fire metallic, and the bullet cylindro-conoidal, with three cannelures, solid base, and flattened point. (See SMALL-ARMS.)

Sharps'town, p.-v., Pilesgrove tp., Salem co., N. J. P. 296.

Sharps'ville, p.-v., Mercer co., Pa., midway on Erie and Pittsburg R. R., has 5 churches, a large public school building, 1 bank, 1 newspaper, 9 blast furnaces, foundry and machine-shop, 2 carriage-factories, and 1 hotel. Principal business, manufacturing pig iron. P. about 1500.
P. J. BARTLESON, ED. "ADVERTISER."

Sharp'town, p.-v. and tp., Wicomico co., Md., on Nanticoke River. P. 695.

Shars'wood (GEORGE), LL.D., b. at Philadelphia, Pa., July 7, 1810; graduated at the University of Pennsylvania 1828; was admitted to the Philadelphia bar 1831; became a judge of the district court 1845, president judge 1851-67, judge of the supreme court of Pennsylvania 1867, and for many years professor in the law-school of the University of Pennsylvania. Author of *Professional Ethics* (1854; new ed. 1864), *Popular Lectures on Commercial Law* (1856), *Lectures Introductory to the Study of the Law* (1870), and editor of Blackstone (1859), Starkie, Roscoe, and other English law-writers.

Shas'ta, county of N. California, extending from the Sierra Nevada on the E. to the Coast Range on the W., intersected by Sacramento and Pitt Rivers, and traversed by the Oregon division of Central Pacific R. R., has several elevated peaks, is covered in its mountainous portion with forests of pine and redwood, contains several boiling

springs and some mines of gold, silver, and copper, has a soil exceedingly fertile in the bottom-lands, and a climate well adapted to the production of semi-tropical fruits. Staples, wheat, barley, hay, wine, wool, and butter. Cap. Shasta. Area, about 4000 sq. m. P. 4173.

Shasta, p.-v., cap. of Shasta co., Cal., on Sacramento River and Oregon division of Central Pacific R. R., has 1 newspaper and flourishing mines.

Shasta, Mount. See CALIFORNIA.

Shas'tra [Sans. *s'âs*, to "teach"], a name applied to the authoritative books of the Hindoos upon religion and law, civil and religious. The most important works of this class are collectively called *Dharma-s'âstra*, or "Law Shastra."

Shatsk, town of Russia, government of Tambov, on the Shat, has some manufactures and 6488 inhabitants.

Shatt-el-Arab. See EUPHRATES.

Shat'tuck (GEORGE CHEYNE), M. D., LL.D., b. at Templeton, Mass., July 17, 1783; graduated at Dartmouth College 1803; became a highly successful physician at Boston and president of the Massachusetts Medical Society; published several professional works; contributed largely to the library of Dartmouth College, and built an observatory for that institution. D. at Boston Mar. 18, 1854. By his will he left more than $60,000 to charitable objects. (See SHATTUCK SCHOOL.)

Shattuck (LEMUEL), b. at Ashby, Mass., Oct. 15, 1793; was for several years a teacher in New Hampshire, New York, and Michigan; a merchant at Concord, Mass., 1823–33; afterward a bookseller and publisher in Boston, where he was a member of the common council 1837–41; was one of the founders of the New England Historic-Genealogical Society 1844, and for five years its vice-president; a member of several other literary and scientific associations, and sat several years in the Massachusetts legislature. D. at Boston Jan. 17, 1859. Author of a *History of Concord, Mass.* (1835), *Vital Statistics of Boston* (1841), *Census of Boston* (1845), *Report on the Sanitary Condition of Massachusetts* (1850), and of a genealogy of the Shattuck family.

Shattuck School, Faribault, Minn., is a collegiate boarding school under the auspices of the Protestant Episcopal Church. It was organized under a State charter in 1865. The name is in honor of a liberal patron, George C. Shattuck, M. D., of Boston, Mass. The bishop of Minnesota is president of its trustees. Boys of ten years and upward are fitted for the junior class in college or for business. It has a military organization under the charge of a U. S. officer. The school occupies two fine stone buildings as a home; has a beautiful stone chapel and fireproof library and other buildings, admirably situated on 50 acres of land; the present value (in 1876) is $90,000. It has no endowments. It numbers 100 boarders. The president is Rev. James Dobbin, A. M. R. W. LOWRIE.

Shaum'burg, p.-v. and tp., Cook co., Ill. P. 931.

Shaw (GEORGE), M. D., F. R. S., b. at Bierton, Buckinghamshire, England, Dec. 10, 1751; graduated at Magdalen Hall, Oxford, 1769; took orders in the Church of England 1774, but relinquished the clerical profession for scientific pursuits; studied medicine at Edinburgh and Oxford, taking the degree of M. D. 1787, after which he settled in London as a scientific lecturer; was one of the original members and the first vice-president of the Linnæan Society; lectured on natural history at the Leverian Museum; became librarian and assistant keeper of natural history at the British Museum 1791, and principal keeper 1807. D. in London July 22, 1813. Author of *The Naturalist's Library* (24 vols., 1790–1813), *Zoology of New Holland* (1794), *General Zoology, or Systematic Natural History* (11 vols., 1800–19), *Zoological Lectures at the Royal Institution* (2 vols., 1809), and of many memoirs in the Philosophical and Linnæan Society's *Transactions*.

Shaw (HENRY W.), b. at Lanesborough, Mass., in 1818; resided for twenty-five years in various parts of the Western States, where he was successively farmer and auctioneer; settled at Poughkeepsie, N. Y., in the latter capacity about 1858; began to write humorous sketches for the newspapers over the signature "Josh Billings" 1863; became immediately popular both as a writer and as a lecturer; has published several volumes of comic sketches, and edited an annual *Allminax*, which has had a wide circulation. His *Complete Works* were published in a single volume in 1876.

Shaw (JOHN), M. D., b. at Annapolis, Md., May 4, 1778; graduated at St. John's College 1795; studied medicine; was surgeon on the American squadron sent against Algiers 1798, and secretary to Consul Eaton at Tunis; studied medicine at Edinburgh, Scotland, 1801–02; went with the earl of Selkirk to Canada 1803, where that nobleman was engaged in founding a settlement on St. John's Island in Lake St. Clair; returned to Annapolis and began practice 1805; removed to Baltimore 1807; contributed both prose and poetry to Dennie's *Portfolio* and other periodicals. D. at sea while on a voyage from Charleston to the Bahamas Jan. 10, 1809. His collected *Poems* appeared, with a *Memoir*, in 1810.

Shaw (LEMUEL), LL.D., b. at Barnstable, Mass., Jan. 9, 1781; graduated at Harvard 1800; became an usher at the Franklin School, and assistant editor of the Boston *Gazette*; studied law with David Everett; was admitted to the bar in New Hampshire Sept., 1804; sat in the legislature 1811–16 and in 1819, and in the State constitutional convention 1820; was State senator 1821–22 and 1828–29, and chief-justice of the Massachusetts supreme court from Aug. 31, 1830, to Aug., 1860. His reported decisions in the collections of Pickering, Metcalf, Cushing, and Gray amount to above 50 vols., and his judicial reputation in Massachusetts was second only to that of Theophilus Parsons. The city charter of Boston was drafted by him in 1822. He was a member of the American Academy, of the Massachusetts Historical Society, and for twenty-seven years one of the corporation of Harvard College. He published a few orations, addresses, and judicial charges, the most important being that upon the trial before him of Prof. John White Webster for the murder of Dr. George Parkman (1850). D. at Boston Mar. 30, 1861.

Shaw (ROBERT GOULD), b. at Gouldsborough, Me., June 4, 1776; became a successful merchant at Boston, where he d. May 3, 1853. By his will he bequeathed $110,000 for a "Shaw fund" to be kept at interest until it accumulates to $400,000, when it is to be applied to found an asylum for the children of sailors.

Shaw (ROBERT GOULD), grandson of the preceding, b. at Boston, Mass., Oct. 10, 1837; graduated at Harvard 1860; entered the famous 7th regiment of New York as a private Apr., 1861, which he accompanied to Washington; became in the following month lieutenant of the 2d Massachusetts regiment; captain Aug. 10, 1862; colonel 54th Massachusetts Volunteers, Apr. 17, 1863, being the first regiment of colored soldiers from a free State mustered into the U. S. service; killed at the assault of Fort Wagner, July 18, 1863, after having reached the parapet of the work at the head of his regiment, which led the advance.

Shaw (SAMUEL), b. at Boston, Mass., Oct. 2, 1754; educated at the Latin School; entered the counting-house of his father, Francis Shaw; was commissioned lieutenant of artillery Jan. 1, 1776; served through the war of the Revolution, being at its close major of artillery and aide-de-camp to Gen. Knox, by whom he was made chief clerk of the war department May, 1785, on his return from a voyage to China; was appointed U. S. consul at Canton, China, Feb., 1786, and made several mercantile voyages between that port and New York. D. at sea while returning to Boston from China May 30, 1794. His *Journals*, with a *Memoir* by Josiah Quincy, were printed in 1847.

Shaw (THOMAS), D. D., F. R. S., b. at Kendal, England, about 1692; educated at Queen's College, Oxford, of which he became fellow 1727; was twelve years chaplain to the English factory at Algiers, after which he travelled through Northern Africa to Egypt, Palestine, and Asia Minor; returned to England 1734; published *Travels and Observations relating to Several Parts of Barbary and the Levant* (Oxford, folio, 1738), republished in Pinkerton's *Voyages* (vol. xv.), a *Supplement* (1746), and a *Further Vindication, etc.* (1747), both in reply to Dr. Pococke and other critics who had questioned the accuracy of his observations. The work of Dr. Shaw has maintained its reputation as one of the best of its kind, having been translated into French and Dutch, and new editions having appeared in 1757 and 1808, both of which contain the supplementary publications. In 1740, Dr. Shaw became principal of St. Edmund's Hall, Oxford, and regius professor of Greek, being also collated to the vicarage of Bramley, Hampshire. D. at Oxford Aug. 15, 1751.

Shaw (THOMAS BUDD), b. in London, England, in 1813; educated in the free school at Shrewsbury and at St. John's College, Cambridge; became professor of English literature at the Imperial Alexander Lyceum, St. Petersburg, 1842, and at the University of St. Petersburg 1851, and was tutor in English to the imperial family of Russia from 1853 until his death, at St. Petersburg Nov. 14, 1862. Author of *Outlines of English Literature* (1848; new ed. 1864) and *Student's Specimens of English Literature* (1864), both valuable works. The former was edited in the U. S. by H. T. Tuckerman.

Shawa'no, county of N. E. Wisconsin, intersected by Oconto, Wolf, and Embarras rivers and their numerous tributaries, having in its centre Lake Shawano; has a gen-

erally level surface and a fertile soil. Staples, wheat, oats, and potatoes. Cap. Shawano. Area, 1260 sq. m. P. 3166.

Shawano, p.-v. and tp., cap. of Shawano co., Wis., on Wolf River, has 2 newspapers (1 German). P. 298.

Shawangunk (shong′gum), p.-v. and tp., Ulster co., N. Y., on Wallkill Valley branch of Erie R. R. P. 2823.

Shawl [Per. *shâl*], a kind of loose garment worn on the shoulders or around the waist, manufactured by the different nations of different materials, as the Cashmere shawl of goat's hair, the Chinese of silk, the barège of wool, etc., and in different patterns, as the palm pattern of India, the plaid pattern of Scotland, etc. The most celebrated kind is the Cashmere shawl, famous over the whole world as early as the sixteenth century. Its manufacture was then under the supervision of the government, and each shawl which issued from the looms received a separate description in the royal registers. The manufacture is still flourishing in CASHMERE (which see), though it is imitated extensively in France, Germany, and England. In Europe shawls are mostly made of wool, of cotton, or of mixed cotton and silk.

Shawnee′, county of N. E. Kansas, on Kansas River, traversed by Kansas Pacific, Kansas Midland and Atchison Topeka and Santa Fé R. Rs., has an undulating prairie surface, with abundance of coal and limestone, and several flourishing manufactures. Staples, Indian corn, wheat, oats, potatoes, hay, and butter. Cap. Topeka, which is also the State capital. Area, 546 sq. m. P. in 1870, 13,121.

Shawnee, tp., Cherokee co., Kan. P. 894.

Shawnee, p.-v. and tp., Johnson co., Kan., on Missouri River Fort Scott and Gulf R. R. P. 2451.

Shawnee, tp., Wyandotte co., Kan. P. 1243.

Shawnee, tp., Fountain co., Md. P. 867.

Shawnee, tp., Cape Girardeau co., Mo. P. 1676.

Shawnee, tp., Allen co., O. P. 1169.

Shawnees, a tribe of American Indians of the Algonkin family, supposed to have been originally identical with the Kickapoos, was first known on the banks of Fox River, in the present State of Wisconsin, in 1648; engaged in war with the Iroquois; was for the most part driven southward to Cumberland River, whence it dispersed, parts of it going to Florida, others to North Carolina, and several bands to Pennsylvania. The latter were parties to Penn's famous treaties of 1682 and 1701, and to those made with the Iroquois at Albany in 1693 and 1722. The Florida bands ultimately settled in the Carolinas, where they were known as Savannahs and Yemassees, lived for a time with the Creeks, and finally joined the northern bands which were driven W. by the Iroquois, and settled on Scioto River. They were usually favorable to the French, whom they aided in the Seven Years' war, took part in the conspiracy of Pontiac, were subdued by Col. Bouquet, were at the head of the confederacy of Western tribes which fought at Point Pleasant Oct., 1774, repulsed Col. Bowman from their towns in Ohio 1779, fought against the expeditions of Harmer, St. Clair, and Wayne, and made peace at the treaty of Greenville 1795. About this time a portion of the tribe settled in Missouri under the protection of the Spanish authorities, and another portion emigrated southward. About 1805 a so-called "prophet" named Elskwatawa, then living on the upper Wabash, and his brother, the celebrated Tecumseh, became the chief leaders of the Shawnees, and attempted to form a confederacy of all the North-western Indians against the whites, visiting for that purpose most of the tribes from the great lakes to the Gulf of Mexico. This project was defeated by Gen. Harrison, who in 1811 marched upon the prophet's town, and routed the gathering forces at Tippecanoe Nov. 7. On the outbreak of the war of 1812, Tecumseh resumed his intrigues, proceeded with a band of Shawnees to Canada, made an alliance with the British, who commissioned him brigadier-general, and fell at the battle of the Thames Oct. 5, 1813. (See TECUMSEH.) The Shawnees on the Scioto remained neutral, sold their lands in 1831, as those in Missouri had done in 1825, and with them settled upon a vast reservation in the Indian Territory, now in Kansas. By the treaty of 1854 the tribal relation was terminated. The Shawnees now number about 1600 souls, some of them living with the Sacs and Foxes, a few with the Quapaws, and others with a band of Senecas. Missions have long been maintained among them by the Methodists, Baptists, and Quakers, and most of them have become civilized.

PORTER C. BLISS.

Shaw′neetown, p.-v., cap. of Gallatin co., Ill., on Springfield and Shawneetown branch of Ohio and Mississippi and the Shawneetown branch of St. Louis and Southeastern R. Rs., has 3 churches, 2 banks, 2 newspapers, excellent schools, 1 foundry, 2 large mills, and 1 hotel. Principal business, farming, salt-making, and coal-mining. P. 1309. F. M. PICKETT, ED. "SHAWNEE HERALD."

Shaw's Creek, tp., Edgefield co., S. C. P. 1760.

Shaws′wick, tp., Lawrence co., Ind. P. 2560.

Shays (DANIEL), b. at Hopkinton, Mass., in 1747; attained the rank of captain during the war of independence, after which he resided at Pelham (now Prescott); took part in an insurrectionary movement in Western Massachusetts directed against the State government 1786, and, though not at first a leader, became ultimately so prominent that the movement is generally known as "Shays's rebellion," the pretexts of which were the high salary paid the governor, the aristocratic character of the Senate, the extortions of lawyers, and the pressure of taxation—grievances which were to be met by the removal of the general court from Boston and the issue of paper money. In Dec., 1786, he led a considerable force of insurgents to Worcester, where he prevented the holding of the Massachusetts court of common pleas, and with 2000 men marched to Springfield to capture the arsenal (Jan., 1787), but was repulsed by the militia under Gen. William Shepard (Feb. 4, 1787). His forces were surprised and completely dispersed by Gen. Lincoln, and Shays fled to New Hampshire; was pardoned in June, 1788, by the Massachusetts legislature, and removed to Sparta, Livingston co., N. Y., where he received a pension for his Revolutionary services, and survived until Sept. 29, 1825. (See Minot's *History of the Insurrection* and Holland's *History of Western Massachusetts*, Worcester, 1788.)

Shea (JOHN D. GILMARY), LL.D., b. in New York City July 22, 1824; educated at the grammar school of Columbia College; studied law, and was admitted to the bar, but has devoted himself chiefly to literature, and has rendered great service in illustrating the obscure early annals of French colonization and Jesuit missions. He has published *The Discovery and Exploration of the Mississippi Valley* (New York, 1853), *History of the Catholic Missions among the Indian Tribes of the U. S.* (1854), *Perils of the Ocean and Wilderness* (1857), *The Catholic Authors of America* (1858), *The Fallen Brave* (1861), *Early Voyages up and down the Mississippi* (Albany, 1862), *Novum Belgium, an Account of New Netherlands in 1643–44* (New York, 1862), *The Operations of the French Fleet under Count de Grasse* (1864), *The Lincoln Memorial* (1865); has translated, with extensive notes, Charlevoix's *History and General Description of New France* (6 vols. 8vo, 1866–72); edited from the MSS. the "Cramoisy" series of *Memoirs and Relations concerning the French Colonies in North America*, embracing documents on the early history of Canada and Louisiana (24 vols., 1857–68), *Washington's Private Diary* (1861), Colden's *History of the Five Indian Nations* (1866), being a reprint of the edition of 1727, Alsop's *Maryland* (1869), 15 vols. of grammars and dictionaries of Indian languages (1860–74); was joint author and translator into English of Courey's *Catholic Church in the U. S.* (1856); prepared for several years the *Catholic Almanac*; revised and corrected several very erroneous Catholic Bibles; issued several prayer-books, school histories, and translations of religious treatises; edited the *Historical Magazine* (1859–65); contributed largely to the *Catholic Magazine* and other periodicals, and to the transactions of historical and philological societies; superintended for a considerable period Frank Leslie's illustrated periodicals, and wrote most of the articles on American Indian tribes for Appletons' *Cyclopædia*. Few American scholars enjoy a higher reputation for accuracy in the several departments to which he has devoted himself.

Shea′fer (PETER WENRICK), b. in Dauphin co., Pa., Mar. 31, 1819; educated at Oxford Academy, N. Y.; became a surveyor, geologist, and mining engineer; displayed a pronounced taste for literature and science; assisted his father, Henry Sheafer, president of the Lykens Valley R. R. and superintendent of the Lykens Valley Coal Co., in introducing that celebrated fuel in the Susquehanna market as early as 1834; joined Prof. H. D. Rogers in the first geological survey of Pennsylvania 1838; was especially active in tracing the remarkable geological features of the "Second Mountain" range extending from near Pottsville to beyond Shamokin and Tamaqua; settled at Pottsville 1848, has since as a mining engineer been one of the chief promoters of the wonderful development of the anthracite and iron interests of that vicinity, having managed, among many others, the coal-mines of the Philadelphia and Reading Coal and Iron Co. and those bequeathed by Stephen Girard to the city of Philadelphia; has extended his professional engagements to the British provinces and to the Deep River coal lands of North Carolina; has been often consulted as an expert in complicated questions of mining-property law; has published many maps and statistical reports; delivered lec-

tures on coal at Lafayette College and elsewhere; secured in 1819 the passage of a bill for the completion of the first State survey; was influential in 1873 in securing the appointment of Prof. J. P. Lesley to make a new geological survey, and is a prominent member of many scientific, charitable, and religious organizations. Among his publications, the map of Pennsylvania as it was in 1775, issued 1875 by the Pennsylvania Historical Society, deserves especial notice.

Sheaffe (Sir Roger Hale), Bart., b. at Boston, Mass., July 15, 1763; obtained a commission in the British army 1778 through Earl Percy, whose head-quarters had been at his mother's house at Boston three years before; had risen to the rank of major-general in 1811; served in Canada 1812–13; took command of the British forces at the battle of Queenstown, after the death of Gen. Brock, and succeeded in inflicting a serious defeat upon the American invaders, for which service he was made a baronet Jan. 16, 1813; defended York (now Toronto) against the attack of Apr., 1813, and became full general in 1828. D. at Edinburgh, Scotland, July 17, 1851.

Sheak'leyville, p.-b., Sandy Creek tp., Mercer co., Pa. P. 273.

Shears, or **Sheers,** a form of the crane or derrick used in masting and rigging ships. It is sometimes mounted on land and sometimes on a floating vessel called a shear-hulk. Still other forms of the crane are called by this name.

Shears (Rev. Alonzo Groesbeck), M. D., b. in Washington, Dutchess co., N. Y., Feb. 3, 1811; educated at Wesleyan University, he became M. A. at Trinity and Yale colleges, and M. D. of New York Medical College; was ordained by Bishop Whittingham in Trinity church, New York, Mar. 4, 1849; founded the New Haven Suburban Home School, of which he was rector seventeen years; visited Europe and the East; preached in Great Britain, Rome, Naples, Jaffa, Jerusalem, and elsewhere; wrote *Sermon on Brotherly Love* (Toledo, O.), *Laus Deo*, with music (1867), *Letters from Abroad*; editor of New Haven *Musical and Masonic Magazine*, and contributed to various periodicals; has charge of a parish in New Haven.

Shear'water, a name bestowed on species of the subfamily Puffininæ and family Procellariidæ, to which belong the petrels or Mother Carey's chickens, etc. The species are of moderate size, the greater shearwater (*Puffinus major*) being about eighteen to twenty inches in length, and the Manx shearwater (*Puffinus anglorum*) about fifteen inches long. They are often met with at sea hundreds of miles from land. Above, they are brown or cinerous, and below white; the tail is rather long and rounded; the feet large; the tarsus shorter than the middle digit; the nasal tubes are short, flat, and obliquely truncated. (See also Procellaridæ.) Theodore Gill.

Sheath'bill, the English name of the species of the family Chionididæ and genera *Chionis* and *Chionarchus*. Only two species are known, and both are inhabitants of the southern hemisphere—one, *Chionis alba*, being native to the Falkland Islands, etc., and the other, *Chionis* or *Chionarchus minor*, is peculiar to Kerguelen's Island. Much difference of opinion has prevailed among naturalists respecting the relations of these birds to others in the class, some having regarded them as waders (Grallatores), others as swimmers (Natatores), and others still as gallinaceous forms. The recent researches of Drs. J. H. Kidder and Elliot Coues (*Bulletin of the U. S. National Museum*, No. 3, 1876) have, however, established the fact that they are most nearly connected with the gulls (Laridæ), and that they form a family (Chionididæ) next to the Laridæ, but distinguishable, perhaps, as the representative of a peculiar super family (Chionidimorphæ). These relationships are expressed especially in the skeleton, and above all in the skull. In their economy and habits they strongly simulate pigeons and fowl; according to Kidder, who studied the species of Kerguelen's Island in life, the "observer is first struck by the strong resemblance which *Chionis* bears to the pigeons in general appearance, gait, and mode of flight. The general shape of the body is of an ordinary columbine character, the head being notably small, as usual in that group, the neck short and full, and the body plump; the tail, moreover, having but twelve rectrices." "The feet, in almost every particular, are thoroughly gallinaceous, even to the character of the marginal fringe of the toes." In color, however, they recall rather the characteristics of the gulls than of either gallinaceous or columbine forms. "On the other hand, the bird's omnivorous diet, habits under confinement, easy domestication, dislike of water, entire inability to swim, and many other points in its habits are strongly gallinaceous characteristics, by so much removing it from the vicinity of either grallatorial or natatorial birds." Nevertheless, the indications furnished by the skeleton outweigh all such superficial correspondences, and conclusively prove that the birds in question are derivatives from gull-like (and therefore primarily natatorial) types, but modified for terrestrial life. They are quite omnivorous in diet, feeding upon vegetable substances (sea-weeds, etc.), mollusks, and eggs. The *Chionis alba* has a total length of about seventeen inches or more, and the *Chionarchus minor* about fourteen or fifteen inches. They are called by whalers "white paddy." Theodore Gill.

Sheath'ing, for a ship's bottom, is made of sheet copper, and was first introduced about 1800. It not only serves to protect wooden ships from boring-shrimps, teredoes, and other small destructive animals, but to a great extent it prevents the fouling of the bottom by sea-weeds and barnacles.

She'ba, or **Saba,** the name of three persons in the Old Testament: (1) A great-grandson of Ham (Gen. x. 7), who appears to have settled somewhere on or near the shores of the Persian Gulf.—(2) The tenth of the thirteen sons of Joktan (Gen. x. 28), who settled in Southern Arabia, and gave his name to the kingdom whose queen visited Solomon in Jerusalem (1 Kings x. 1–13).—(3) A grandson of Abraham and Keturah (Gen. xxv. 1–3), whose descendants were nomads, in close connection with the descendants of the Hamitic Sheba mentioned above. R. D. Hitchcock.

Shebance, tp., Iroquois co., Ill. P. 2530.

Sheboy'gan, county of E. Wisconsin, on Lake Michigan, watered by Sheboygan River and Pigeon Creek, traversed by Milwaukee Lake Shore and Western, Wisconsin Central, and Sheboygan and Fond du Lac R. Rs., has an even surface affording excellent pasturage, a productive soil, and thriving manufactures. Staples, wheat, oats, potatoes, hay, vegetables, hops, maple-sugar, butter, cheese, and wool. Cap. Sheboygan. Area, about 550 sq. m. P. 31,749.

Sheboygan, city and tp., cap. of Sheboygan co., Wis., on Lake Michigan, at the mouth of Sheboygan River, on Milwaukee Lake Shore and Western R. R., at E. terminus of Sheboygan and Fond du Lac R. R., has a fine harbor, ships annually 500,000 bushels of wheat, has an extensive trade in lumber, 10 churches, 3 weekly newspapers, 2 banks, a high school, and above 50 manufacturing establishments. P. in 1870, 5310; in 1875, 6828.

Sheboygan Falls, p.-v. and tp., Sheboygan co., Wis., on Sheboygan River and Sheboygan and Fond du Lac R. R., has good water-power and flourishing mills and manufactures. P. of v. 1174; of tp. 3223.

Shech'em [Heb. *Shekem*, "shoulder," "ridge"], a very ancient city of Palestine, so called because it was on the watershed between the Mediterranean and the Jordan. It is about 35 miles N. of Jerusalem, and was Abraham's first camping-ground in the country. Jacob dug a well, and Joseph was buried there. It was one of the cities of refuge, and the first capital of the northern kingdom of Israel. In the New Testament it is called *Sychar*. During the reign of Vespasian (69–79 A. D.) it was rebuilt and named Neapolis, corrupted by the Arabs into Nablus (which see). R. D. Hitchcock.

Shechi'nah [Heb., "presence"], a name which first appears in the Jerusalem Targum to designate the Divine Presence wherever it exists in a special manner, but more particularly as manifested in the holy of holies within the ancient sanctuary of Israel.

Shedd (William Greenough Thayer), D. D., LL.D., son of a clergyman, b. at Acton, Mass., June 21, 1820; graduated at University of Vermont in 1839, and at Andover Theological Seminary in 1843; was pastor of the Congregational church in Brandon, Vt., 1844–45; professor of English literature in the University of Vermont 1845–52; professor of sacred rhetoric and pastoral theology in Auburn Theological Seminary 1852–53; professor of ecclesiastical history and lecturer on pastoral theology in Andover Theological Seminary 1853–62; pastor of the Brick church (Presbyterian), New York City, 1862–63, and professor of biblical literature in Union Theological Seminary, New York City, 1863–74, when he was transferred to the chair of systematic theology in the same institution. Besides editing the *Works* of Coleridge (7 vols., 1853) and the *Confessions* of Augustine (1860), he has published *Outlines of a System of Rhetoric*, from the German of Theremin (1850), *Lectures upon the Philosophy of History* (1856), *Discourses and Essays* (1856), Guericke's *Church History* (2 vols., 1857, 1870), *A History of Christian Doctrine* (2 vols., 1863), *Homiletics and Pastoral Theology* (1867), and *Sermons to the Natural Man* (1871). He has also published occasional addresses and essays.

Shediac', p.-v., Westmoreland co., N. B., on European and North American and Intercolonial railways, 106 miles

from St. John, and on Shediac Island and the Gulf of St. Lawrence. It has a fair harbor, some trade, and a weekly newspaper. P. about 500.

Shee (Sir Martin Archer), D. C. L., b. in Dublin, Ireland, Dec. 23, 1770; studied painting at the school of the Royal Dublin Society; was introduced in 1788 by Edmund Burke to Sir Joshua Reynolds, under whose patronage he entered as a pupil in the Royal Academy; became an exhibitor in the following year; was elected an associate of the academy 1798 and a member 1800, and was chosen successor to Lawrence as president of that institution in 1830, on which occasion he was knighted. He took Romney's house in Cavendish Square 1798, obtaining as a portrait-painter the patronage of the latter's distinguished friends; was a formidable rival of Lawrence, and in a long career preserved the lineaments of many illustrious men. He retained the presidency of the academy through life; was an effective orator on public occasions; survived all his original academical associates, and received a pension during his later years. D. at Brighton Aug. 19, 1850. Author of several poems, a tragedy, and a novel. A *Life*, by his son (2 vols., 1860), was published at London.

Sheeah. See Shias.

Sheen's, tp., Sanford co., Ala. P. 567.

Sheep. See Appendix.

Sheep'shanks (John), b. at Leeds, England, in 1787, son of a wealthy cloth-merchant, by whom he was bred to the same business; employed his fortune and his leisure in forming a magnificent collection of pictures by English artists, including many of the best works of Turner, Stanfield, and Chalon, which in 1856 he presented to the nation upon certain conditions, and which is now a prominent feature of the South Kensington Museum. D. at London Oct. 6, 1863.—His brother, Richard, b. at Leeds in 1794, graduated at Trinity College, Cambridge, 1816, where he became a fellow 1817; studied law; was called to the bar 1822; became a clergyman about 1824; devoted himself to mathematics and astronomy, being elected to the Royal Astronomical Society 1824, and fellow of the Royal Society 1830; had a fine observatory, first at London and afterward at Reading; conducted a long series of experiments in the rooms of the Astronomical Society at Somerset House; was a boundary commissioner under the Reform bill 1831; completed the restoration (begun by Francis Baily) of the national standards of weights and measures destroyed by the burning of the houses of Parliament 1834, a task which occupied him eleven years; wrote a valuable series of astronomical articles for the *Penny Cyclopædia*, and published a number of scientific memoirs. D. at Reading Aug. 4, 1855.

Sheeps'head (the *Archosargus probatocephalus* of recent American authors, the *Sargus ovis* of most ichthyological works), a well-known and esteemed fish of the family Sparidæ, found along the Atlantic coast of the U. S. south of Cape Cod, but most abundant in the warmer waters. The name is given in allusion to a fancied resemblance of the head to that of a sheep, produced by the form and color as well as the cutting teeth of the jaws. The form is compressed oval, the profile very declivous; the dorsal fin has twelve spines and eleven rays, and is preceded by a recumbent spine; the anal fin has three spines and ten rays; the color is distributed in five or six blackish bands; the front or incisor teeth are quite broad, the lateral teeth molars, and in several rows. The species frequently exceeds two feet in length, although averaging less. It is one of the most esteemed fishes found in American waters, and on account of the delicacy of its flesh has been likened to the English turbot. It is also highly regarded as a game-fish, and its great strength and the formidable armature of the mouth render it a redoubtable antagonist for the angler. It feeds chiefly on mollusks and crustaceans, and its molar teeth and stout jaws are eminently adapted for breaking shells. Theodore Gill.

Sheep'-Tick, the *Melophagus ovinus*, a wingless parasitic insect of the order Diptera and family Hippoboscidæ. They are often extremely annoying to sheep. There are various arsenical washes which will destroy them; a solution of carbolic acid is also recommended for the purpose.

Sheeraz', or **Schiraz,** town of Persia, capital of the province of Fars, in lat. 29° 36′ N., lon. 52° 44′ E., at an elevation of 4500 feet above the sea. It is in a beautiful and fertile valley, covered with rose-gardens, vineyards, groves of platane and cypress, and orchards in which pears, oranges, cherries, and other fruits ripen to the highest perfection. It was for more than five centuries one of the most splendid cities of Persia, the residence of the ruler, the seat of science and art. Saadi died here 1282, and Hafiz 1388. It was magnificently built, and celebrated both for its delicious climate and for its elegant manufactures. But in 1812 a large portion of it was laid in ruins by a fearful earthquake, and the rest of it was nearly destroyed by the same cause in 1824. It was rebuilt, but in 1853 a new and still more fearful earthquake destroyed it for the second time. It has been rebuilt once more, but not in the same style, and its manufactures and trade have declined considerably. Of its buildings, the large bazaar, the mosques, and the numerous public baths are the most remarkable. Its gardens are still wonderful. P. about 40,000.

Sheerness', a seaport and market town of England, on the right bank of Medway River, at its junction with the Thames. The harbor is safe and commodious, and, being almost at the mouth of the Thames estuary, often crowded with vessels. As a naval establishment it is of inferior importance, being principally used for fitting out, refitting, and repairing ships of war, and in this capacity may be considered auxiliary to the great dockyard of Chatham, 13 miles higher up the Medway. The principal commercial business of the place is due to the fisheries, supplying shipping, the corn-trade, etc. It is also a favorite summer resort. P. 16,880.

Shef'field, town of England, West Riding of Yorkshire, at the junction of the Sheaf and the Don, is picturesquely situated at the foot and on the slopes of a range of hills, and is generally well built, though it presents a rather unpleasant aspect on account of the smoke and dust with which its numerous factories envelop it. Noticeable among its public buildings are the parish church, 240 feet long, 130 feet broad, built in the reign of Henry I.; St. Mary's Roman Catholic church; the cutlers' hall; the town hall; the new music hall, etc. Its educational and benevolent institutions are numerous and good. Its school of art enjoys a great reputation; a public park was opened in 1874; in 1872 the places of worship numbered 123, of which 62 belonged to various Methodist denominations, 28 to the Church of England, 13 to the Congregationalists, 4 to the Baptists, and 4 to the Roman Catholics. The river Don is navigable to within 3 miles, and by a canal the city can be reached by vessels of 60 tons burden; its means of communication by rail are perfect. In the time of Chaucer the city was celebrated for its manufacture of cutlery, and it is still the centre in England of the manufacture of knives, files, saws, carriage-springs, and all kinds of agricultural, mechanical, medical, and optical instruments. Silver-plating and britannia metal were both invented here, and have given rise to a very comprehensive manufacturing industry. Of the old Sheffield Castle, in which Mary Queen of Scots was imprisoned for twelve years, nothing is left. P. 261,029.

Sheffield, p.-v., Concord tp., Bureau co., Ill., on Chicago Rock Island and Pacific R. R. P. 771.

Sheffield, tp., Tippecanoe co., Ind. P. 1599.

Sheffield, p.-v. and the southernmost tp. of the Housatonic Valley, Berkshire co., Mass., the State line forming its southern boundary. Westward are the Taconic Mountains (which see), of which the "Dome" (improperly named by Prof. Hitchcock in his geological report "Mount Everett") is, excepting "Greylock" (or Saddle Mountain) in Williamstown, the highest summit in Massachusetts, being 2650 feet above tide and 2000 feet above the village. Eastward the Hoosac range, rising to heights of 2000 feet, bound the valley, which, from foot to foot of ranges, here reaches the unusual width of about 4 miles, the otherwise nearly level plain of which is broken by frequent abrupt ridges or monticles of limestone or gneiss, generally wooded. The Housatonic meanders through with tortuous course and gentle current, and furnishes (for this and almost the only part of its course) no water-power. Sheffield, with a small rural population, is almost exclusively agricultural, having, if the usual grist and saw mills and a limited working of its exhaustless marble-quarries (the marble for Girard College, Philadelphia, as also much of that for the new court-house in New York City, came from them) are disregarded, no manufactures. Though the level site of the village has not the beauty of those of some of its neighboring Berkshire rivals, the region possesses a manifold variety of beautiful scenery. The autumnal splendor of its forests and the excursion-routes to the "Dome," "Sage's Ravine," to the "Bash-a-pish" Falls, to the Twin Lakes of Salisbury, etc. are unrivalled. Sportsmen, too, resort here for trout-fishing and shooting the woodcock, which are numerous in the autumn. Near the N. E. boundary, and elevated on the slopes of the Hoosacs, are the "Berkshire Soda Springs," resorted to, principally, for cutaneous diseases. There are Congregational and Methodist churches, and quite recently an Episcopal parish has been organized and a small church built. P. 2535. J. G. Barnard.

Sheffield, tp., Ashtabula co., O. P. 770.

Sheffield, p.-v. and tp., Lorain co., O., on Lake Erie and Black River. P. 973.

Sheffield, p.-v. and tp., Warren co., Pa., on Tionesta Creek and on Philadelphia and Erie R. R. P. 660.

Sheffield, p.-v. and tp., Caledonia co., Vt. P. 811.

Sheffield (John), Duke of Buckinghamshire and Normanby, b. in England in 1649; succeeded his father as earl of Mulgrave 1658; served in the Dutch wars of 1666 and 1672; defended Tangier against the Moors 1680; became privy councillor and lord chamberlain Feb., 1685; favored the revolution of 1688; was made marquis of Normanby May 10, 1694, duke of Normanby Mar. 9, lord privy seal and duke of Buckinghamshire Mar. 23, 1703, and built in St. James's Park the residence now known as Buckingham Palace and belonging to the Crown. He was said to have been an early lover of Queen Anne; was author of some poems which enjoyed fame during his own generation, and was a friend of Dryden, to whose memory he erected a monument in Westminster Abbey. D. Feb. 24, 1721. His poetical works were printed in 1723, and several times afterward. The title became extinct on the death of his son Edmund 1735, but the present marquis of Normanby is a descendant.

Shef'ford, one of the "south-eastern counties" of Quebec, Canada. It is traversed by Stanstead Shefford and Chambly Railway, is generally fertile, and possesses valuable ores of copper and iron. Cap. Waterloo. P. 19,077.

Shehr, town on the south-eastern coast of Arabia, in lat. 14° 43′ N., lon. 49° 40′ E., has some manufactures of coarse cotton fabrics and a brisk general trade, though it has no harbor, but only an open roadstead. P. 6000.

Sheik [Arab., "elder"], among the Arabs, the chief of a Bedouin tribe; a title bestowed also upon learned men, eminent religious dignitaries, and reputed saints. For instance, the grand mufti at Constantinople is called Sheikh-ul-Islam, "the chief of the faith."

Sheil (Richard Lalor), b. at Dublin, Ireland, Aug. 17, 1791; educated at the Jesuit college, Stonyhurst, England, and at Trinity College, Dublin; studied law at Lincoln's Inn; was called to the bar at Dublin 1814; wrote several successful dramas; contributed *Sketches of the Irish Bar* to Campbell's *New Monthly Magazine*, republished in the U. S. by R. S. Mackenzie (New York, 2 vols., 1854); became an effective popular orator in the agitation for Roman Catholic emancipation; was chosen by the Catholic Association, in conjunction with O'Connell, to represent that body at the bar of the House of Lords 1825; was active in promoting the election of O'Connell to Parliament 1828; was himself chosen member for Milburne Port shortly after the passage of the Relief act 1829; was returned for the county of Lowth 1831, and for Tipperary 1832; became noted as a brilliant and effective parliamentary orator, and aided O'Connell for several years in his campaign for the repeal of the Union, until 1838, when he accepted the sinecure post of commissioner of Greenwich Hospital. He subsequently became vice-president of the board of trade, member of the privy council 1839, and judge-advocate-general 1841; was master of the mint 1846–50, and was appointed minister to Tuscany 1850. D. at Florence May 23, 1851. His *Memoirs* were written by W. Torrens McCullagh (2 vols., 1855); a collection of his *Speeches* appeared at London 1845.—His younger brother, Sir Justin Sheil, became major-general and minister to Persia, and aided his wife in the preparation of a valuable work, *Glimpses of Life and Manners in Persia* (1856).

Shek'el [Heb., "weight"], a standard weight among the ancient Israelites, and also a coin of gold, silver, or copper, originally of a shekel's weight. The shekel corresponded to the Greek stater, and contained 60 *gerus* or 2 *bekahs*. There were common, sacred, and royal shekels. The gold shekel was worth about $5.69 of our money; the silver, 53 cents; the copper shekel, a little more than 3 cents.

Shelbi'na, p.-v., Shelby co., Mo., on Hannibal and St. Joseph R. R., has 1 newspaper and a considerable trade in tobacco and stock. P. 1145.

Shel'burn, p.-v., Curry tp., Sullivan co., Ind., on Evansville and Crawfordsville R. R.

Shel'burne, the southernmost county of Nova Scotia. Its coast-line is broken by numerous excellent harbors, and a part of the interior is mountainous. Maritime pursuits are chiefly followed. Cap. Shelburne. P. 12,417.

Shelburne, a seaport, cap. of Shelburne co., N. S., has a very fine harbor. Shelburne Lights, on Cape Roseway, are in lat. 43° 38.5′ N., lon. 65° 15.5′ W. The town is 141 miles S. W. of Halifax. There is excellent water-power, afforded by the river Roseway. Fishing, commerce, and shipbuilding are extensively pursued. P. about 1000; of sub-district, 2789.

Shelburne, p.-v. and tp., Franklin co., Mass., on Deerfield River and Vermont and Massachusetts and Troy and Greenfield R. Rs. P. 1582.

Shelburne, p.-v. and tp., Coos co., N. H., on Androscoggin River and Grand Trunk R. R. P. 259.

Shelburne, p.-v. and tp., Chittenden co., Vt., on Lake Champlain, Laplotte River, and Central Vermont R. R., includes Shelburne Pond, a considerable sheet of water. P. 1190.

Shel'burne (William **Fitz-Maurice Petty**), Earl of, afterward Marquis of Lansdowne, b. in Dublin, Ireland, May 20, 1737, was a great-grandson of Sir William Petty and son of John Fitzmaurice, who in 1753 was made earl of Shelburne in the peerage of Ireland. He spent his early childhood at Lixnaw, Ireland, under the tutelage of his grandfather, Thomas Fitzmaurice, earl of Kerry, by whom his education was neglected; entered Christ Church, Oxford, 1753; entered the army as an officer of the 20th regiment, commanded by Gen. Wolfe, 1757; served in the expedition against Rochefort; distinguished himself at the battles of Minden (1759) and Kloster Kampen (Oct. 16, 1760); was rewarded with the rank of colonel and the post of aide-de-camp to the king; was instrumental in negotiating the support of Henry Fox to the Bute ministry, and was chosen to Parliament for Chipping Wycombe early in 1761, but before taking his seat succeeded to the earldom, by the death of his father, May 10, 1761; became president of the board of trade and privy councillor in the Grenville ministry Apr., 1763; opposed the policy which led to the enactment of the Stamp Act and other measures oppressive to America; became a personal friend of Benjamin Franklin; was dismissed from office Sept. 8, 1763; separated from Bute and Fox, attaching himself to Pitt; declined entering the Rockingham ministry 1765; became secretary of state for the southern department in Pitt's administration July, 1766; exerted himself without success to moderate the arbitrary colonial policy of Grafton and Townshend, which became dominant during the prolonged illness of Pitt; resigned his post Oct., 1768; became thenceforth a powerful opponent of the Grafton and North administrations, especially in regard to the American questions; was intimately associated with Col. Barré; frequented the society of Johnson, Reynolds, Blackstone, and Hume; laid the foundation of an extensive library and collection of historical MSS.; visited Italy and France, making at Paris the acquaintance of many eminent men, and forming an especial friendship with the Abbé Morellet, by whom he was converted to free-trade views of political economy; became intimate soon afterward with Bentham and Romilly, and with the celebrated Unitarian divines Drs. Price and Priestley; made the latter his librarian at Bowood 1772; became secretary of state in the foreign department in the Rockingham cabinet Mar., 1782, and premier on the death of Rockingham, July, 1783; negotiated the preliminaries of peace with the U. S.; resigned Feb. 21, 1783, giving place to the coalition of Fox and North; was created marquis of Lansdowne 1784, and passed the remainder of his life in political retirement. D. in London May 2, 1805. His valuable collection of historical MSS. was sold to the government, and is now in the British Museum. (See his *Life*, by his grandson, Lord Edmond Fitz-Maurice, London, 1875–76.) Porter C. Bliss.

Shelburne Falls, p.-v., Shelburne tp., Franklin co., Mass., on Troy and Greenfield R. R., at the picturesque falls of Greenfield River, 40 feet high, which afford water-power for important manufactories of cutlery, locks, bits, and gimlets; has 3 churches, 2 banks, and an academy. A part of the village is on the S. bank of the river, in Buckland tp.

Shel'by, county of Central Alabama, bounded E. by Coosa River, intersected by the Cahawba, traversed by Selma Rome and Dalton and Louisville and Montgomery line of Louisville Nashville and Great Southern R. R., has a broken surface, with deposits of coal and iron ore. Staples, Indian corn, wheat, oats, sweet potatoes, cotton, tobacco, and wool. Cap. Columbiana. Area, about 900 sq. m. P. 12,218.

Shelby, county of Central Illinois, on Kaskaskia and Little Wabash rivers, traversed by Springfield division of Ohio and Mississippi, Chicago branch and main line of Illinois Central, and Indianapolis and St. Louis R. Rs., has a nearly level, somewhat marshy surface. Staples, Indian corn, wheat, oats, potatoes, hay, tobacco, sorghum-molasses, butter, and wool. Stock-raising is an important industry. Cap. Shelbyville. Area, 780 sq. m. P. 25,476.

Shelby, county of S. E. Indiana, on Big Blue and other tributaries of E. branch of White River, traversed by Columbus branch of Jeffersonville Madison and Indianapolis and by Indianapolis Cincinnati and Lafayette, and Cincinnati Hamilton and Dayton R. Rs., has a generally

level surface and a fertile soil. Staples, wheat, Indian corn, hay, tobacco, sorghum-molasses, butter, and wool. Horses, cattle, sheep, and swine are abundant. Cap. Shelbyville. Area, 400 sq. m. P. 21,892.

Shelby, county of W. Iowa, watered by Nishnabatona River and Mosquito Creek and their tributaries, traversed in its S. extremity by Chicago Rock Island and Pacific R. R. Staples, Indian corn, hay, oats, butter, and wool. Cap. Harlan. Area, 550 sq. m. P. 2540.

Shelby, county of N. Kentucky, traversed by Shelbyville and Lexington divisions of Louisville Cincinnati and Lexington R. R., has a hilly surface, with extensive forests and a fertile soil. Staples, Indian corn, wheat, oats, tobacco, sorghum-molasses, butter, wool, and swine. Cap. Shelbyville. Area, 460 sq. m. P. 15,733.

Shelby, county of N. E. Missouri, intersected by N. Salt and South Fabius rivers, and traversed by Hannibal and St. Joseph R. R., has a broken surface and a productive soil, with frequent deposits of limestone and of bituminous coal. Staples, Indian corn, oats, hay, butter, and wool. Sheep and swine are numerous. Cap. Shelbyville. Area, about 560 sq. m. P. 10,119.

Shelby, county of W. Ohio, on Great Miami River and Miami Canal, and traversed by Cleveland Columbus Cincinnati and Indianapolis R. R., and by Cincinnati Dayton Lima and Toledo line of Cincinnati Hamilton and Dayton R. R., has a surface level in its N. part and hilly in the S. Staples, Indian corn, wheat, oats, hay, tobacco, butter, and wool. Horses, cattle, sheep, and swine are abundant. Cap. Sidney. Area, 425 sq. m. P. 20,748.

Shelby, county of S. W. Tennessee, adjoining Mississippi, on Mississippi River, drained by Loosahatchie and Wolf rivers, traversed by Louisville and Nashville and Great Southern, Memphis and Charleston, and New Orleans St. Louis and Chicago R. Rs., has a level and fertile surface. Staples, Indian corn, cotton, and sweet potatoes. Cap. Memphis. Area, 720 sq. m. P. 76,378.

Shelby, county of E. Texas, adjoining Louisiana, from which it is separated by Sabine River, has a level surface and a rich soil. Staples, Indian corn, cotton, sweet potatoes, and swine. Cap. Centre. Area, 844 sq. m. P. 5732.

Shelby, tp., Edwards co., Ill. P. 1469.

Shelby, tp., Shelby co., Ill. P. 1058.

Shelby, tp., Jefferson co., Ind. P. 1890.

Shelby, tp., Ripley co., Ind. P. 2412.

Shelby, tp., Tippecanoe co., Ind. P. 1395.

Shelby, tp., Macomb co., Mich. P. 1695.

Shelby, tp., Oceana co., Mich. P. 557.

Shelby, tp., Blue Earth co., Minn. P. 728.

Shelby, tp., Orleans co., N. Y. P. 3366.

Shelby, p.-tp., cap. of Cleveland co., N. C., on Carolina Central R. R., 56 miles W. of Charlotte, has 4 churches, 2 excellent schools, 1 bank, 2 newspapers, a Masonic hall, a literary and temperance society, 1 tobacco-factory, a foundry, a steam saw-mill, and an extensive vineyard. P. 1849.

W. C. Durham, Ed. "Banner."

Shelby, p.-v., Richland co., O., at the junction of Baltimore and Ohio and Cleveland Columbus Cincinnati and Indianapolis R. Rs., has 6 churches, excellent schools, 1 bank, 1 newspaper, several steam grist-mills, and 3 hotels. P. 1807. S. S. Bloom, Ed. "News."

Shelby, p.-v. and tp., in the southern part of La Crosse co., Wis. P. 654.

Shelby (Isaac), b. near Hagerstown, Md., Dec. 11, 1750, son of Gen. Evan Shelby; received a common-school education; became a surveyor in Western Virginia; served as lieutenant in a company under his father's command at the battle of Point Pleasant, 1774; became captain 1776; was commissary of the frontier 1777; major and member of Virginia house of delegates 1779; colonel 1780; rendered distinguished service at King's Mountain, Oct. 7, 1780; served under Marion 1781, and under Greene with 500 mounted volunteers 1781–82, in which years he sat in the North Carolina legislature, from which he received a vote of thanks and a sword; settled in Lincoln co., Ky. (then Virginia), 1788; was a member of the constitutional convention 1791; governor of Kentucky 1792–96 and 1812–16; joined Gen. Harrison in Canada with 4000 Kentuckians raised by proclamation; took part in the victory of the Thames, for which Congress voted him a gold medal; declined the post of secretary of war 1817, and was commissioner with Gen. Jackson in negotiating a treaty with the Chickasaw Indians 1818. D. at Traveller's Rest, Lincoln co., Ky., July 18, 1826. His services are commemorated in the names of counties in nine of the Western and Southern States and in the name of a college at Shelbyville, Ky.—His son, James, b. 1784, served as major in the war of 1812–15, became general of militia, and d. in Sept., 1848.

Shelby (John), M. D., b. near Nashville May 24, 1786; was severely wounded and lost an eye while in the campaigns under Gen. Jackson against the Indians; practised his profession more than fifty years with skill and success. The second medical college in Nashville was called Shelby after him. Pres. Taylor appointed him postmaster of the capital of Tennessee. D. in Nashville May 15, 1859.

Paul F. Eve.

Shelby City, p.-v., Boyle co., Ky., on Knoxville branch of Louisville and Nashville and Great Southern R. Rs. (Danville Station). P. 223.

Shel'byville, p.-v., cap. of Shelby co., Ill., on Indianapolis and St. Louis R. R., 151 miles W. of the former place, contains 7 churches, a handsome public-school building, 3 banks, 3 newspapers, 2 large flouring mills, 1 foundry, 1 woollen mill, agricultural implement factory, and 3 hotels. The surrounding country is rich in coal and timber. P. 2051. Martin Bros., Eds. "Union."

Shelbyville, city, Noble tp., cap. of Shelby co., Ind., on Big Blue River, and at the junction of a branch of the Jeffersonville Madison and Indianapolis with Indianapolis Cincinnati and La Fayette R. R., is situated in a rich farming region, and has 7 churches, 2 banks, 3 weekly newspapers, 5 hotels, several mills, and a good fire department. P. 2731.

Shelbyville, p.-v. and tp., cap. of Shelby co., Ky., at the S. terminus of Shelby branch of Louisville Cincinnati and Lexington R. R., has 2 weekly newspapers and is the seat of Shelby College. P. of v. 2180; of tp. 4822.

Shelbyville, p.-v., cap. of Shelby co., Mo., 8 miles N. of Hannibal and St. Joseph R. R., has 4 churches, an academy, a savings bank, 1 newspaper, and 2 hotels. Principal business, stock-raising. P. 530.

W. L. Willard, Ed. "Shelby Co. Herald."

Shelbyville, p.-v., cap. of Bedford co., Tenn., on Nashville Chattanooga and St. Louis R. R. and Duck River, contains the Shelbyville Institute and high school, 10 churches, 2 newspapers, 2 flouring-mills, 1 cotton-factory, and 1 carriage and wagon factory. P. 1719.

R. C. Russ, Ed. "Commercial."

Shelbyville, p.-v., Shelby co., Tex.

Shel'don, p.-v. and tp., Iroquois co., Ill., on Cincinnati Lafayette and Chicago and Toledo Peoria and Warsaw R. Rs. P. of v. 231; of tp. 812.

Sheldon, p.-v., O'Brien co., Ia., on Sioux City and St. Paul R. R., has several churches, excellent schools, 1 newspaper, and good hotels. Business, farming and dairying. P. about 500. Frank T. Piper, Ed. "Mail."

Sheldon, p.-v. and tp., Houston co., Minn. P. 828.

Sheldon, p.-v. and tp., Wyoming co., N. Y. P. 2258.

Sheldon, p.-v. and tp., Beaufort co., S. C. P. 2225.

Sheldon, p.-v. and tp., Franklin co., Vt., on Missisquoi River and Central Vermont R. R. P. 1697.

Sheldon, tp., Monroe co., Wis. P. 615.

Sheldon (David Newton), D. D., b. at Suffield, Conn., June 26, 1807; graduated at Williams College 1830; studied at Newton Seminary; was a Baptist missionary in France 1835–39; pastor of a church at Halifax, N. S., 1840–42; became pastor at Waterville, Me., 1842; president of Waterville College 1843–53; pastor at Bath, Me., from 1853 to 1856, when he changed his theological views, and has since been pastor of Unitarian churches at Bath (1857–62) and at Waterville. Author of *Sin and Redemption* (1856) and of essays in the *Christian Review*.

Sheldon (Gilbert), D. D., b. at Staunton, Oxfordshire, England, July 19, 1598; graduated at Trinity College, Oxford, 1617; became fellow of All Souls' College 1622; obtained the vicarage of Hackney 1633, and the rectories of Ickford and Newington; was appointed warden of All Souls' and chaplain to Charles I. May, 1635; was ejected from the wardenship and imprisoned for loyalty to the royal cause 1647–48; lived in seclusion until the Restoration; became bishop of London 1660, archbishop of Canterbury 1663, and chancellor of Oxford University 1667, and built for that institution, at a cost of £16,000, the famous Sheldonian Theatre, opened 1669. D. at Lambeth Palace Nov. 9, 1677.

Sheldon (John P.), b. in Western New York in 1793; founded the first newspaper printed in English in Michigan Territory, the Detroit *Gazette*, and published it from 1817 to 1830, being official printer for several years. He subsequently emigrated to Wisconsin, and published a newspaper at Madison for about two years. D. at Winfield, Ill., in 1871. W. S. George.

Shel'drake, or **Shieldrake,** the common name of two genera of Anatinæ or river-ducks, of which the most common species is *Tadorna vulpanser*, a beautiful water-fowl of rich, brilliant colors, green, white, chestnut-brown, and black, with a vermilion-colored bill. It abounds on all the sea-coasts of Europe, making nests lined with down in abandoned rabbit burrows, feeding on marine plants and Crustacea, whence probably the name, which in America is given only to the red-breasted merganser.

Shellac. See LAC, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Shel'ley (MARY WOLLSTONECRAFT **Godwin**), daughter of William Godwin, b. in London, England, Aug. 30, 1797; educated in accordance with the peculiar social theories of her parents; married the poet Shelley Dec. 30, 1816, after having lived with him two years previously to the death of his first wife. D. in London Feb. 1, 1851. Author of *Frankenstein, or the Modern Prometheus* (1818), a singular novel displaying great power, of *Valperga*, *Lodore*, and other less successful romances; contributed to the *Cabinet Cyclopædia* a series of biographies of eminent literary and scientific men of France, Italy, and Spain, and edited the works of her husband, with biographical prefaces and notes (1839–40).

Shelley (PERCY BYSSHE), b. at Field Place, near Horsham, Surrey, England, Aug. 4, 1792. His grandfather, Bysshe Shelley, was an American, born at Newark, N. J., 1731, who acquired a large fortune, was made a baronet in 1806, and d. Jan. 6, 1815. His father, Timothy, b. Sept., 1753, married, in 1791, Elizabeth, daughter of Charles Pilfold of Effingham, Surrey. The domestic surroundings of the poet were unfortunate, neither of his parents having given him suitable training or inspired him with affection—a circumstance to which much of the waywardness of his career may be attributed. He received his early education at a school taught by the parish clergyman at Warnham; entered at the age of ten Zion House School, Brentford, where he was noted rather as an insatiable reader than as a successful student; was subject to waking dreams, and suffered from the brutality of the "fagging" system; entered Eton College at the age of fifteen; was addicted to experiments in chemistry; read much upon ghosts and the "occult sciences;" was careless of his tasks, but translated half of Pliny's *Natural History* for his own satisfaction; wrote an incredible amount of fragmentary verses, mostly "poor stuff," as he afterward perceived; composed, with his cousin Medwin, one or more plays and novels, and with another cousin, Miss Grove (with whom he was deeply enamored), a romance entitled *Zastrozzi*, which was printed in 1810, and, strange to relate, brought him £40; printed also a volume of poems, which he quickly withdrew from circulation, and of which no copy is known to be extant, and another romance, *St. Irvyne*, all within the same year (1810) in which he entered University College, Oxford; published anonymously a volume of burlesque poems; was expelled from his college Mar. 25, 1811, for having written a pamphlet entitled *The Necessity of Atheism;* went to London with his friend Hogg, who was also expelled in connection with the same affair; was left without support by his offended father, but received occasional supplies from the savings of his sisters, then at school; eloped to Scotland with Harriet Westbrook, the beautiful daughter of a retired innkeeper, and married her there Sept., 1811; effected a settlement with his father, by which he received a small annuity; travelled with his wife to York and Keswick, where he met Southey and De Quincey; proceeded to Dublin, Ireland, Feb. 24, 1812, where he printed two revolutionary pamphlets, addressed one or more political meetings, and was requested by the police to leave the city; went to the Isle of Man, to North and South Wales, Devonshire, and Caernarvonshire, making but brief residences at any point; returned to Dublin finally; settled in London May, 1812; printed early in 1813 *Queen Mab*, his first poem of real literary merit, a production strongly tinctured with anti-religious fanaticism; was remarried in London Mar. 24, 1814, but soon found his married life uncongenial; separated from his wife, settling upon her nearly all his disposable income, and about this time conceived a passion for Mary Godwin (daughter of William Godwin and Mary Wollstonecraft), which was fully returned. As neither of them had any respect for the marriage bond, they saw no difficulty in consulting their own inclinations, and proceeded to Switzerland, travelling as man and wife; returned to England at the close of 1814; obtained an annuity of £1000 in consequence of the death of his grandfather and his father's succession to the baronetcy (Jan., 1815); studied surgery during the winter of 1815–16, and daily walked a London hospital; wrote in 1815 his second poem of permanent interest, *Alastor, or the Spirit of Solitude;* proceeded to the Lake of Geneva in the spring of 1816; resided there some months in daily intercourse with Byron; returned to London in the autumn; legalized his connection with Mary Godwin by marriage Dec. 30, 1816, Harriet having shortly before (Nov. 10) drowned herself in the Serpentine; conducted an unsuccessful chancery suit against Mr. Westbrook (Harriet's father) for the custody of his two children, decision being given against him by Lord Eldon on the ground of atheism Aug. 23, 1817; settled at Great Marlow, Buckinghamshire, where he played the part of a country gentleman; made about this time the acquaintance of Keats and the brothers James and Horace Smith, and became very intimate with Leigh Hunt; published at the close of 1817 *The Revolt of Islam* (originally called *Laon and Cythna*), a grandly-conceived, sublime, and highly-original poem, but with many inequalities and blemishes; suffered much from pulmonary disease, which led him early in 1818 to leave England for the last time; travelled with his early friend Hogg to Italy, residing successively at Milan, Pisa, Leghorn, and Bagno di Lucca; visited Byron at Venice, remaining there some weeks; completed *Rosalind and Helen* (published 1819), a poem of little value; translated, or rather abridged, the *Symposium* of Plato; wrote at Byron's villa, near Este, *Julian and Maddalo,* one of his poetical masterpieces, not published during his life; proceeded to Rome in November, and to Naples Dec., 1818; spent the winter at the latter and the spring of 1819 at the former city; proceeded to Florence Oct., 1819; made in each of the Italian capitals an assiduous study of their works of art; wrote, chiefly at Florence, during this year, his two greatest works, the tragedy *Prometheus Unbound* and tne tragedy *The Cenci*, both of which were published in London in 1820; removed to Pisa Jan., 1820; wrote in this year his *Epipsychidion* and his *Witch of Atlas;* in 1821 *Adonais*, a beautiful monody on the death of Keats, and *Hellas*, a noble drama inspired by the insurrection in Greece; made a long visit to Byron at Ravenna Aug., 1821; was joined by the latter at Pisa during the ensuing winter (1821–22); commenced his unfinished poem, *The Triumph of Life;* took a summer residence Apr., 1822, at Lerici, a village on the Genoese coast; went frequently upon boating excursions with his friends, Capt. Trelawney and Lieut. Williams, and was drowned, along with the latter, in the Bay of Spezia July 8, 1822, while returning from a visit to Leigh Hunt at Leghorn, owing to their boat having capsized in a squall. The bodies were cast upon the shore many days later, and were burned in the presence of Byron and Leigh Hunt, in accordance with the quarantine laws of Tuscany. The ashes were buried by Trelawney in the Protestant burial-ground at Rome, near the tomb of Keats. A son, Sir Percy Florence Shelley, b. 1819, is still living (1876), and a daughter, Ianthe, by Shelley's first wife, was living in 1870, as were also three sisters of the poet. His poetical works were edited by his widow in 1839, and a selection of his letters, prose writings, and translations was issued by her in 1840. The first complete edition of his *Works* was edited by R. H. Shepherd (London, 4 vols., 1875). Fragmentary memoirs and reminiscences were written by Capts. Medwin (1847) and Trelawney (1858) and by Lady Shelley (1859). W. M. Rossetti prefixed a short *Memoir* to an edition of the *Poems* (1870), an unfinished *Life* was written by his college friend, T. J. Hogg (2 vols., 1858), and Denis F. McCarthy issued in 1872 *Shelley's Early Life, from Original Sources.* The *Life of Godwin* (2 vols., 1876), by C. Kegan Paul, contains some valuable elucidations. Many parts of the career of Shelley are involved in deep uncertainty, and concerning others there is an almost hopeless conflict of testimony. The text of his poems is singularly uncertain, they having usually been printed in his absence, and the judgment of the world upon his merits as a man and as a poet is still conflicting. Severely judged by most of his contemporaries in both respects, the current of opinion is now setting strongly in the opposite direction; he is styled "the poet of poets," and by the Swinburne and Rossetti school of critics, now in the ascendant in England, is regarded as the greatest English poet since Shakspeare.

PORTER C. BLISS.

Shell'-Marl, a pulverulent calcareous deposit, composed largely or exclusively of shells of fresh-water and land Mollusca, found accumulating at the bottom of a few lakes (such as Milk Pond, Sussex co., N. J.), more commonly beneath peat or muck in marshes. In the latter cases the marl occupies the place of a lake that has been filled up and obliterated, chiefly by the growth of vegetation, and has been formed from successive generations of shells which inhabited the water or the immediate shore. In a few instances marl is sufficiently pure to be used for quicklime; more generally, however, it contains too much earthy matter for this purpose, but is a very valuable fertilizer, as which it is largely used. J. S. NEWBERRY.

Shell Mound, v., Marion co., Tenn. (Nicojack P. O.), on Tennessee River, at the base of Raccoon Mountain, on Nashville Chattanooga and St. Louis R. R., is the site of the celebrated Nicojack (or Nickajack) Cave, said to extend 15 miles S. E. under Raccoon Mountain. During the civil war it was one of the chief sources which supplied saltpetre to the Confederate armies.

Shell Rock, p.-v. and tp., Butler co., Ia., on Burlington Cedar Rapids and Minnesota and Iowa Pacific R. Rs., has 2 churches, schools, 1 woollen and 2 flouring mills, and 1 newspaper. P. 1142.

Silas White, Ed "Enterprise."

Shell Rock, p.-v. and tp., Freeborn co., Minn. P. 512.

Shells, in artillery. See Projectile, by J. G. Butler.

Shells, in natural history. See Conchology, by G. W. Tryon, Jr.

Shells'burg, p.-v., Canton tp., Benton co., Ia., on Burlington Cedar Rapids and Minnesota R. R., has 1 weekly newspaper.

Shelly's Case, a celebrated case at law decided in the 23d year of Elizabeth (1591), and reported in the first part of Lord Coke's *Reports*, which established a technical dogma of the English real-property law, long known as "the rule in Shelly's case." This rule is stated by Mr. Preston, a very eminent legal writer, in nearly the following terms: When a person takes an estate of freehold—that is, for life—under a deed or will, and in the same instrument there is a limitation by way of remainder (either with or without the interposition of another estate) to his heirs or to the heirs of his body as a class of persons, the limitation to the heirs entitles the ancestor to the whole estate; if it be to the heirs of his body, he takes an estate in fee tail; if to his heirs generally, an estate in fee simple. Perhaps no reported decision has been more discussed and commented upon, or more frequently referred to in subsequent adjudications, than this. The rule as above recited has, however, been abolished by statute in New York and in many other American States, and in pursuance of this modern legislation the ancestor would take only a life estate, while his heirs would take the fee by way of remainder, according to the express language of the conveyance.

John Norton Pomeroy.

Sheloc'ta, p.-v., Armstrong tp., Indiana co., Pa. P. 113.

Shel'ter Island, p.-v. and tp., Suffolk co., N. Y. This island, embracing 8000 acres, is in Gardiner's Bay, near the E. extremity of Long Island; was originally the residence of the Manhassett Indians; was sold by the earl of Stirling to citizens of Connecticut Colony, who made a settlement here as a part of Connecticut in 1652. P. 645.

Shel'ton (Frederick William), LL.D., b. at Jamaica, L. I., in 1814; graduated at Princeton 1834; was ordained in the Protestant Episcopal Church 1847; has been settled over churches at Huntington, L. I., Fishkill-on-the Hudson, and at Montpelier, Vt., since 1854. He was a frequent contributor to the *Knickerbocker Magazine*, and author of *The Trollopiad, or Travelling Gentleman in America* (1837), *Salander and the Dragon* (1851), *Chrystalline* (1854), *The Rector of St. Bardolph's* (1853), *Up the River* (1853), and *Peeps from the Belfry* (1855).

Shel'ton (Thomas), b. in England about 1580; made the earliest English translation of *Don Quixote* (London, 2 vols. 4to, 1612–20), which was "improved" by Capt. John Stevens (3 vols. 8vo, 1705–06) and has been largely drawn upon by subsequent translators. Shelton was author of *A Century of Similes* (1640) and of a work on *Tachygraphy*. The time and place of his death are unknown.

Shelton's, tp., Pickens co., S. C. P. 218.

Shemakha, town of Russia, in Transcaucasia, on the Pirsaghut, at an elevation of 2230 feet above the sea. It is fortified, and has large and well-stocked bazaars and manufactures of silk and cotton stuffs. In the vicinity is produced much wine and fruit. P. 20,000.

Shemitic. See Semitic.

Shenando'ah, a famous Confederate war-steamer, built at Glasgow in 1863 by a London company for the China trade, under the name of the Sea King, and transferred to the Confederate government in 1864, when she was converted into a war-vessel, and afterward bore the name of Shenandoah. (For her cruise see Waddell, James Iredell, who was her commander.)

A. H. Stephens.

Shenandoah, county of N. Virginia, intersected by N. fork of Shenandoah River, consisting of a portion of the fertile "Valley of Virginia," between ranges of the Blue Ridge and Alleghany mountains, is traversed by Harper's Ferry and Valley branch of Baltimore and Ohio and by Washington City Virginia Midland and Great Southern R. R.; has deposits of iron, lead, copper, and coal, and was the theatre of many important military operations during the civil war. Staples, wheat, Indian corn, oats, hay, butter, and wool. Cap. Woodstock. Area, about 500 sq. m. P. 14,936.

Shenandoah, p.-v., Grant tp., Page co., Ia., on Nishnabatona River and on Nebraska City branch of Burlington and Missouri River R. R., has 1 weekly newspaper and a thriving trade.

Shenandoah, p.-b., Mahanoy tp., Schuylkill co., Pa., on Mahanoy branch of Lehigh Valley R. R. and Shenandoah branch of Philadelphia and Reading R. R., is an important centre of anthracite coal-mining and trade, and has 1 weekly newspaper. P. 2951.

Shenandoah Iron-Works, p.-v. and tp., Page co., Va. P. 2175.

Shenandoah River rises in Augusta co., Va., and runs N. E. along the Valley of Virginia, W. of the Blue Ridge. At Front Royal it is joined by its N. fork. It is about 170 miles long, and for 140 miles is navigated by bateaus. It joins the Potomac at Harper's Ferry, W. Va. It flows through a rich and picturesque region, and affords great water-power.

Shenan'go, tp., Lawrence co., Pa. P. 1748.

Shenango, tp., Mercer co., Pa., includes the large village of Greenville. P. 2616.

Shen'dy, town of Nubia, on the Nile, in lat. 16° 38′ 35″ N., was formerly a place of great commercial importance, and, although it has declined, large quantities of corn, cattle, and manufactured goods are sold at its weekly markets. P. 10,000.

Shen-See', province of China, bordering E. on the Hoangho, and bounded N. by Mongolia, comprises an area of 67,400 sq. m., with 10,207,256 inhabitants. It is mountainous, and rich in iron, gold, porphyry, jasper, and copper. Wheat, millet, rhubarb, ginseng, and excellent timber are produced. Cap. See-Sang-Foo.

Shen'stone (William), b. at the Leasowes, near Hales-Owen, Shropshire, England, in Nov., 1714; studied at Pembroke College, Oxford, and passed his life in retirement on his hereditary estate, writing elegies, ballads, odes, and pastorals which had considerable popularity. The poem entitled *The Schoolmistress* (1742) is the only one now remembered, being still found in many volumes of poetical selections. D. at the Leasowes Feb. 11, 1763. His *Works* and *Letters* were posthumously collected in 3 vols. 1764–69. An edition of his *Poems*, edited by Gilfillan, with a memoir, appeared at Edinburgh in 1854, and his *Essays on Men and Manners* were republished at London in 1868.

Shep'ard, tp., Crawford co., Ark. P. 335.

Shepard (Charles Upham), M. D., LL.D., b. at Little Compton, R. I., June 29, 1804; graduated at Amherst College 1824; studied botany and mineralogy at Cambridge under Nuttall; taught those branches at Boston; was for two years assistant in the laboratory of Prof. Silliman at New Haven, and for one year lecturer at the Brewster Scientific Institute at New Haven; was employed on a government commission to investigate the methods of sugar-culture and manufacture in the Southern States 1832–33; was lecturer on natural history at Yale College 1830–47; associate of Dr. J. G. Percival in the geological survey of Connecticut 1835; professor of chemistry and natural history at Amherst 1845–52, and in the Medical College at Charleston, S. C., 1851–61; afterward became again professor of natural history at Amherst; is author of a *Treatise on Mineralogy* (1832; 3d ed., enlarged, 1855), and of a *Report on the Geology of Connecticut* (1837), and has contributed many papers to the *Transactions* of scientific associations.—His son, Charles Upham Shepard, Jr., M. D., b. at New Haven Oct. 1, 1842; prepared for college at Phillips Academy, Andover, Mass.; graduated at Yale College 1863, and in medicine at Göttingen, Germany, 1867, and has been professor of chemistry at the Medical College of Charleston, S. C., since Oct., 1867.

Shepard (Silas E.), D. D., b. at New Berlin, N. Y., in 1801; d. at Troy, Pa., Oct. 12, 1877; began to preach in Pennsylvania when nineteen years old, and was in active service as a minister till his death; visited Europe, Egypt, and Palestine in 1857–58, and was one of the founders and editors of *The Christian Quarterly*. Pres. of Hiram College, O., in 1867–68.

Shepard (Thomas), b. at Towcester, England, Nov. 5, 1605; graduated M. A. at Emanuel College, Cambridge, 1627; became a preacher at Earle's-Colne, Essex; was silenced for nonconformity in 1630. He emigrated to Massachusetts, arriving at Boston Oct. 3, 1635; succeeded Hooker as pastor of the church at Cambridge Feb., 1636; was influential in founding Harvard College at that place the same year; published *New England's Lamentation for Old England's Errors* (London, 1645), *The Sound Believer* (1645), *The Clear Sunshine*

of the Gospel breaking forth upon the Indians in New England (London, 1648; New York, 1865), *Theses Sabbaticæ* (1649), and other theological works; married as his second wife a daughter of his predecessor, Rev. Thomas Hooker, after whose death he was esteemed the most learned and skilful exponent of Puritan theology in New England. D. at Cambridge Aug. 25, 1649. By a third wife he was ancestor of Pres. John Adams. He left numerous works in MS., some of which were published in England, especially *Subjection to Christ* (1652), to which was prefixed a *Life* of Shepard by Samuel Mather and William Greenhill; *The Parable of the Ten Virgins Opened and Applied* (London, folio, 1660; new eds. 1839, Aberdeen, 1838), and various collections of *Sermons*. He left an *Autobiography*, first printed at Cambridge (1832) for the "Shepard Congregational Society." A collective edition of his *Works* appeared at Boston (3 vols., 1853), with a *Memoir* of his life and character by Rev. Dr. Alger of Cambridge. A full memoir by Cotton Mather may be found in the *Magnalia Christi Americana*, and another in the *Lives of the Chief Fathers of New England*.

Shepard (William), b. in Massachusetts Dec. 1, 1737; served through the French war as captain under Sir Jeffrey Amherst, and through the Revolutionary war, during which he participated in twenty-two engagements; became a farmer at Westfield, Mass., and was brigadier-general of militia when in 1787 he was entrusted with the defence of the arsenal at Springfield against the insurgents led by Daniel Shays; was a member of the executive council 1788–90; became major-general of militia; was member of Congress 1797–1803, and passed his later years in great poverty. D. at Westfield Nov. 11, 1817.

Shep'herd, tp., Jefferson co., West Va. P. 1859.

Shepherd (Alexander R.), b. at Washington, D. C., Jan. 31, 1835; was apprenticed to a carpenter at the age of ten years, and to a plumber at the age of seventeen; became a successful business-man in the plumbing business; took an active part in local politics, especially in promoting the erection of the District of Columbia into a Territory; became in 1870 president of the Citizens' Reform Association, and in 1871 vice-president of the board of works, in which capacity he was largely instrumental in the rapid growth and adornment of the city. In 1873 he was appointed governor of the District, and held that office until the form of government was changed.

Shepherd (Oliver Lathrop), b. in New York City about 1818; graduated at West Point 1840; served in the Florida war 1841–42, on the Rio Grande frontier 1846, in the Valley of Mexico 1847, being brevetted captain and major of infantry for gallantry at Churubusco and Chapultepec; took part in campaigns against the Indians of New Mexico 1856–57; was engaged with the rank of brigadier-general of volunteers in the campaigns of 1861–62 in Tennessee and Mississippi; was brevetted colonel U. S. A. for gallantry at the siege of Corinth May 17, 1862, and brigadier-general U. S. A. for services at Stone River, Mar. 13, 1865; retired from the army July 15, 1870.

Shepherd Kings. See Hyksos.

Shepherd's Dog, a name applied to the breeds of domestic dog which are trained to assist in attending the flocks of sheep. Of all strains of shepherd's dog, the Scotch colly is the most celebrated. It is one of the most sagacious and docile of dogs, and becomes attached to a kind master, but is shy, and sometimes fierce to strangers.

Shep'herdstown, p.-v., Wheeling tp., Belmont co., O. P. 44.

Shepherdstown, p.-v., cap. of Jefferson co., West Va., on Potomac River, 8 miles W. of Harper's Ferry, contains 8 churches, Shepherd's College, good schools, 1 bank, a large paper-board mill, an axe-handle factory, cement and flour mills, 1 newspaper, and 2 hotels. P. 1389.

J. H. Zittle, Ed. "Register."

Shep'herdsville, p.-v., cap. of Bullitt co., Ky., on E. fork of Salt River, and on Louisville and Nashville and Great Southern R. R. P. 267.

Shep'ley (Ether), LL.D., b. at Groton, Mass., Nov. 2, 1789; graduated at Dartmouth College 1811, in the same class with Amos Kendall, Joel Parker, and Daniel Poor; became a lawyer at Saco, and subsequently at Portland; sat in the Massachusetts legislature 1819, and in the Maine constitutional convention 1820; was U. S. district attorney for Maine 1821–33; U. S. Senator 1833–36; became a justice of the supreme court of the State Sept. 23, 1836; was chief-justice 1848–55; published 26 volumes of *Reports* while on the bench, and was a commissioner to prepare the *Revised Statutes of Maine* (1857). D. Jan. 15, 1877.

Shepley (George F.), son of the preceding, b. at Saco, Me., Jan. 1, 1819; graduated at Dartmouth College in 1837, and at Dana Law School, Cambridge, 1839; admitted to the bar of the supreme judicial court, Bangor, Me., 1840; in 1844 removed to Portland; was appointed U. S. attorney for Maine district in 1848, and reappointed in 1853 and 1857, subsequently devoting himself exclusively to a very extensive and general practice of his profession, in the course of which he was called upon to argue several cases of great importance in the U. S. Supreme Court, until Sept., 1861, when he was commissioned colonel of the 12th Maine Vols.; commanded a brigade in Gen. Butler's expedition against New Orleans, and on the occupation of that city was appointed military commandant and acting mayor, and assigned to the command of the defences of New Orleans, and charged with the administration of civil affairs in the city. Shortly after he was commissioned brigadier-general of volunteers by Pres. Lincoln, who appointed him military governor of Louisiana June 3, 1862. In 1864 he commanded the military district of Virginia and North Carolina; served with the army of the James 1864–65; entered Richmond with the 25th army corps Apr. 3, 1865, and was appointed military governor of that city. Resuming his profession at the close of the war, he declined the appointment of judge of the supreme court of Maine, but in 1869 accepted that of U. S. circuit judge for the first judicial circuit. His decisions are reported in Shepley's *Circuit Court Reports*. D. July 20, 1878.

Shep'pard (John H.), b. at Cirencester, England, Mar. 17, 1789; came with his parents to Hallowell, Me., 1793; studied at Harvard; was admitted to the bar in Maine 1810; practised law at Wiscasset; was register of probate for Lincoln county 1817–34; settled at Boston, Mass., 1842; was an early and efficient member of the New England Historic-Genealogical Society, and its librarian 1861–69; contributed largely to the *Register* of that society; published occasional poems, several addresses on Masonic and antiquarian subjects, and a *Life of Commodore Tucker* (1868).

Sher'bet [Arab., a "draught"], an Oriental name for various drinks, often cooled by means of snow, usually sweetened, and flavored with lemon-juice and various fruit-syrups.

Sher'born, p.-v. and tp., Middlesex co., Mass., on Mansfield and Framingham branch of Boston Clinton and Fitchburg R. R. and Milford branch of Boston and Albany R. R., is noted for the extensive cultivation of apples, cranberries, and the basket willow. There is a good town-history by Abner Morse (Boston, 1856). P. 1062.

Sher'borne, town of England, county of Dorset, on the Irel, has some silk-throwing mills. P. 5793.

Sher'brooke, county of Quebec, Canada, consisting of the townships of Ascot and Orford, and including the important town of Sherbrooke, the capital. It has extensive water-power, afforded by the river St. Francis. Cap. Sherbrooke. P. 8516.

Sherbrooke, p.-v., cap. of Sherbrooke co., Quebec, Canada, on both sides of the river Magog and on Grand Trunk Railway, 100 miles E. of Montreal. It has a splendid water-power, an extensive trade, 3 weekly newspapers, a bank, an industrial college, and manufactures of fine tweeds and many other goods. It is the most important town in South-eastern Canada. P. 4432.

Sherbrooke, a seaport of Guysborough co., N. S., at the head of navigation of the beautiful St. Mary's River, 12 miles from its mouth. Shipbuilding, the lumber-trade, gold-mining, and quartz-milling are carried on. P. about 500.

Sher'burne, county of Central Minnesota, on the Mississippi, intersected by Elk and Rum rivers, and traversed by a branch of St. Paul and Pacific R. R., is dotted with numerous small lakes, and has a diversified surface and a productive soil. Staples, wheat, Indian corn, oats, potatoes, hay, and butter. Cap. Elk River. Area, 445 sq. m. P. 2050.

Sherburne, tp., Fleming co., Ky. P. 158.

Sherburne, p.-tp., Chenango co., N. Y., on Utica branch of Delaware Lackawanna and Western R. R., 40 miles S. W. of Utica, has 5 churches, an academy, 1 bank, 1 newspaper, a woollen-mill, 1 steam flouring-mill, several butter and cheese factories, 2 hotels, and 1 sash, door, and blind factory. P. 2927.

Thomas Randall, Ed. "Sherburne News."

Sherburne, p.-v. and tp., Rutland co., Vt. P. 462.

Sher'idan, county of Central Dakota, watered by affluents of Cheyenne and Mouse rivers, contains several lakes. The Plateau du Coteau du Missouri embraces the W. part. It is still unorganized. Area, about 1750 sq. m.

Sheridan, county of N. W. Kansas, on Solomon and Saline rivers, consists of rolling prairies well adapted to pasturage; is still unorganized. Area, about 900 sq. m.

Sheridan, p.-v., cap. of Grant co., Ark.

Sheridan, tp., Logan co., Ill. P. 1002.

Sheridan, tp., Carroll co., Ia. P. 472.

Sheridan, tp., Poweshiek co., Ia. P. 558.

Sheridan, tp., Scott co., Ia. P. 1222.

Sheridan, tp., Cherokee co., Kan. P. 1149.

Sheridan, tp., Crawford co., Kan. P. 1042.

Sheridan, tp., Linn co., Kan. P. 828.

Sheridan, tp., Ottawa co., Kan. P. 798.

Sheridan, tp., Calhoun co., Mich. P. 1619.

Sheridan, tp., Clare co., Mich. P. 87.

Sheridan, tp., Huron co., Mich. P. 158.

Sheridan, tp., Mecosta co., Mich. P. 134.

Sheridan, tp., Newaygo co., Mich. P. 458.

Sheridan, tp., Redwood co., Minn. P. 111.

Sheridan, tp., Daviess co., Mo. P. 923.

Sheridan, tp., Washington co., Neb. P. 260.

Sheridan, p.-v. and tp., Chautauqua co., N. Y., on Erie and Lake Shore and Michigan Southern R. Rs. P. 1686.

Sheridan, tp., Colleton co., S. C. P. 1121.

Sheridan, tp., Calhoun co., West Va. P. 589.

Sheridan, tp., Lewis co., West Va. P. 2320.

Sheridan, tp., Lincoln co., West Va. P. 949.

Sheridan, tp., Dunn co., Wis. P. 117.

Sheridan (Frances **Chamberlaine**), b. in Ireland in 1724; wrote at the age of fifteen a romance, *Eugenia and Adelaide*, which was dramatized by her daughter long afterward, and successfully acted at Dublin; made the acquaintance of Sheridan, the theatrical manager, during the controversies in which he was involved, by the publication of a pamphlet in his favor; married him about 1748; wrote two popular novels, *Sidney Biddulph* (3 vols., 1761) and *Nourmahad* (1788), and two comedies, *The Discovery* (1763) and *The Dupe* (1764), and left an unpublished play, *The Trip to Bath*, which was of great use to her son in the preparation of his comedy, *The Rivals*. D. in Blois, France, Sept., 1766.

Sheridan (Philip Henry), b. in Somerset, Perry co., O., Mar. 6, 1831; was graduated from the U. S. Military Academy, and assigned to the 1st Infantry as brevet second lieutenant July 1, 1853. After a brief term in barracks he was ordered to Texas; transferred to the Pacific coast in 1855, serving in Washington and Oregon Territories until the fall of 1861, at which date he was captain in the 13th Infantry. Recalled to the "States," he was in December assigned to the army of S. W. Missouri as chief quartermaster. After the battle of Pea Ridge (Mar., 1862) he was relieved, and in the Corinth campaign accompanied Gen. Halleck as quartermaster until May 25. On this date he was appointed colonel of the 2d Michigan Cavalry; three days later was off on a raid to Booneville, and May 30 in pursuit of the enemy retreating from Corinth. On the 1st of July, in command of a cavalry brigade, he defeated a superior cavalry force at Booneville, and was commissioned brigadier-general of volunteers from that date. Transferred to the Army of the Ohio, he commanded a division at the battle of Perryville (Oct. 8), where "he held the key of our position, and used the point to its utmost advantage." At the battle of Murfreesboro' (Dec. 31) (which see) Sheridan's division held the left of the right wing. An attack on his front had been met and the enemy driven back, when by the giving way of the two divisions on his right his flank became exposed to the advancing foe. Hastily forming a new line under cover of a charge, he made a brave resistance for an hour, when he was again compelled to take up a new line, this time connecting with Negley of the centre wing, the two divisions repulsing three desperate assaults by four divisions of the enemy, when, Sheridan's ammunition giving out, he ordered a bayonet charge and withdrew his lines from the field. But by his obstinate resistance priceless time had been gained for Rosecrans to make his new dispositions. In due time Sheridan's commission as major-general of volunteers followed, to date from this battle. With the exception of skirmishes with Forrest and Van Dorn, not much occurred until late in June, 1863, when Rosecrans advanced against Bragg, who fell back into Georgia. The battle of Chickamauga took place Sept. 19-20, where Sheridan fought with great gallantry, rescuing his division from a perilous position. Grant superseded Rosecrans in October, and on Nov. 24-25 was fought the battle of Chattanooga, where, on the 25th, Sheridan, by his fearless assault at the head of his division upon the centre of the enemy's lines on Missionary Ridge, gained additional and merited renown. The march to Knoxville, where Burnside was besieged, next followed. Upon Grant's promotion to be lieutenant-general (Mar., 1864) he applied for the transfer of Sheridan to the East, and appointed him chief of cavalry of the Army of the Potomac. In the campaign of 1864 the cavalry covered the front and flanks of the infantry through the battles of the Wilderness until May 8, when the greater part of it was withdrawn, and next morning Sheridan started on a raid against the enemy's lines of communication with Richmond. On the 25th he rejoined the army, having destroyed the dépôts, trains, and track at Beaver Dam and Ashland stations, liberated 400 of our men, and defeated the enemy's cavalry at Yellow Tavern, where their best cavalry leader, J. E. B. Stuart, was mortally wounded. The outer line of works around Richmond was taken, but the second line was too strong to be carried by assault; and crossing the Chickahominy at Meadow Bridge, James River was reached May 14, thence by White House and Hanover Court-house back to the army. This raid drew off nearly all the enemy's cavalry, making the guarding of Grant's trains an easy matter. Resuming the advance, the battle of Hawes's Shop was fought May 28, and Cold Harbor occupied on the 31st, and held until the arrival of the infantry. On June 7, Sheridan with two divisions started around the left of Lee's army to destroy the Virginia Central R. R. in rear, which accomplished, the Fredericksburg road was struck at Chesterfield, thence again striking the Virginia Central at Trevilian's, where he routed Wade Hampton (June 11), and next day tore up the road nearly to Louisa Court-house, when, advancing toward Gordonsville, an indecisive engagement took place; not hearing from Hunter, who was to meet him here, he withdrew, rejoining the army June 19. On Aug. 7 the Middle department and departments of West Virginia, Washington, and Susquehanna were constituted "the Middle military division," and Sheridan assigned to command of the same. Numerous severe cavalry skirmishes occurred during August and early in September, but no general engagement, although the two armies lay in such position—the enemy under Gen. Early on the W. bank of Opequan Creek, covering Winchester, and Sheridan in front of Berryville—that either could bring on a battle at will. Defeat to Sheridan, however, would expose Maryland and Pennsylvania to invasion. But the imperative necessity of having the unobstructed use of the Baltimore and Ohio R. R. and the Chesapeake and Ohio Canal, among other reasons led Grant to take the initiative; but before giving orders to attack he visited Sheridan (Sept. 16), the latter expressing such confidence of success that Grant gave him but two words of instruction: "Go in!" Three days later he attacked Early at the crossing of the Opequan, and after a vigorous battle routed the enemy and captured 3000 prisoners and 5 guns. Early rallied his army at the strong position of Fisher's Hill, where, on the 22d, he was again defeated, with heavy loss, and pursued to the mountains. Sheridan devastated the Valley on his return, rendering it untenable for an enemy's army. He was now (Sept. 20) appointed a brigadier-general in the regular army. On Oct. 19, Early, after surprising our army in the morning, was disastrously defeated. (See Cedar Creek.) The thanks of Congress were bestowed upon Sheridan and his army, and Nov. 8 he was appointed major-general in the regular army. On Feb. 27, 1865, starting out with 10,000 cavalry, he destroyed the Virginia Central R. R., the James River Canal, and immense quantities of supplies, and defeated Early again at Waynesboro', rejoining Grant before Petersburg Mar. 27. Sheridan had now a force of about 9000, and in subsequent operations was under the immediate orders of Gen. Grant. He commanded at the battle of Five Forks (which see), and displayed great generalship. This decisive battle compelled Lee to evacuate Petersburg. Sheridan, pursuing, struck the flying army at Sailor's Creek, capturing 16 guns and 400 wagons, and detaining him until the 6th corps could come up, when a combined attack resulted in the capture of upward of 6000 prisoners. On the 8th four supply-trains were captured at Appomattox Station, and at Appomattox Court-house the advance of Lee's army was resisted until dark. On the morning of the 9th the enemy endeavored to break through his dismounted command, but abandoned the attempt when Sheridan, moving aside, disclosed the infantry behind. Mounting his men, Sheridan was about to charge when the white flag betokening surrender was displayed in his front. In June, 1865, he was placed in command of the military division of the South-west, of that of the Gulf in July, of the department of the Gulf Aug., 1866, and of the fifth military district (Louisiana and Texas) Mar., 1867. In Sept., 1867, he was transferred to the department of the Missouri, continuing in command until Mar. 4, 1869, when he was promoted to be lieutenant-general, and assigned to command of the division of the Missouri, head-quarters at Chicago. Dur-

ing the political disturbances in Louisiana in 1875, Gen. Sheridan was sent to New Orleans, returning to Chicago on quiet being restored. G. C. SIMMONS.

Sheridan (RICHARD BRINSLEY BUTLER), son of Thomas and Frances, b. in Dublin, Ireland, in Sept., 1751; educated at Harrow School, where he made some poetical translations from the Greek; married, in 1773, Miss Linley, a celebrated singer at Bath; undertook the study of law at the Middle Temple, but with little assiduity, and was never called to the bar; produced his comedies of *The Rivals*, adapted from his mother's *Trip to Bath*, with great success at Covent Garden Jan., 1775; *The Duenna*, Nov. 21, the latter having a run of seventy-five nights; became purchaser of Garrick's share in the patent of Drury Lane Theatre June, 1776; brought out *A Trip to Scarborough* Feb. 24, and *The School for Scandal*, his most celebrated comedy, May 8, 1777; produced his farce, *The Critic*, 1779; became a prominent member of the circle of wits which surrounded Charles James Fox, by whose influence he was chosen to Parliament for Stafford 1780; proved by his eloquence a useful auxiliary to the great Whig leader; was under-secretary of state 1782, and secretary of the treasury 1783; won a dazzling reputation as an orator by his two "Begum" speeches against Warren Hastings—one in the House of Commons Feb. 7, 1787, the other in Westminster Hall June, 1788; wrote adaptations of Kotzebue's plays *The Stranger* and *Pizarro* (1798); became treasurer of the navy and privy councillor 1806; lost heavily by the burning of Drury Lane Theatre 1809; fell into habits of dissipation and extravagance, and was constantly molested in his later years by numerous creditors. D. in London July 7, 1816. His *Life* was written by Thomas Moore (1825), and his complete *Works* have passed through many editions.

Sheridan (THOMAS), D. D., b. in county Cavan, Ireland, about 1684; educated at Trinity College, Dublin; took orders in the Church of England; opened a classical school at Dublin; was appointed chaplain to the lord lieutenant; became intimate with Dean Swift, through whose influence he obtained an ecclesiastical living in the county of Cork; was subsequently master of the free school at Cavan; was noted for wit and extravagance, being generally in pecuniary distress; published a prose translation of Persius and a metrical one of Sophocles' *Philoctetes*. D. at Dublin Sept. 10, 1738. Many of his letters are included in Swift's *Miscellanies*.

Sheridan (THOMAS), son of the preceding, b. in 1721 at Quilca, near Dublin, Ireland (the residence of Dean Swift); educated in his father's school, also at Westminster School and at Trinity College, Dublin; became an actor 1743; played tragedy at Covent Garden Theatre 1744 and at Drury Lane 1745; was by some considered a rival of Garrick; was manager of the Dublin theatre 1746–55; was ruined by a riot which took its origin in his proceedings as manager; withdrew temporarily from the stage; became a successful teacher of elocution at London, Oxford, and Cambridge, and in Scotland and Ireland; returned to the stage 1760; was pensioned by George III.; was manager of Drury Lane 1776–79; published several works on elocution; edited the works of Swift (1784), and wrote his *Life*, and was author of a *General Dictionary of the English Language* (1780), of considerable phonetic value. D. at Margate Aug. 14, 1788.

Sher'iff. The sheriff is one of the most ancient and honorable officers known to the English law. Under the earliest Saxon commonwealths each shire (*scyre*) or modern county was presided over by a high dignitary called the *ealdorman*. A portion of his functions were performed by his *gerefa*, or deputy. From the Saxon title *scyre-gerefa*, gradually corrupted into *shire-reeve*, was derived the English "sheriff." In the several States of the U. S. the sheriff is the chief administrative officer of each county, representing and acting for the executive department of the State government—in England representing the Crown—in all matters pertaining to the execution and enforcement of the law, whether civil or criminal. He is *ex-officio* the administrative organ of all the superior courts sitting within his county, charged with the duty of carrying into effect their judgments and orders. He is wholly a State official, and has never been incorporated into the executive branch of the U. S. government.

How Chosen.—In England the sheriffs of all the counties, with a very few exceptions, are appointed by the Crown from persons nominated by the lord chancellor and the judges of the superior law-courts. The selection of sheriffs for Middlesex county is vested in the city of London, and in one or two other counties the office is hereditary in particular families. In the great majority of the American States the sheriff is elected by popular vote in each county for a fixed term of office, generally three years, and the same person is often prohibited by statute from holding the office during two successive terms. In a few States the ancient practice of appointment by the governor is still retained. The sheriff himself appoints his under-sheriffs and deputies, who may perform in his name all acts which are purely administrative in their nature, but not those which are judicial. They are in all respects his agents; their acts are his acts; he is responsible for all their defaults done under color of office, even when wilful and intentional trespasses or violations of law. To protect himself he can take from them bonds with sureties for their good behavior.

His Functions.—The sheriff is the highest peace-officer of his county. As such he is empowered and bound to restrain all breaches of the peace, to apprehend the offenders, to pursue and arrest all criminals, to put down riots, to defend the jail, which is under his charge, and to do all other similar acts by which the good order of the community shall be maintained. To this end he may if necessary summon to his aid the "power of the county." (See POSSE COMITATUS.) As the executive organ of the courts, he arrests and imprisons persons charged with crime, takes bail when ordered, and carries into effect the sentences when pronounced, either by conducting the convicts to the prison or by capitally executing them, as the case may be. He may also serve all civil process by which actions are commenced, unless he is a party, when the service is to be made by the coroner; he also executes mesne process by levying attachments, seizing and taking into his custody, when necessary, the property attached, and by making arrests of defendants and holding them to bail. Executions upon judgments, either against the debtor's property or his body, are issued to him, and he enforces them by seizing and selling the property or by arresting the person and committing him to the jail. In performing this branch of his duty the sheriff is necessarily exposed to great liabilities. If under an execution against A he levies upon property belonging to B, he is a trespasser, he is not protected by the process, and he is responsible to B in damages for the conversion. To protect himself against such liability, he may in cases of doubt demand from the creditor a bond of indemnity. On the other hand, he is exposed to a similar liability from the opposite direction. If he neglects to collect the execution when there is property of the debtor subject to be seized thereon, an action will lie against him at the suit of the creditor, and a judgment may be recovered therein for the damages sustained through his negligence. In executing criminal process the sheriff may break open the outer door of any dwelling-house or other building, but in executing civil process he cannot force an entrance into a dwelling house, although when once admitted he may break an interior door; and he may break the outer doors of buildings which are not dwellings. He also summons and returns the juries for all the superior courts within his county. The jail of the county is under his charge, the jailer being officially his deputy; and he becomes liable for the escape of imprisoned debtors who have been enlarged from confinement and placed upon the jail-limits. At the common law the sheriff had extensive judicial powers: these have been taken from him in the U. S., and his judicial functions have been restricted to the assessment of damages, with the aid of a jury, in certain classes of actions, generally for torts, in which the defendants have made default, and which are sent to him for that purpose by the court. The powers of the sheriff, of which the foregoing is an outline, are with a few formal exceptions limited to the territorial jurisdiction of his county. His compensation consists in fees which are regulated by statute. JOHN NORTON POMEROY.

Sher'lock (THOMAS), D. D., son of Dean William, b. in London, England, in 1678; educated at Eton; graduated at Catharine Hall, Cambridge, 1697, of which he became master 1714; was master of the Temple forty-nine years (1704–53); was made a prebendary of London 1713, vice-chancellor of Cambridge 1714, dean of Chichester Nov., 1715, prebendary of Norwich 1719, bishop of Bangor Feb. 4, 1728, of Salisbury 1734, and of London 1748, having declined in 1747 the archbishopric of Canterbury. He took an active part in the Bangorian controversy in opposition to Dr. Hoadley (1716), wrote several controversial works on Christian evidences, of which the most celebrated were *The Use and Intent of Prophecy* (1725) and *Tryal of the Witnesses of the Resurrection of Jesus* (1729), and published 4 vols. of his *Discourses at the Temple Church* (1754–58), which gained him a high reputation as a pulpit-orator. D. at London July 18, 1761. His *Works* were edited by T. S. Hughes, D. D. (London, 5 vols., 1830).

Sherlock (WILLIAM), D. D., b. in Southwark, London, England, about 1641; educated at Eton; graduated at Peterhouse, Cambridge, 1660; took orders in the Church of England; became rector of St. George's, London, 1669, prebendary of St. Paul's 1681, master of the Temple 1684,

and dean of St. Paul's 1691, in which year he at first refused to take the oaths of allegiance to William and Mary, but subsequently took them: published a pamphlet in justification of his course, *The Case of Allegiance Due to Sovereign Powers Stated* (1691), which caused a great sensation and elicited vast numbers of replies. D. at Hampstead June 19, 1707. Author of above sixty publications, chiefly theological and controversial, of which the *Vindication of the Doctrine of the Trinity* (1690), directed against Dr. South, is the only one now read.

Sher'man, county of N. W. Kansas, adjoining Colorado, drained by affluents of Republican River, consists of rolling prairies, and is still unorganized. Area, about 900 sq. m.

Sherman, county of Central Nebraska, intersected by Loup fork of Nebraska River, consists chiefly of prairie. Cap. Loup City. Area, 576 sq. m.

Sherman, tp., Johnson co., Ark. P. 107.

Sherman, p.-v. and tp., Fairfield co., Conn., on Housatonic River. P. 846.

Sherman, tp., Calhoun co., Ill. P. 545.

Sherman, tp., Mason co., Ill. P. 590.

Sherman, tp., Hardin co., Ia. P. 77.

Sherman, tp., Jasper co., Ia. P. 1007.

Sherman, tp., Monona co., Ia. P. 196.

Sherman, tp., Montgomery co., Ia. P. 295.

Sherman, tp., Story co., Ia. P. 420.

Sherman, tp., Clay co., Kan. P. 952.

Sherman, tp., Crawford co., Kan. P. 567.

Sherman, tp., Dickinson co., Kan. P. 177.

Sherman, tp., Leavenworth co., Kan. P. 834.

Sherman, p.-v. and tp., Aroostook co., Me. P. 701.

Sherman, tp., Huron co., Mich. P. 385.

Sherman, tp., Isabella co., Mich. P. 134.

Sherman, tp., Keweenaw co., Mich. P. 929.

Sherman, tp., Mason co., Mich. P. 152.

Sherman, tp., Newaygo co., Mich. P. 382.

Sherman, tp., Osceola co., Mich. P. 116.

Sherman, tp., St. Joseph co., Mich. P. 1160.

Sherman, p.-v., cap. of Wexford co., Mich., on Manistee River.

Sherman, tp., Redwood co., Minn. P. 67.

Sherman, tp., Wabashaw co., Minn. P. 740.

Sherman, tp., De Kalb co., Mo. P. 1116.

Sherman, tp., Putnam co., Mo. P. 987.

Sherman, p.-v. and tp., Chautauqua co., N. Y., on French Creek and on Buffalo Corry and Pittsburg R. R. P. of v. 610; of tp. 1470.

Sherman, tp., Huron co., O. P. 1260.

Sherman, tp., Darlington co., S. C. P. 1385.

Sherman, p.-v., cap. of Grayson co., Tex., at intersection of Houston and Texas Central with the N. line of Texas and Pacific R. R., is a trade-centre for a cotton and agricultural district. P. 1439.

Sherman, tp., Boone co., West Va. P. 878.

Sherman, tp., Calhoun co., West Va. P. 640.

Sherman, tp., Hampshire co., West Va. P. 1089.

Sherman, tp., Dunn co., Wis. P. 305.

Sherman, tp., Sheboygan co., Wis. P. 1664.

Sherman, p.-v., Albany co., Wyoming Terr., on Union Pacific R. R., at the highest point on the road.

Sherman Mills, p.-v., Aroostook co., Me., has several manufactures.

Sherman (Charles R.), b. at Norwalk, Conn., Sept. 26, 1788; settled as a lawyer in Fairfield co., O., 1810; became an eminent member of the Ohio bar; was revenue collector for that county several years, and judge of the supreme court of Ohio from 1825 to his death, at Lebanon June 24, 1829. His three sons became distinguished in military or civil life—John, U. S. Senator from Ohio; Gen. William Tecumseh; and Charles T., U. S. district judge for the northern district of Ohio.

Sherman (John), b. in Dedham, England, Dec. 26, 1613; graduated A. M. at the University of Cambridge, England, 1633; emigrated to Connecticut 1634; preached in that colony several years; became a magistrate there 1641, and was minister of Watertown, Mass., from 1647 to his death, Aug. 8, 1685. He was distinguished as a mathematician, lectured at Harvard College, of which institution he was a fellow, and published several almanacs.

Sherman (John), grandson of Roger, b. at New Haven, Conn., in 1772; graduated at Yale College 1792; was pastor of the First church at Mansfield, Conn., from Nov., 1797, to Oct., 1805, when he left that post on account of having embraced Unitarian principles; was for a short time pastor of a church at Trenton Falls, N. Y. (1806); built at that picturesque locality a residence, which he called the "Rural Resort," and d. there Aug. 2, 1828. Author of *One God in One Person Only* (1805), the first elaborate defence of Unitarianism that appeared in New England, *Philosophy of Language Illustrated* (1826), and of other doctrinal and controversial publications.

Sherman (John), son of Charles R., b. at Lancaster, O., May 10, 1823; received an academic education; was admitted to the bar 1844; was a delegate to the Whig conventions of 1844 and 1848; sat in Congress 1855–61; was Republican candidate for the Speakership 1859, and defeated after a prolonged contest by one or two votes only; became chairman of the House committee of ways and means; was re-elected to Congress 1860, but before taking his seat was chosen U. S. Senator; re-elected 1866 and 1872; was long the chairman of the Senate committees on finance and on agriculture; took a prominent part in debates upon finance and the conduct of the war, was one of the authors of the reconstruction measures adopted 1866–67, and was appointed Secretary of Treasury March 7, 1877.

Sherman (Roger), b. at Newton, Mass., Apr. 19, 1721; was in childhood apprenticed to a shoemaker, and followed that occupation until 1743, when he settled at New Milford, Conn., and joined an elder brother in keeping a small store; obtained by private study a tolerable education, especially in mathematics; was chosen county surveyor 1745; made for several years from 1748 the astronomical calculations for an almanac issued in New York; studied law; was admitted to the bar 1754; sat several years in the colonial assembly; removed to New Haven 1761; was assistant governor nineteen years (1766–85), judge of common pleas and of the superior court twenty-three years; treasurer of Yale College 1766–76; sat in Congress from 1774 until his death; was one of the five members of the committee to draft the Declaration of Independence 1776; served on many important committees on the board of war and ordnance and on the treasury board; assisted in codifying the laws of Connecticut 1783; was one of the framers of the original "Articles of Confederation" 1777, an active member of the Federal constitutional convention 1787, U. S. Senator 1791–93, and mayor of New Haven from 1784 to his death in that city, July 23, 1793. He was an earnest Christian, renowned for practical good sense, and exercised a great influence upon public affairs. No adequate biography has ever been written.

Sherman (Roger Minot), LL.D., nephew of Roger, b. at Woburn, Mass., May 22, 1773; graduated at Yale College 1792; was tutor there 1795; became a lawyer at Fairfield, Conn., 1796; sat in both houses of the legislature; was a delegate to the Hartford Convention 1814, and judge of the superior court and of the supreme court of errors 1840–42. D. at Fairfield Dec. 30, 1844.

Sherman (Sidney), b. July 23, 1805, in Marlborough, Mass., the lineal descendant of Roger Sherman; educated in the town of his nativity; removed to New York and engaged in business; in 1831 removed to Cincinnati, O., and thence to Newport, Ky., where he established himself in the manufacture of sheet lead, the first of the kind W. of the Alleghany Mountains; was also one of an association that first manufactured cotton bagging by machinery; in Dec., 1835, answered the call of Texas, then struggling for her independence with Mexico, by raising a small force, equipping it, and fitting out two pieces of artillery. Gen. Houston found him already at Gonzales with his company; under his command Capt. (now elected colonel) Sherman fell back before the Mexican general Santa Anna to San Jacinto. On Apr. 20, Col. Sherman led a daring sortie, and on the 21st, in command of the left wing, he led the attack upon the Mexican lines. Col. Sherman was the first to raise the cry, "Remember Goliad and the Alamo!" The enemy were routed and slaughtered or captured, and their general taken prisoner. Pres. Burnet declined his resignation, and gave him a commission as colonel in the regular service; returned to Kentucky on a mission for the army, in which he was successful; removed to Texas in 1837, and in 1842 was elected to Congress from Harris county; in 1846 obtained the first railroad charter, the Buffalo Bayou Brazos and Colorado R. R.; repaired to Boston and secured capital to build it; on the eighteenth anniversary of the battle of San Jacinto he introduced on a Texas prairie the first locomotive W. of the Mississippi. This enterprise he never gave up till completed to Columbus on the Colorado. During the civil war Gen. Sherman planned the defences of Galveston, whither he had removed on the loss of his home at Harrisburg by fire. In the battle of Galveston, on Jan. 1, 1863, he lost his only son, a lieutenant of artillery.

After the war he resumed the presidency of the railroad. D. Aug. 1, 1873. C. G. Forshey.

Sherman (Thomas W.), b. at Newport, R. I., Mar. 26, 1813; graduated at the U. S. Military Academy July, 1836, when assigned to the artillery as second lieutenant, and sent to Florida, where he served against the Indians until 1842; subsequently employed in recruiting and in garrison until 1846. In the war with Mexico he commanded his battery at Buena Vista, and was brevetted major; again in garrison and on frontier duty 1848–61, in April of which latter year he attained a majority in his corps, and was assigned to duty, guarding the Philadelphia and Baltimore R. R. and in restoring communications with Washington. On the 14th of May he was promoted to be lieutenant-colonel, and three days later appointed brigadier-general of volunteers. In the Port Royal expedition (Oct., 1861) he commanded the land forces, which he had organized, continuing in command in South Carolina until the close of Mar., 1862, when assigned to the Army of the Tennessee as division commander, participating in the Corinth campaign (April to June). Transferred to the department of the Gulf, he commanded a division in the vicinity of New Orleans until May, 1863, when he joined the expedition to Port Hudson, and in the investment of that place commanded the 2d division 19th corps, forming the left wing of the besieging army. In the assault of May 27 he lost a leg while leading the assaulting column. Colonel of artillery June 1, 1863. Returning to duty in Feb., 1864, he held various commands in Louisiana until 1866, when mustered out of the volunteer service. Brevetted brigadier and major general for gallantry, and Dec. 31, 1870, was retired from active service with the rank of major-general. D. at Newport, R. I., Mar. 16, 1879.

Sherman (William Tecumseh), son of Judge Charles R., b. in Lancaster, O., Feb. 18, 1820. From the time of his father's death, in 1829, he was reared in the family of the Hon. Thomas Ewing; in July, 1836, he was appointed a cadet at the U. S. Military Academy, and in July, 1840, was graduated, and appointed a second lieutenant in the 3d Artillery; first lieutenant Nov., 1841. He served in Florida until 1842, and from that date, with a brief interval, in garrison at Fort Moultrie, S. C., until 1846, when ordered to California, serving as acting assistant adjutant-general of the department of California, until Feb., 1849, when transferred to San Francisco on similar duty on the staff of Gen. Persifer F. Smith, commanding the division of the Pacific. Ordered to New York in Jan., 1850, as bearer of despatches, he was married on the 1st of May to Ellen, daughter of Thomas Ewing, then secretary of the interior. In September of that year he was transferred to the commissary department with the rank of captain, and stationed at St. Louis and New Orleans until Mar., 1853, when, after a six months' leave of absence, he resigned from the army Sept. 6, 1853, to engage in the banking business in San Francisco; removed to New York in 1857, in which year the affairs of his firm were closed. In 1858 he removed to Leavenworth, Kan., where he practised law until July, 1859, when he was elected superintendent of the proposed military academy in Louisiana. The institution was opened Jan. 1, 1860, as the Louisiana State Seminary of Learning and Military Academy, and Sherman remained at its head until Jan. 18, 1861, when he addressed a letter to the governor asking to be relieved "the moment the State determined to secede." His request was soon after granted, and in the latter part of February he left for St. Louis, where for a short period he held the presidency of a street railroad. On the 14th of May, 1861, he was appointed colonel of the 13th regular Infantry, and soon after his arrival in Washington was placed in command of a brigade in Tyler's division, which he led at the battle of Bull Run, July 21. On the 3d of August following, his commission of brigadier-general of volunteers was issued to date from May 17, and Aug. 24 he was ordered to duty in the department of the Cumberland under Gen. Anderson, succeeding to the command of that department Oct. 8, 1861, but was relieved in November and sent to Missouri. After a brief service on inspection duty he was (Dec. 23) placed in command of the camp of instruction and post of Benton Barracks, from whence in Feb., 1862, he was transferred to Paducah, Ky., to aid in the operations then in progress on the Tennessee River. Here he organized the division which he subsequently commanded at the battle of Shiloh (Apr. 6–7), where his conduct did much to check disorder and overcome the shock of the unexpected onset. Gen. Halleck reported that Sherman's firmness on the 6th "saved the day;" Grant officially announced, "I am indebted to Gen. Sherman for the success of the battle." The advance upon and siege of Corinth next followed, resulting in the evacuation of that place May 29. In the mean while (May 1) he had been promoted to be major-general of volunteers. In July, having been assigned to command the district of Memphis, he occupied that place on the 21st, where he remained until called upon in December by Gen. Grant to take command of the expedition for the capture of Vicksburg. As this movement was intended to be a surprise, the preparations were hastily executed. Embarking his troops Dec. 21, a landing was effected on the 26th at Johnston's Landing, some 12 miles up the Yazoo, separated, however, from the high and strongly-fortified bluffs opposite by almost impassable swamps and bayous. On the 29th the attempt to carry the position by assault was bravely made, but without success, and, owing to the surrender of Holly Springs, which overthrew Gen. Grant's plan of co-operation, reinforcements were now arriving to the enemy, and Sherman returned to Milliken's Bend, where Gen. McClernand, who had arrived, took command Jan. 4, 1863, Sherman being assigned to the 15th corps, which took a leading part in the assault and capture of Arkansas Post (Fort Hindman) on the 11th inst. In the Vicksburg campaign which succeeded, Sherman bore a prominent part with his command—in the expedition up Steele's Bayou to the Yazoo (March); the feint upon Haines' Bluff (Apr. 29–May 1); movement to Grand Gulf (May 1–6); capture of Jackson (May 14); the occupation of Walnut Hills; and subsequent assaults upon the land-defences of Vicksburg (May 19 and 22), in each attempt the colors of the corps being planted on the enemy's works; and in the siege operations which resulted in the surrender of the city July 4, 1863, when Sherman with a detached command was at once ordered to pursue Johnston, who with a relieving force had been lying E. of the Big Black, but retreating hastily on the news of the surrender. By the 10th he was driven behind the intrenchments of Jackson. Siege operations were actively pressed, but on the night of the 16th Johnston succeeded in escaping. Steele's division pursued to Brandon, and after destroying the railroads in all directions, Sherman fell back to the W. of the Big Black, along which he lay when summoned (Sept. 22) to the relief of Rosecrans's beleaguered army at Chattanooga. Meanwhile, he had been appointed brigadier-general in the regular army, to date from July 4. By the 27th of Sept. the last of his command were embarked at Vicksburg, and by Oct. 4, Memphis was reached, whence he marched eastward, repairing the railroad as he proceeded, until the 27th, when orders reached him at Tuscumbia from Gen. Grant, who had superseded Rosecrans, to abandon all work and hasten on to Chattanooga. By Nov. 15, Sherman himself arrived at that place, and, viewing the situation, hastened back to his command, which by forced marches was up and in position by the 23d, and, by 3 P. M. the next day, had carried the N. end of Missionary Ridge, which position he strongly fortified during the night. At sunrise on the 25th, by orders, Sherman attacked Bragg's right, and a furious battle was maintained all day, compelling Bragg to so weaken his centre to support his right that when Thomas was thrown in on the centre at 3 P. M. the success of the day was ensured, and by midnight Bragg's army was in full retreat. Sherman and Hooker pursued at daylight (26th) the routed army, the former turning back on the 29th to take command of the force for the relief of Burnside, besieged at Knoxville and reported to be unable to hold out later than Dec. 3. Moving rapidly, and making the last 84 miles in three days, Longstreet was compelled to raise the siege and retreat to Virginia, whereupon Sherman returned to Chattanooga and ordered his command into winter quarters. Since Oct. 27, Sherman had commanded the department of the Tennessee, though retaining command of troops in the field. On Feb. 2, 1864, Sherman moved out from Vicksburg with four divisions, and making his way to Meridian, the great railway-centre of the South-west and chief source of supplies for the Confederate army in that region, destroyed the railroads in every direction, bridges, locomotives, etc.; but, owing to the failure of the cavalry division of Smith to perform its part, the expedition was obliged to return (Feb. 26). Gen. Grant having been promoted to be lieutenant-general, he named Sherman as his successor in command of the military division of the Mississippi, composed of the departments of the Ohio, the Cumberland, the Tennessee, and the Arkansas. Assuming this command about the middle of March, Sherman at once entered upon the task of organizing his army and enlarging his communications preparatory to the spring campaign, which was to be directed against Atlanta, Ga., and to commence simultaneously with the opening of the Richmond campaign by Grant. Accordingly, on the 6th of May, Sherman set forth with his army from the winter quarters about Chattanooga. To oppose him was the army of Johnston, lying about Dalton and numbering not far from 50,000. Sherman's strength numbered 98,797 men

of all arms, with 254 guns. Space will permit but a brief mention of the important events of this campaign, which was inaugurated at Dalton May 7, which strong position Johnston was compelled, by Sherman's flank movement, to abandon May 13, and fall back upon Resaca, which in turn he evacuated after a severe battle (May 15), and retreated to Allatoona Pass. Without attempting to force this strong position in front, Sherman, on the 23d, by a circuit to the right, marched on Dallas; Johnston took up a strong position about New Hope Church, where severe fighting occurred May 25–28. On the 1st of June, Allatoona was occupied by Sherman, and made a secondary base of supplies; on the 4th, Johnston retreated to the strong positions of Kenesaw, Pine, and Lost mountains. From June 10 to July 2 almost constant fighting occurred, when, after two unsuccessful assaults on Kenesaw (June 27), Sherman commenced (July 2) another flank movement by the right; that night Kenesaw was abandoned by Johnston, and by July 10 the latter had fallen back across the Chattahoochee and taken up a line covering Atlanta. Here he was superseded in command (July 17) by Hood. On this day Sherman completed his crossing of the Chattahoochee, and on the 19th and 20th the battle of Peachtree Creek was fought, resulting in the withdrawal of the enemy to the intrenchments of Atlanta. On the 22d, Hood by a night march had gained the left of Sherman's line, which he attacked furiously, a fierce battle ensuing; the enemy finally retiring to their defences. A movement to flank Hood out of Atlanta by cutting the railroads in his rear was in progress when (July 28) Hood made a vigorous attack, but was repulsed with great loss. Sherman now determined upon bold measures to gain Atlanta. On the 12th of August he had been made a major-general in the regular army. Sending Kilpatrick out to destroy the railroads in the rear, he swung around to the S. W., and by Aug. 28 his entire army, excepting the 20th corps, was behind Atlanta, busily engaged in destroying the only railroads by which that city was supplied. On the 29th the Macon road was reached near Jonesboro', where Hardee was with his own and Lee's corps, the battles of Aug. 31–Sept. 1 ensuing, leaving Sherman between Jonesboro' and Atlanta. During the night of Sept. 1, Hood evacuated Atlanta, after destroying everything that could be used, and on the 2d, Slocum with the 20th corps entered the city. Sherman's losses from Chattanooga amounted to 31,687; the Confederate loss was near 35,000. Hood had been reinforced from time to time, and had yet an effective force of 40,000. Sherman received in June Blair's 17th corps, numbering 13,000. Hood now drew off to about Lovejoy's, uniting with Hardee, while Sherman gave his army a much-needed rest. On Sept. 28, Hood resumed operations by crossing the Chattahoochee and operating against Sherman's communications, appearing before Allatoona Oct. 5, held by a garrison of 1944 men. The repeated assaults of the enemy were of no avail, and were finally abandoned, but not until 707 of the little band had fallen, while the loss of the enemy was not less. Hood now moved N. W., Sherman following as far as Gaylesville, Ala., when, becoming convinced that Hood's only design was to draw him out of Georgia, he abandoned further pursuit, and detaching the 4th and 23d corps to reinforce Thomas at Nashville, and leaving the latter to defend Tennessee against Hood, he ran back all the surplus property and supplies to Chattanooga, broke up the railroad, destroyed Atlanta, and, cutting the telegraph behind him, Nov. 12, started on the 15th upon his famous "march to the sea." The history of this march is well known. By Dec. 10, Sherman was before Savannah; Fort McAllister was carried on the 13th; and on the night of the 20th Savannah was evacuated, while Sherman was on his way to Hilton Head to arrange for making this very step impossible. Returning to Savannah, he entered the city on the 23d. His loss from Atlanta was but 567, including wounded (245) and missing (159). After resting at Savannah and refitting his army he moved northward Feb. 1. Columbia was occupied on the 17th; Cheraw, Mar. 3; Fayetteville, Mar. 11; the battle of Averysboro' was fought Mar. 16; that of Bentonville, Mar. 19–20; Goldsboro' was occupied Mar. 22; Raleigh, Apr. 13; and Apr. 18th, at Durham Station, Sherman accepted the surrender of Johnston's army on a "basis of agreement" which was rejected by the government, but on the 26th received the surrender on the terms accorded to Lee by Grant. Resuming his march, Washington was reached May 24, 1865, where, after the grand review, his army was dissolved. On the 27th of June, 1865, he was appointed to command the military division of the Mississippi; was promoted to be lieutenant-general July 25, 1866, and Aug. 11 assigned to command the military division of the Missouri. On the accession of Gen. Grant to the Presidency he became general (Mar. 4, 1869). In 1871–72 he made an extended tour in Europe and the East. In Oct., 1874, the head-quarters of the army were removed from Washington to St. Louis, but in Apr., 1876, were re-established at Washington. He published in 1875 *Memoirs of General W. T. Sherman, by himself*. G. C. SIMMONS.

Sher'rill, p.-v. and tp., Texas co., Mo. P. 1399.

Sherry Wine. See WINE.

Sher'win (THOMAS), LL.D., b. at Westmoreland, N. H., Mar. 26, 1799; served an apprenticeship to a clothier at Groton, Mass.; graduated at Harvard 1825; taught an academy at Lexington, Mass., 1825–26; was mathematical tutor at Harvard 1826–27; was sub master of the English High School, Boston, 1828–38; was one of the originators of the American Institute of Instruction 1830; president of the Massachusetts Teachers' Association 1845; one of the editors of the *Massachusetts Teacher*; a member of the American Academy; took an active part in procuring the establishment of the Massachusetts Institute of Technology, and was from 1838 through life the principal of the English High School, which was reputed a model of its kind. D. at Dedham, Mass., July 23, 1869. Author of an *Elementary Treatise on Algebra* (1841) and of a *Common School Algebra* (3d ed. 1855).—His son THOMAS was lieutenant-colonel of the 22d Massachusetts Vols. during the civil war, and at its close was brevetted brigadier-general.

Sher'wood, p.-v. and tp., Branch co., Mich., on Air-line division of Michigan Central R. R. P. 1088.

Sherwood (MARY MARTHA **Butt**), b. at Stanford, Worcestershire, England, July 6, 1775; married Capt. Sherwood of the army 1803, with whom she resided in India 1804–18, and settled on her return at Wickwar, Gloucestershire, where they lived many years. D. at Twickenham Sept. 30, 1851. Authoress of 90 vols. of widely-circulated works, chiefly written with a moral object, and many of them for juvenile readers. The best known are *Little Henry and his Bearer*, *Henry Milner*, *Ermina*, *Roxobel*, and *The Lady of the Manor*. A *Memoir*, including an autobiography, was published in 1854 by her daughter, Mrs. Sophia Kelly.

Sherwood Forest, a hilly region in the W. of Nottinghamshire, England, between Nottingham and Worksop, about 25 miles in length by 8 in breadth, was once a royal hunting forest, and known to legend as the scene of Robin Hood's exploits, but now divided into farms, includes the town of Mansfield, several villages, and many parks and gentlemen's country-seats. The soil is gravelly and usually unproductive.

Shes'hequin, p.-v. and tp., Bradford co., Pa., on Susquehanna River. P. 1596.

Shet'land (or **Zetland**) **Islands,** a group of about 100 islands, of which 23 are inhabited, in the Atlantic Ocean between lat. 59° 50′ and 60° 50′ N., and belonging to Scotland. Area, 5388 sq. m. P. 31,605. The largest island is Mainland, with the town of Lerwick; among the others are Yell, Unst, Barra, and Toula. They are all high and rocky, presenting steep, abrupt, and bold coasts, with fine natural harbors, and a rugged, wild surface in the interior. In the valleys some oats, barley, and potatoes are cultivated. Of trees there are none, but good pastures, as the climate is mild and damp. Many cattle and sheep are reared, but the principal occupation of the inhabitants is fishing, especially cod, of which about 3000 tons, salted and dried, are annually exported, and herrings, of which about 10,000 barrels are annually exported. Eggs form another important article of export.

Shew (JOEL), M. D., b. at Providence, Saratoga co., N. Y., Nov. 13, 1816; studied medicine; visited the celebrated water-cure establishment of Dr. Priessnitz in Germany; became an advocate of his system, which he introduced into the U. S.; wrote several works on the subject; founded and edited the *Water-cure Journal*, and superintended a large hydropathic institution. D. at Oyster Bay, N. Y., Oct. 6, 1855.

Shi'as, or **Shi'ites** [Arab. for "sectaries" or "followers"], called by themselves *Al-Adeliat* (the "party of the just"), the followers of Ali, the husband of Fatima, the daughter of Mohammed. They maintain that Ali was the first legitimate khalif or successor to Mohammed, and consequently reject Abu Bekr, Omar, and Othman as usurpers. They differ amongst themselves—thirty-two of the proverbial seventy-three Mohammedan sects being assigned to the Shias. From the Sunnis they differ very much as Protestants do from Roman Catholics. Since 1499 the Shia faith has been the national religion of Persia. (See Hughes's *Notes on Muhammadanism*, 1875.) R. D. HITCHCOCK.

Shiawas'see, county of Central Michigan, intersected by Shiawassee River, traversed by Detroit and Milwaukee and by Jackson Lansing and Saginaw division of Michigan

Central R. R.: has a rolling surface, well adapted to pasturage, with abundance of timber and some deposits of bituminous coal. Staples, wheat, Indian corn, oats, potatoes, hay, maple-sugar, butter, and wool. Cap. Corunna. Area, 450 sq. m. P. in 1870, 20,858.

Shiawassee, tp., Shiawassee co., Mich. P. 1422.

Shib'boleth [Heb. for "ear of corn"], a test or password by which one's rank in society is indicated. It is recorded in Judges xii. that after Jephthah's victory over the Ephraimites, the men of Gilead detected their fugitive enemies by requiring them to pronounce the word *shibboleth*, which the Ephraimites called *sibboleth*, and thus betrayed their origin; whereupon they were put to death.

Shickshin'ny, p.-b., Luzerne co., Pa., on Lackawanna and Bloomsburg R. R. and Susquehanna River, 17 miles S. W. of Wilkesbarre, has 3 churches, good schools, 1 bank, 1 newspaper, 3 hotels, 2 extensive coal-works, and several mills. Shickshinny is celebrated for its fine mountain-scenery and waterfalls. P. 1045.

C. A. Boone, Ed. "Mountain Echo."

Shield [Ang.-Sax. *scild;* Ger. *Schild*], a buckler, a broad defensive weapon carried upon the left arm in former times to protect the body from blows and missiles. Most savage nations employ shields of some form, and all the nations of antiquity, as in mediæval Europe, down to the general introduction of gunpowder in warfare. The shield is of great importance in heraldry. For practical use, shields were of leather, wood, basketwork, etc. (See Heraldry.)

Shields. See Iron-Plating for Fortifications.

Shields, the name of two towns of England, opposite to each other on the Tyne, near its entrance into the North Sea—North Shields on the northern bank, in the county of Northumberland; South Shields on the southern, in the county of Durham. The harbor is provided with a large stone pier, and the entrance of the Tyne, which is somewhat difficult, with two lighthouses. Ship building and repairing are extensively carried on; also the manufacture of shipbuilding articles, alum, glass, pottery, etc. Roman remains were discovered at South Shields in 1875. P. of North Shields, 8619; of South Shields, 45,336.

Shields, tp., Lake co., Ill. P. 1262.

Shields, tp., Dodge co., Wis. P. 1119.

Shields, tp., Marquette co., Wis. P. 566.

Shields (Charles Woodruff), D. D., b. at New Albany, Ind., Apr. 4, 1825; graduated at Princeton 1844, and at the Theological Seminary at the same place in 1847; was pastor of the First church in Hempstead, L. I., 1849–50, of the Second church in Philadelphia 1850–65, and has been since Dec., 1865, professor of the relations of religion to science at Princeton. Author of a *Funeral Eulogy on Dr. Kane* (1857), *Philosophia Ultima* (1861), *A Manual of Worship* (1862), *The Directory for Public Worship* (1863), and editor of *The Book of Common Prayer, etc., as amended by the Westminster Divines* (1864).

Shields (James), b. at Dungannon, county Tyrone, Ireland, in 1810; emigrated to the U. S. about 1826; settled as a lawyer at Kaskaskia, Ill., 1832; was elected member of the legislature 1836, and State auditor 1839; became judge of the supreme court 1843, commissioner of the U. S. land-office 1845, brigadier-general U. S. A. 1847; was dangerously wounded at Cerro Gordo, and brevetted major-general; again severely wounded at Chapultepec; declined the governorship of Oregon Territory 1848; was U. S. Senator from Illinois 1849–55, and from Minnesota 1858–60, after which he settled in California; was appointed brigadier general of volunteers Aug. 19, 1861; commanded at the battles of Winchester and Port Republic 1862; resigned his commission 1863; settled soon after in Wisconsin, and subsequently in Missouri. D. June 1, 1879.

Shields'borough, now Bay St. Louis, p.-v. and sta., cap. of Hancock co., Miss., on New Orleans and Mobile R. R. and the Bay of St. Louis, has 2 churches, custom-house, good schools, 1 newspaper, 3 hotels, and numerous orange-orchards. It is a summer resort for tourists. P. about 1700.

F. Heiderhoff, Ed. "Sea-coast Republican."

Shields, South. See Shields (England).

Shieldsville, p.-v. and tp., Rice co., Minn. P. of v. 110; of tp. 558.

Shiites. See Shias.

Shikarpoor', town of British India, presidency of Bombay, in a low, level, regularly inundated, but fertile and not unhealthy plain, in lat. 27° 57′ N., lon. 68° 45′ E., 15 miles W. of the Indus, with which it communicates by a canal. Its extensive bazaars are well stocked with woollen, cotton, and silk goods and metal wares, and a large trade is carried on in horses and grain; but as it is situated on the main route from India to Afghanistan, its principal trade is a transit one, and its chief business banking. Its bankers enjoy a general confidence from Astrakhan to Calcutta, and carry on very large transactions. P. 31,000.

Shil'laber (Benjamin P.), b. at Portsmouth, N. H., in 1814; entered a printing-office at Dover 1830; was a compositor at Demerara, Guiana, 1835–37, and in the office of the Boston *Post* 1840–47; was editorially connected with the latter paper 1847–50, acquiring celebrity by his "sayings of Mrs. Partington;" was printer and editor of the *Pathfinder* 1850–52, editor and proprietor of the *Carpet-Bag* 1850–52; returned to the *Post* 1853–56, and was one of the editors of the *Saturday Evening Gazette* 1856–66, since which time he has written for various other periodicals. He published several very successful volumes, among which were *Rhymes with Reason and Without* (1853), *Poems* (1854), *Life and Sayings of Mrs. Partington* (1854), and *Knitting-Work* (1859).

Shil'ling [a word of doubtful origin], a coin of Great Britain, Denmark, Sweden, and North Germany. The British shilling is of silver, and worth about 24 cents in U. S. money. The Danish is of copper, worth about half a cent; the Swedish is worth 1 cent U. S. money; the North German shillings were little silver coins, worth about 2 cents.

Shi'loh, an ancient town of Palestine, the present *Seilun*, 20 miles N. of Jerusalem, was the seat of the ark of the covenant from the last days of Joshua to the time of Eli, but sank into total insignificance when the ark was carried away by the Philistines. Some insignificant ruins of a Roman town are found on the spot, but none of Jewish origin.

Shiloh, p.-v., Marengo co., Ala. P. 1391.

Shiloh, tp., Edgar co., Ill. P. 745.

Shiloh, p.-v. and tp., St. Clair co., Ill. P. 298.

Shiloh, tp., Grundy co., Ia. P. 539.

Shiloh, p.-v. and tp., Camden co., N. C. P. 1546.

Shiloh, tp., Iredell co., N. C. P. 1541.

Shiloh, p.-v., Cass tp., Richland co., O., on Columbus division of Cleveland Columbus Cincinnati and Indianapolis R. R. P. 297.

Shiloh, p.-v. and tp., Sumter co., S. C. P. 1518.

Shiloh, a locality in Hardin co., Tenn., about 2 miles W. of Pittsburg Landing, on Tennessee River, taking its name from a rude log chapel there known as "Shiloh Church." After the fall of Forts Henry and Donelson, Gen. Grant moved by transports up the Tennessee, and by the middle of Mar., 1862, his army lay stretched out from Shiloh Church to Pittsburg Landing, the latter a mere steamboat landing, as its name implies. The division of Lew. Wallace was stationed at Crump's Landing, some 8 miles lower down and nearly opposite Savannah, at which last-named place Gen. Grant established his head-quarters and dépôt of supplies. Gen. Buell, now on his way from Nashville, was to join with Grant at this point, when a general advance was to be made. Meanwhile, Gen. Beauregard had assembled at Corinth, an important railroad centre, 92 miles E. of Memphis, all the available forces from the Mississippi Valley, when he was joined by the command of Gen. A. S. Johnston from Kentucky and Middle Tennessee, who assumed control of the combined forces Mar. 29. Aware of Buell's approach, it was decided on the 2d to attack Grant before Buell could join him. The attack was arranged for the morning of the 5th, and on the 3d the Confederate army moved out from Corinth. A heavy rain and other causes delayed the attack until the 6th, when at an early hour the blow was struck, taking the Union army by surprise, and their front line driven out of its camps, excepting two of Sherman's brigades, whose position outreached the first line of battle. These brigades resisted stubbornly, and by the personal efforts of Sherman a gallant stand was made, but again compelled to give ground and take position on McClernand's right, which was held until afternoon, when both divisions were forced back. Grant had arrived on the field at 8 A. M., and ordered Lew. Wallace to hasten up with his division, while he set to work to re-form his troops and repair his lines. The divisions of Hurlbut and W. H. L. Wallace next received the enemy's attention, assault after assault being delivered along the whole line, which were each time repulsed, until at 3½ P. M. Hurlbut's exhausted division fell back, thus compelling Wallace to retire half an hour later. At this moment that heroic leader, whose gallant defence had been the admiration of all, received a mortal wound. Lew. Wallace's advance having been obstructed by the enemy, he was compelled to countermarch, and did not reach the field till nightfall. The Union army was now crowded back nearly to the river, with all their

encampments, some 60 guns, and 3000 prisoners in possession of the enemy. During the brief interval, while the enemy halted in attack after the withdrawal of W. H. L. Wallace, the remaining Union artillery was hastily assembled by Gen. Webster, chief of Gen. Grant's staff, advantageously posted on a commanding ridge covering Pittsburg Landing, so that at 6 P. M. a renewal of the attack was successfully resisted, and two gunboats now adding their fire, the enemy withdrew. Buell's advance had reached Savannah on the evening of the 5th, but it was after 6 P. M. of the 6th when Ammen's brigade was crossed—just in time to secure the final repulse of the day. By next morning all of Nelson's, Crittenden's, and McCook's divisions had crossed, and, with Lew. Wallace's, some 25,000 fresh troops were now available. The Confederate leader, Gen. Johnston, had fallen at 2½ P. M. on Sunday, the command devolving upon Beauregard, by whom the plan of operations was prepared and carried out. At daylight on Monday, Grant attacked along the whole line, which was gallantly resisted, a stubborn battle continuing until 4 P. M., when the Union lines of the day before and 30 guns were regained, and the Confederate army was in full retreat for Corinth; but pursuit was not pressed. Beauregard reported a loss of 1728 killed, 8012 wounded, and 959 missing. Grant's loss was 1735 killed, 7882 wounded, and upward of 3000 in prisoners. The armies were about equal in strength on the first day, but on the second the Confederates were largely outnumbered.

Shiloh, p.-v. and tp., King George co., Va. P. 1797.

Shimeall (RICHARD C.), b. in New York City in 1803; graduated at Columbia College 1821, at the Episcopal General Theological Seminary 1824; was pastor of St. Jude's church ten years, when he joined the Reformed (Dutch) Church; subsequently transferred his ecclesiastical connection to the New York presbytery; was successively pastor of several churches in New York; gave considerable attention to Greek and Hebrew, and wrote several works on sacred chronology and the interpretation of prophecy, in which he belonged to the Millenarian school. D. in New York City Mar. 19, 1874.

Shimonoseki. See SIMONOSEKI.

Shin'dler (Mrs. MARY S. B. **Palmer**), b. at Beaufort, S. C., Feb. 15, 1810; educated in seminaries at Wethersfield, Conn., Elizabethtown, N. J., and New Haven, Conn.; married to Charles E. Dana of New York 1835, with whom she settled at Bloomington, Ia., 1838; lost her husband 1839; returned to her parents in South Carolina; contributed poems to the *Rosebud*, a paper edited by Mrs. Caroline Gilman at Charleston, S. C.; published several volumes of poems and novels—*The Southern Harp* (1840), *The Northern Harp* (1841), *The Parted Family and other Poems* (1842), *The Temperance Lyre* (1842), *Charles Morton, or The Young Patriot* (1843), *The Young Sailor* (1845), *Forecastle Tom* (1845), and *Letters to Relatives and Friends* (1845), the last work being an account of her conversion from Calvinism to Unitarianism. In 1848 she became an Episcopalian, shortly after her marriage to Rev. Robert D. Shindler, who in 1851 became a professor in Shelby College, Ky., and ultimately settled in Texas. Specimens of Mrs. Shindler's poems appeared in the collections of Mrs. Hale, J. S. Hart, T. B. Read, and Mary Forrest.

Shin'er, a name applied in a vague manner to numerous small species of fishes of the family Cyprinidæ inhabiting the fresh waters of the U. S., characterized by a compressed body and shining, silvery color. The most notable of the species so designated is the *Stilbius americanus*, a form quite nearly allied to the breams (*Abramis*) of Europe, but not attaining so large a size, and rarely exceeding a few inches in length. This is one of the most abundant species in the streams of the Eastern and Middle States, and affords much sport to the boyish angler.

THEODORE GILL.

Shin'gle [Lat. *scindula*, "splinter"], a thin piece of wood used in covering roofs after the manner of slates. In thickness shingles usually diminish from one end to the other. They are laid in courses upon the roof, in such a way that one course overlaps and covers the joints of another. Long split shingles are called *shakes*. Shingles are split, sawed, or in some instances shaved off from a block of wood by a knife worked by machinery. Split shingles are the best as a general rule. Pine, cedar, chestnut, oak, spruce oak, and other kinds of wood are used in making shingles, but pine is generally the best. In sawing shingles a peculiar machine called the shingle-mill is employed.

Shingles (a disease). See HERPES.

Shin'necock, v., Southampton tp., Suffolk co., Long Island, N. Y., on Shinnecock Bay, is a settlement of a remnant of the Shinnecock tribe of Indians. P. 97.

Shiogoon, Tai-Shiogoon, or **Tycoon,** the title of the hereditary military ruler of Japan, once considered as emperor. The office has been abolished since the revolution in favor of the mikado or "spiritual ruler." The shiogoons held their court at Yedo (now Tokio), and were the highest authorities known to foreigners. The treaties which opened Japan to foreign commerce and residence were negotiated with the shiogoon.

Shipbuilding. See NAVAL ARCHITECTURE, by T. D. WILSON.

Ship-Canals. See APPENDIX.

Ship'ley (JONATHAN), D. D., b. in England in 1714; educated at Christ Church, Oxford; took orders in the Church of England; became incumbent of Silchester and Chin Bolton, prebendary of Winchester 1743, canon of Christ Church 1749, dean of Winchester 1760, bishop successively of Llandaff and of St. Asaph 1769, and chaplain to the duke of Cumberland 1775; was a disinterested friend of America, for which he predicted a brilliant future; defended the American cause in his writings and by personal influence. One of his daughters married Sir William Jones. D. Dec. 9, 1788. His *Works, consisting of Sermons, Charges, and Parliamentary Speeches* (2 vols., 1792), contain judicious discussions of questions of the times.

Ship'man, p.-v. and tp., Macoupin co., Ill., on Chicago and Alton R. R.

Shipp (ALBERT M.), b. in Stokes co., N. C., Jan. 15, 1819; graduated at the University of North Carolina 1840; became a Methodist preacher 1841, president of Greensboro' Female College 1848, professor of history and English literature in the University of North Carolina 1849, president of Wofford College, S. C., 1859, and professor of exegetical theology in Vanderbilt University, Nashville, Tenn., 1875.

Ship'pen, tp., Cameron co., Pa. P. 1824.

Shippen, tp., Tioga co., Pa. P. 270.

Shippen (EDWARD), LL.D., b. at Philadelphia, Pa., Feb. 16, 1729; studied law at Philadelphia and at the Temple, London, where he was admitted a barrister 1750; became prothonotary of the supreme court of Pennsylvania and judge of admiralty 1753; was afterward member of the council and president of the courts of quarter sessions for the county of Philadelphia; became judge of the supreme court 1791, and was chief-justice of Pennsylvania 1799-1806. D. at Philadelphia Apr. 16, 1806.—His daughter MARGARET married Gen. Benedict Arnold.

Shippen (WILLIAM), M. D., b. at Philadelphia, Pa., in 1735; graduated at Princeton 1754, and in medicine at Edinburgh; began at Philadelphia May, 1762, the first course of anatomical lectures ever given in the U. S.; became professor of anatomy and surgery in the Philadelphia Medical School Sept., 1765; served in the medical department of the army of the Revolution, and was its director-general from Apr. 11, 1777, to Jan., 1781. D. at Germantown July 11, 1808.

Ship'pensburg, p.-b. and tp., Cumberland co., Pa., on Cumberland Valley R. R. and National Pike, 41 miles W. of Harrisburg, contains 7 churches, 1 bank, normal school and an institution of learning for teachers, 2 newspapers, 2 flouring-mills, 4 hotels, 4 carriage-factories, and 2 machine-shops. Large deposits of iron ore exist in the neighborhood. P. of b. 2065; of tp. 381.

Shippigan', p.-v., Gloucester co., N. B., on the Gulf of St. Lawrence, near the N. E. angle of the province, 254 miles N. of St. John. It has 3 large harbors, and important herring, cod, and mackerel fisheries. P. about 500.

Shipping, Law of. This department of the law is concerned with the ownership of merchant-ships, their use in commerce, the rights, powers, and duties of ship-owners, owners of cargo, masters, and seamen, the contracts with reference to their employment, and the maritime torts committed by their means or by persons engaged in their navigation. The term "ship," especially in the U. S. includes all vessels of commerce for the transport of goods or passengers, whether propelled by wind or by steam, plying either on the high seas, on other tide-waters, or on the great lakes and rivers over which the national admiralty jurisdiction extends. The general principles of the law relating to shipping were embodied in the various maritime codes of the Middle Ages, and have thence been incorporated into the existing jurisprudence. (For a description of these maritime codes see MERCANTILE LAW.)

I. *Nationality of Ships.*—It was formerly the policy of all maritime countries to foster and protect their domestic ships and ship-owners by conferring special advantages upon them, and by discriminating heavily against those of foreign nations. This policy is still retained in the legislation of the U. S.: extensive privileges are granted to U. S. vessels. To constitute a vessel of the U. S. under the statutes of Congress it must be wholly owned by citizens of the U. S.,

and, with certain exceptions, by resident citizens; its master and officers must also be citizens: it must have been built in the U. S., or bought at a judicial sale when condemned as prize or forfeited for a violation of the laws; but if a foreign vessel should be wrecked in the U. S., and then purchased by citizens, and repaired by them within this country at a cost equalling at least three-fourths of its value when completed, it would thereupon become a national vessel. The statutory system requires that when a ship is built, or becomes the property of citizens in any of the modes above mentioned, it must be either "registered" or "enrolled" as a U. S. vessel before it can be used as such for purposes of trade. If it is designed for foreign commerce, the evidence of its ownership and of all other necessary facts is presented by affidavit to the collector of the district in which it belongs, and he issues the first certificate of registry, which recites the owners, the place or port where it belongs, the tonnage, the name, and all the other particulars necessary to identify the vessel and to establish its national character. If it is designed for the coasting-trade or for fishing, and is of 20 tons burden, or more, it is enrolled in the same manner, and a similar certificate of enrolment is issued, and in addition thereto it must be licensed; while if of less than 20 tons burden, the license is the only requisite. This certificate of registry or of enrolment forms the most important part of the "ship's papers," and is evidence at home and abroad of her character and use. If any change of owners takes place, either total or partial, the old certificate of registry or of enrolment must be surrendered and a new one issued, which shall represent the actual ownership. The statute enacts that in case of a sale or transfer there must be a bill of sale, which shall recite at length the original certificate, or else the vessel cannot be registered anew. The result of this provision is that after a ship is once registered or enrolled as a vessel of the U. S. it cannot be effectively conveyed by a verbal contract; unless transferred in writing it cannot be registered anew, and cannot therefore be used without violating the statute. The special privileges enjoyed by U. S. vessels are as follows: They alone, when properly enrolled and licensed, can engage in the coasting-trade and in the fisheries. A foreign ship bringing an imported cargo into one port may, however, carry the goods to another port if they have not been unladen. This statutory provision has been partially interfered with by the Treaty of Washington, which grants certain rights of trading among the Northern and Western lake and river ports and coasts to the inhabitants of the Canadian Dominion. In regard to foreign commerce the statute provides that "no goods shall be imported into the U. S. except in U. S. vessels, or in foreign vessels wholly belonging to subjects of that country of which the goods are the growth, production, or manufacture, or from which they can only be, or most usually are, first shipped for transportation." This restriction does not apply to nations which do not maintain a similar discrimination against U. S. vessels, nor to those nations with whom there exist treaties of commerce and navigation containing stipulations of a contrary import. The result is, that U. S. ships have a virtual monopoly of the coasting and fishing business, and that they enjoy an absolute freedom—so far as our own laws are concerned—to carry on the export and import trade to and from all parts of the world. The limitation upon imports in foreign bottoms is of little practical account, since the commercial treaties between the U. S. and other maritime countries have generally stipulated for the mutual liberty of their respective national ships to trade in each other's ports.

II. *Property in Ships.*—Ships are chattels, and the rules which govern the property in them, its transfer, and its devolution in case of death, are the same, except when changed by statute, which regulate personal property generally. It has already been stated that the original property in a U. S. vessel can only be acquired either by building, by purchase at judicial sale after a capture or forfeiture, or by purchase and repair of a wreck. After the title is thus first obtained it may be transferred by a bill of sale, by a chattel mortgage, by seizure and sale on execution, by assignment in bankruptcy or insolvency, by a sale in an admiralty suit to enforce a maritime lien, and by succession through intestacy or by will. In order to preserve record evidence of title a statute of Congress enacts that every bill of sale, mortgage, hypothecation, or conveyance of any vessel or part of a vessel of the U. S. must be recorded in the office of the collector where the same is registered or enrolled, or else it shall not be valid against any person other than the grantor or mortgagor, his heirs and devisees, and persons having actual notice thereof; but bottomry bonds given while the ship is on a voyage are not affected by this statutory provision.

III. *Owners of Ships, their Rights and Liabilities.*—A ship may be owned by a single proprietor, by a partnership, or by several part-owners. (See PART-OWNERS.) In either case the owners determine its employment, appoint the master and all other agents, and are entitled to the compensation earned by its use. They often delegate their authority to a special agent—usually selected from among themselves—called the "ship's husband," whose extensive powers are well settled by the law. (See SHIP'S HUSBAND.) They are liable for all expenses and charges incurred, as for repairs, supplies, seamen's wages, and the like, and on all contracts made either by themselves or by their lawful agents; and when the ship is used by themselves for the carriage of goods, they are liable to the shippers for all losses and damages to the cargo unless caused by some one of the excepted perils (see CARRIERS, COMMON), and to the owners of other vessels and cargoes for injuries thereto occasioned through negligence in navigating their own. The extent of their liability has been limited by legislation in the U. S., in Great Britain, and in other maritime countries. The statute of Congress enacts—and the British statute is substantially the same—that a ship-owner shall not be liable to the owner of cargo for loss by fire, "unless such loss is caused by the design or neglect of such owner," so that a responsibility does not attach to him when a fire is occasioned by the fault of the master or seamen. Another clause provides that the owner shall not be liable for certain valuable articles, such as gold, silver, money, etc., unless the shipper notifies him in writing of their true nature and value, and the same is entered in the "bill of lading therefor;" nor is he ever responsible for such articles beyond the amount so notified and entered. Finally, the liability of the owner or owners for any embezzlement, loss, or destruction by the master, officers, seamen, or other person of any goods shipped, or for any loss or injury by collision, or for any act, loss, damage, etc. done or incurred without the knowledge of such owner or owners, "shall in no case exceed the amount or value of the interest of such owner or owners in such ship or vessel and her freight then pending;" if the whole value of the ship and freight is not sufficient to fully compensate all the owners of property destroyed or injured, they shall receive compensation in proportion to their respective losses. In some cases the liability of the owners is purely personal, and can only be enforced by an ordinary pecuniary judgment against them; in other cases it creates a lien on the ship itself, and is enforced by a proceeding *in rem* in a court of admiralty.

IV.—*Persons employed in the Navigation of Ships.*—The master is the agent both of the ship-owners and of the owners of the cargo, and his powers are many and great. He is clothed with a large discretion, and by its exercise, if done in good faith and with reasonable judgment, he may bind all the parties whom he represents. Actions upon shipping contracts may be brought by or against him personally as though he were the ultimate contracting party; and in fact all such contracts are generally executed in his name. He has the supreme command and responsibility in navigating the ship and an absolute supremacy of the officers and crew. As a general proposition, the master may enter into all ordinary contracts relating to the usual employment of the ship, and bind the owners thereby. While the vessel is in her home port, or under the immediate supervision of the ship's husband or other managing agent, his authority is restricted, and he acts in subordination to the owners or to such agent in matters pertaining to her condition and use. When she is in a foreign port, and communication with her owners would be attended by a dangerous delay, the actual necessities of her situation become the foundation and furnish the limit of his authority, provided that his acts are such as would have been done by a reasonably prudent owner under the same circumstances. Thus, if she is injured and disabled, he may, if necessary, borrow money for her repairs, and hypothecate the ship or cargo as security by a bottomry or *respondentia* bond; he may sacrifice portions of the vessel or cargo by jettison; he may in certain emergencies even abandon or sell the vessel or cargo, or charter another ship in order to complete the voyage; in short, he may do any act customary in the transactions of commerce which, to a reasonable man acquainted with the course of such business and placed under the same circumstances, would seem to be for the best interests of all the parties represented—the ship-owners, the cargo-owners, and the insurers. While these doctrines have long been established in the maritime law, it has been recently held by very eminent courts that the introduction of the magnetic telegraph, and its extension to so many distant parts of the world, and the consequent ability of immediate communication with owners at home, have very much lessened these extraordinary powers of the master, and that when within reach of the telegraph he should first obtain, or at least attempt to obtain, instructions before taking the final steps which will create a liability or change the legal relations of his principals.

The statutes of the U. S., as well as of Great Britain and of other maritime countries, prescribe the regulations which govern the hiring, treatment, and conduct of seamen, the form and contents of their agreements with the ship-owners, the measures deemed necessary for their welfare and protection. The provisions of this legislation are so numerous, extensive, and minute that even an abstract of them is wholly impracticable. The claim of seamen for their wages when earned is highly favored by the law; it constitutes the first lien on the vessel, taking precedence of all others without regard to their priority in time; and it may be summarily enforced in admiralty by a proceeding *in rem*. It is a doctrine of the maritime law that the liability for wages on a voyage depends upon the earning of freight. (For a statement of this rule, with its limitations and exceptions, see the article FREIGHT.)

V. *The Employment of Ships in Commerce.*—A ship may be used for purposes of traffic in three distinct modes: (1) It may be entirely let or leased, for a given period at an agreed compensation, to parties who take complete possession and control, appoint the master and crew, and assume for the time being the character of owners. This species of hiring is sometimes, though not with perfect accuracy, termed chartering, and the contract of lease a charter party. (2) The owners, retaining the possession and management of the vessel, and employing the master and crew, let out, for a given time or for a given voyage, either the entire carrying capacity or some specified portion thereof by a contract called a charter-party. (3) The owners of a ship sailing regularly on a definite and constant route, or of a ship destined for some particular voyage, receive on board and undertake to carry the goods in varying quantities of parties generally who desire to use that mode of conveyance. The agreement in this case between the shipper and the ship-owner is a bill of lading. (The form, nature, and usual provisions of these two principal shipping contracts, the special incidents accompanying their use, and the rights and duties of the respective parties thereto, will be found in the articles CHARTER-PARTY, BILL OF LADING, FREIGHT, and DEMURRAGE.) Among the possible incidents of every voyage are the jettison of goods, masts, etc. in time of peril; the contributory liability of all parties when sacrifice, loss, or extraordinary expense has been incurred by some interests for the benefit of the whole; the salvage liability to those who have rescued the ship or cargo from impending danger; and the special contracts of hypothecation by means of which the master is sometimes enabled to complete the voyage. (For a discussion of these several topics see articles JETTISON, AVERAGE (GENERAL), SALVAGE, BOTTOMRY BOND, and RESPONDENTIA. For the rules of navigation which have been adopted to prevent collision see article ROAD, LAW OF THE.) If a collision is caused solely by stress of weather or overpowering natural forces, without the fault of either party, it is a peril of the sea, and no liability whatever ensues. The rules of admiralty in cases of fault are well settled as follows: If both vessels are in fault, the loss is apportioned equally between them; if one of the colliding vessels is wholly in fault, it not only bears its own injury, but is also responsible for the damage inflicted upon the other and upon its cargo. This liability in such case constitutes a lien upon the offending vessel, and is usually enforced by an admiralty suit *in rem*. (In addition to the topics already referred to, the reader should consult STOPPAGE IN TRANSITU and the various articles relating to INSURANCE (MARINE), which is intimately connected with the entire law of shipping.)

JOHN NORTON POMEROY.

Ship's Husband, in the maritime law, is a general agent of the owners for the management of the ship. The place of his employment is usually the home port, or that where the vessel is fitted out and from which she sails on her various voyages. He may be appointed by writing, verbally, or in any manner by which an agency can be constituted. He is often one of the part-owners, and indeed in several of the U. S. statutes he is designated as the "managing owner." The general functions of the ship's husband, belonging to him by virtue of his office, are to see that the ship is in a proper condition to be used for the earning of freight, and to see that she is in fact used for that purpose. In carrying out these duties he possesses the following specific powers: to keep the vessel in complete repair, and to procure a proper outfit of tackle, apparel, and furniture, so that she shall be seaworthy; to employ a competent master, officers, and crew; to purchase the supplies of provisions and other sea-stores necessary for the voyage; to obtain the regular ship's papers, and to transact all needful business with the customs and other public officials; to enter into all the contracts required for the foregoing objects, and to provide for and make the payments therein; to negotiate and execute all contracts for the carriage of goods, either by chartering the vessel or by employing her as a general ship; to agree upon, settle, and receive payment of freight; to adjust liabilities, demands, and averages with the shippers; to preserve the vouchers and other papers; and to keep the ship's books of account. While accomplishing these purposes his acts are within the scope of his employment, and are binding upon the owners whom he represents. On the other hand, the ship's husband, as such, has no power to borrow money for the use of the vessel; he cannot insure it and make the owners liable for the premiums; he cannot purchase a cargo on their account, nor bring actions on their behalf, nor delegate his own authority; and, although he may settle and receive payment of freight, he cannot do so by giving credit therefor to the shippers, and delivering up the cargo to them and surrendering the lien thereon, unless such credit was expressly stipulated for in the contract of affreightment. Of course the power to perform any of these acts may be expressly conferred, and if done without antecedent authority they may be ratified and thus made obligatory. The compensation of the ship's husband is usually a commission upon his receipts and payments, or upon the amount of his purchases, and the liability for it is either a joint obligation of all the owners or an individual and *pro rata* obligation of each.

JOHN NORTON POMEROY.

Ships, Iron-clad, vessels clad with iron plates to give protection against shot and shell.

(1) A retrospect of naval construction prior to the use of armor is necessary to make the subject clear. Artillery was first mounted in naval vessels during the reign of Edward III., about 1350. For several centuries naval construction did not advance as would be expected from so radical a change in weapons. Only by degrees ships were divested of the unwieldy top-hamper which they had in the hand-to-hand conflicts of the Middle Ages. During this long period the improvements in construction and armament made slow progress, but during the last fifty years—since the Nile and Trafalgar—a revolution in naval warfare has been brought about by entirely new systems. This has been wrought by three agents: (1) the application of steam, strictly the screw-propeller, as the naval motor; (2) horizontal shell-firing from naval artillery; (3) application of iron plates to keep out the shells. The submarine torpedo may be added to this list; already are iron-clads designed in vain, it would seem, to be proof against this weapon. As soon as the peculiar qualities of the screw were established to the satisfaction of admiralty boards, it became certain that steam would be the universal naval motor. This may be dated from the U. S. S. Princeton (1842–43), the first screw war-steamer planned as such: she was designed by Ericsson. Great naval powers are reluctant to begin changes that involve costly reconstruction; this, with the conservatism regarding any new system, was the reason of the otherwise inconceivable reluctance of the English to take up the project of a screw navy. When the French built the screw line-of-battle ship Napoleon (1850), the English took alarm and began reconstruction with vigor, and the renovation of their navy by the application of the screw was well advanced in 1859. This year the French launched the iron-plate frigate La Gloire; then began the decline of the wooden fleets and the beginning of new ones on the new system.

(2) The principal incentive to the application of iron armor was the destruction anticipated from horizontal shell-firing against wooden ships. This mode of using shells, perhaps from the danger attending it, made slow progress in ships of war: it was not until 1854 that naval batteries consisted entirely of shell guns, the magazines being filled with loaded shells, ready fused. Admiral Dahlgren in the U. S. S. frigates of 1854 carried the application of this missile to great perfection. The Merrimack, one of these, visited Europe in 1856, startling naval administrations by the enormous shell-power of her battery. It was the extreme use of shells that brought about resort to armor to keep them out. The French general Paixhans some forty years ago suggested iron as a protection against this deadly missile, with which his name is so much identified. The swift destruction of the Turkish fleet at Sinope by the shells of the Russian ships during the war in the Crimea had much to do with hurrying forward its application; the destruction of the Congress and Cumberland, and the engagement between the Monitor and Merrimack, gave it fresh stimulus.

(3) The first definite proposal for building an iron-clad was made in 1841 by R. L. Stevens; armor, it is stated, was suggested by his father, J. C. Stevens, in 1812. An act approved Apr. 12, 1842, authorized the secretary of the navy to enter into a contract with Stevens for the construction "of a war-steamer for harbor defence, shot and shell proof, to be built principally of iron." The contract was made Feb. 10, 1843; it called for the following dimensions:

"Length, not less than 250 feet; beam, not less than 40 feet; depth amidships, 40 feet; protection against shot, 4½ inches of iron; horse power, 900." About this time Com. Stockton, U. S. N., was experimenting at Sandy Hook with one of the 12 inch wrought-iron guns planned for the Princeton: a 224 pound shot, with 30-pound charge, was fired from it against a target representing the armor proposed by Stevens: it pierced the target and passed through a sandbank 8 feet thick. This stopped the construction of the iron-clad until by a second contract (Nov. 14, 1844) Stevens increased the dimensions as follows: Length, 415 feet; beam, 48 feet; depth, 33 feet 6 inches; protection, 6¾ inches of iron; horse-power intended, 8624. Work was begun 1854, and when the vessel was about half completed the government refused further appropriations. In the early part of the civil war (1861) the navy department again declined to ask Congress for money, a naval board having made an adverse report.

(4) The first iron-clads used in battle were the French floating-batteries Devastation, Lave, and Tonnante (1855), built for special service in the Crimea. Particulars: length, 171 feet 9 inches; beam, 43 feet 1 inch; draught, 8′ 8″; hulls of wood; armor, 4.33 inches thick; armament, 16 guns of "50," carried 2 feet 11 inches above water-line. They formed part of the fleet, carrying 1500 guns, which destroyed Fort Kinburn, an inferior barbette work. The iron-clads engaged at 700 yards; at that range they were proof against 32-pound shot with 10-pound charges. The English adopted the design, and built five; they were very uncouth, in model like a canal-boat.

(5) La Gloire, completed 1861, was the real beginning of the present era of iron-clads; she was the first attempt at a swift, invulnerable, ocean-going iron-plated vessel; her hull, of wood, was on the model of the line-of-battle ship Napoleon of 91 guns, and at the same draught had equal displacement, but being more heavily laden her draught was greater; her guns, thirty-six 6.3-inch rifles, were carried in broadside, in one tier, 6 feet above the water-line. Her sides were completely covered with armor—at the water-line, 4.72 inches thick, above it, 4.33 inches; this was proof against projectiles from guns then in use. With the development in artillery which immediately began, this soon changed; now (1875) naval artillery can put loaded shells through the strongest armor afloat. La Gloire was, in other points than armor, a wide departure from the conventional and time-honored war-vessel. There was no vestige of ornamentation; the stem, in order to increase the ram-power, inclined somewhat backward; to lessen the labor of bending and fitting the heavy iron plates, the hull at bow and stern is of the plainest form. The rig is very simple; it consists of three masts, with very long mast-heads to give support to topmasts which, with the short bowsprit, can be housed at pleasure; the foremast carries a square sail; all the others are plain fore-and-aft sails, the idea being to have as little rigging as possible to be shot away and foul the screw. The sail-area was 11,840 square feet; an ordinary war-vessel of the same tonnage would have 35,000 square feet in the principal sails. This shows that with the iron-clad came increased dependence on steam, sails becoming an auxiliary that will never be used in action. The speed was reported to be 12.8 knots; the bunkers carry five days' fuel. After La Gloire came two iron-clads of the same dimensions and material. In 1863–64 the Magenta and Solferino were completed; these carried out the emperor's idea of a large number of medium-calibre guns; they were armed with fifty-two 6.3-inch rifles. In 1865 eight floating batteries were built, each carrying sixteen medium guns, protected by 4½ and 5½ inch plates. In 1867 the Alma class of corvettes, seven in number, were commenced; hulls of wood; armament, six 7.48-inch rifles; armor at water-line, 5.91 inches, over the battery, 4.72 inches. About the same time the Provence class, eleven in number, were in progress, all of the same dimensions, but differing in armament and method of mounting it. One of these, the Surveillante, carried eight 9.5-inch rifles, capable of piercing 10-inch armor up to 500 yards. During 1867–69 the Marengo class, four in number, were put afloat; with one exception, the Friedland, the hulls were of wood; they carry eight 10.6-inch rifles, which can pierce 12-inch armor up to 600 yards, and six 7.6-inch guns which are mounted in semicircular iron shields projecting their full semi-diameter from the vessel's sides—an arrangement adopted to give increased horizontal range, and suited to the peculiarities of breech-loading, on which plan all heavy French naval guns are made. The armor is 7.87 inches at the water-line, and over battery 6.3 inches thick. The Colbert, Richelieu, and Redoubtable, the largest so-called ocean-going iron-clads in the French navy, are nearly completed; the two former carry eight 10.63-inch rifles, which use 88-pound charges and 476-pound projectiles, and one 9.5-inch rifle. These vessels, with the exception of the rams Tonnerre and Tempête, have the thickest armor in the French navy; it is 8.66 inches at the water-line and 6.3 inches over the battery. All of these (except rams) are masted broadside iron-clads; most of them carry their guns on one deck. The Cerbère, Bélier, and Boule-dogue are coast-defence rams; they are without rigging, and are intended to be fought head on; they carry two 9.5-inch rifles in fixed turrets. The armor on the sides is 8.66 inches thick. The Taureau, similar to these, but with her upper deck formed like the back of a tortoise, carries one gun of the same calibre. The Tonnerre and Tempête, the latest ram-vessels, have monitor hulls and fixed turrets; they carry two 12.6-inch rifles, which use 136-pound charges with 760-pound projectiles; these are said to be able to pierce 15-inch armor up to 300 yards. Their armor is the heaviest in the French navy, being 11.81 inches thick.

(6) As with the screw-propeller the English showed it was their policy to imitate no novel changes which would cause immense and costly reconstruction in their existing establishment, so with the iron-clad they adhered to the same policy until forced to change. No sooner was it known that their naval rival was seriously at work on a real sea-going iron-clad than they set about to reply to the challenge, and before La Gloire was finished the Warrior (1861) was well advanced. The differences between the rival ships show how tenaciously the naval mind clings to conventional forms and usages. The French ship was plain and uncouth; the Warrior is a splendid-looking frigate, with masts and rigging in the old style, her bow and stern of the same form and ornamented in the same manner as the old ships which were passing away; her lines, to ensure high speed with moderate power, were unusually fine. But there were more essential differences: the French vessel, 263 feet in length by 59′ 9″ beam, 5530 tons displacement, was armored from stem to stern; her English rival, 419 feet in length, 58 feet beam, displacement 8950 tons, had a patch of armor on her sides of 4½-inch tongued and grooved plates covering $\frac{5}{12}$ths of her length (see Diagram No. 1), the rest of the ship being unarmored; behind this armor twenty-six 8-inch smooth-bore guns were carried; at the ends of this protected part armored bulkheads of the same thickness, in order to protect the guns from fore-and-aft fire, were carried across the vessel. This was the plan of Russell, the eminent English engineer; with modifications not affecting the principle, and combined with a belt of armor along the water-line, it is now adopted in all broadside iron-clads. The speed was 14.35 knots, but obtained as it was by large dimensions, fine lines, and small relative carrying capacity, it was a costly achievement, as in efforts to equal it in subsequent constructions thickness of armor and celerity of turning were sacrificed. The Warrior was followed by her duplicates, the Black Prince and Achilles, in all respects alike, except that in the latter was an armored belt around the water-line and a perpendicular ram-bow. Shortly after, the Defence, Resistance, Hector, and Valiant were in progress; these were 100 feet shorter than the Warrior; the two former had a patch of armor on their sides like that vessel; the latter had the addition of an armored belt *above* the water-line. Then came the Minotaur, Agincourt, and Northumberland, longer than the Warrior, their displacement being 10,275 tons, so that they could carry a complete cuirass of armor, 5½ inches thick, from stem to stern. These, with the exception of seven wooden ships converted into iron-clads, were the last attempt to carry complete armor in broadside vessels. So great was the increase in the power of ordnance that diminution in the area to be protected in order to increase the thickness of armor became imperative, and all iron-clads built after these, except rams and monitors, carried armor only over a central casemate and around the water-line. The most powerful iron-clads now in European waters are monitors; their construction seems to have been brought about by the rapid development of armor-piercing ordnance. The names and chief particulars of the principal iron-clads are given in Table A (on the following page).

(7) Enough has been said about the European iron-clads to show the development of the system; this can be followed up from the table. The principal forms and varieties of iron-clads emanated from America, France, and England. Those of the other naval powers, many of them built in England, are summarized in the sections immediately following the table mentioned, with such facts as are necessary for an understanding of their power and capacity.

The following synopsis, together with Table A, comprises a complete list of all the iron-clads of any consequence in the world, except those of the U. S. navy, which are given farther on. It must be remembered that the development of ordnance power (to say nothing of sub-marine movable and fixed torpedoes) is now making such rapid advances that iron-clad construction is very far from

TABLE A.—*Principal Particulars of English and French Iron-clads.*

Number built.	Name of vessel.	Date of construction.	Length between perpendiculars.	Breadth.	Draught forward.	Draught aft.	Thickness of armor.	Thickness of iron skin.	Thickness of wood backing.	Piercing figures (P. F.).	Length of casemate.	Height of guns above water-line.	Speed.	Displacement.	Armament, etc.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
	English.		ft.	ft. in	ft. in.	ft. in.	in	in.	in.		ft.	ft. in.	knots.	tons.		
2	Warrior	1860	380	58 4	25 0	26 9	4.5	$\frac{5}{8}$	18	53	213	8 10	14.4	8,952	(4) 8-in. R., (22) 7-in. R.	C.
1	Achilles........	1863	380	58 4	26 3	27 4	4.5	$\frac{5}{8}$	18	53	213	9 0	14 3	9,681	(4) 9-in. R., (22) 7-in. R.	C. and W.-L. B.
3	Minotaur.......	1865	400	59 4	26 0	27 0	5.5	$\frac{5}{8}$	9	54	385	9 0	14.7	10,395	(16) 9 in R., "	W.
1	Royal Oak......	1863	273	58 6	23 10	25 5	4.5	....	$29\frac{1}{2}$	43	280	7 6	12.5	6,416	(4) 8 in. R., (20) 7-in. R.	W.
1	Royal Alfred...	1863	273	58 5	25 2	26 7	6	....	$29\frac{1}{2}$	56	165	7 6	11.8	6,400	(10) 9-in R., (8) 7 in. R.	C. and W.-L. B.
3	Prince Consort.	1863	273	58 5	23 6	26 9	4.5	....	$29\frac{1}{2}$	43	280	7 6	13.1	6,430	(4) 8 in R., (20) 7 in R.	W.
2	Lord Clyde.....	1864	280	58 9	24 0	26 6	4.5–5.5	$1\frac{1}{2}$	$31\frac{1}{2}$	80, 60	280	8 0	13 4	7,675	(16) 9-in R., (4) 7-in. R.	W.
1	Zealous	1864	252	58 7	24 6	26 0	4.5	....	$30\frac{1}{2}$	45	103	.....	12.6	6,027	(20) 7-in. R.	C.
2	Hector...	1864	280	56 5	24 0	25 7	4.5	$\frac{5}{8}$	18	53	288	.....	12 3	6,960	(2) 8-in. R., (16) 7-in R.	C.
2	Resistance......	1861	280	54 1	23 6	25 6	4.5	$\frac{5}{8}$	18	53	143	6 11	11.8	5,986	" (14) 7-in. R.	C.
1	Bellerophon....	1865	300	56 0	21 0	26 0	6.	$1\frac{1}{2}$	10	70	110	7 11	14 2	7 510	(10) 9-in. R., (4) 7-in. R.	C. and W.-L. B.
1	Hercules........	1868	325	59 0	22 0	27 0	9–8–6	$1\frac{1}{2}$	10	130, 102, 70	....	12 2	14 0	8,700	(10) 10-in. R., (2) 8-in. R.	C. and W.-L. B.
1	Penelope	1868	260	50 0	15 7	17 7	6-5	$\frac{3}{4}$	10	70, 55	....	.....	12.7	4,394	(8) 9-in R., (3) 40-pdr. R.	C. and W.-L. B.
1	Monarch........	1868	330	57 6	22 6	26 0	10–7–6	$1\frac{1}{2}$	14–12	135, 88, 70	....	16 0	14.2	8,303	(4) 10-in. R.	Turret.
1	Royal Sovereign	1864	241	62 2	22 0	23 9	5.5	....	36	50	246	.....	11.0	5,000	(5) 9-in R.	4 turrets.
1	Prince Albert..	1864	240	48 0	20 0	20 0	4.5	$\frac{5}{8}$	18	53	245	.....	10.5	4,020	(4) 9-in. R.	Turret.
1	Pallas..........	1865	225	50 0	18 0	24 0	4.5	....	22	43	50	7 11	12.6	3,688	(4) 6-in. R., (2) 68-pdrs.	C. and W.-L. B.
1	Favorite........	1864	224	46 9	18 11	21 10	4.5	....	26	43	66	8 6	11.8	3,116	(8) 7 in. R., (2) 68-pdrs.	C. and W.-L. B.
1	Research.......	1864	195	38 6	12 9	15 3	4 5	....	$19\frac{1}{2}$	43	34	6 11	9 0	1,780	(4) 7 in. R.	C. and W.-L. B.
1	Enterprise......	1864	180	36 0	13 3	15 6	4.5	....	$19\frac{1}{2}$	43	34	6 11	9.8	1,370	(4) 7-in. R.	C. and W.-L. B.
2	Scorpion	1863	220	42 6	15 0	15 0	4 5	$\frac{1}{2}$	9	50	225	4 9	11.4	2,777	(4) 9-in. R.	2 turrets.
2	Viper	1865	160	32 0	9 6	10 6	4.5	$\frac{1}{2}$	10	50	59	5 11	10.0	1,220	(4) 9-in. R.	
1	Water Witch...	1866	162	32 0	11 11	11 7	4.5	$\frac{1}{2}$	10	50	60	5 0	9.2	1,278		
1	Captain........	1866	320	53 9	22 6	23 6	12–8–7	$1\frac{1}{2}$	12	160, 102, 85	....	8 2	....	7,823	(4) 11-in R., (2) 7-in. R.	2 turrets.
6	Audacious......	1869	280	54 0	22 0	23 0	8–6	$1\frac{1}{4}$	10	110, 70	....	7 8	12.8	6,103	(10) 9-in. R., (4) 68-pdr.	C. and W.-L. B.
3	Cerberus	1868	225	45 0	15 6	15 6	10–8	$1\frac{1}{4}$	10	135, 102	....	9 1	9 6	3 344	(4) 10-in. R.	Monitor.
1	Glatton	1871	245	54 0	19 0	19 0	14–12	$1\frac{1}{2}$	18–15	198, 163	....	10 5	12.0	4,862	(2) 12 in. R.	"
2	Devastation....	1871	301	62 3	26 4	26 6	14–12–10	$1\frac{1}{2}$	$18–14\frac{1}{2}$	198,163,135	....	14 0	13 8	9,046	(4) 12-in. R.	"
4	Gorgon	1871	225	45 0	16 5	16 5	10–9–8	$1\frac{1}{4}$	10	135,117,102	....	9 0	11.1	3,430	(4) 10-in. R.	"
1	Repulse........	1871	252	54 0	25 6	26 6	6	....	31	56	....	.....	....	.....	(10) 9-in. R.	C. and W.-L. B.
1	Sultan..........	1870	325	59 0	24 10	27 6	9–8–6	$1\frac{1}{2}$	12	117,102,70	....	11 7	14.1	9,293	(13) 10-in. R.	C. and W.-L. B.
1	Alexandra......	1875	325	63 8	26 0	26 6	12–8–6	$1\frac{1}{2}$	10	160, 102, 70	75	.....	14.0	9,492	(2) 12-in. R., (10) 10-in. R.	C. and W.-L. B.
1	Hotspur........	1870	235	50 0	19 0	20 8	11–8	$1\frac{1}{4}$	12	146, 102	....	10 6	12 6	4,010	(1) 10-in. R.	Ram.
1	Fury...........	1870	320	63 10	26 6	27 0	14–10	$1\frac{1}{2}$	18–15	198, 135	....	.....	14.0	10,886	(4) 12-in. R.	T. R.
1	Rupert.........	1872	250	53 0	21 6	23 6	12–11	$1\frac{1}{4}$	12	160, 146	....	10 10	13 6	5,358	(4) 12-in. R.	T. R.
1	Shannon.......	1872	260	54 0	22 0	22 6	9	$1\frac{1}{4}$	12–10	117	....	.....	....	5,103	(9) 9-in. R.	C. and W.-L. B.
1	Inflexible	1875	320	75 0	23 0	25 0	24–18	2	......	....	....	.....	13 0	11,165	(4) 81-ton R.	Monitor.
1	Téméraire......	St'ks.	285	62 0	26 6	27 0	11	$1\frac{1}{2}$	12	146	....	.....	14.0	8,412	(3) 12-in. R., (5) 10-in. R.	C. and W. L. B.
	French.															
3	Gloire..........	1859	252	55 9	23 1	27 10	4.72–4.33	....	26–23	45, 40	....	6 2	12.8	5,530	(36) 6 3-in. R.	W.
1	Couronne	1859	262	54 9	23 0	26 11	4.7	$\frac{5}{8}$	10	53	....	6 2	13.0	5,982	(20) 6.3-in. R., (10) 55-pdr.	W.
2	Magenta	1861	284	57 0	24 1	28 0	4 72	....	26–23	45	....	6 3	12 8	6,876	(52) 6.3-in. R.	W.
10	Provence.......	1868	258	55 11	23 6	26 10	5.9–4.33	....	26–23	55, 40	....	7 3	13.9	5,703	(8) 9.45-in. R., (4) 7 48-in. R.	W.
4	Marengo	1869	282	57 0	24 10	29 1	7.87–6.3	....	32–24	85, 70	....	11 9	13.5	7,360	(4) 10.63-in. R., (4) 7.48-in. R.	C. and W.-L. B.
6	Alma...........	1867	230	46 0	18 10	23 9	5.91–4.72	....	26	55, 45	....	6 3	11.8	3,678	(6) 7.48-in. R.	C. and W.-L. B.
1	Belliquese......	1867	230	45 0	17 6	21 0	5.9	....	10	55	....	.....	12.5	3,347	(16) 9.45-in. R.	C. and W.-L. B.
1	Colbert.........	Stk's.	314	57 0	24 7	27 10	8.66–6.30	....	32–24	108, 70	....	13 4	....	8 167	(8) 10.63-in. R., (1) 9.45-in. R.	C. and W.-L. B.
1	Richelieu.......	"	322	57 0	24 7	27 10	8 66–6.30	....	32–24	108, 70	....	13 4	....	8,269	(6) 10.63-in. R., (4) 9.45-in. R.	C. and W.-L. B.
1	Redoubtable....	"	312	64 0	22 3	24 11	......	....	......	.. ..	....	13 7	....	8,658	(4) 10.63-in. R., (2) 12.6-in. R.	C. and W.-L. B.
1	Rochambeau....	"	352	69 0	21 0	22 2	4 72–3.54	....	35	50, 35	....	4 8	13.0	7,758	(4) 10.63-in. R., (11) 9.45. in. R.	C.
4	Cerbère.........	1868	216	53 0	18 7	19 7	8.66–7.09	....	31–20	108, 88	....	17 5	11 3	3,703	(2) 9.45-in. R.	Turret.
4	Paixhan........	1868	156	46 0	10 9	10 9	4.5	....	10	40	....	.....	7 0	1,539	(16) 55-pdr.	F. B.
4	Embuscade.....	1865	130	51 2	9 6	9 6	5 51–4.33	$\frac{1}{2}$	$15\frac{3}{4}$	53, 40	....	3 0	7.0	1,422	(4) 7 48-in. R.	F. B.
3	Arrogante......	1864	144	48 0	8 8	8 8	4 72–4.33	....	$15\frac{3}{4}$	45, 40	....	4 9	7.0	1,339	(9) 6 3-in. R.	F. B.
1	Taureau........	1864	197	47 6	16 5	16 5	5.9	....	10	53	....	.....	12.3	2,439	(1) 9.45 in. R.	R.
1	Onondaga......	1862	228	51 0	12 3	12 7	5.51	1.18	11.8	53	....	.....	9.0	.....		T.
1	Tonnerre.......	St'ks.	241	57 0	20 8	21 4	11 81	1 18	$15\frac{3}{4}$	158	....	13 5	....	5,494	(2) 12.6-in. R.	T. R.
1	Tempête........	"	241	57 0	16 9	16 9	11.81	1.18	$15\frac{3}{4}$	158	....	13 1	....	4,454	(2) 12.6-in. R.	T. R.

This table does not give the *names* of all the iron-clads in the English and French navies, but it gives the names of each class, with number (in Column 1), either built or laid down, according to the latest information. A number of them, as Royal Oak, Royal Alfred, Lord Clyde, Zealous, and Royal Sovereign (wooden hulls), have probably already been condemned. The Pallas, Favorite, Research, and Enterprise (wooden hulls), if still to be found in the British naval register, are of but little account as iron-clads These obsolete iron-clads, as well as the turret-ship Captain (lost at sea), have been included in order that the table may be a synopsis of the iron-clads constructed for the English navy up to the present time

The principal source of information regarding the French iron-clads has been the tables of M. Dislere in *La Marine Cuirassée* (trans. by Commander Meade, U. S. N.). With the exception of the Couronne, Embuscade, one of the Marengo class, two or three of the Provence class, and the last three in the table, all these vessels have wooden hulls. If relative impregnability is taken as a standard, the French vessels are, on the whole, very inferior; and a large number of them as iron clads are practically worthless, if not already condemned. The Magenta was recently destroyed by fire.

The armament of the English iron-clads is frequently changed, 9-inch rifles being substituted for 8-inch, and so on.

NOTE —W., sides wholly armored, C., central casemate (see Fig. 1); W.-L. B., water-line armored belt (see Fig. 2); F. B., floating battery; T. R., turreted ram; R., rifle. Figures in parentheses are the number of guns. (For explanation of "Piercing Figures" see Table D and Section 29.)

being in a settled state—so much so that in all probability it will require but a few years to make this information valuable only to the naval antiquarian.

(8) *Russian Iron-clads.*—Two wooden broadside iron-clads, 300 feet long; 21′ 6″ draught forward and 24′ 8″ aft; armed with 16 to 20 ton rifles; 4½″ armor, 9″ backing; piercing figure, 40; speed, 14 knots. Three iron broadside iron-clads, 220 feet long; 14′ 6″ draught; 4½″ armor, 10″ backing; P. F. 47. Two monitors, 248 feet long; 16′ 9″ draught; 3 turrets; 6½″ side armor, 17″ backing. Two of same dimensions with 2 turrets. One casemate and armor-belt broadside, 265 feet long; 18′ 6″ draught. One 3-turret monitor, 289 feet long; 20′ 9″ draught; 7½″ armor, 17″ backing; P. F. side-armor, 93; armament, six 300-pdr. rifles. Nine 1-turret (12″ thick) monitors, 200 feet long, 11′ 6″ draught; 5″ armor, 30″ backing; armament, two 9″ rifles of 15 tons; speed, 8 knots. Three monitors somewhat smaller than last. One monitor of same type as English Devastation. The Russians have lately constructed two circular monitors, the Kiev and Novgorod (called Popoffka after their designer, Admiral Popoff). They were designed "with the exclusive purpose of defending passages already protected by obstructions," and are intended for special service in the Baltic in the neighborhood of St. Petersburg, and in the Black Sea at the Straits of Kertch. The peculiarity is in the shape of the hull, which is *circular*, an upright cylinder about 100 feet in diameter. It is claimed that this form gives a maximum of displacement with a minimum of draught. The tops of decks are about 18″ above the water, and the sides carry 9″ armor, laid on peculiar backing of channel iron, which, it is claimed, makes the armor equal to a solid 11″ plate. The hulls are of iron with double skin, and are sheathed with wood and coppered: the draught is 13′ 2″. They are propelled by six separate engines and screws: it is stated that a speed of between 8 and 9 knots was realized on their trial. The turrets have 9″ armor, and are stationary; they are placed in the centre of vessel: the guns, two 11″ 28-ton rifles, fire over the top of them. Several of the same class, larger than the above, are now building; they will carry side armor 18″, and deck armor 2½″ thick.

(9) *Italian Iron-clads.*—Two wooden broadside iron-clads, 260 feet long: 24′ 9″ draught; 36 medium guns; 4¾ and 4½ inch armor, 10″ backing; P. F. 50 and 53. Three iron broadsides, 252′ 6″ long: 24′ 8″ draught: 26 medium guns; speed, 13 knots; 4¾ inches armor, 10″ backing; P. F. 53. Three wooden broadsides, 246 feet long; 21′ draught forward, 24′ 6″ aft; 22 medium guns: 4½″ armor, 10″ backing; P. F. 50. Two iron broadsides, 203 feet long; moderate draught; speed, 8 knots; 4½″ armor, 10″ backing. Two small wooden broadsides, 183 feet long; medium draught; 12 small guns; 1½″ armor, 10″ backing; P. F. 40. One small battery, 4 guns; 4½″ armor, 10″ backing; P. F. 40. Two iron broadsides, 5780 tons displacement: 26 medium guns. Four small batteries, 642 tons displacement. The Duilio, a two-turreted monitor, and one of the most powerful of iron-clads, has lately been launched for the Italian navy. Chief dimensions, length between perpendiculars, 339.48′; extreme breadth, 64.61′; medium draught, 25.9′; displacement, 10,600 tons; height of the battery above water, 15.74′. The hull, of iron, is constructed on the double-bottom system described in Sec. 20: this bottom is 229.6′ in length; it is divided into many watertight compartments. The two turrets, which are each to carry two 100-ton rifles, throwing 2200 pound projectiles, with corresponding charges of powder, are mounted on the box

or "breastwork" system described in Sec. 45. The centres of the turrets do not coincide with the centre line of the vessel, but are arranged in a manner similar to those of the Inflexible (Sec. 47), these centres being placed 7.67′ on one side of the centre fore-and-aft line; the arrangement enables three of the guns to be discharged simultaneously in a direction parallel with the keel. The armor of turrets is to be 17.68″ thick, fixed on a backing of iron and teak; the armor at the water-line, in wake of turret-box, is to be 21.61″. The description from which this is taken (*Army and Navy Gazette*) does not give the thickness of the armor of the box, nor the length over which the above thickness of side armor is carried. This vessel is built with an under-water ram, and is also fitted with an apparatus for projecting torpedoes; there will also be carried "at the stern, in a tunnel closed by a grated door, a very rapid torpedo-boat," to be launched against the sides of the enemy as opportunity presents itself. The Duilio has two screws, which will be driven by engines of 7500 horse-power; the speed is expected to be 14 knots; the bunkers will carry 1200 tons of coal, a sufficient quantity, so it is stated, to carry the ship 1000 knots at full speed, and 4000 at a moderate rate. From the above it is seen that the commander of this vessel will have three weapons at his disposal—viz. the gun, the ram, and the torpedo. The opinion is held by some that it is the wisest course, especially for coast and harbor defence, to separate these weapons, as so many combined in one vessel may confuse the commander and defeat that unity of purpose which is essential to success. It may be safely said that the more limited and definite the object for which a naval vessel is planned, the greater will be her success in answering the purposes of her construction.

(10) *Austrian Iron-clads.*—One wooden broadside, 284 feet long, 23′ 1″ draught forward, 27′ 5″ aft; twelve 9″ rifles; 6″ armor, 28″ backing; P. F. 65. Three same, 230 feet long; 20′ draught forward, 23′ 4″ aft; twelve 7″ Armstrong rifles, 4½″ armor, 24″ backing; P. F. 40. Three same, 205 feet long; 19′ 4″ draught forward, 23′ 4″ aft; ten 9″ Armstrong rifles; 5″ and 6″ armor, 28″ oak; P. F. 52 and 65. A powerful broadside iron-clad is now constructing at Trieste for this navy. The following particulars of this vessel, furnished by the chief constructor of the Austrian navy, were lately read by Mr. Reed before the Society of Naval Architects: Length between perpendiculars, 286′ 11¼″; total length, 303′ 1¼″; breadth at water-line, 62′ 9″; extreme breadth outside of the armor, 71′ 1½″; depth of hold, 34′ 9″; draught of water aft, 26′ 7¼″; ditto forward, 23′ 1″; displacement in tons with one-half provisions, 7390; area of midship section immersed, 1301 square feet; area of the load water-line, 14,308 square feet; height of metacentre above the centre of gravity of displacement, 14.623′; height of metacentre above water, 4.770′; distance of centre of gravity of displacement before the midship section, 3.356′; depth of the centre of gravity of displacement below water, 9.853′; coefficient of displacement, 0.582; coefficient of water-line, 0.782; coefficient of midship section, 0.82; displacement of an inch immersion at the load water-line, 34.47 tons; weight of armor and backing, 2160 tons; armament, six 11-inch Krupp rifles; area of sails, 82,165 square feet; cost of hull, estimated, £172,790; ditto engines and boilers, £81,715; number of cylinders, 2; diameter of ditto, 125″; length of stroke, 4′ 3″; diameter of propeller, 23′ 6″; number of blades, 2; pitch, 2; revolutions per minute, 70; number of boilers, 4; area of fire-grate, 850 square feet; heating surface, 25,500 square feet; superheating surface, 1800 square feet; pressure of steam, 30 pounds; number of furnaces, 36; indicated horse-power, estimated, 8000; speed, estimated, 14 knots. A belt of armor extends from the stern to within about 30′ of the foremost perpendicular, where it terminates in a transverse armored bulkhead, and a stout iron deck going forward to the stern at about 7′ below water. The hull above water is made of such a form as to simplify as much as possible bending and fitting the armor-plates. The ship is armored on the central casemate and water-line belt system; the casemate overhangs, the battery projecting from the vessel's sides between 4′ and 5′ at a height of 6′ above the water. The Austrian chief naval constructor says: "The ship Tegethoff is in many respects a novelty, its casemate allowing an all-around fire, avoiding at the same time, by its particular form, the dangerous projection of the muzzles of the midship guns, in consequence of experiences acquired in the battle of Lissa, but which are very little known even in our own navy." Transverse bulkheads are fitted in the casemate similar to the Alexandra (see Sec. 24). This bulkhead inclines forward at a considerable angle to within about 4′ of the middle line, where it becomes transverse; immediately over this foremost portion of the battery is a very strong pilot-tower, standing well up above both the gunwale and the forecastle. This shows that the Austrian officers who have been in action in iron-clads do not consider such towers unnecessary.

(11) *German Iron-clads.*—One iron broadside, central casemate and water-line belt; 9761 tons displacement; 355 feet long; 24′ 6″ draught forward, 26′ 6″ aft; armament, 10″ Krupp rifles; 8″ armor, 20″ backing; P. F. 103. Two same, 286 feet long, 26 feet draught; sixteen 8″ Krupp rifles; 5″ armor, 10″ and 15″ backing. Two turret iron-clads, 200 and 172 feet long; 15′ draught; 4½″ and 4¾″ armor, 9″ backing.

(12) *Turkish Iron-clads.*—Three iron broadsides, 293 feet long; 24′ 9″ draught; eighteen 150-pdrs. and two 300-pdr. Armstrong rifles; 5½ armor, 9″ backing; P. F. 54.

(13) *Spanish Iron-clads.*—One iron broadside, 7420 tons displacement; 288 feet long; 27′ 4″ draught; 5½″ armor, 15″ backing; P. F. 55; speed, 13 knots. One, nearly the same, of wood; 4¾″ armor; P. F. 42. One, same, of iron, 316 feet long; 24′ 8″ draught; 5½″ armor, 9″ backing; P. F. 54. Three, same, of wood, 279 feet long; 26′ draught; 4¾″ armor, 9″ backing; P. F. 42.

(14) *Swedish Iron-clads.*—Three 1-turret (12″ thick) monitors, 200 feet long; 11′ 3″ draught; speed, 8 knots; 5″ armor, 40″ backing; two 20-ton guns. Three small monitors, with one 15″ gun.

(15) *Danish Iron-clads.*—Three floating batteries 190 to 280 feet long; 19′ to 21′ 6″ draught; 4½″ to 5″ armor; speed, 9 to 10 knots; armament of small guns. One monitor, 1246 tons; twin screws; 185′ long; 10′ 4″ draught; 4½″ armor, 9″ backing; armament, four 68-pdr. smooth-bores. Two small gunboats, with 2″ armor.

(16) *Iron-clads of Holland.*—One small gunboat, 4½″ armor; 3′ 3″ (?) draught. One 11″ turret: 4⅝″ armor, 10″ backing. Three monitors, 7′ 11½″ draught forward, 10′ aft; one 11″ turret; 5⅝″ armor, 10″ backing. The Hollanders rely chiefly on torpedoes to close the Scheldt.

(17) Brazil has a miscellaneous collection of some ten inferior broadside iron-clads, with from 4 to 4½ inch armor; one formidable monitor similar to the English Devastation; and eight small monitors for river-service. Peru has seven iron-clads of an inferior description, divided between monitors and broadsides. Chili has two broadside iron-clads, Almirante Cochrane and Valparaiso, which carry along the water-line 8 inches of armor. Greece has one small iron-clad. China and Japan have each started an iron-clad navy; the former has one and the latter two of a very feeble type.

Referring to Table A, the great length of the early English iron-clads, compared with the French, will be noticed. Some of these were nearly 100 feet longer than the finest wooden frigates previously built. The object was to carry great weight of armor with fine lines, and thereby secure high speed with moderate power. This reasoning is no doubt correct in the case of vessels intended to steam long distances at high speed; but in the case of iron-clads, which will never use full power except during short periods, and where handiness is all important, practice has shown (if practice were needed to show it) the system to be a mistake. High speed was attained with small relative engine-power, but at the cost of unhandiness and great deficiency in manœuvring power—qualities of cardinal importance in all war-vessels. The system of partial protection carried out in the early vessels was for a time looked upon in official circles as a mistake; so, to carry complete armor and retain the high speed with the same proportion of engine-power, the Minotaur class were made 20 feet longer; these proved to be so unwieldy, and so vulnerable too, that complete protection, with fine forms and great dead rise, was abandoned, and much fuller models adopted. This change was begun by Mr. Reed, who at that time (1864) became chief constructor of the British navy.

Table B.—*Steering-power of Typical Iron-clads.*

		Bellerophon.	Achilles.	Marengo.	Warrior.	Lord Clyde.
Length		300′	380′	282′10″	380′	280′
Breadth		56′	58′4″	56′11⅛″	58′4″	58′11″
Draught aft		27′1″	27′	29′1″	27′	
" forward		....	26′	24′10″	26′	
Speed, 12 knts.	Time of completing circle, starboard, min. and sec.	4.40	6.40	5.12	7.21	4.56
	Do. port	4.55	6.40	....	8.11	4.52
	Diam. of circle, yds. star.	365	616	366	753	377
	Diam. of circle, yds. port.	437	620	....	768	379
Speed, 5 knts.	Time of completing circle, starboard, min. and sec.	9.5	13.18	....	10.51	9.54
	Do. port	8.32	12.35	....	12.18	9.52
	Diam. of circle, yds. star.	270	618	....	687	392
	Diam. of circle, yds. port.	420	615	....	532	388
Area of rudder, sq. ft.		248	167	250	177	

Omitting some small vessels, the Bellerophon was the first of the new style; her superiority in point of handiness and increased thickness of armor, obtained by decreasing its area, was such that future broadside iron-clads were built after her general plan. Table B shows better than a description the relative merits in respect of manœuvring of the long and the short vessels. The Bellerophon was the first vessel in the British navy fitted with the balanced rudder—*i. e.* with the axis about one-fourth of the total width from the forward edge. This was taken from our monitors, where it had proved very efficient. To place the old-style rudder of the Minotaur class, with an area of only 198 square feet, at an angle of 23° with the keel, the engines working at full speed, required 18 men at the wheel, and no less than 60 more at the tackles connected with the tiller; while the Bellerophon's rudder, 248 square feet area, could be put at an angle of 37° by 8 men. In large iron-clads steam is now generally applied for this purpose.

(18) Respecting the models of the iron-clads, the following will explain the gain by the change from fine to full water-lines. The shape of hull which will give maximum displacement with given dimensions of length, breadth, and draught is obviously a parallelopipedon. The quantity of this circumscribing solid that is always cut away in forming the model determines the degree of fineness of the water-lines. In the Minotaur, for example (10,395 tons), where much was conceded to fineness of model, the displacement (carrying power) is 54 per cent. of the solid; in the Bellerophon (7450 tons) it is 62 per cent. On a six hours' trial the former made 14.16 knots, the engines exerting 6193 horse-power; on a similar trial, both vessels having been out of dock but a few days, the latter made 14 knots with 6199 horse-power, the Bellerophon thus requiring, practically, the same power as the Minotaur to propel at the same speed 2800 tons less weight. This is due to superior fineness of model of the former. Under ordinary circumstances the use of so great power to give 14 knots to a ship so small, comparatively, as the Bellerophon, would be inadmissible; but in an iron-clad, where so much of the displacement must be used to carry armor and armament, the case is very different. The full water-lines, together with making the transverse sections, in the extreme fore-and-aft bodies, in the shape of U, instead of V, as is usual, constitute the changes in models adopted by the chief constructor. These principles have been carried out in all iron-clads built after the long, sharp Minotaur system was set aside in 1864. But to keep the high speed of the early ships depended altogether on the ability of the engine-builders to construct machinery of much greater power than had been before required. To their success in accomplishing this the speed of Mr. Reed's models is due.

(19) Respecting the advantages of these changes, it has been held by some that as the armor-piercing power of guns has been brought to so high a point, the armor of the short, bluff iron-clads is of but little if of any more value than the thinner armor of their predecessors, and consequently that the Minotaurs, from the greater number of guns their length enables them to mount, would be the victors in an open-sea fight. If, however, broadside iron-clads can be made to carry armor thick enough to cope with the guns now built (which is doubtful), it will be by following the changes which have increased their flotative power.

(20) A change in the mode of constructing the hull was introduced at the same time with those mentioned—viz. a skilful economizing of material, which added to the proportion of weight—guns, armor, etc.—carried with given dimensions. This is a modification of the cellular or double-bottom system, first carried out on a considerable scale in the Great Eastern. Iron ships are usually built on what is called the transverse system—*i. e.* the plates are riveted to continuous angle-iron frames running from gunwale to gunwale, spaced about 18 inches, and strengthened by deep floor-plates; longitudinal strength is added to by keelsons placed between and over the frames. The cellular system was adopted in the Bellerophon to save weight, simplify construction, and to increase both strength and safety. In this hull (a type of all built on this system) the usual angle-iron ribs, except high up on the side, are dispensed with. Continuous longitudinal frames, thirteen in number, the centre one being over the keel-plate, beginning at the lower edge of the armor, are carried well into the bow and stern: these are from 17 to 49 inches in depth; they add to the longitudinal and local strength of the ship. Between them, at intervals about twice as great as the ribs in the transverse system, bracket-frames of equal depth are fitted. This construction thus forms a cellular framing, on the outside of which the bottom plating is riveted, while on the inside a water-tight inner bottom is similarly fastened, which extends two-thirds of the vessel's length, and transversely well up on the turn of the bilge, where it is joined on each side by the vertical wing-passage bulkheads (common to all English iron-clads with iron hulls), which extend up to, and thus in effect continue to the main deck, the water-tight inner skin. The space between the inner and outer bottoms is thus divided up into cells deep enough for men to enter and paint every part. Most of the iron-clads built on this system have three of the longitudinals made water-tight, also the transverse bracket-frames at distances of about 20 feet. Should the outer plating only be ruptured, the water would be confined to the space between the two bottoms; should both be broken through, the ship would be in the same condition as one with a single skin; she would then depend on the transverse water-tight bulkheads. It is estimated that the cellular system saves some 7 per cent. in weight of iron, while at the same time it adds to the longitudinal strength some 10 per cent.

Mr. Reed and others place great reliance on the numerous water-tight divisions of this system, as adding to the ship's chances of escape from being sunk if struck by torpedoes. There is much in favor of this view if the torpedo is a canister of explosive, to be placed near the enemy's side by fastening it to a spar rigged out from a vessel or carried by a swift launch; but with a heavy torpedo, containing several hundredweight of explosive, fired in contact with the iron-clad's sides below the armor, it is not probable that the double bottom would save the vessel so attacked from destruction. The iron hulls of armored ships are now so skilfully built that it is not probable any further reduction in the weight of material can be made. The iron-clads of the Audacious class (1869) and the Alexandra, just launched, it may be said, have the least weight of hull that is compatible with a due regard to safety. The following example will show what has been done in this direction: The total weight of the Defence (1861–62) is 6073 tons, and of the Audacious (1869) 6103 tons; the hull of the Defence weighs 3474 tons, and the weights carried—viz. armor, guns, etc. etc.—are but 2599; the Audacious' hull weighs only 2667 tons, while the weights carried are 3436 tons.

TABLE C.—*Showing Proportions of Weights in Typical Iron-clads.*

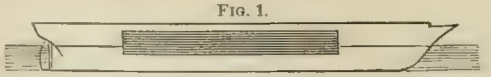
Name of ship.	Displacement, tons.	Weight of hull, tons.	Ratio to total weight of vessel equipped.							Total weight carried, tons.	Ratio of weight carried to displacement.
			Hull.	Armor.	Objects of ordnance.	Machinery and water in boilers.	Coal.	Masts and rigging.	Provisions and miscellaneous.		
	1	2	3	4	5	6	7	8	9	10	11
French.											
Gloire, wood....................1859	5,530	2611	0.472	0.144	0.066	0.114	0.116	0.112	0.076	2919	0.528
Magenta, " 1861	6,876	3263	0.474	0.160	0.073	0.108	0.107	0.011	0.067	3613	0.525
Marengo, " 1869	7,360	3554	0.483	0.181	0.063	0.111	0.077	0 012	0.073	3806	0.517
Richelieu, " ....on stocks	8,269	3936	0.476	0.195	0.068	0.095	0.085	0.030	0.051	4133	0.524
Tonnerre, iron ram.. "	5,494	1965.5	0.358	0.371	0.036	0.119	0.052	0.000	0.064	3528.5	0.642
English.											
Ocean, wood...............1863	6,920	3447	0.498	0.135	0.052	0.124	0.085	......	0.106	3473	0.502
Lord Clyde, " 1863	7,675	3696	0.482	......	......	......	......	......	......	3979	0.518
Warrior, iron...............1861	8,952	4609	0.515	0.151	0.062	0.102	0.094	......	0.076	4343	0.485
Defence, " 1861	6,074	3473	0.572	0.138	0.048	0.061	0.074	......	0.107	2601	0.428
Achilles, " 1863	9,681	4871	0.503	0.183	0.048	0.107	0.072	......	0.087	4810	0.497
Minotaur, " 1865	10,395	5118	0.492	0.195	0.047	0.101	0.072	.. ...	0.093	5277	0.508
Bellerophon, " cellular...1865	7,540	3636	0.482	0.171	0.054	0.118	0.085	......	0.090	3904	0.518
Monarch, " " ...1868	8,303	3602	0.434	0.217	0.041	0.132	0.072	......	0.104	4701	0.566
Sultan, " " ...1870	9.293	3982	0.428	0.209	0.062	0.133	0.080	......	0.088	5311	0.572
Audacious, " " ...1869	6,103	2662	0.436	0.222	0.055	0.117	0.085	......	0.085	3441	0.564
Glatton, monitor..............1871	4,862	1570.3	0.323	0.356	0.067	0.112	0.111	......	0.031	3291.7	0.677
Devastation, " 1871	9,046	3282	0.363	0.287	0.056	0.111	0.152	......	0.031	5764	0.637

(21) Table C shows the proportion of the weight carried to the weight of the hull alone in several typical iron-clads. The ratio that the weight of each of the elements which together make the complete vessel bears to the total displacement is set down in decimals: by multiplying the displacement by these, the actual weight of the elements, guns, armor, fuel, etc., will be ascertained. It is seen that those broadside vessels with full models and cellular bottoms carry larger proportionate loads than the others, while those which stand the highest in this ratio are the rams, as the Tonnerre, and the monitors, as Devastation. This follows from the fact that they are unincumbered with the rigging and other paraphernalia of the broadside ships, as well as from the less height of side exposed above water. Before the time of iron-clads, wooden hulls for large ocean-steamers were about given up, but the use of iron was so successfully opposed for naval purposes that no iron war-ship of any consequence had been built up to that period. This was changed so suddenly that it may well cause surprise. The reasons are obvious: one of the important points in an iron-clad is to secure adequate strength with the least weight; in well-built wooden iron-clads, as the Lord Clyde (see Table C), the hull alone requires one-half the displacement. Wooden hulls, even unarmored, always work and twist more or less; when iron plates are bolted to their sides, this evil is increased; and whether they are wholly or partially armored, they can be set on fire by shells. This is not the case with properly-built iron hulls, which will last a great many years if well cared for, while the wooden ones are sure to rot and need continual repairs. Besides, it is very difficult to fit in them efficient water-tight bulkheads. The English wooden iron-clads are mostly "converted" line-of-battle ships. The French were deficient in iron shipbuilding facilities or experience, and consequently used wood, but their latest constructions are of iron. The rapid fouling of the bottoms of iron ships has been so far overcome by the device of applying a layer of wood and sheathing it with copper that even the most important non-armored naval vessels are now built of iron.

(22) As has been observed, the change in the design of iron-clads from the beginning has been guided by the constant tendency—at no time stronger than at the present—to diminish the number and increase the power of guns. Carry this idea of concentration to extremes, and the monitor principle of 1854 is reached. The early abandonment of complete protection, and the substitution therefor of the central-armored casemate, with its recessed ports and the armored water-line belt; the full models to increase flotative capacity; the efforts made to save weight in hull, the saving to go in increased thickness of armor,—all show the exertions that have been made to make the iron-clads keep pace with the penetrating power of guns, which seem always to be a little in advance. An inspection of Tables A and D shows that by far the largest portion of the iron-clads afloat can be pierced by shells from medium guns—viz. rifles, French, English, and German, of from 7 to 10 inches bore.

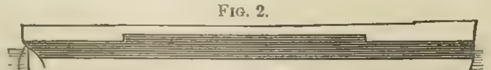
(23) The outline diagrams, drawn to scale, show the varieties in the modes of disposing the armor that have been successively tried from the La Gloire and Warrior up to the present time. Several of these look as though the arrangement was made more to meet the crotchets of current naval opinion than in accordance with any recognized principle. The dark tints show the area of thickest armor, the medium tint that of less thickness, and the light tint the thinnest of all. The chief particulars of all these classes are given in Table A.

Fig. 1.



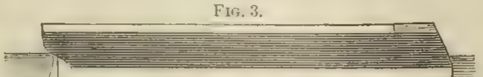
Warrior class, central casemate.

Fig. 2.



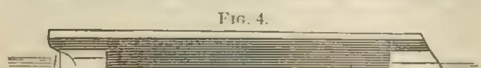
Achilles, central casemate and water-line belt.

Fig. 3.



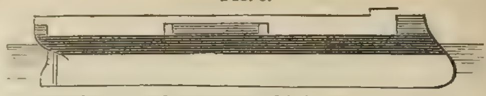
Lord Clyde, wholly armored, as Gloire, Minotaur, etc.

Fig. 4.



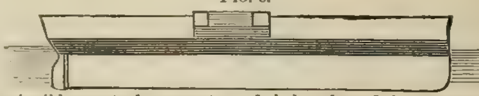
Hector, armor-belt above water-line.

Fig. 5.



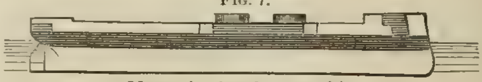
Hercules, central casemate and belt, with end screens.

Fig. 6.



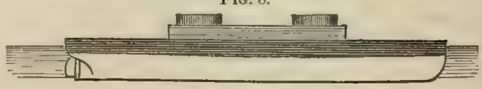
Invincible, central casemate and belt, adopted in Audacious class.

Fig. 7.



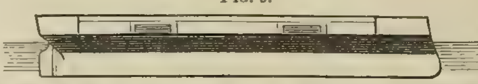
Monarch, rigged turret ship.

Fig. 8.



Cerberus, type of English monitors.

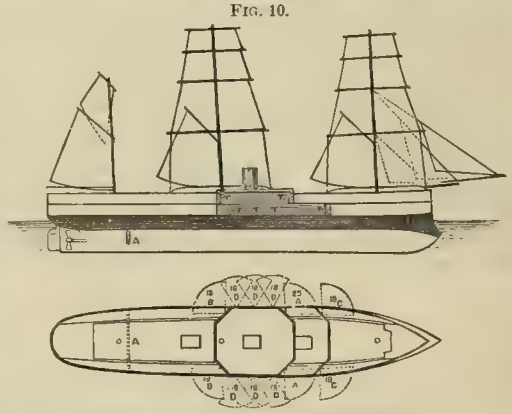
Fig. 9.



Captain, rigged turret vessel, with low freeboard, planned by Coles. (This vessel capsized in a moderate gale.)

(24) By placing in contrast the following ships, a clear idea will be had of the progress during some fifteen years in the construction of broadside iron-clads. Compare La Gloire, 5530 tons (1859–60), sides wholly plated with armor, the piercing figure of which is 45 and 40, armament 36 light guns, with the Redoubtable, now on the stocks, 8658 tons, water-line and central casemate plated with armor, the P. F. of which is 108, and the armament 6 heavy guns. Also, the Warrior, 8950 tons (1861–62), with a patch of armor on her sides, the P. F. of which is 53, and the armament 26 light guns, with the Alexandra, just launched, 9292 tons, two-story central casemate, and water-line belt covered with armor, the P. F. from 70 to 160, and the armament 10 heavy guns. The Alexandra, one of the latest English constructions, is regarded as the most perfect of the broadside type. A cut and description of this ship will therefore be of interest. Her dimensions are given in Table A. She is fitted

Fig. 10.



English broadside iron-clad Alexandra.

with twin screws, driven by engines of 8000 horse-power, and the estimated speed is 14 knots. *Armor.*—The belt shown by deep shading in the cut is 12 inches thick amidships, tapering to a much less thickness at the ends. The first story of the casemate, shown by the middle shading, is plated with 8-inch armor, and the second story, shown by the light tint, with armor 6 inches thick; the teak backing on sides and casemate is 10 inches thick. The 8 and 6 inch armor which shields the armament is a miserable defence against the artillery now carried by the principal navies. The reason of this is, as *London Engineering* (from which the cut and particulars are taken) says, "the ship must before all things be kept above water." In order to localize the effect of a shell exploding between decks, the casemate is divided into two parts by an armored bulkhead; but the effect of a 600 or 700 pound shell, containing, as it does, some five times greater bursting charge than the

heaviest shells so much dreaded in the days of wooden walls, and which made such havoc on the Alabama, bursting inside either compartment of the two-story casemate of the Alexandra, among the guns and gunners, can hardly fail to place them *hors de combat*. The short interval necessary for the explosion of the bursting charge, which is fired by the heat generated by the impact on striking the armor, is about sufficient to allow the passage of the shell through it before it bursts. Thus, the armor is made use of to destroy the guns and gunners it is designed to protect. The armored belt forward is carried down (see figure) over the ram, to strengthen the latter, as well as to guard the vitals of the ship from raking fire from ahead. The magazines, etc. are similarly protected by an armored bulkhead A. A peculiarity of this ship is the method of mounting the guns; in the second story of the casemate, behind the 6-inch armor, two 25-ton rifles and two of 18 tons are mounted; these are shown at A and B, Fig. 2; the 25-ton rifles are arranged to point some 2° across the bow, and about the same distance abaft the beam; the 18-ton rifles are similarly arranged in the after corner of the casemate. In the first story, behind the 8-inch armor, eight 18-ton rifles are carried; six of these, shown at D, Fig. 2, point from the broadside, while the two shown at C in the forward corners are arranged similarly to the two 25-ton guns above them. In order that the guns in the corners of the casemate (A, B, and C guns) may point ahead or astern, the outside skin of the ship forward and aft of casemate, as shown by figure, is set back about 10 feet from the level of the upper edge of the armored water-line belt. The wisdom of spending so much money (some $2,500,000) on a vessel of this character in these days of 700-pounder rifles is questioned by many authorities. *Engineering* says, if so much money was to be spent, it should have been on a monitor, such as an Inflexible, or even upon a Devastation. The Téméraire (see Table A), lately launched, differs from the Alexandra chiefly in the plan of carrying her battery and the reduction of her masts from three to two—a compromise between a mastless monitor and a full-rigged ship. She will have 11″ plates for the protection of the hull, and 2″ horizontal deck-plating. The main battery will carry two 25-ton rifles in its forward part, mounted to fire directly ahead or in broadside; in the after part, which is cut off from the fore part by an armed bulkhead, there are mounted four 18-ton rifles, arranged to fire simply in broadside. This battery, then, can fire three guns in each broadside—one 25-ton rifle and two 18-ton rifles. The upper battery directly over this will mount one 25-ton rifle at the forward, and one 18-ton rifle at the after end. The low turret, over which the gun at the fore is fired, is of 10″ armor, and "will serve the purpose of a lookout house, as well as a partial protection for guns and gunners." The turret for the other gun is armored with 8″ plates. There will be two independent propellers, driven by two sets of engines, separated by a longitudinal bulkhead (as is the case with all the later double-screw iron-clads in the English navy); the total horse-power will be 7000, which, it is expected, will give a speed of 14 knots.

(25) *Rolling*.—When the high broadside iron-clads were introduced, it was thought generally by naval men that on account of their assumed top-heaviness they would be deficient in stability, and consequently that they would roll much more than the old wooden vessels. The trials made in 1863 respecting these qualities (according to M. Xavier Raymond in *Revue des Deux Mondes*) with the French iron-clads Solferino, Magenta, Couronne, Invincible, and Normandie, and the wooden line-of-battle ships Napoléon and Tourville, proved this opinion to be erroneous. The average total roll of the iron-clads was 38.4°, and of the unarmored ships 39°. It was observed on these trials that the ships with the highest centres of gravity—with the least distance between that centre and the metacentre (see NAVAL ARCHITECTURE)—rolled the least. But such rolling will in any case seriously interfere to prevent accurate practice for great guns. The chief point (and the only one that can be noticed here) which influences rolling is the distance that the metacentre is above the centre of gravity of the weight of vessel; when the distance is great, the ship is very "stiff" and will safely carry large area of sails, but this is usually accompanied by very violent rolling. Since these facts, long known to scientific naval constructors, were experimentally confirmed by the French trials, the metacentric height has been lessened gradually in all broadside iron-clads, until, it is believed, the minimum compatible with safety has been nearly reached. This has been attended with less amplitude of roll, and has increased what is technically called dynamic stability. (See NAVAL ARCHITECTURE.) In the most severe recorded tests with the English iron-clads the Bellerophon rolled 29°–16° to starboard and 13° to port, and the Lord Clyde 23° to starboard and 24½° to port. The monitors, as long practice has shown, are remarkably steady; this is not in most cases due to the cause mentioned respecting the high-sided vessels, but it is due to the comparatively short distance they rise above the water-line and the clear decks, without any bulwarks to retain water. The waves cannot rush up their sides and heel them over; the water that reaches their decks quickly flows off again, there being nothing to keep it on. In Assistant Secretary Fox's report of his voyage across the Atlantic in the monitor Miantonomoh, he says: "The extreme lurch observed when lying broadside to a heavy sea and moderate gale was 7° to windward and 4° to leeward." The reports of the experience of officers on other monitors is to the same effect. But this steadiness of the monitor type does not show that they are capable of carrying large sail-power. The angle through which they may be heeled without passing the point (although it takes great force to heel them so far) at which the righting effort becomes zero is much less than in a high-sided ship; hence, low freeboard and great sail-area cannot be safely combined. The English ship Captain, a low-sided turret iron-clad, with high centre of gravity, intended to combine the merits of the turret with full sail-power, designed by a captain in the English navy, capsized and carried with her to the bottom nearly all on board. At an angle of keel of 14° this vessel had a reserve of righting-power represented by 410 foot-tons, while Mr. Reed's high-sided turret-ship Monarch has 6500 at the same angle.

(26) *Armor and Guns*.—When the reconstruction of navies was begun by the application of iron armor (1859–61), the most powerful gun in service was the 8-inch 68-pounder smooth-bore, which with a charge of 16 pounds gave 1600 feet per second initial velocity to the shot. The first iron-clads were proof against this, with considerable margin, but from their time the power of guns has been steadily increasing. France and England were no sooner committed to the innovation of armor than great perplexity arose regarding its inadequacy to withstand the tests to which it was foreseen it would soon be submitted. In 1844, at Sandy Hook, a 12-inch shot had been fired through 4½ inches of laminated iron, and 8 feet of sand besides. The Warrior was hardly through with her trial-trip when the 10½-inch smooth-bore gun put a 150-pound shot through a representative of her armor, and shortly after the same gun penetrated 5½-inch armor and 9 inches backing. Succeeding this, the Horsfall 13-inch smooth-bore sent its 270-pound shot through the same armor, making a hole some 2 feet in diameter; at 800 yards it nearly made a clean breach. Whitworth followed with his hexagonal rifle, and sent a 130-pound 7-inch *shell* through the Minotaur's 5½-inch armor; exploding in the backing, it made a clean breach through. Other experiments of a similar nature might be cited; it is enough to state, however, that these huge ships at this early date were vulnerable to what are now regarded as small guns. The 15-inch smooth-bores afloat in our monitors in 1862 could make a large hole through the armor of any of the European iron-clads built before the end of the civil war. A writer in *Revue des Deux Mondes* states that the guns made for La Gloire had been proved at Gavres to be competent to pierce the Warrior's armor at considerable ranges. It is in evidence before a select committee on ordnance (London, 1862) that the 6½-inch French naval rifle (Aug., 1861) put a 100-pound shot through 4½ inches of iron, 18 inches backing, and 1 inch inner skin at 1089 yards. These early experiments show that as soon as it was established that guns were required for a new purpose they were speedily produced. The progress made in ordnance shows there was good reason for the tendency, early developed, to increase the thickness of armor by concentrating it over a small area; otherwise ships could not float any adequate protection. Ordnance (see ORDNANCE and ARTILLERY) is not in the scope of this article; only enough will be said about it to give an idea of the relations, present and prospective, between the resistance of armor and the power of guns.

(27) The chief advantage of the rifle as compared with smooth-bore artillery for naval warfare and coast defence consists, for the most part, in its greater penetrative power, as well as the increased distance that the elongated rifle projectile will maintain sufficient *vis viva* to pierce armor. For instance, if the 1000-pound ball from our 20-inch smooth-bore was cast into an elongated projectile of the same weight, of say 15 inches in diameter, and discharged from a rifle with the same energy, its penetrative power would exceed the former nearly proportionally to its diminished circumference—about 33 per cent.; while, owing to the lesser resistance the atmosphere would present to its progress, it would retain a far higher ratio of its energy throughout its flight than the spherical shot. Smooth bores have long ceased to be thought of as weapons to attack armor.

(28) The early experiments with ordnance *vs.* armor were

desultory and unsystematic; the best kind of gun and projectile, and quality of powder best suited to answer the new requirements, were a long time in reaching anything like a settled basis: even now on some of these points opinions differ widely. Subsequently, however, they were very systematically conducted, and from the records which were kept of the work of various kinds of guns, powder, and projectiles on various thicknesses, qualities, and systems of armor, artillerists were able to make close calculation respecting the *work* required of projectiles of different materials and forms to penetrate a given thickness of armor. The velocities of projectiles at various distances, from the muzzle up to several thousand yards, were determined, and, knowing this velocity at different distances (from experiment), the *work* (energy) is expressed by $\left(\frac{v^2}{2g}\right)$, which gives the height from which the projectile would fall to attain the ascertained velocity; this, multiplied by its weight, gives its energy in foot-pounds or tons (the latter unit being used for convenience—viz. pounds or tons raised 1 foot). From the great number of firings against armor, the resistance it presented to penetration was likewise established; hence, very close predictions could be made as to the strength of any proposed armor and the energy required of the projectile to overcome it.

(29) The energy required to penetrate a given thickness of armor, expressed in foot-tons, for *every inch in the circumference of the projectile,* is called the *piercing figure.*

TABLE D.—*Showing the Penetrating Energy in foot tons per inch of the Circumference of the Projectile, at various Distances in yards from the Muzzle of the Gun.*

Guns, Woolwich rifles.					Distance in yards.																				
Projectile.	Charge of powder.	Initial velocity.	Calibre.	Weight of gun.	At muzzle.	200.	400.	600.	800.	1000.	1200.	1400.	1600	1800.	2000.	2200.	2400.	2600.	2800.	3000.	3200.	3400.	3600.	3800.	4000.
lbs.	lbs.	feet per sec	in.	tons.					Pene	trati	ng e	nerg	y per	inch	of ci	rcum	fere	nce	in	foot-	tons.				
700	110	1300	12	35	219	211	204	198	192	186	180	174	169	164	159	155	151	147	143	140	137	134	131	129	127
600	85	1300	12	25	188	181	174	167	161	155	149	144	139	135	131	127	123	120	117	114	112	110	108	106	104
535	85	1315	11	25	187	180	173	167	161	156	150	145	140	136	132	128	125	122	119	116	113	111	109	107	105
400	70	1364	10	18	166	159	152	147	140	134	129	124	120	115	111	107	104	101	98	95	93	91	89	87	86
250	50	1420	9	12	125	118	111	105	100	95	90	85	81	77	74	71	68	66	64	62	61	59	58	56	55
180	35	1413	8	9	100	94	88	83	78	74	70	66	63	60	58	55	53	51	50	48	47	45	44	43	42
115	30	1525	7	6½	85	79	73	67	63	58	54	51	48	45	43	41	39	37	36	35	34	33	32	31	30

NOTE.—If the *piercing figure* of any armor is but equal to the *penetrating energy* of any of the projectiles, as given in the table, the distance from the gun, at which penetration will result, will be found in yards over this figure. Thus, the piercing figure of the 6-inch armor of the Bellerophon is 70; by referring to the table, it is seen that the 7-inch rifle will penetrate up to 400 yards, the 8-inch up to 1200 yards, the 9-inch up to 2200 yards, the 10-inch to over 4000 yards, and so on.

Table D shows the energy expressed in *foot-tons,* at various ranges, for each inch of the circumference of the projectiles of the Woolwich wrought-iron rifle, supplied to the British navy. A large number of these figures are the direct result of experiment, as recorded in the English Blue-books; the others are calculated from these according to the data found in the same authority; they are sufficiently accurate for the purpose intended—viz. to show near enough for all practical purposes the distance at which the guns will penetrate iron-clads. To show that this table will also apply with practical accuracy to the German and French naval rifles of nearly corresponding calibre, Table E is given, which compares their power with the Woolwich ordnance:

TABLE E.—*Comparison of French, English, and German Naval Guns.*

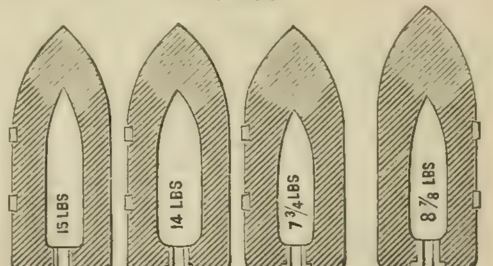
GUNS.	Bore, inch.	Weight of gun, tons.	Weight of projectile, lbs.	Powder-charge, lbs.	Muzzle velocity.	Total energy, foot tons.	Energy per pound of powder, foot-tons
French....	6.48	......	99.3	16.5	1312	1185	71.8
English ..	7.	6½	115	30	1561	1943	64.8
German...	6.79	......	123	25.35	1559	2073	81.7
French....	7.63	8	165.4	33.1	1486	2533	76.5
English...	8.	9	180	35	1413	2492	71.2
German...	8.23	9.8	217.2	37.48	1385	2889	71.1
French....	9.49	14	317.6	61.7	1427	4484	72.7
English...	9.	12	250	50	1420	3496	69.9
German...	9.49	15	306.4	52.91	1312	3657	69.1
French...	10.80	22	476	88.2	1378	6273	71 1
English...	11.	25	535	85	1315	6415	75.5
German...	10.23	22	414.5	70.55	1385	5514	78.2
French....	12.6	34.5	760.5	136.69	1312	9077	66.4
English .	12.	35	700	110	1300	8205	74.6

The piercing figure of the armor of most important iron-clads is given in Column 11 of Table A; by comparing this figure (the energy per inch of shot's circumference required to penetrate) with the energy per inch of the several projectiles (Table D), the distance in yards at which the various vessels will be penetrated is found.

(30) A wrought iron and steel rifle is now constructing at Woolwich which will weigh 81 tons; diameter of bore, 14 inches; the projectile will weigh about 1200 pounds; and the powder-charge, some 200 pounds, will give an initial velocity to it of about 1300 feet per second. The shot, approximating from the results with other large guns, will have an energy of 320 foot-tons per inch at 2000 yards, and it is expected that at that distance it will penetrate 20 inches of iron.* Krupp has furnished the following particulars to the German government respecting a huge gun he is about to commence: Diameter of bore, 18.22 inches; weight of shell, 2000 pounds; powder-charge, 500 pounds, which will give an energy of about 460 foot-tons per inch at 2000 yards: this will probably pierce the 24-inch armor of the Inflexible now building at Chatham. The Inflexible is to be armed with four of these 81-ton guns. The bursting-charge of the *shells* for these huge pieces will be very large. It must be remembered respecting these huge guns that the difficulties in construction and the danger attending their use increase in a higher ratio than the diameter of the bore, and were it not for the improvements in gunpowder introduced by the late Gen. Rodman their failure would be almost certain. All the experiments and calculations that have been given are based on the shot striking at nearly a right angle, but in the case of most of the iron-clads there is so much margin on the side of the gun that penetration will take place at wide deviation from the normal. Armor-piercing shot and shell are now, for the most part, made of strong cast iron, with the front end chilled in the same manner as the tread of American cast-iron car-wheels: the piercing figures in the tables are for this description of shot.

The diagrams show several forms of armor-piercing projectiles for the 12-inch Woolwich rifle; the chill is shown by the light shading. These are loaded from the rear and have no fuses, the heat generated by the impact on striking armor being sufficient to explode.

FIG. 11.



600 lbs. loaded. 600 lbs. loaded. Cored shot, 607¾ lbs. loaded. Cored shot, 700 lbs. loaded.

Armor-piercing projectiles for 12-inch Woolwich rifle.

(31) At the commencement of the experiments against armor numerous inventions were brought forward, and many tested, which were founded on the notion that combinations of cork, india-rubber, wood, iron, etc., other than great thickness of iron, would have the effect, as one said who proposed to apply steel cones to split and glance the shot, of "robbing the shot of a great portion of its power." Suffice it to say, that experiments have shown that nothing

* Since this was in type this enormous gun has been successfully fired with its original calibre of 14 inches, the calibre was subsequently bored up to 15 inches, and the gun fired with 300 pounds of 1.5 and 2 inch powder, giving the velocity of 1540 feet per second to a projectile of 1466 pounds weight. The force of this shot at the muzzle of the gun is estimated to be about 22,500 foot-tons.

can take the place of good solid plates of iron, backed by a moderate thickness of wood. At first, great tensile strength and hardness were thought to be important elements in armor. In 1861, British steelmakers, in answer to invitations, furnished steel targets for tests; cast, puddled, and Bessemer steel were successively tried. It was quickly seen that the injury to armor bore a close relation to its hardness. It was soon established that armor-plate should be made of very tough, ductile iron, in contradistinction to a metal possessing high tensile strength and brittleness. The usefulness of wood backing was early discovered; its thickness has, however, been decreased; the Warrior (1861) had 18 inches, the Alexandra (1875) had 10 inches. The question of vertical *vs.* inclined armor was soon settled in favor of the former—among other reasons, because with the same total weight the latter gave no more protection, while it introduced constructional difficulties and cramped the interior space. Cole's "cupolas," with their inclined walls, were set aside for the vertical monitor turret before any of them were fairly finished. The manufacture of armor-plates has been brought to great perfection. Cammel's works at Sheffield have successfully rolled plates 21 inches thick. Solid plates of great thickness have been pierced by heavy shot, with scarcely a crack or fissure to be seen; the plate apparently uninjured except where struck by the shot. The fact that other shot striking near the hole previously made experienced about as much resistance as though the plate had not been struck, shows the great results that have been accomplished in this branch of iron manufacture.

(32) Early trials proved that *solid* plates offered much greater resistance than the same aggregate thickness made up of a number of thin plates—the so-called laminated armor. The law of the resistance of solid plates up to 5½ inches has been shown by experiment to vary about as the square of the thickness; this is probably approximately correct for greater thicknesses. But this rule does not hold good in comparison of *solid* with laminated armor; a 6-inch plate, by the law of the squares, would be thirty-six times as strong as a 1-inch plate, yet it would not, as experiment shows, be six times as strong as six 1-inch plates. Experiments by Capt. Noble of the English ordnance against three targets, each 7 inches thick—one 7″ plate, one of two 3½″ plates, one of three 2⅓″ plates—showed that the resistances to penetration were in the ratio of 61, 57, and 52. He estimated that three 5-inch plates are equal to one 13-inch solid plate. It is probably true that the resistance to punching iron in a punching-machine varies as the circumference of the hole punched out multiplied by the thickness; but this rule, applied to the effects of projectiles on plates, does not hold, and it is of little value in estimating the resistance of armor, which seems to be governed by some law not thoroughly understood. When the laminated armor of 1-inch plates was applied to monitors in 1862, it was with great difficulty that even this thickness could be obtained.

(33) *Rams.*—With the iron-clad, practical shape was given for the first time to the proposition, long talked about by naval men, of reviving the method of attacking the enemy so successful in the hands of the Greeks and Romans at Salamis and Actium—viz. ramming. The bows of La Gloire and Warrior were especially strengthened, so that they could be safely used as rams; all subsequent iron-clads intended to operate at sea have their bows made of a shape to adapt them for ramming; they are strengthened by bulkheads, flats, breasthooks, etc. Three forms of ram-bows have their advocates: (1) the overreaching bow, like the Warrior's, which is claimed to have an advantage in ramming low-decked iron-clads by running over them; (2) a vertical or straight bow inclined somewhat backward, as La Gloire, Minotaur, Defence, etc. It is claimed that these two forms are not so likely to become entangled with the vessel rammed, and to be less liable to twisting and wrenching; but they have both been abandoned in later constructions for (3) the under-water (so-called) spur-bow. This is intended to strike the enemy on his unprotected sides below the armor, which in the heaviest iron-clads does not extend more than 6 feet below the water-line. This form has an important advantage over the others, as a relatively moderate speed will be sufficient to enable it to puncture the plain hull and inflict fatal injury if the cellular divisions and bulkheads do not prevent large quantities of water from entering. This feature, the moderate velocity at which it will inflict serious damage, while the other forms would have to strike at pretty high speed to seriously injure a well-built iron-clad with an iron hull, seems to have been decisive in its favor. It is the form now exclusively adopted; its shape is shown in the diagram of the Hercules and the cuts of the Alexandra and the monitor Inflexible. The French and English have very powerful vessels constructed to be used almost exclusively as rams. (See Table A.)

(34) The following is the projection under water of the ram-bow beyond a perpendicular let fall at the load-water for several of the more important vessels: Magenta, 6′ 6″; Marengo, 1′; Colbert, 7′ 10″; Redoubtable, 11′ 4″; Defence, 4′ 3″; Bellerophon, 18′ 11″; Sultan, 10′ 6″; Hercules, 9′ 10″; Audacious, 4′ 11″; Friedrich Karl, 10′; Devastation (monitor), 10′; Fury (ram-vessel), 10′; Cerbère (turret), 9′ 10″; Tonnerre and Tempête (ram-vessels), 9′ 10″. The ram-vessels have no rigging; none of them, with one exception, have more than two heavy guns, several of them but one; and, as they are intended for firing over the bow, they have quite limited horizontal train. Unquestionably, this is a wise arrangement, because with a vessel built for a special object her commander will not then be tempted to use her in a different way. Admiral Goldsborough has said the use of guns will defeat the unity of purpose (in rams) which is so essential to success; and he has given his opinion that it would be well to have rams without guns. In any case—whether with one or two guns to fire over the bow, which can be fired at the moment of striking, or not so provided—such vessels ought to be fitted with the "deck-scraper" fitted by Ericsson to the monitors. This is a large oblong shell, arranged to be pushed through the deck from below, and by exploding (by a blow on a wafer of fulminate) in a horizontal direction clear the deck of intruders. The Gatling battery is also regarded as an effectual protection against boarders.

(35) The very large dimensions of the heaviest iron-clads seem not to be necessary for a ram-vessel; the dimensions and displacement should not exceed what is required to carry armor thick enough to give a fair degree of invulnerability and speed. The cardinal points that should be kept in view are general handiness, celerity in turning, and engine-power to give high speed. A ram-vessel of 4500 tons weight—little more than half that of the Bellerophon, reported to be a very handy ship—striking at the velocity of 10 knots (16.8 feet per second), will give a blow the energy of which is a trifle less than 20,000 foot-tons; the energy of a 760-pounder rifle shot as it leaves the muzzle is 9077 foot-tons. This mode of comparing the striking force of the ram with that of a projectile has often been used; but reasoning therefrom that the ram ought to be looked upon as a projectile seems to be straining the comparison. The shot rests in the gun until it is pointed at the enemy; a pull on the lock-string, and in a second or two it has reached its mark. A ram weighing say 4500 or 5000 tons, at rest waiting for a fair chance to charge, will, under favorable circumstances respecting skilful management of the engines, require some five minutes to reach the velocity of 10 knots; or if moving slowly, say 4 or 5 knots, it will take some minutes at least to reach the same speed. Any one who has observed the time taken by a large steamer to get well under way, after stopping, for example, to discharge a pilot, will probably admit this. It should not be forgotten that the resistance through the water, as well as the force of the blow on striking, increases as the square of the velocity.

(36) There is another point which should not be omitted in comparing rams with projectiles—viz. the difference in the effect of the impact of bodies moving at very high or very low velocities, though the latter may have much more energy $\left(\frac{v^2}{2g}\right)$ than the former. A ram of 4500 tons striking at, say, 5 knots (8.4 feet per second) has an energy of nearly 10,000 foot-tons, and a 760-pound shell (12.6 inch rifle), moving 1312 feet per second, has an energy of 9077 foot tons. The heavy ram at 8.4 feet per second, unless it strikes nearly square, will probably either scrape along the side or push the opposing ship around, without inflicting serious injury, while the shell, from its high velocity and the concentration of its impact, will pass through 14 inches of armor. Take the extreme case of a ram heavy enough to strike a blow of 20,000 foot-tons at 1-knot speed; even this great energy, exerted at this low velocity, would do but little more than push along a floating object. It is probably fair to assume that an alert antagonist with plenty of sea-room and good command of steam has it in his power to out-manœuvre the ram—by presenting his bow, for example—so that he cannot be advantageously rammed, or perhaps even struck, without inflicting as much damage as he himself receives. Some writers on ram-manœuvres have constructed diagrams which appear to show that they think a steam-vessel can be turned at a very abrupt angle. Some manœuvre is to be carried into effect, and it is at once executed—in the diagram—precisely as the tactician wishes it. But a steamer in altering her course, even with the rudder hard up, turns by traversing the arc of a large circle; this will be seen by referring to Table B.

(37) A large majority of naval officers are of opinion that the ram will play a very important part in future naval wars. Commodore F. A. Parker, who enjoys a distin-

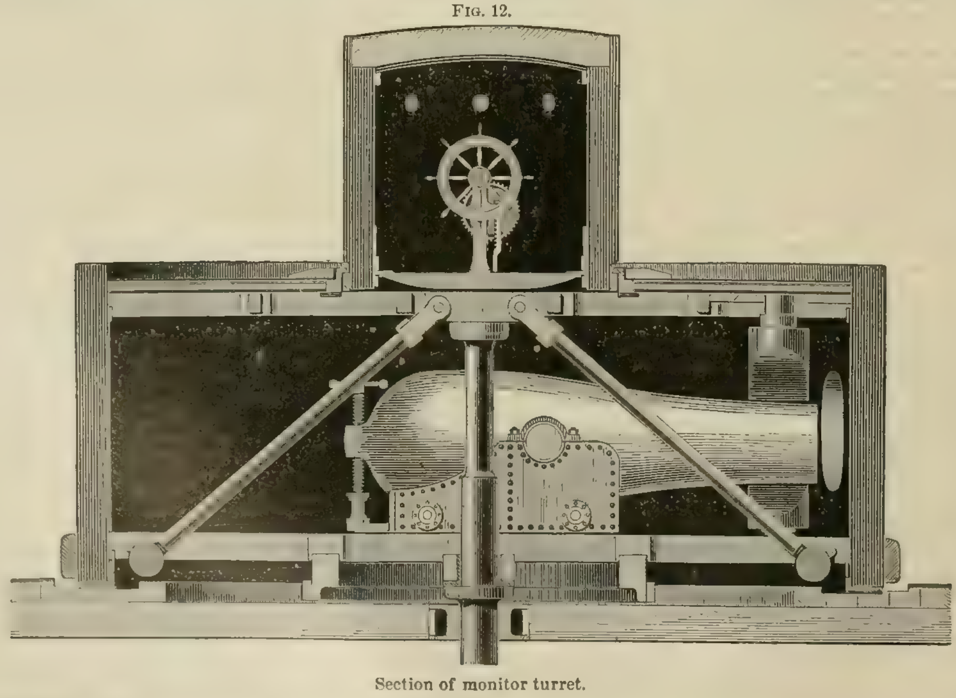
guished reputation as a naval tactician, is of opinion that they are the most efficient vessels for fleet-fighting on the open sea, and that they should "hunt in couples or by threes," so that while the enemy is avoiding one he will be rammed by another. Many hold that so far as our navy is concerned an important field for the use of the ram is as part of the defence of harbors and roadsteads against the unwieldy iron-clads that must be used by a Transatlantic enemy. If the rams are of moderate draught, and possess the celerity of movement mentioned as of cardinal importance, the immense iron-clads of Europe (drawing from 24 to 29 feet) will be taken at such a disadvantage the moment they reach shoal water that it is almost inevitable that they would have their sides punched below their armor, and their screws and rudders—which in these iron-clads are vulnerable to ram-attack—would be pretty sure to be rendered useless.

(38) The qualities that a ram should have for such use are speed, moderate draught, handiness, and no incumbrance whatever by rigging. Celerity of movement would be secured by moderate dimensions, large rudder-power, and twin-screws: the area of the rudder should be considerably greater than is usually applied; the rudder itself and all its attachments should be so strong that by the application of steam-power it could be put hard up in an instant without danger of breakage; and any other practical device that will increase the quickness of turning should be adopted. The steam-power should be ample to secure high speed, and the condensing apparatus should be so arranged that when in action the steam made with clean fires and closed furnace-doors, while the engines are stopped or moving slowly, could be discharged into the condenser instead of escaping into the air with a deafening noise and obscuring the view of the commander. With independent air, circulating, and feed pumps a vacuum would be maintained in the condenser while the engines were at rest, and they would be able to start at full speed at a moment's notice. If the ram is armed at all, it should have one or two of the heaviest guns obtainable, well shielded, and arranged to fire over the bow with small horizontal train, and fixed so that but 1° or 2° of elevation could be given, thus removing the temptation of distant firing.

(39) There is no experience respecting the effect of ramming on a well-built iron-clad with iron hulls and double sides, such as the Hercules, for example.* The most noted instances of the effect of this weapon are the sinking of the Re d'Italia at Lissa, and the Cumberland at Newport News by the ram of the Merrimack. The Re d'Italia had an ordinary wooden hull. She was struck by the Ferdinand Max, a vessel weighing about 5500 tons, fitted with an under-water prow; it is stated she struck her opponent at about 8 knots speed; hence she delivered a blow of 15,950 tons energy. The Cumberland was a sailing frigate, and was sunk while at anchor. The Tennessee, with very strong sides at her water-line, was vigorously rammed by the wooden ships of Farragut's fleet in Mobile Bay without apparently doing her any injury. Rams were used with great effect during the war on the Mississippi and its tributaries, but the vessels bore no comparison in point of strength with those that will be encountered on the ocean.

(40) *Monitor System.*—On the breaking out of the civil war (1861) the navy department knew that iron-clads were wanted for the coming struggle, but much perplexity existed respecting the system that should be adopted, especially for those to be employed on the Atlantic coast. These would certainly be used against the insurgents, with a probability that they might be called on to defend our harbors and roadsteads from a foreign foe. To copy the huge iron-clads building in Europe—two then afloat—was impracticable, for our vessels, if built on this plan, in order to cope with them must have nearly equalled them in dimensions, and some two years would have been required for their construction, while from their great draught they could not approach within gunshot of the coast S. of the Chesapeake. In answer to a call from the government for plans, among others offered, Ericsson presented the design of the Monitor. This invention proved that invulnerability to any ordnance then in service, here or abroad, with peculiar facility for handling guns of any weight attainable, could be had with a small vessel with light draught, and one, too, that could be very quickly built. The work of the Monitor in Hampton Roads (Mar. 9, 1862), when but a few days from the builder's yard, made a profound impression in Europe, which was not lessened by the fact that a fleet of these vessels, superior to the original, was immediately commenced, or by the intelligence which followed a few months later that this monitor fleet was ready for service, mounting 20-ton guns, throwing projectiles some five times heavier than any in foreign navies. The two iron-clads then afloat abroad could not resist these guns, and to send wooden fleets against positions defended by such weapons would be to invite a repetition of the fate of the Turkish ships at Sinope and of the Cumberland and the Congress. The chief constructor of the English navy said in 1869, "It is but five years ago that Parliament was discussing the practicability of carrying $6\frac{1}{2}$-ton guns at sea, especially in broadside iron-clads."

Fig. 12.



Section of monitor turret.

(41) The monitor principle (see Monitor), stripped of novel minutiæ of detail, is a low hull with pointed ends, the deck flat and free of incumbrances that would prevent the guns, which were mounted in a cylindrical revolving turret, from being pointed over some 340° of horizon. The vessel itself, almost immersed, was impregnable, and gave protection to the engine, propeller, and rudder, as well as to the anchor,

*Since this was written the English iron-clad Vanguard was sunk by being accidentally rammed by her consort, the Iron Duke.

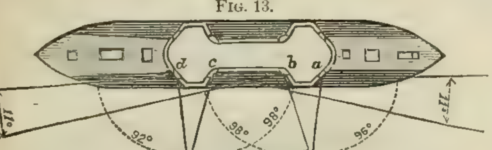
which could be let go and taken up without exposure of the crew while under fire, while the guns and gunners were protected by the turret. This system gives maximum thickness of armor that can be carried with a given displacement, combined with peculiar facility for protecting and pointing the heaviest artillery. Hence, it is especially adapted for coast and harbor defence (which is the chief duty of all iron-clads), because it admits of a higher degree of invulnerability with minimum dimensions and moderate draught. It is the system of *concentration* of armor and guns. Originally proposed in 1854 by Ericsson in a communication to Napoleon, it has nothing in common with the Coles system but the ancient device of rotating the gun platform. Coles proposed to carry a number of *conical cupolas on the deck of a high-sided rigged ship of the usual form;* this is shown in the model of the Royal Sovereign, with five of these cupolas, which was placed by Coles in the great exhibition of 1862. At this time, it appears, he had no idea of the essential principle of the monitor—viz. *concentration.*

TABLE F.—*Iron-clads built during the War for Atlantic Seaboard.*

Name and number.	Displacement.	Draught.	Thickness of armor.	Backing.	Inner skin.	No. and thickness of turrets.	No. and size of guns.	No. remaining.	When built.
Monitors.	tons.	ft. in.	in.	in.	in.	No. in.	No. in.		
Monitor (1)	1000	10 0	5	36*	5/8	1 8	2 11	0	1861
Passaic (9)	1250	10 9	5	36*	5/8	1 11	2 15	7	1862
Monadnock (4)†	abt. 3000	13 0	6	37	...	2 10½	4 15	4	1862
Kalamazoo (4)‡	" 5500	18 0	14	40	...	2 15	4 15 or 20	4	1863
Canonicus (9)	1750	12 2	9½	28*	5/8	1 10½	2 15	6	1862
Puritan	4851	20 0	10½	48*	1	....	....	1	1862
Dictator	4383	20 6	10½	48*	1	1 15	2 15	1	1862
Broadside.									
New Ironsides	3820	16 0	4½	20	...	....	14 11		

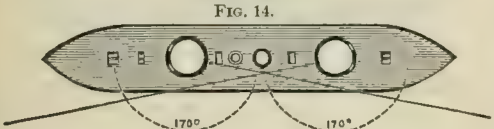
(42) The importance of giving the guns great horizontal range, or "all-around fire," as it is termed, is shown by the devices resorted to in broadside vessels to secure it; as, for example, the recessed ports and two-story casemates of the Alexandra (1875, see figure), also the semicircular casemates projecting from the vessel's side (suited to breech loading) extensively adopted by the French, as in the Marengo and Suffrén and in the Alma and Montcalm classes. The diagrams—one of the Moyini Zaffer, a central-casemate iron-clad, the product of the joint efforts of three distinguished English engineers, Armstrong, Samuda, and Ravenhill, the other of a two-turreted monitor—show the points of superiority, in respect to horizontal range, of the revolving-turret system over the central casemate, or, what is pretty much the same thing, the stationary

FIG. 13.



Moyini Zaffer.

FIG. 14.



Two-turreted monitor.

turret. The Moyini Zaffer is 235 feet in length, with 35 feet 6 inches beam; the armor along the water-line is 6 inches thick, while on the casemate it is 5 inches. The casemate is pierced for 8 guns, but carries four 12-ton rifles, the intention being to transfer them from one side of the battery to the other during action. The complexity attending the form of this casemate shows that the designers were dealing with a difficult subject—viz. to secure great horizontal range with a fixed battery. The monitor is of the same dimensions as the Moyini Zaffer, but she carries on her sides 10 inches of armor against 6 inches, and on her two turrets 15 inches against 5 inches carried by the latter. The turrets each mount two 24-ton guns, which command 340° of the horizon. In order to compare the *broadside* fire of the two iron-clads, the ports of the Moyini Zaffer are denoted by the letters *a*, *b*, *c*, *d*; each gun, beginning with *a*, respectively ranges over a field of 96°, 98°, 98°, and 92°. Referring to plan view of the monitor, each of the four guns sweeps a field of 172°. The 24-ton rifle throws a shot of 600 pounds, and the 12-ton, one of 300 pounds. If the ordnance power of the two vessels is contrasted by multiplying the degrees of horizontal range by the weight of the projectiles, we have, for the 12-ton gun *a*, 300 × 96° = 28,800; this, added to similar multiplication for the others, *b*, *c*, and *d*, gives a total of 115,200. Performing the same operation for the four 24 ton turret-guns, the comparison stands 108 for the monitor against 115 for the fixed casemate. The circumference of this casemate is greater than that of the two turrets in the proportion of 25 to 15; the height from the water-line to the top of the armored belt of the former is several times more than the height of the deck of the latter; hence deeper armor below the water-line must be given to the Moyini Zaffer to afford adequate protection, increased rolling being the result of high sides. This explains how it is that the guns of the monitor are shielded by armor of some nine times greater, and the sides by armor of some three times greater resistance, than the casemate vessel of same displacement, assuming the resistance to be as the squares of the thickness. If the suggestion is made that heavier guns could be mounted on the Moyini Zaffer, it is met by the fact that much heavier guns could more easily be mounted in the turret, the limit of weight being much sooner reached in the casemate.

(43) The advantages of the turret are so obvious that many naval men opposed to the low monitor hull have advocated placing it on high-sided ships with large sail-power, but its best points are destroyed when so placed. The "all-around" fire disappears, as the decks, over which the guns must be pointed to secure it, are encumbered with masts, rigging, and other obstructions, which obscure the sight and diminish the sector of fire. The sides of the high-sided vessel below the level of the armored part of the turret may be penetrated; consequently, there is a great length of side where penetration may destroy the revolving machinery or damage the gun-slides, which, with part of the mechanism of the carriages, are below the armored walls of the turret. The English turret-ship Monarch, 8070 tons displacement, is a case in point. Rigged with two-thirds of the sail-power usual in men of war, she carries two turrets with armor 8″ and 10″, backing 10″, and inner skin 1½″ in thickness; these turrets project above the upper deck. In order to secure even a limited horizontal range, it is part of the plan (so her commander informed the writer) to cast loose the shrouds before going into action. The turret-guns can fire neither astern nor within 20° of ahead; even if they could, the person pointing them could not see the object aimed at, unless it was at a considerable distance. About the water-line the armor is 7 inches thick; above this, and below the level of the armored part of the turrets, where penetration would make them inoperative, the armor is 6 inches thick. This puts it in the power of a single shot, penetrating any part of a large area of 6-inch armor, to stop the use of the guns. When the writer visited the Monarch at Portland, the U. S. monitor Miantonomoh was anchored near by, her proximity suggesting a comparison between the two systems. The Miantonomoh was a wooden vessel, built to meet the exigencies of the war, of about 3000 tons displacement; she carried two turrets 11 inches thick, mounting four 20-ton guns. Her sides, about two feet above the water-line, hardly visible from the Monarch, were plated with armor 6 inches thick. The Monarch, on the other hand, presented a large target to the monitor, which with her "all-around" fire could engage head on, stern on, or in any other position that suited the tactics of her commander. As an example of the great protection that is afforded by a low hull, the writer may mention that he has been in a monitor anchored within easy range of a well-armed fortification; the whistling of shot over the deck and the splashing alongside showed the difficulty of hitting the small height of side exposed above water, even under exceptional circumstances, as in this case, where the range was known to the enemy. It is then

* Besides entire width of main deck. † Wooden hulls.
‡ Wooden hulls so rotten that they will not be completed.

clear that the most appropriate place for a revolving turret is on a low hull with clear decks. In 1867 the controller of the British navy in a report to the admiralty said: "I still hold that for coast defences . . . the turret system of armament, properly designed, in vessels known as the monitor type, is superior to all others, and the most formidable engine of war that can well be conceived; so I still maintain that combining a sea-going vessel with masts, rigging, and sails, and this kind of armament, entails a sacrifice of a large portion of its efficiency."

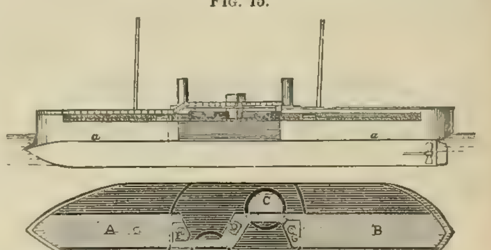
(44) Admiral Dahlgren, in his report to the secretary of the navy, made while in command off Charleston Jan. 28, 1864, speaking of the monitors, says: "The battering received was without precedent. The Montauk had been struck 214 times: the Weehawken 187 times, and almost entirely by 10-inch shot. What vessels have ever been subjected to such a test? Any defects of detail were marked by this searching process," he adds, "and no vital principle was seriously touched." These monitors mounted one 15-inch 20-ton gun, and one 11-inch. Speaking of the rate of fire, the admiral says: "That this was due to the calibre of the gun, and not to its being located in a turret, may be shown by one notable instance: In one engagement the 11-inch fired 25 shells successively in one hour, of which 21 hit the wall of the fort—distance, 1600 yards. This is at the rate of one shell in 2.4 minutes, which is not only rapid, but also exceedingly accurate practice. . . . Each turret contains two guns, and from the peculiar facility which it has for giving direction to the heaviest ordnance, no doubt arises the desire to make them of the heaviest description." With both guns handled with the same rapidity as that above mentioned the turret would deliver a shot in every 1.2 minutes; the improvements shortly after introduced in the gun-carriages enabled this to be done with the heavy calibres. The admiral further says: "I have been in a monitor in all the principal actions, and the recurrence of casualties to fleet-captains near me shows that I was in a situation to judge. . . . I have also watched the behavior of the monitors through all phases of winter weather in this exposed situation. . . . The completeness with which four little monitors (1250 tons) and an iron-clad frigate have closed this harbor is well worth noting." The total hits received by the monitors in these engagements, mostly by 10-inch shot fired with (for those days) heavy charges, was 1030, and the weight of projectiles fired by them was 817,600 pounds. At the present time, fourteen years after the Monitor, by far the most powerful iron-clads in the European navies are on this principle; several of the largest have nearly as great tonnage as our whole fleet, nine in number, which came immediately after the original. The monitors of the Devastation class, 26 feet draught, are 9000 tons displacement; the total displacement of our fleet of sixty-two referred to, was 11,250 tons, yet they carried turrets 11 inches thick against the 14 inches, 10 inch backing, and 1½ inner skin turrets of the Devastation.

(45) A great variety of plans for mounting and working the monitor turrets has been proposed; in fact, nearly every one with an inventive turn who has seen one has had a device to propose. Many of these, no doubt, have merit, but space will not allow any to be mentioned except those that have been adopted. The chief difference between the monitors built by us during the war and those of the English (built many years later), apart from their much greater dimensions, is in the manner of mounting the turrets. Ours revolved on a broad, flat, polished plate, placed slightly lower than the level of the deck, the principal parts of the revolving machinery being below the water-line. In the English monitors a long rectangular box, called a "breastwork," somewhat wider than the diameter of the turret, is fixed upon the deck; the turret rests on rollers, and projects just far enough above this box to allow the guns to be fired over it. This plan has in a less degree the defects spoken of in the Monarch—viz. it gives a large target where penetration will destroy the turret mechanism—rollers, gun-slides, etc.—which is behind it and below the armored part of the turret. If the armor of the box is less than the turrets (as it is in some cases), it is equivalent to making the lower and more important part the most vulnerable. The box should be the target aimed at, as penetration with a heavy shell would be disastrous. To have the same invulnerability with the box-plan, other things being equal, requires more weight, as the area to be armored is greater; this and other things which are not of so much consequence in the 9000 to 11,000 tons displacement, 26-feet draught monitors, that can be used in European waters; but where invulnerability with medium draught and moderate dimensions is the object, as was the case with American iron-clads built during the war—which had a displacement of but about one-eighth that of the English vessels, and with but 11 feet 6 inches draught—the constructor could take no liberties that would add to the weight to be floated. For large, deep-draught monitors, with great fuel capacity, intended to make long voyages, the box-plan of carrying turrets, if skilfully carried out, may be on the whole preferable, as it carries the guns higher above the water-line, and gives access to the hurricane deck without passing through the turrets. The much-talked of danger of the revolving of the turret being impeded by impact of shot is very small in either case; the plan used here during the war was submitted to long and severe tests under the skilful eye of Dahlgren; the turrets were heavily battered in every part of their walls with 10-inch shot; these turrets were built of laminated plates, which are so greatly inferior to the solid armor (which would now be used) that these trials were far more searching than they are generally thought to be.

(46) There is no point connected with monitors that has been more misunderstood than ventilation. Probably of all places human beings have been forced to live in, none are more wanting in ventilation than the between-decks of the old frigates and line-of-battle ships—where from 500 to 700 men swung their hammocks—when the weather made it necessary to close the air-ports and cover the hatches. The accounts current during the war made it generally believed that good ventilation had been the rule, and that its absence came in with the iron-clads. The records of the bureau of medicine and surgery of the navy department show that the "sick-list" of the monitors was less proportionately than the wooden ships; the reason was the ventilation could be controlled at will by modifying the working of the rotary fans.

(47) The Inflexible, now constructing, is intended to be the most formidable iron-clad ever built. She is to carry armor of such thickness that it is expected it will be far in advance of the penetrative power of guns for many years to come. The chief dimensions are in Table A; the following description and diagrams will explain the particulars of her construction:

Fig. 15.

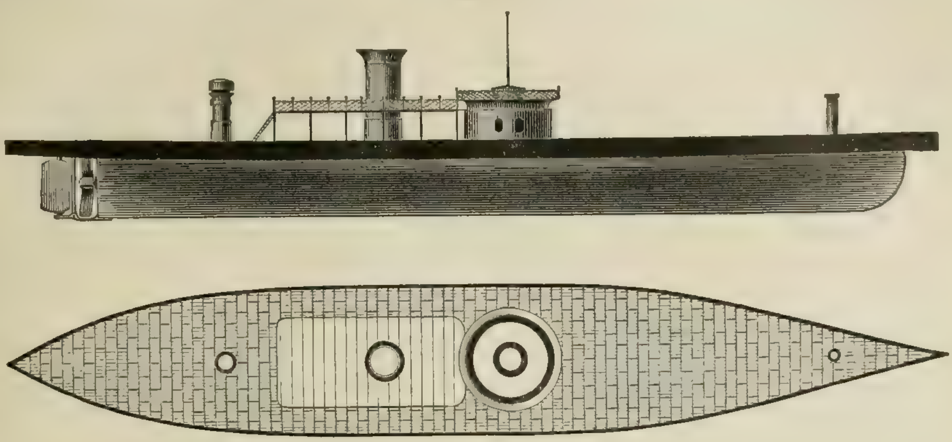


English monitor Inflexible. Displacement, 11,095 tons.

The turret-deck, through which the armored part of the turrets project, is at the top of the dark-shaded area of armor on the sides; it is 10 feet above the water-line from stem to stern. On the top of this there is another deck, 20 feet above the water-line; this deck is shown at A, B. It is set back from the sides to allow the guns to be fired by it. The turrets are carried one on each side, placed zigzag, shown by C, C, Fig. 2; this allows all the guns to be fired ahead or astern. Each turret carries two 81-ton rifles. There is no pilot or "conning" house, as in the American monitors, from which the commander can direct the steering and the firing of the guns: this will be done from the top of one of the turrets; but the ship is so broad, and as the top of the turrets are on a level with the upper deck, it seems that a clear all-around view cannot be had from this place. The central box, shown by dark shading below the turrets, Fig. 1, is 110 feet in length by 75 feet, the full beam of the vessel, in width. It is armored with two plates, each 12 inches thick, separated by a layer of wood; the object of this, it is said, being that a shell may be exploded and destroyed by the outer plate before it reaches the inner plate. The armor of the box, though not of the same thickness, extends 6 feet below the water-line; at this depth a deck (*a a*, Fig. 1), covered with 3-inch plates, extends fore and aft to the ends of the vessel. The sides above this 3-inch deck, 210 feet in length, are unarmored; above this, where penetration would probably allow water to enter in sufficient quantity to "disable or even sink the ship," if it could fill this space, there are numerous compartments in which the main coal-supply and a large part of the stores and provisions are carried, the object being to exclude water to the extent of their bulk; part of this space, not so occupied, is filled with cork and a part left vacant. It is intended to admit a certain quantity of water before going into action, in order to increase the immersion; this is the plan proposed by E. A.

Stevens to the naval board of 1861 for completing the battery which bears his name. It is intimated in the English journals that much of the top-hamper of this vessel has been introduced as a sort of compromise to settle the diverse views of the gunmakers, naval constructors, and sailors. The hull of the Inflexible is constructed avowedly to resist the effect of torpedoes, but it will scarcely be doubted that a charge of some 1000 pounds or 1500 pounds of such explosives as gun-cotton or the nitro-glycerine preparations, exploded in contact with her unarmored sides below water, would cause her destruction. An appliance to handle such heavy charges is now being experimented with, and it is probable it will be in practical shape at an early day.

FIG. 16.



U. S. iron-clad Dictator.

The monitor Dictator (see diagram), built of iron, 4500 tons displacement, planned by Ericsson in 1862, is 320 feet in length over all, 270 feet between perpendiculars, 41 feet 6 inches breadth of hull, and 50 feet breadth over all: the sides are covered from stem to stern with 10-inch armor. She carried one turret, 26 feet inside diameter and 15 inches thick; it contained two 20-ton guns, mounted on carriages which were worked by steam. The armored sides were very massive, the backing being 48 inches thick, which were supported by the entire width of the heavy deck, which was laid on oak beams 14 inches square. This vessel has been severely tried on several occasions in heavy gales, and proved to be an excellent sea-boat. The ventilation in the quarters is excellent, and the crew experienced no inconvenience during the heavy weather encountered. In the case of the English monitor Devastation (1872), which carries her turrets on the central-box system, combined with high deck-houses, the arrangement being almost expressly made to secure comfortable quarters, the crew, according to English accounts, were greatly annoyed by the deficiency of pure air.

(48) *Iron-clads on the Western Rivers.*—At the beginning of the civil war the Confederates were in possession of many important points below Cairo on the Mississippi, where they constructed batteries which almost completely closed the river. The government took immediate steps to build an iron-clad flotilla. The first seven of these, the De Kalb, Carondelet, Cairo, Benton, etc., were built under contract with the war department; they were mostly converted Mississippi steamboats. The armament was mounted in casemates erected on the deck, armored for the most part with $2\frac{1}{2}$-inch plates, which with the heavy backing were placed at an angle of 45°; this was vulnerable to heavy guns, such as the 8- and 10-inch smooth-bores used by the Confederates at several places. The records of the navy show that these vessels, with many others which were facetiously called "tin-clads," did some of the most severe and effective fighting of the war; their officers never hesitated, when the occasion required it, to run by or engage the heaviest fortification on the river. Later, two monitors, 145 feet long, 45 feet beam, draught 4 feet, with one 6-inch turret and two 11-inch guns, sides plated with $2\frac{1}{2}$ inches of iron, were built by J. B. Eads. After these came three monitors, by the same contractor, of the Kickapoo class; they were 236 feet long, 56 feet beam, 6 feet draught, 3-inch armor on the sides; they carried two 8-inch turrets, with two 11-inch guns in each.

(49) *Conclusion.*—The most formidable iron-clads of the European powers, as the foregoing description of their construction shows, are practically without sails or rigging. It seems to be the tendency to abandon these, and to concentrate all the weight possible in armor and guns. This indicates that these vessels are more for defensive than aggressive purposes; more to prevent a naval force from attacking harbors, roadsteads, and other important points than for assailing the enemy in his own strongholds. The weight of professional opinion is in favor of abandoning all incumbrances for heavy fighting vessels, and of constructing monitor-hulled, rotating-turret iron-clads, unhampered with masts. That this is the tendency is shown by such constructions as the English monitors Glatton, Devastation, Inflexible, etc., and the ram-vessels Fury and Hotspur; by the Russian monitor Peter the Great and the so-called circular monitors of Admiral Popoff; by the Tonnerre, Tempête, etc. of the French navy; and by the large turret-vessels building by the Germans. Such naval fighting engines as these are evidently suited for defensive purposes, and they are so greatly superior in guns and armor to the fleets of masted broadside iron-clads, thinly armored, as to place it out of the power of the latter to conquer positions protected by these so-called floating gun-carriages; nor could they safely venture in their neighborhood unless ready at any moment to avail themselves of their speed in retreating. It would seem that with the present appliances for destruction these relations must always be in favor of vessels for defensive purposes, constructed, as they can be, without the great fuel-capacity or incumbrances that are necessary for distant voyages or keeping the sea for long periods. High speed is undoubtedly of importance, but for coast and harbor defence thick armor, powerful guns, handiness, and moderate draught are greater essentials. Such vessels can be made far superior, in these points, to any structure fit to make distant voyages; and that, too, of more moderate dimensions and at less cost; while a small increase in displacement, with corresponding power, would enable them to surpass the offensive vessels of the enemy if that should be deemed important. It seems probable that the signal failure of the vast fleet of Sir Charles Napier before Cronstadt will be recorded as the last purely naval attack seriously attempted against any harbor or roadstead defended with the appliances which the resources of modern engineering have placed at the disposal of the defence, which it has done in a higher degree than it has added to the aggressive power of iron-clad navies.

Principal Sources of Information used.—Reports and documents of U. S. navy department; *U. S. Army and Navy Journal; Revue maritime et coloniale* (Paris); *Engineering* (London); *Journal of United Service Institution* (London); *Our Iron-clad Ships* (Reed, London).

ISAAC NEWTON.

Ships' Mag'netism and Devia'tion of Com'pass. It is well known that the earth, as a whole, acts like a combination of magnets, and that in consequence the magnetic needle of a ship's compass (see COMPASS), for any given place on the earth's surface, will put itself, if free to move, in the direction of the horizontal component of the magnetic force existing at that point. (See MAGNET and EARTH, VII.) The direction of this force is different in different localities, and moreover varies with the time, though slowly, and when referred to the direction of the meridian produces what is known nautically as the variation of the compass, and scientifically as the magnetic declination. The vertical component of the earth's magnetism likewise enters into our considerations, as well as the intensity of the force. It is also a matter of expe-

rience that the line of force becomes locally affected by the near presence of iron, of steel, and feebly by a few other substances, but more powerfully by magnets. This disturbing effect of the action of iron in the vicinity of the compass on board ship is known as the "deviation of the compass."

So long as ships were chiefly built of wood, it sufficed to avoid the use of iron about the compass within a radius of a few metres, and, in case metal had to be employed, to substitute copper. With the increased use of iron in the shape of beams, girders, posts, stanchions, guns, large anchors, engines, funnels, wire rigging, and principally with the construction of iron hulls, armor-plates, deck-plates, iron gun and steering-turrets, and when the ship itself could be regarded as a large magnet under the earth's inductive force, the subject of the deviation of the compass at once assumed a vast practical and theoretical importance.

Considered magnetically, iron may be soft, hard, or of an intermediate condition. By soft iron is understood cast iron or malleable iron not subjected to mechanical vibrations when cold, which when presented in the shape of a bar to a suspended magnet will of itself not disturb its equilibrium, but will temporarily act upon it as a magnet under the effect of the earth's induction. It possesses no independent magnetism, but is subject to induced magnetism, which is instantaneously taken up or parted with. Hard iron or steel when once magnetized retains its magnetism for a long time, and is but slightly susceptible of induction. Sub-permanent magnetism may be developed in a rod of iron when struck or subjected to tremor; magnetism thus imparted, though retained for some time, is slowly dissipated. The rate of loss at first is large. Iron of this character is subject to the laws of induction and of permanent magnets, but is variable in its effects. Compared with hard iron, iron of sub-permanent magnetism possesses but feeble coercive force, while soft iron has none at all. The disturbance of the compass is principally due to sub-permanent magnetism of the ship's iron, and is always produced by the transient induced magnetism of masses of soft iron. In wood-built ships there is little of permanent magnetism, and the character of the generally small observed deviation is that of the temporarily induced magnetism. In iron-built ships, on the contrary, the peculiarity of the generally large deviation is dependent on permanent magnetism, and remains indicative of the direction in which the ship was built, its magnetism, as a whole, having then become fixed by the process of hammering and riveting.

Before entering more minutely into the analysis of the deviation of the compass as depending on the location on board, on the character and distribution of the ship's iron, on the heading of the ship, and its geographical position, we may state the following laws of magnetism: (1) Under the influence of terrestrial magnetism the force on a magnet acts as a couple, one end being drawn N., the other S., with equal force; this is the law of duality of powers. (2) One magnet acting upon another, there is attraction between dissimilar ends, and repulsion between similar ends. (3) The magnetism collected in or near each pole of a magnet acts equally in all directions. (4) The attraction or repulsion (as the case may be) between two quantities of magnetism is proportional to the product of their magnetic energies; and, lastly, the attraction or repulsion of magnetic masses is inversely as the square of the distance between them. These statements apply properly to magnetic particles, but, when the mutual total actions of magnetic bodies are considered, require great modification; thus, the mutual effect of two magnets, supposing their distance large in comparison with their length, is more nearly inversely proportional to the third power of the distance; the attraction between the magnetisms—namely, that of the permanent magnetism of a magnet and of the induced magnetism of a mass of soft iron—will be nearly inversely as the fourth power of the distance. It is thus seen that the disturbing effect on a compass by surrounding masses of iron diminishes very rapidly with distance. The inductive effect of the earth's magnetism is greatest in the line of the magnetic dip. Iron-plated ships during construction, and under this inductive influence, have part of their magnetism fixed through molecular vibrations produced by hammering. By means of a small compass the writer was enabled to trace out with chalk on the iron gun-turret (sides 11 inches thick) of one of our iron-clad vessels its magnetic equator, and found its plane inclined to the horizon at an angle of nearly 90° dip: after revolving the turret 180°, the line of no polarity again was traced out, when the plane, passing through the intermediate horizontal position, gradually approached its former place after a lapse of about twelve hours: it probably takes weeks before the fixed position is reached, depending on the coercive power of the iron. Inside such turrets the magnetic intensity is very much weakened, but 12 per cent. was found to be left in the above case. (For the mathematical investigation of the action of one magnet upon another in various positions of the magnets, and for the disturbing force produced on a small compass-needle by a large magnet, and for the inductive effect of masses of soft iron, and the combination of these actions with that of terrestrial magnetism, the reader is referred to Sir George B. Airy's *Treatise on Magnetism* (London, 1870) and to the *Admiralty's Manual for the Deviations of the Compass*, by Capt. F. J. Evans, R. N., and Mr. Archibald Smith (3d ed., London, 1869). This manual is at present the standard work on the subject of the deviation of the compass, and the reader is once for all referred to it for all details, theoretical and practical, needed by the navigator.)

Although we are not in possession of any satisfactory theory, physical or mathematical, of the actions of magnetic bodies upon each other, and of induction produced by terrestrial magnetism, yet the disturbing effect upon a small compass-needle produced by the permanent, sub-permanent (the principal agent), and transient (induced) magnetism of a ship admit, with the assistance of Poisson's theory (*Mémoires de l'Institut de France*, tome v., 1824), of a tolerably direct expression and analysis with regard to magnitude and sign of the disturbance produced by each of these masses of iron. For this purpose the earth's magnetic force has been represented by three component forces, drawing the N. point of the compass-needle to the ship's head, to the starboard side, and to the keel respectively; similarly, we have the components of the combined total magnetic force of earth and ship in these directions; their respective differences or components of their disturbance can be expressed by linear equations possessing each a constant and three coefficients, which are to be determined by experiment for each ship and position of compass, and must be numerically worked out by application of the method of least squares. The mathematical development of Poisson's theory to the special case of application to the disturbance of a compass on board ship is due to Mr. Archibald Smith, and will be found in Appendix No. 1 to the *Admiralty's Manual*, referred to above.

We proceed to the statement of the results of experience, resting upon the examination of a large number of ships of various kinds. The general character of the deviation in wood-built sailing ships, with compass as usual on the quarter-deck and over the middle fore-and-aft line of the ship, is found as follows: No deviation when heading (magnetically) N. or S.; greatest deviation when heading (magnetically) E. or W.; deviation easterly when head in eastern semicircle, and westerly when head in western semicircle. In steam-vessels, with the compass aft, these directions of no and maximum deviation will often be found displaced by several degrees, yet preserving their general symmetrical character. In the southern (magnetic) hemisphere the deviations are reversed, though for steam-vessels they may be only partially changed. In iron-built ships we have to recognize an individual character. The points of no deviation are shifted from the N. and S. points, and lie nearly in the direction (by compass) of the ship's head and keel while building; they may not be opposite to each other, nor be removed exactly at right angles from the point of maximum deviation. In general, the deviation is easterly when the part of the ship which was S. in building is E. of the compass; westerly when W. In the southern (magnetic) hemisphere the deviation may appear reduced or aggravated, depending on the intensity of the fixed magnetism of the hull, and too many other circumstances to be known except by observation. Composite-built ships conform generally in their magnetic character more nearly to that of iron-built ships, especially if fitted with iron ribs. The deviation described above is technically known as the semicircular deviation, and may be expressed by $B \sin\zeta' + C \cos\zeta'$. In the general deviation formula $\delta = A + B \sin\zeta' + C \cos\zeta' + D \sin 2\zeta' + E \cos 2\zeta'$, the angle ζ' being the azimuth or the compass-bearing of the ship's head reckoned from the disturbed magnetic meridian positive to the eastward; it is a constant, generally small, + if easterly deviation is in excess. + B is approximately the deviation at E., and + C at N.; in the last terms of the harmonic function involving $2\zeta'$, and which are technically known as the quadrantal deviation, + D is the mean deviation approximately at N. E. and S. W.; the coefficient E is generally small or zero; the deviation δ is reckoned + when the N. end of the needle is drawn to the E.; and the above empirical expression applies, provided the deviation on any course does not much exceed 20°, or about two points, in which latter case the formula becomes somewhat more complicated. The correct magnetic course will be $\zeta = \zeta' + \delta$. The semicircular deviation rarely exceeds 10° in wood-built vessels, but in iron-

built ones may reach double and treble this amount. The quadrantal deviation seldom exceeds 1° or 2° in wood-built ships, but in iron-built ones may reach three or four times this amount. The semicircular deviation is principally due to the effect of permanent or sub-permanent magnetism. The quadrantal deviation, which undergoes no change with a change in the ship's place, is mainly due to the effect of induced magnetism.

The heeling error in wood-built ships is not appreciable, but in iron-built ones it may be serious; generally, the error vanishes with the ship's head at or near E. or W., and attains a maximum value with headings at or near N. or S. The sign of the error changes with a change from the northern (magnetic) to the southern hemisphere. In the northern (magnetic) hemisphere, with the compass above the upper deck, the majority of iron ships have the N. end of their compass-needle drawn to windward, and in the southern hemisphere to the leeward. The heeling error is due to the joint disturbing effect of the vertical components of permanent and of induced magnetism.

The values of the coefficients A B C D E are found directly from observations, the deviation of the compass being observed with the ship heading in a number of equidistant points around the horizon, usually either 32, 16, or 8. If the deviation is observed on four cardinal compass-points, D remains indeterminate; if on four quadrantal compass-points, E remains indeterminate. These observations are made by swinging the ship (or allowing it to swing by the tide), and noting for the several headings the bearing of a *distant* object, or by reciprocal bearings if the locality be confined, or when at sea by azimuths of the sun, the local time and latitude being known. The deviations being determined for a number of points, they may be plotted on what is known as Napier's diagram, and graphically interpolated by drawing a curve with a free hand through the several fixed positions. The deviations for any compass course will then become known. They may also be tabulated. If we deduce numerically the coefficients A B C D E, we can compute directly the values of δ for plotting or tabulation. In either case, we know the correct magnetic course corresponding to the disturbed or compass course, as well as the reverse of the compass course belonging to any correct magnetic course. An ingenious instrument has recently been invented (first exhibited at the World's Exposition at Vienna in 1873) by Dr. F. Paugger of Triest, Austria. It is described by him under the name of "Dromoskop," or course-indicator. After impressing upon it the known values of the deviation coefficients A, B, C, D, E, it furnishes directly, by means of its mechanism, the deviation of the compass, due to the effect of ship's iron, as represented by the above coefficients, for any course desired.

It has been remarked that inside iron turrets the magnetic intensity is greatly diminished; the same is the case with nearly all iron ships, the directive force of the needle being diminished. The relative horizontal force is found by means of the number of oscillations in a given time of a small needle, and the proportion of the disturbed to the undisturbed horizontal force, usually called λ, is determined from oscillations in four equidistant azimuths. It is usually less than 1, and is closely connected with the coefficient D, as may be surmised from the fact that λ is due to the effect of the horizontal induction of soft iron. D and λ are nearly constant. A knowledge of the value of λ is of importance; by its assistance the values of B and C may be found without swinging the ship from observations of δ and λ on one course; similarly, observing on two courses, we may determine B C D and λ. The value of λ is further needed in the computation of the heeling error, which is expressed $-\left(D + \frac{\mu}{\lambda} - 1\right) \tan\theta \, . \, i \, . \, \cos\zeta'$ for a heel of the vessel of $+i$ degrees to the starboard. Here μ is the ratio of the disturbed vertical force at the compass to the earth's vertical force; it is found by means of oscillations of the dipping-needle in the plane of the magnetic prime vertical; μ changes with a change in the geographical position; θ is the magnetic dip. It is therefore not necessary to actually heel the ship in order to determine the heeling deviation. It should be added to the general deviation table.

Experience has shown that the magnetic character of an iron ship is subject to slow changes from the lapse of time; this is particularly the case within a few months after launching. A more permanent condition, however, is attained in a year or two, especially when the ship has not quitted the hemisphere in which it was built. On account of this more or less unstable magnetic character, the direction tables constantly need verifying or renewing; the same must also be done in case of any change in the distribution or amount of iron in the vicinity of the compass.

The mechanical correction of the deviation of the compass is properly resorted to in case no suitable position for the standard compass can be found where the deviations are comparatively small; in ships built head S. (northern hemisphere), and intended for navigation in northern magnetic dips, the compass should be placed as far forward as practicable. It may also be elevated three or four mètres above deck, as in the case of Ritchie's fluid compass or of a tell-tale compass, read by optical means. The semicircular deviation may be corrected mechanically, either by means of two magnets or by one magnet; the quadrantal deviation may be corrected by a mass of soft iron placed near the level of the compass; the same may be effected by the mutual action of two compasses placed side by side; the heeling deviation may be corrected by the application of a vertical magnet. In mechanically-corrected compasses there is always some danger that, with change of geographical position, loss of magnetism of magnets, and change in the sub-permanent magnetism of the hull, deviations may reappear, though the disturbing force may have been completely neutralized in one place and at one time. It is therefore never to be trusted, and, as a rule, *deviation tables should be formed whether mechanical corrections have been applied or not.*

The investigation of the subject of ships' magnetism, and of its effect in producing the deviation of the compass under the influence of terrestrial magnetism, is of comparatively recent origin; having attracted the attention of practical men and of scientists in the early part of this century, it may be said that by their joint labor the solution of the problem has met with much success. About 1803, Capt. Flinders observed that the disturbance of his compass could be explained by the attraction of magnetic iron in the direction of the ship's head and of dissimilar polarity in the northern and southern hemispheres, and suggested the use of a vertical bar for its correction. Between 1820 and 1833, Profs. Barlow and Christie experimented on the action of induced magnetism, and about 1821, Dr. Scoresby on that of sub-permanent magnetism. In 1824, Poisson communicated to the Academy of Sciences a memoir on the theory of magnetism, and in 1838 published his paper on the deviations of the compass in the *Mémoires de l'Institut de France*. Gen. (now Sir) E. Sabine discussed the compass deviations in Sir James Ross's voyage (1839–43). The first explanation of the disturbance of the compass produced by iron ships was given by Prof. (now Sir) G. B. Airy in 1838 (*Phil. Trans.*, 1839), with whom the methods then introduced, and still in use, for the mechanical correction of the compass originated. Other communications by the present astronomer-royal are contained in Colburn's *U. S. Journal* (1840), in the *Phil. Trans. Roy. Soc.* (1856), in the *Trans. Inst. Nav. Arch.* (1860 and 1862). About 1855 the subject of sub-permanent magnetism, and its connection with the direction of iron ships when building, was investigated by the Liverpool committee of merchants, W. W. Rundell, secretary; the committee's first report appeared in 1855, and others in subsequent years. In 1859, Mr. Frederick J. Evans, R. N., communicated a paper on the magnetism of ships in the *Journal of the United Service Institution*, and a second on the same subject in 1860, in the *Phil. Trans. Roy. Soc.* The *Phil. Trans.* of 1861 contain a paper on compass deviations by Messrs. Smith and Evans; the mathematical formulæ relating to the subject were elaborately discussed and published by Mr. Archibald Smith in 1862, in the *Trans. Inst. Nav. Arch.* The *Phil. Trans.* of 1865 contain a paper by these authors on the character of armor-plated ships. In 1862 appeared the first edition of the *Admiralty Manual for the Deviation of the Compass*, by F. J. Evans, staff-captain R. N., and Archibald Smith, M. A., the standard work already referred to above (3d ed. 1869). Capt. Evans also published in 1870 an *Elementary Manual for the Deviation of the Compass in Iron Ships*. An excellent collection of the most important memoirs noticed above, entitled *A Series of Papers from the Transactions of Foreign Societies by Poisson, G. B. Airy, A. Smith, F. J. Evans, W. W. Rundell*, with other papers and documents, was published by the bureau of navigation, by order of the secretary of the navy, under the direction of Commodore T. A. Jenkins, U. S. N. (edited by Mr. B. F. Green), in 2 vols. (Washington, 1867 and 1869). C. A. Schott.

Ship-Worm. See Teredo.

Shipwrecks. See Wrecks.

Shiras (Alexander Eakin), b. in Philadelphia Aug. 10, 1812; graduated at the U. S. Military Academy in 1833, and entered the service as brevet second lieutenant of artillery, serving in garrison until 1846, except while at the Military Academy (1839–43) as professor of mathematics. He was in the West in 1846 in charge of subsistence of the volunteers for the Mexican war; was appointed commissary of subsistence, with the rank of captain, Mar., 1847; assistant to the commissary-general in Washington 1847–63, when he was appointed colonel and assistant commis-

sary-general. In 1871 he became commissary-general, with the rank of brigadier-general. He was brevetted brigadier and major-general in 1865 for faithful, meritorious, and distinguished services in his department. D. at Washington, D. C., Apr. 14, 1875.

Shiraz. See SHEERAZ.

Shire. See COUNTY.

Shiré′, river of South-eastern Africa, issues from the Lake of Nyassa in lat. 14° 28′ S., and flows through many rapids and cataracts from the elevated plateau of the interior into the flat coastland, where it forms a broad, calm stream, navigable for the largest vessels, and joins the Zambesi at Shupanga.

Shire′mantown, p.-v., Lower Allen tp., Cumberland co., Pa., on Cumberland Valley R. R.

Shir′land, p.-v. and tp., Winnebago co., Ill., on Western Union R. R. P. 559.

Shir′ley, p.-v., Funk's Grove tp., McLean co., Ill., on Chicago and Alton R. R. P. 163.

Shirley, tp., Cloud co., Kan. P. 637.

Shirley, p.-v. and tp., Piscataquis co., Me. P. 206.

Shirley, p.-v. and tp., Middlesex co., Mass., on Nashua River and on Fitchburg R. R., is a thriving manufacturing town, having 4 cotton and 2 paper mills, 4 churches, 9 public schools, and a Shaker village. P. 1451.

Shirley, tp., Huntingdon co., Pa. P. 1633.

Shirley (JAMES), b. in London about 1594; educated at Merchant Taylors' School, St. John's College, Oxford, and Catharine Hall, Cambridge; took orders in the Church of England, and obtained a curacy in Hertfordshire, but soon vacated it by becoming a Roman Catholic; taught for some time a grammar school at St. Alban's, but, being unsuccessful, became a dramatic writer in London; had produced 33 plays before the Great Rebellion, in which he fought on the royalist side; founded a classical academy at White Friars, and wrote several grammatical treatises. D. in London Oct. 29, 1666, from exposure consequent upon the great fire of that year. His *Dramatic Works and Poems* (6 vols., 1833) were first edited by Gifford and Dyce.

Shirley (WALTER WADDINGTON), D. D., b. in England July 24, 1828; was only son of Dr. W. A. Shirley, bishop of Sodor and Man; was educated at Rugby School and at University College, Oxford, graduating with high honors in 1851 from Wadham College, where he had obtained a scholarship, and where he was subsequently fellow and tutor; took orders in the Church of England; was a brilliant and thorough historical scholar and an able preacher and lecturer; edited, with learned prefaces and notes, for the master of the rolls, the *Fasciculi Zizaniorum Magistri Johannis Wyclif* (1858) and *Letters Illustrative of the Reign of Henry III.* (1863), both works of great interest for students of early English history; issued in 1865 a *Catalogue of Wickliffe's Writings*, giving an account of all the numerous MSS. of that Reformer known to exist in public or private collections; became select preacher to the university 1862, and was the successor of his friend, Dean A. P. Stanley, as professor of ecclesiastical history at Oxford (1864), and also as canon of Christ Church. D. at Oxford Nov. 20, 1866.

Shirley (WILLIAM), b. at Preston, Sussex, England, in 1693; became a lawyer; settled at Boston, Mass., 1734; was commissioner for fixing the boundary-line between Massachusetts and Rhode Island; was royal governor of Massachusetts 1741–45; planned the successful expedition against Cape Breton 1745; was in England 1745–53; returned to Massachusetts as governor in the latter year; treated with the Eastern Indians 1754; explored Kennebec River, erecting there several forts; was commander-in-chief of the forces in British North America at the outbreak of the French war, 1755; planned the expedition of Prideaux against Niagara, and proceeded himself as far as Oswego; was appointed lieutenant-general 1759; became afterward governor of the Bahama Islands, but returned to Massachusetts, where he built a fine residence at Roxbury. D. there Mar. 4, 1771. Author of *Electra*, a tragedy; *The Birth of Hercules*, a masque; *A Letter to the Duke of Newcastle, with a Journal of the Siege of Louisburg* (1745), and *The Conduct of Gen. William Shirley briefly Stated* (1758).—His son WILLIAM, an officer in the army, was killed at Braddock's defeat, 1755.—His son, Sir THOMAS, became a major-general in the British army, was created a baronet 1786, was governor of the Leeward Islands. D. Mar., 1800.

Shir′leysburg, p.-b., Shirley tp., Huntingdon co., Pa. P. 329.

Shir′wa, lake of South-eastern Africa, 30 miles S. E. of the Lake of Nyassa, is 60 miles long, from 10 to 23 miles broad, and surrounded with well-wooded mountains 2400 feet high. It swarms with crocodiles and rhinoceroses.

Shis′dra, town of Russia, government of Kaluga, on a river of the same name, an affluent of the Oka, has manufactures of cloth, glass, iron goods, and leather. P. 10,083.

Shi′shak, the name of several monarchs of the twenty-second Egyptian dynasty, called by the Egyptians *Shashanqa*, by the Hebrews *Shishaq*, and by the Greeks *Sousakim*, the most remarkable of whom was SHISHAK I. There is great difficulty in tracing the succession of Shishak from some monarch of the twenty-first dynasty, apparently one named *Namrut* or *Nimrod*, a priest, to whom he instituted a priesthood in the temple of Abydos. Certainly of Shemitic origin, and apparently also a chief of the Libyan Maxyes, Shishak united Egypt under one government, but was unable to subdue the Ethiopian rulers established at Napata. Hadad and Jeroboam found an asylum at his court, and five years after the schism of the tribes he overran Judah (B. C. 962), and went up to Jerusalem, from which he took as spoil the treasures of the temple and the palace in the sixth year of Rehoboam. In this expedition Shishak had 1200 chariots and 60,000 horsemen, besides a large army of Libyans and Ethiopians. He is supposed for this siege to have marched in three columns, and to have overrun not only Judæa, but also part of Idumæa and the country of the Philistines. At that part of the temple of Karnak called the Portico of the Bubastites, Shishak has inscribed the names of 130 cities occupied or captured, and amongst them are Rabbith, Thaanach, Sunera, Rehob, Hapharaim, Adoraim, Mahanaim, Gibeon, Bethhoron, Kedemoth, Ajalon, Megiddo, and Jerusalem, called Jehuda Maluk. The highest regnal year of his reign is the twenty-first, the same as that given by Manetho. His conquests in Asia appear to have been quite ephemeral.—SHISHAK II. was an obscure monarch, of whose reign no particulars are known, and was the fourth successor of Shishak I.—SHISHAK III., an equally inglorious monarch, appears, from a tablet found in the Serapeum at Memphis, to have reigned fifty-one years at least; and SHISHAK IV., the last king of the twenty-second or Bubastite dynasty, is only known for an insignificant reign of thirty-seven years. S. BIRCH.

Shit′tim. (1) Wood of the shittah tree, repeatedly mentioned in Exodus as the timber principally employed in building the tabernacle. It has been identified with the *Acacia seyal*, which abounds in the Sinaitic peninsula. The wood is light, but close-grained and enduring, of a fine orange-brown color. Its leaves are small, and in spring it is covered with tufts of yellow blossoms. It yields the gum-arabic of commerce. (2) A fertile plain, so called from its acacia-groves, just opposite Jericho, in which the Israelites were encamped before crossing the Jordan.

R. D. HITCHCOCK.

Shoa. See ABYSSINIA.

Shoal, tp., Clinton co., Mo. P. 2475.

Shoal Creek, tp., Johnson co., Ark. P. 1355.

Shoal Creek, tp., Barry co., Mo. P. 1686.

Shoal Creek, tp., Newton co., Mo. P. 763.

Shoal Creek, tp., Cherokee co., N. C. P. 1332.

Shoal′ford, tp., Limestone co., Ala. P. 1536.

Shoals, p.-v., Martin co., Ind., on Ohio and Mississippi R. R., equidistant from Cincinnati and St. Louis, has 3 churches, an academy, 1 newspaper, a blast furnace, an axe factory, a flouring-mill, 3 hotels, 3 saw-mills, and a pottery. Business, farming and grazing. P. 513.

HENRY A. REED, ED. "MARTIN CO. HERALD."

Shoals, Isles of. See ISLES OF SHOALS.

Shoc′co, tp., Warren co., N. C. P. 1637.

Shock [O. H. Ger. *Scoc*], sudden vital depression, the peculiar effect upon the animal system produced by violent injuries or violent mental emotions. It is especially a surgical term. Following serious accidents, the crushing of a limb by a railroad injury or its removal by a cannon-ball, extensive superficial burns, extensive surgical procedures, as amputations or ovariotomy, and as the result of blows over important organs, concussion of the brain, a kick or sudden blow in the region of the stomach over the solar plexus,—a powerful impression is made on the nerve-centres proportionate to the extent of the superficial or peripheral nerve-irritation. Every sensation conveyed, in the state of health, from the surface to the nerve-centres, and recognized by the brain, whether as sensation of simple touch, of pain, or a special sense, as taste or smell, involves the functional activity and wear of the ganglionic or nerve-cells. A violent impression upon many superficial nerves involves sudden and violent action in the ganglionic centres. When the surface impression is extreme, the functional activity of the brain and other central ganglia is disturbed, or may be temporarily or permanently suspended. The vital phenomena of the body—consciousness, respiration, heart-action, capillary circulation—are depressed in pro-

portion to the shock received by the nerve-centres. The symptoms of shock are extreme pallor and coolness of the face and surface of the body, a small, feeble, slow pulse, infrequent and often irregular respiration: if conscious, the mind feeble; often unconscious, or deep coma with relaxation of the muscles. In special cases, delirium, hiccough, convulsions are present. The circulation and respiration may be so depressed that death is immediate, or speedily ensues unless reaction is artificially hastened. Sensation of pain is annulled: in the gravest injury, as the laceration and removal of a limb by a cannon-ball, there may be no pain and no loss of blood during the period of shock; the period of shock, if survived, is followed by reaction, a resumption of ganglionic or central nerve-power, and revival of the dependent functions; extreme loss of blood is a prominent cause of shock, producing sudden anæmia, inanition, and disturbed action of nerve-centres. The depressing after-effect of the inhalation of chloroform and ether, and of alcoholic excess, is sometimes spoken of as shock, but with doubtful propriety. The influence of great mental excitement or depression in causing shock is undoubted. The sight of blood causes many to faint. Fright, terror, sudden sorrow have caused the hair to turn white in a night—have produced delirium, convulsions, incurable epilepsy, dementia, permanent nervous prostration, and death. No satisfactory lesion or organic change has been found to explain shock, as when autopsies have been performed following sudden death by lightning or blows over the solar plexus. The treatment of shock is to be directed to the immediate development of reaction. The sinking pulse must be rallied by ammonia and alcohol, by stimulating enemata, heat to the extremities and surface. Counter-irritants to the extremities, epigastrium, and occiput aid to equalize capillary circulation. The galvano-electric poles to the region of the medulla and diaphragm may facilitate respiration. In mild cases of shock external warmth, a little diffusible stimulant, and rest are all that is required.

E. Darwin Hudson, Jr. Revised by Willard Parker.

Shod'dy [originally, the wool that was *shed* or wasted in carding and spinning], in a strict sense, a fibre made by tearing in pieces in a suitable mill rags of worsted or combed-wool goods. The corresponding fibre of carded-wool rags is called mungo. But more frequently both kinds are classed together as shoddy or "devil's dust." Notwithstanding all the hard words which have been used against shoddy goods, there is no doubt that there has been much good accomplished by the shoddy manufacture. Some classes of useful goods cannot be profitably made without shoddy; and if used in reasonable proportion its presence cannot be detected, and the wear of the goods is not much diminished. None but the very best sorts of woollen goods are perfectly free from shoddy.

Shoe [Ang.-Sax. *scôh*], in general, any covering to protect the foot (with the exception of hosiery) of which warmth is the special purpose. If the shoe consists mainly of a sole, it is called a sandal or slipper: if it also has a part coming up and covering a portion of the leg, it is called a boot. The earliest form of the shoe was the simple sandal, which was secured to the foot by thongs, and often by a button, coming between the first and second toes. Almost every material has been used for the construction of shoes; the skins of animals, tanned or untanned, more frequently than any other. In some parts of Europe wooden shoes, or *sabots*, are very common among the poorer classes. In Japan sandals of straw are usually worn by the common people; and in South America we find them made of plaited thongs of hemp. There have been great changes in the forms of shoes as worn in different countries and at different periods among civilized nations. The early Greeks usually went barefoot, or confined themselves to simple sandals, which in time came to be highly ornamented. The early shoes of the Romans were buskins, not very dissimilar to the moccasins of the American Indians; thick soles, sometimes of metal, were a later invention. In time they grew into shoes, or even boots, sometimes covering the entire leg. In Europe, during the Middle Ages, shoes often assumed fantastic fashions. At one time they had pointed toes two feet long, which were often brought up and tied to the knee; and not unfrequently a man of fashion would wear them of different colors, as a red one on one foot and a yellow one on the other. In the sixteenth century top-boots, or "trunk-hose," familiar to us on the stage, were the vogue among persons of quality. The tops of these were not unfrequently ornamented with lace. Long after pantaloons had superseded breeches, the boot-legs were worn outside, and consequently were very large. For many years there has been very little change in the general form of the covering for the foot as worn by either sex; the main variations being in the height of the heel and the shape of the toe, whether pointed, round, or square. With us a boot or shoe consists essentially of two parts—the sole, almost universally of thick leather, and the upper, usually of a softer leather, but not unfrequently of cloth of some kind—for females often of satin. These parts are attached to each other in various ways, usually by sewing or pegging. Until quite recently a boot or shoe was made throughout by a single person; at present there are several persons, each performing only a single part of the work, a considerable portion of which is done by ingenious machinery. Indeed, in no single trade is there a more perfect division of labor or a greater adaptation of machinery. Until within a few years pegged boots and shoes were confined to the coarsest and cheapest kinds of articles, but now immense quantities of fine pegged work are produced. This is owing mainly to the pegging-machine, invented about 1851 by A. C. Gallahue, subsequently much improved by E. Townsend and B. F. Sturtevant of Boston, of which there were two or three years since about 1700 in operation in the U. S., each one of which will peg two pairs of women's shoes in a minute, putting in as many rows as may be required. The machine cuts its own pegs as it works, from ribbon-like strips of white birch, which it receives in rolls of 75 to 100 feet. In this country alone 1000 cords of birch are annually fashioned into shoe-pegs. Quite as important is the machine for sewing soles, improved by Gordon McKay. One of these in the hands of a good operator will easily sew on the soles of 800 pairs of women's shoes in ten hours. Of this machine there were in use in 1874 about 1200 in the U. S., 400 in England, and 100 on the continent of Europe. The patentees receive a royalty of from one to three cents a pair, and their income from this source for the years 1870–74 averaged $500,000 a year. This machine sews clear through the outsole, insole, and upper, attaching the sole to the upper. All shoes not so attached are technically known as "turns," the sole being fastened to the upper inside out, which is then turned, and lasted, and finished, partially by hand. There are, however, sole-sewing machines which produce "turns," and even almost perfect imitations of work done wholly by hand. By far the greater part of the boots and shoes used in this country are made in large establishments, much of it, especially the finer kinds, in New York, Philadelphia, Baltimore, and other large cities, but more in several towns in Massachusetts, Maine, and New Hampshire. Lynn, Mass., is the greatest seat of the manufacture, the product in 1874 amounting to 11,000,000 pairs, mostly for women and children, valued at about $14,000,000, and employing 10,000 of its 28,000 inhabitants. Among other large seats of this manufacture are Haverhill, Marblehead, Worcester, Braintree, and Danvers in Massachusetts; Portland, Augusta, and Lewiston in Maine; Dover and Farmington in New Hampshire. Boston is the seat of the principal wholesale shoe-trade, it being estimated that from here 55,000,000 pairs were shipped in 1874, valued at about $62,000,000; the entire production of the shoe-towns of New England being fully $100,000,000 per annum, the consumption being almost wholly confined to the U. S., the value of the exports in 1874 being not quite $450,000. The imports are insignificant, those entering the port of New York in that year being valued at only $41,270. A. H. Guernsey.

Shoeburyness. See Appendix.

Shoe Heel, p.-v. and tp., Robeson co., N. C. P. 460.

Shoeing of Horses. See Farriery, by M. C. Weld.

Shoe'makertown, p.-v., Cheltenham tp., Montgomery co., Pa., on North Pennsylvania R. R.

Shohola, p.-v. and tp., Pike co., Pa., on Delaware River and on Erie R. R. P. 729.

Shoko'kon, v., Honey Creek tp., Henderson co., Ill., on Mississippi River. P. 79.

Shomer, or **Jebel Shomer**, a part of Arabia, bounded N. by the Syrian desert, N. E. by Irak-Arabee, S. by the Wahabee sultanate, and W. by Turkish Arabia, in the beginning of this century was under the authority of the Wahabees, but forms now an independent sultanate. Its population is estimated at about 500,000; the capital is Hayel. Good crops of corn and fruit are raised by means of artificial irrigation. Dates, cotton, horses, mules, and asses are exported. A considerable trade is carried on between Hayel and Medina.

Shoom'la, or **Schumla**, town of European Turkey, eyalet of Silistria, on a fertile plain surrounded on the three sides with inaccessible spurs of the Balkan, which, together with its artificial fortifications, make it a fortress of the first rank. It contains large barracks, hospitals, magazines, and military storehouses, and besides its importance as a military point, it has extensive manufactures of silk, leather, tin and copper ware, and ready-made clothing. P. 20,000.

Shoo'sha, town of Asiatic Russia, capital of the district of Karabagh, Caucasia, is an almost impregnable

fortress on a commanding height whose three sides are wholly inaccessible. The winters are very cold here, and the summers very hot. The silk cultivation of the place is quite important. P. 15,000.

Shoos'ter, or **Schuster**, town of Persia, province of Khoozistan, on the Karoon, in lat. 32° N., lon. 49° E., is fortified, and its streets, though narrow and dirty, are lined with elegant houses, but large parts of the city are in ruins and uninhabited since the plague and the inundation which early in this century successively visited the city. P. about 8000.

Shooting Creek, p.-v. and tp., Clay co., N. C. P. 423.

Shooting Stars. See METEOR, by PROF. HUBERT A. NEWTON, LL.D.

Shore (JANE), b. in London, England, about 1445; married a rich London goldsmith named Matthew or William Shore; became mistress of King Edward IV. about 1470, and of Lord Hastings after the death of the former, 1483, and was accused of witchcraft as an accomplice of Hastings, who was beheaded for that pretended crime, though the real reason for the proceedings against them was their known partiality to the cause of the young princes. Jane Shore was charged by King Richard III. with having withered his arm by her arts of sorcery; was committed to the Tower and her property confiscated; was never brought to trial, but was compelled by the bishop of London to do public penance for impiety and adultery. The king's solicitor, Thomas Lynom, desired to marry her after the death of Hastings, but was prevented by Richard. She survived until after the accession of Henry VIII., and popular legend represented her as having died of hunger in a ditch—a version which long retained currency through the famous drama of Rowe bearing her name; but the legend was probably derived from the name of a London locality still called Shoreditch. Sir Thomas More bears emphatic testimony to her beauty, kindliness, and wit.

Shore (SIR JOHN). See TEIGNMOUTH, BARON.

Shore'ham, p.-v. and tp., Addison co., Vt., on Lake Champlain and on Central Vermont R. R. P. 1225.

Short (CHARLES), LL.D., b. at Haverhill, Mass., 1821; received his early education at Bradford Academy and Phillips Andover Academy; graduated with high honors at Harvard College in 1846; in 1847 was first assistant master in Phillips Academy; master of the Public Classical School in Roxbury, Mass., 1847–53, and of a private classical school in Philadelphia 1853–63; president of Kenyon College, O., and professor of intellectual and moral philosophy 1863–67. On the death of Dr. Anthon, professor of Greek in Columbia College, New York, Dr. Henry Drisler was transferred to the Greek chair, and Dr. Short succeeded Dr. Drisler as professor of Latin in 1868. He has edited, with additions, *Advanced Latin Exercises* in Schmitz and Zumpt's Latin series; revised Mitchell's *New Ancient Geography*; written an elaborate essay on the *Order of Words in Greek*, prefixed to Dr. Drisler's edition of Yonge's *English-Greek Lexicon*; and is now (1876) engaged in a revision of Andrews' Freund's *Latin Dictionary*. He has contributed many articles, mostly critical, to reviews and other periodicals, chiefly to the *Bibliotheca Sacra*. He is a director of the American Oriental Society and a member of other learned bodies, and has been from the outset a member of the American committee co-operating with the British committee in the revision of the English Bible.

Short (CHARLES W.), M. D., b. in Kentucky Oct. 6, 1794; graduated in the University of Pennsylvania about 1815; in 1825 was elected professor in Transylvania University, Lexington, Ky., and in 1838 removed to Louisville, and was associated with Drake and Caldwell in the university of that city until 1849, when he retired, and devoted himself to the preservation of plants and flowers; contributed several articles to the medical journals of his day. D. in Louisville Mar. 7, 1863. PAUL F. EVE.

Short (WILLIAM), b. at Spring Garden, Va., Sept. 30, 1759; studied at William and Mary College; was at an early age a member of the executive council of Virginia; accompanied Thomas Jefferson on his embassy to France as secretary of legation 1784; was appointed chargé d'affaires to France by Washington 1789 (being the first commission signed by him as President), and was subsequently minister to the Netherlands and to Spain. D. at Philadelphia, Pa., Dec. 5, 1849. Several of his published state papers display great ability, especially those upon the boundaries of the U. S. with Florida and Louisiana.

Short Creek, p.-v. and tp., Harrison co., O. P. 1799.

Shorter (JOHN GILL), b. in Jasper co., Ga., in 1818; graduated at the University of Georgia in 1837; was admitted to the bar 1838; became a circuit solicitor 1842; served several terms in the State senate; was a circuit judge 1852–61; became a member of the provisional congress of the Confederate States 1861, and was governor of Alabama 1861–63. D. at Eufaula May 29, 1872.

Shorthand Writing. See PHONOGRAPHY and STENOGRAPHY.

Short-horns, a breed of cattle externally distinguished by the shortness of their horns, of which there are several classes, each designated from the region in which it originated, usually in the British Islands, though some of them are from Holland and other parts of Europe. Bulls and cows of this breed have been largely imported for improving our native stock. Prominent among the short-horns are the Durham breed, characterized by the squareness of the body, which, when the head and legs are removed, presents the form of a rectangle, having no unfilled space, and furnishing much solid meat with little offal; for beef they are unrivalled, and are fair milkers, but for this purpose Mr. Solon Robinson, a good authority, gives the preference to the Devons. The Durhams are red, roan, white, or a mixture of these colors. The Ayrshire short-horns are much smaller than the Durhams, and are celebrated at home and here for their milking qualities. Many good dairy-farmers are of the opinion that these will give a larger return of milk for the quantity of food consumed than any other breed. They are usually spotted or mottled in red and white, although other colors are sometimes found. Smallest of all the short-horns is the Alderney breed, which Mr. Robinson considers "the best of all where only a few are kept, and where butter is the principal object, since their milk is the richest of all for household consumption, and makes the most and the best butter." Of the Devons there are two varieties—the North and the South, the former being preferable for slaughter, the latter for the dairy. (See CATTLE.)

Short Mountain, tp., Franklin co., Ark. P. 375.

Shorts'ville, p.-v., Manchester tp., Ontario co., N. Y., on Syracuse and Rochester branch of New York Central R. R.

Sho'shone, county of N. Idaho, adjoining Montana, from which it is separated by Bitter Root range of the Rocky Mountains, on the N. and S. forks of Clearwater River, has a rugged surface, with abundant timber and many placer-mines of gold. Cap. Pierce City. Area, about 3500 sq. m. P. 722, of whom the greater part were Chinese.

Shoshones, or **Snakes**, a family of North American Indians of the Californian group, inhabiting a wide range of territory from Idaho southward into Utah, and from the Sierra Nevada eastward to the Rocky Mountains. They are divided into Shoshones proper and UTES or UTAHS (which see), to which some authorities add, on the evidence of language, the Comanches and Moquis of New Mexico and Arizona, the Netelas and other tribes of California. The Shoshones proper include the Bannacks, who are sometimes classed as a separate tribe, and are subdivided into numerous independent bands, of which the most important are the Koolsatikara or Buffalo-eaters on Wind River, the Tookarika or Mountain-Sheep-eaters on Salmon and Snake rivers, the Shoshocos or White Knives (frequently called Diggers) of Humboldt River and the Great Salt Lake basin, the latter denomination apparently including the Hokandikahs, Yahooskins, and Wohlpapes. These names are destitute of all scientific accuracy, and in the present state of knowledge it is impossible to establish any reliable tribal distinctions. The Shoshones have usually been peaceably inclined, but have several times come into collision with the white settlers and suffered severely, several bands having been nearly exterminated. Treaties were made at Fort Bridger and vicinity in 1863, 1864, and 1865 with six large bands, and in 1867–68 attempts were made to gather them all upon the Bannack reservation at Fort Hall, Id., and the Shoshone reservation in Wyoming. Most of the southern Shoshones live upon roots and small animals, but the northern bands obtain a comfortable subsistence from the fisheries of the Shoshone River and by hunting larger game, some of them being very expert with the bow, and of late years possessing some horses and firearms. They are very fond of barter and of personal adornment, are usually dressed in buffalo or deer skins, live in skin tents, are fond of games of chance, and have borrowed from the whites as a favorite amusement the game of "poker." The property of a dead warrior is buried or burned with him, the favorite wife or horse having formerly been killed over the corpse. Few efforts at their conversion or education have as yet been made, and no critical study of their language. The entire number of the various bands is estimated at about 5000, the greater part being in Utah and Nevada. PORTER C. BLISS.

Shot. See PROJECTILE, by J. G. BUTLER.

Shoulder-joint. See JOINT.

Shoveller Duck. See ANAS.

Showers of Fishes are recorded to have fallen from the sky in numerous instances. Investigation shows that they usually take place near large bodies of water, and there can be no doubt that in all well-authenticated cases of the kind whirlwinds and storms have been the means by which they have been lifted. In India, fishes of three pounds weight are reported as having fallen from the sky. Aristotle, Ælian, Cardan, Duméril, and Arago are quoted as authorities for the statement that frogs and toads also sometimes fall from the clouds in the same way.

Shrapnel. See Projectile, by J. G. Butler.

Shreve, p.-v., Wayne co., O., on Pittsburg Fort Wayne and Chicago R. R., 60 miles S. of Cleveland, contains 3 churches, graded public schools, 1 newspaper, 2 flouring and 2 planing mills, several manufactories, and 2 hotels. P. 479. James N. Brady, Ed. "Journal."

Shreve (Thomas H.), b. at Alexandria, D. C., in 1808; settled at Cincinnati as a merchant 1830; became one of the editors of the *Mirror* 1834, and of the Louisville *Journal* 1842. D. at Louisville, Ky., Dec. 23, 1853. Author of *Drayton, an American Tale* (1851), and of many poems which appeared in periodicals.

Shreve'port, city, cap. of Caddo parish, La., situated on the 32d degree of latitude, and on the W. bank of Red River, 500 miles from its mouth, and at the head of low-water navigation. It is now the eastern terminus of the Texas and Pacific Railway, and also the terminus of the projected roads from New Orleans and Memphis, Tenn. It has 10,000 inhabitants, and is the second commercial city in the State. It was incorporated in 1839. Situated in the very heart of the finest cotton-growing region in the world, it has become one of the most important cotton-markets in the South-west, shipping annually from 110,000 to 125,000 bales, dependent upon the cotton crop. Having very few manufactories, its population falls far short of the extent of its trade. A large portion of the cotton is sold to Eastern and European spinners' agents, who ship on through bills to Liverpool or to the Eastern manufacturers. There are 2 fine cotton-compresses in the place. There are 3 miles of street railway, 7 churches (the Presbyterian church and Jewish synagogue being fine buildings), 5 private and 4 public schools (2 of the latter colored), an extensive cotton-seed oil-factory, 2 large steam saw and planing mills, 2 small iron-foundries, 1 daily, 1 semi-weekly, and 2 weekly newspapers, a marine and a charity hospital, a cotton exchange in successful operation; 3 private banks or rather exchanges, of limited capital in comparison with the large amount of money required to move the cotton crop. There is no better opening in the South for the establishment of a national or private bank prepared to discount commercial or other paper. From 3 to 5 per cent. a month is frequently paid on good security. Shreveport also offers a splendid field for the establishment of cotton and other factories and flouring-mills. It is the first port of delivery E. of the Pacific coast on the line of Texas and Pacific Railway, and the country immediately tributary to it embraces large portions of South Arkansas, East Texas, and North Louisiana. P. 4607.

A. D. Battle, Ed. "Shreveport Times."

Shrew, or **Shrew-Mouse,** a small, insectivorous, mouse-like mammal of the family Soricidæ, found in nearly all parts of the northern hemisphere, is nocturnal, frequently aquatic, produces its young blind and naked, does not hibernate, is distinguished by an elongated and pointed muzzle, small eyes, plantigrade, six-toed feet, and glands which secrete a musky fluid. There are several sub-families and many species, twelve having been described as natives of the Pacific States of North America, most of them belonging to the genus *Sorex*.

Shrews'bury, town of England, capital of the county of Salop, on the Severn, is well built, has important salmon fisheries in the river, and manufactures of linen thread, canvas, and iron wares, and carries on an extensive trade in coal and corn, partly on the Severn and partly on a branch of Grand Junction Canal. P. 23,300.

Shrewsbury, p.-v. and tp., Worcester co., Mass., on Quinsigamond Lake. P. 1610.

Shrewsbury, p.-v. and tp., Monmouth co., N. J., on Atlantic Ocean and on New Jersey Southern R. R., includes the v. of Red Bank. P. 5110.

Shrewsbury, tp., Lycoming co., Pa. P. 442.

Shrewsbury, tp., Sullivan co., Pa. P. 209.

Shrewsbury, p.-v. and tp., York co., Pa., on Northern Central R. R. P. of v. 600; of tp. 3559.

Shrewsbury, p.-v. and tp., Rutland co., Vt., on Central Vermont R. R. P. 1145.

Shrewsbury, p.-v., Kanawha co., West Va.

Shrike [*Laniidæ*], a family of birds of the tribe Dentirostres and order Passeres, embracing more than thirty species, of which the best known is the butcher-bird (*Lanius excubitor*, Linn.), found in the Atlantic States of North America, and noted for its habit of impaling insects and small birds upon the points of thorns (whence its usual name). It imitates the notes of other birds in distress as an artifice to ensnare them, and in the Southern States is useful to the planter by destroying field-mice and insects. By some the name of *excubitor* is confined to the European variety, which in Russia is trained to catch birds and mice, but the best authorities consider it identical with the great American shrike.

Shrimp, a name applied to a vast number of small crustaceans, but proper to the long tailed Crangonidæ, of which there is a single genus, *Crangon*. In Europe *C. vulgaris* is extensively caught for food. The common shrimp of the U. S., *C. septemspinosus*, is principally used for fish-bait. The red shrimps are Alpheidæ; the sword shrimps, Penæidæ; the opossum shrimps, Mysidæ (Stomatopods). The Squillidæ are also called shrimps. Not a few small amphipod crustaceans are called shrimps. Noteworthy are *Chelura terebrans* and *Limnoria terebrans*, the wood-boring shrimps, so destructive to submarine timber. Some of these creatures inhabit fresh water, but most are marine. Among the more interesting kinds are the brine shrimps. (See Brine-Shrimp.)

Shrop'shire, or **Salop,** county of England, on both sides of the Severn, and bounded W. by Wales, comprises an area of 1343 sq. m., with 248,064 inhabitants. The northern part is level and wholly under tillage; the southern is hilly, and here cattle-breeding is the chief occupation. An excellent breed of sheep and an excellent kind of hops are peculiar to this county, which also is very rich in coal, iron, lead, and copper.

Shrove'-Tuesday, the day preceding Ash-Wednesday, so called from the old custom of confessing and receiving shrift on that day. It is in general a day of pleasure in most Roman Catholic countries. It is the Carnival of Italians, the *Mardi Gras* of the French, and the Pancake-Tuesday of former days in England. (See New Orleans.)

Shu'benacadie, p.-v., Hants and Colchester cos., N. S., on the navigable Shubenacadie River, 20 miles from its mouth, and on Nova Scotia Railway, 39 miles N. of Halifax. Wooden-ware, shipping, and bricks are manufactured. P. about 350.

Shu'brick (William Branford), the fourth of six brothers, all of whom served in the army or navy in the war of 1812 with Great Britain, b. in South Carolina Oct. 31, 1790. His grandfather, Thomas, was one of the committee of safety organized at the commencement of difficulties between the mother-country and the American colonies. His father, Thomas, and two brothers, Richard and Jacob, early and persistently espoused the cause of liberty, the first having served as aide to Gens. Lincoln and Green. Two of the admiral's brothers died in the U. S. military service in 1813; his third brother was lost at sea in 1815, while in command of the Epervier; the fifth brother, Edward Rutledge, died in command of the frigate Columbia on her passage to the Mediterranean in 1844; the sixth, Irvine, died a commander in the navy in 1849. The subject of this notice, after attending a grammar-school at Charleston and passing two years of study in New England, became in 1805 a student of Harvard, but was soon after recalled to Charleston for training for the naval service, in which he was appointed midshipman by Jefferson, June 20, 1806; in May, 1807, joined the sloop-of-war Wasp; at the beginning of the war of 1812 was an acting lieutenant on board the Hornet, commanded by Capt. Lawrence, attached to the squadron under Com. Rodgers, which sailed from New York the day after the declaration of war; soon after was transferred to the frigate Constellation, which rendered important services in the defence of Norfolk and the navy-yard at Gosport, where he performed efficient duty on land in defence of the batteries; in 1813 was transferred to the Constitution, at the request of Stewart, her commander, and made two cruises, aiding in the capture of three ships of war, including the Cyane and the Levant. When the Levant surrendered after a bloody action, he was ordered to her command. He returned to the U. S. in May, 1815, second in command of the Constitution, and in consideration of his conspicuous services was awarded a sword by his native State, and a medal by Congress, enjoying a few months' leave of absence after a continuous service of eight years. In Dec., 1815, was made senior lieutenant of the Washington, 74 guns, under Creighton, the first ship of the line which made a full cruise under the U. S. flag, returning to the U. S. in 1818; in 1820 was promoted to the rank of commander, and served second in command at the navy-yard

at Charlestown, Mass., and New York, until Apr. 6, 1826, when he was appointed to the command of the Lexington: in 1829 was appointed commander of the Natchez, and made a cruise in the West Indies; afterward inspector of ordnance, etc.; second in command of the navy-yard at Washington until 1838, when he was ordered to the command of our West India squadron, which he held until 1840, having in 1831 been promoted to the rank of captain; from Oct. 28, 1840, to Oct., 1843, was in command of the navy-yard at Norfolk, Va.; Feb. 3, 1844, appointed chief of the bureau of provisions and clothing for the navy. Asking for sea-service at the beginning of our war with Mexico, he was appointed July 9, 1846, to command the Pacific squadron; sailed from Boston Aug., 1846, returned Mar., 1849; Sept. 24, 1852, was appointed to the lighthouse board, and in 1853 chairman of the bureau of construction; July 8, 1853, placed in command of the eastern coast squadron for the protection of American fishermen, and in September returned to Washington and resumed his duties as chairman of the lighthouse board; Aug. 3, 1857, appointed president of board to prepare regulations for the navy; Sept. 8, 1858, appointed to command the Brazil squadron and Paraguay expedition, from which, his last sea-service, he returned May 11, 1859, to resume duty as chairman of the lighthouse board; July 17, 1862, was appointed senior member of advisory board, having the day previous been commissioned rear-admiral after a service of fifty-five years, his entire service to the time of his decease, which occurred May 27, 1874, extending to a period of sixty-one years and ten months. The naval history of the country records the details of his long and faithful services, of which only the outline can here be given. JOSEPH C. G. KENNEDY.

Shubuta, p.-v., Clark co., Miss., on Chickasawha River and on Mobile and Ohio R. R.

Shu'feldt (ROBERT W.), U. S. N., b. Feb. 21, 1822, in New York; entered the navy as a midshipman May 11, 1839; became a lieutenant in 1854, a commander in 1862, a captain in 1869; commanded several vessels on the coast during the civil war, and was actively engaged against the defences of Charleston; commanded the flag-ship of the East Indian fleet during 1865 and 1866, and that of the Mediterranean from 1871 to 1873; in 1875 appointed chief of the bureau of equipment and recruiting. Capt. Shufeldt was for several years in civil life, during which time he held many responsible positions, of which the most conspicuous was that of consul-general to Cuba during the first year of the rebellion—a place of great importance at that trying period, which he filled with admirable tact, judgment, and discretion. FOXHALL A. PARKER.

Shuf'field, tp., Moore co., N. C. P. 1270.

Shujabad', town of British India, Punjaub, on the right bank of the Chenaub, in lat. 29° 53′ N., is fortified and well built, and has flourishing manufactures of silk and cotton. The adjacent districts are very fertile and well cultivated. P. 10,000.

Shulls'burg, p.-v. and tp., Lafayette co., Wis. P. 2702.

Shul'ze (JOHN ANDREW), b. in Tulpehocken tp., Berks co., Pa., July 19, 1775; was well educated, and entered the Lutheran ministry; in 1802 became a successful merchant of Myerstown, Dauphin co., Pa.; entered political life in 1806; was clerk of the courts and prothonotary of Lebanon co., 1813–21; governor of Pennsylvania 1823–29, and president of the U. S. electoral college 1840. D. at Lancaster Nov. 18, 1852.

Shumla. See SHOOMLA.

Shunk (FRANCIS RAWN), b. at the Trappe, Montgomery co., Pa., Aug. 7, 1788, of German ancestry; became at fifteen a teacher; in 1812 a clerk in the surveyor-general's office at Harrisburg, and began the study of law; marched in 1814 as a private to the defence of Baltimore; became clerk of the house of representatives, secretary of the canal commission, secretary of state 1838, and was governor of Pennsylvania 1845–48. D. at Harrisburg July 30, 1848. Gov. Shunk was a man of noble personal character and of fine intellectual culture.

Shuqualak, p.-v., Noxubee co., Miss., on Mobile and Ohio R. R.

Shurt'leff (NATHANIEL BRADSTREET), M. D., b. at Boston, Mass., June 29, 1810; graduated at Harvard 1831, and at the Medical School 1834; became a physician at Boston; was a zealous and learned scientist, genealogist, and historical student; mayor of Boston 1868–70. He traced his descent to eleven of the Pilgrims of the Mayflower, a number probably exceeding that which any other of his contemporaries could reckon, but, though tolerant of the Puritan opinions of his ancestors, was himself a Roman Catholic. D. at Boston Oct. 17, 1874. Author of *An Epitome of Phrenology* (1835), *A Perpetual Calendar for Old and New Style* (1848), *Passengers of the Mayflower* (1849), *Notice of William Shurtleff of Marshfield* (1850), *Genealogy of the Leverett Family* (1850), and *A Topographical Description of Boston* (1871), besides many minor publications and contributions to the *Genealogical Register.* He was the editor of the valuable series of original *Records of the Governor and Company of Massachusetts Bay 1628–86* (6 vols. 4to, 1853–54), and, with David Pulsifer, of the equally important *Records of the Colony of New Plymouth* (12 vols. in 11, 4to, 1855–61), being chiefly a publication from the MSS. of Secretary Nathaniel Morton.

Shurtleff College, an institution of learning at Upper Alton, Madison co., Ill., founded in 1832 as Alton Seminary, chartered in 1835 as Alton College, and took its present name in 1836 in honor of Dr. Benjamin Shurtleff of Boston, who gave it $10,000. It is under the management of the Baptist denomination, and was originally designed chiefly for the training of candidates for the ministry, for which purpose a theological department was organized in 1863. There is a Kendall Institute for young ladies, a preparatory department, and two academic courses, classical and scientific. Both sexes are admitted. The number of instructors in 1875 was 14, of collegiate students 53, of graduates 159. The library contains 7300 volumes.

Shushan, p.-v., Salem tp., Washington co., N. Y.

Shush'waps, a family of North American Indians of the Columbian group, occupying the valleys of the Fraser, Thompson, and upper Columbia rivers and tributary streams in British Columbia, Montana, Idaho, and Washington Territory. They are subdivided into Shushwaps proper, also known as Atnahs or Flat-bows, the KOOTENAIS and OKANAGANS (which see).

Shute (SAMUEL), b. in London, England, in 1653; educated at the University of Leyden, Holland; served in the Dutch army under William, prince of Orange; was afterward lieutenant-colonel under the duke of Marlborough; was royal governor of Massachusetts 1716–23, and had a bitter and protracted controversy with the legislature as to the powers of his office. D. in England Apr. 15, 1742.

Shutesbury, p.-v. and tp., Franklin co., Mass. P. 614.

Shuttle. See LOOM and SEWING-MACHINES.

Shyenne', new county of S. W. Dakota, embracing the extensive and little-known region called the "Bad Lands," on Shyenne and White rivers. A portion of the "Black Hills," which attracted so much attention in 1875–76, falls within the limits of this county.

Sial'agogues [Gr. σίαλον, "saliva," and ἀγωγός, "leader"], a term sometimes used in medical parlance to refer to such drugs as cause an increased secretion of saliva. Mercury has this property more than any other substance, but as the increased salivary flow is simply one among many effects of a poisonous dose of the drug, the term "sialagogue" is not a proper definitive appellation. The word is now seldom used. EDWARD CURTIS.

Siam' is called by its people *Muang Thai*, "the kingdom of the free"—*i. e.* free from the superstitions of the Brahmans. The appellation which we employ is derived from a Malay word, *Sâyâm*, or "the brown race." This name was hardly known to the natives in ancient times, while the country itself is never so named in the ancient or modern annals of the kingdom. Siam proper occupies the middle portion of the Indo-Chinese peninsula, with all the country surrounding the Gulf of Siam, and stretches between lat. 6° and 20° N. and lon. 98° and 106° E., and measures N. and S. 960 miles, and E. and W. 420 miles in its greatest extent. In the Malayan peninsula, however, the width is only from 60 to 80 miles. It is bounded on the N. by the country of the Laos, E. by Laos and Anam, S. by the Gulf of Siam, along which it has a most beautiful and picturesque coast-line of 1400 miles, and W. by the Indian Ocean and the Tennasserim provinces. Area, 188,000 sq. m. The surface is covered with hills and mountains, especially in the N., while in the centre lies the rich and alluvial plain watered by the beautiful Mèinam. The two mountain-ranges running S. E. from the Himalaya form at the same time the natural boundaries of Siam. The mountains on the E. and W. belong also to the two great chains which stretch S. from the table-land of Yunan, and run on either side of the great valley watered by the Mèinam. A third range, less continuous and direct, rises in the central regions. In this is situated the P'hra Bat, or "mountain of the sacred footprint of the Booddha." Over the footprint is built a beautiful temple, in the centre of which is found a depression in the rock about five feet long by two broad, probably some of the fossil remains that abound in this neighborhood; a grating is usually placed over it, and is only removed on festal occasions. The temple is so dark that it is impossible to discover anything except the five marks of the toes, and yet millions of costly gifts are offered here, and crowds of ardent Booddhists perform long

and painful journeys to press with their lips this holy footprint. The most westerly of the mountain-chains reaches an elevation of 5000 feet: the height of the eastern range is yet unknown. The mountains of the Siamese-Malayan provinces nowhere exceed 3000 feet. The whole region abounds in small rivers, but there are only three great navigable streams—the Saluen, forming a part of the western boundary; the Meikong, or "river of Cambodia;" on the boundary toward Anam, it is 1500 miles long; its entrance was long held by the Cochin-Chinese, and is now in the possession of the French: and the Mèinam. Of these the Mèinam is the most important, being in all respects the Nile of Siam. It has three distinct names. In the ancient annals it is called *Suen Samudra*, "ocean sister;" in the royal archives, *Chow P'hya*, "His or Her Royal Highness;" and by the people simply *Mèinam*, or "mother of waters." It is a noble river. Rising among the southern slopes of the snow-covered mountains of Yunan, it traverses the whole length and breadth of the great valley of Siam, receiving in its course of nearly 900 miles the waters of many other streams, and almost monopolizing the trade and navigation of that portion of the East. It falls into the Gulf of Siam by three different channels, only the eastern one of which is navigable for sea-going vessels. Ancient annals relate that in the fifteenth, and as late as in the seventeenth, century Chinese junks of great size ascended this river as far as Sangkalok, nearly 120 leagues from its mouth; now, owing to the increasing alluvial deposit, it is not navigable more than 15 leagues at most. The only other river worthy of notice is the Bangphakong, about 240 miles long, which enters the gulf at Bangplasoe, 60 miles E. of the Mèinam. All the rivers of Siam are flooded. In the month of June, the mountain-snows begin to melt, the deluging rains of the wet season set in, the strong southerly winds (called the monsoon) dam up the waters of the Mèinam, and it begins to rise—an event most eagerly looked for by the people, and hailed by them as a blessing from heaven; and these annual inundations account for the extreme fertility of the basins watered by the rivers of Siam. In August the inundation is at its height, and the whole vast valley is like an immense sea, in which towns and villages look like islands connected by drawbridges and interspersed with groves and orchards, the tops of which only are seen; while boats, small steamers, and native craft pass to and fro without injury to the rice and other crops starting beneath them. The whole valley is intersected by canals, some of great size and extent, in order to distribute as far as possible the benefits of this grand operation of nature; but the lands situated in the middle of great plains derive the greatest advantage therefrom. When the inundation is supposed to have reached its height, and is about to subside, a deputation of talapoins or priests, sent by the king, descend the river in magnificent state barges, and with chants and incantations and movements of magical wands command the waters to retire. The popular river-festival, which takes place after the waters have subsided, both in origin and character belongs to the Hindoos, rather than to the Booddhists. It is an annual festival held at night, and the scene which is exhibited during its celebration is exceedingly beautiful. The banks of the Mèinam are brilliantly lighted up; accompanied and announced by numerous flights of rockets, a number of floating palaces, built on rafts, the grandest of which belongs to the king, come sailing down the stream, preceded by tens of thousands of lamps and lanterns wreathed with chaplets of flowers, which cover with their gay brilliancy the entire surface of the flashing water. The rafts, which are formed of young plaintain trees fastened together, are often of considerable extent, and the structures which they bear are such as Titania herself might delight to inhabit. Towers, gates, arches, and pagodas rise in fantastic array, bright with a thousand colors, and shining in the light of numberless cressets. So the fairy-like spectacle moves on, while admiring crowds of men, women, and children throng the banks of the river, not only to join the brilliant pageant, but to watch their own frail little plaintain tree barque, freighted, perchance, with a single lamp, yet full of life's brightest hopes, as it floats unextinguished down the rapid stream, glimmering on with ruddy flame amidst the shadows of night.

Granite and mountain limestone are supposed to constitute the chief Primary rocks, covered in the lower districts with thick beds of stiff clay and alluvial strata.

The products of Siam, as may be supposed from its range of latitude, its tropical heats, its variety of climate, and the fertility of the valley, annually renewed by the overflow of the Mèinam, are very diversified and almost unlimited in quantity. Vegetation is luxurious and beautiful beyond description. Not more than one-third of the land is under cultivation, but this renders a rich return to the farmers. Its rice, of which there are forty varieties, is excellent: its sugar is esteemed the best in the world. Among the other exports are cotton, tobacco, hemp, cutch, dried fish, cocoanut oil, areca-nut, bees-wax, precious gums, spices, dye and other woods, especially teak and ebony. In the abundance and variety of its fruit trees, vegetables, and aromatic herbs and spices Siam is unsurpassed, and is justly termed the garden of the world. The durian (a very delicious but unpleasantly odoriferous fruit), the mango, the mangosteen, the pineapple, and bread-fruit are cultivated in large plantations, trenched, and watered by the daily tide. In the forests they are found in great numbers also, putting forth leaf, bud, flower, and fruit almost simultaneously, and greatly enhancing the stately beauty of the poh, banyan, peipal, and other trees. Here also are found gutta-percha, lac, dammar, catechu, gum-benzoin, and the fragrant agilla, or eagle wood; gamboge, transplanted from Cambodia, is everywhere cultivated. Of medicinal plants there are innumerable varieties, many of which are well known to the native physicians as possessing wonderful curative properties for diseases common to the climate. The butterfly plant is found in the vicinity of P'hrabat, the leaves of which are very much like butterflies with green wings striped with red. The most remarkable of the woods are the sapan, indigo, fustic, and many other dyes. The lofty silk-cotton abounds; its soft silky gloss is only used for the pillows and mattresses of the rich, as its fibre is found too brittle for the loom. There are many varieties of the palm, of which the attap, areca, and cocoanut are the most valuable; the attap is mostly used for covering houses, while the cocoanut furnishes beams and rafters for habitations; the leaves when plaited make excellent thatch, umbrellas, coarse mats; the finer fibres are woven into beautiful mats, and then painted in a variety of patterns for the houses of the rich: the nuts afford abundance of oil, and when it is expressed the remains feed cattle and poultry, besides making excellent manure; the shells of the nut furnish cups and ladles and other domestic utensils; the husk is manufactured into ropes and cordage of every kind and size, and is more durable than hemp. Many of the trees are not permitted to bear: the embryo bud from which the blossoms and buds would spring is tied up to prevent its expansion, and a small incision is made at the end, and a cool, pleasant liquor called *taree*, the palm wine of the poets, oozes out, which in its turns furnishes arrack, vinegar, and jaggaree, or coarse sugar; from the roots is manufactured a very valuable black paint, as well as other inferior articles for foreign and domestic markets. The rattan and bamboo are of manifold use to the natives; the teak, the monarch of the forest, and more durable than the oak, is very abundant, and with the iron, the red, and white woods is used for house and ship building. Besides these there are the ebony, banyan, and sacred fig tree. Of flowers, the water-lily, the rose, the lotus, and jessamine are the most common, while there are a number of flowers peculiar to this region, and not only not classified, but unknown to the European world. After the rainy season the bamboo forests are curtained to the height of from 60 to 70 feet with wild flowering creepers, and in particular with huge clusters of wild convolvuli of every shade of color.

The animal kingdom is equally varied, singular, and interesting. The most celebrated is the *chang p'hoouk*, or white elephant. According to the Booddhist's philosophy of metempsychosis, each successive Booddha, in passing through a series of transmigrations, must necessarily have occupied in turn the forms of white animals of a certain class, particularly the swan, the stork, the white crow and sparrow, the dove, the monkey, and the elephant; all of which are peculiar to Siam. But there is much obscurity and diversity in the views of their ancient writers on this subject. Only one thing is certain—that the forms of these nobler and purer creatures are reserved for the souls of the good and great, who find in them a kind of redemption from the baser animal life. Thus, almost all white animals are held in the deepest reverence by the Siamese, because they were once superior human beings; and the white elephant in particular is supposed to be animated by the spirit of some king or hero. Having once been a great man, he is thought to be familiar with the dangers that surround the great, and to know what is best and safest for those whose condition in all respects was once his own. He is hence supposed to avert national calamity, and bring prosperity and peace to a people; and from the earliest times the kings of Siam and Burmah have anxiously sought for the white elephant. The titles reserved for the white elephant vary according to the purity of complexion (for these favored creatures are rarely true albinos, salmon or flesh-color being the nearest approach to white in almost all the historic "white elephants" of the courts of Burmah and Siam). The stately occupant of the stable-palace at the court of the late king

was distinguished by the high-sounding appellation of *Mâê P'hya Sri Wongsah Ditsarah Krasâât* ("august and glorious mother descendant of kings and heroes"). In 1862 a magnificent white—or rather salmon-colored—elephant was "bagged," and preparations on a gorgeous scale were made to receive him. A temporary pavilion of great splendor sprang up, as if by magic, before the eastern gate of the palace, and the whole nation was wild with joy, when suddenly came awful tidings: he had died. It was a terrible affliction to the people, not less than to the king. His body was not burned; only his brains and heart were thought worthy of that last and highest honor. The carcase, shrouded in fine white linen and laid on a bier, was carried down the river, with much wailing and many mournful dirges, to be thrown into the Gulf of Siam. In the stable-palace of the white elephant is kept a white monkey to ward off evil spirits. The national standard is a white elephant on a deep crimson ground. Among the other animals are the rhinoceros, the buffalo, the ox, which with the elephant are used as beasts of burden; the striped tiger, equal in size and ferocity to the Bengal tiger, whose bones and decomposed carcase form a valuable export for the Chinese *materia medica*; the pangolin, an animal covered with scales overlapping each other like tiles, and which when attacked rolls itself into the form of a ball; the anabas, a genus of acanthopterygious fishes, having cells in the pharynx capable of retaining water, which gradually drops into the branchial cavity, so as to moisten the gills, whereby they are enabled to climb trees and wander a mile or two from the water; the flying-fish; the singing-fish or mollusk; the platoo, or sardine-like fish, so abundant as to form the common food of the people, as well as an article of export when dried or compounded into a sort of kapee, a fetid mass; water-snakes of great size; crocodiles from three to twenty-five feet long, some of which are tamed and kept in artificial ponds adjoining the temples, and looked upon as sacred; the flying tree-gecko; the python; the cobra de capello, to which also the natives attach a superstitious reverence as a messenger from the unknown; the viper, most deadly of its kind; in fact, there are a great many varieties of snakes, and many of singularly beautiful coloring. Cats are numerous; a species of wild-cat is much dreaded by the natives; dogs, vultures, and crows are the scavengers of the great plain; they abound in the cemeteries or cremation-grounds at Bangkok. Birds are the most varied, beautiful, and gorgeous in plumage in the world—some of great size, and many of them songsters of wonderful power and sweetness of melody, in which the *sooruk*, or red-and-brown-spotted rice-bird, is unsurpassed, even by the nightingale. The edible swallow's nest is much sought after by epicurean Chinese, Siamese, and even by Parisian gourmands. It is also a valuable article of export. The butterflies are large and of exquisite beauty, both in form and coloring, while the bright mantis and firefly are the most beautiful of an infinitely varied and curious insect-realm.

Tin underlies the whole Malayan peninsula, even down to its extreme S. point; it is found in great abundance in the Siamese territory between lat. 11° and 14°, and the mines in the island of Salang, off the W. coast, are scarcely less productive than those of Banca. Gold is extensively found, especially in the province of Bangtaphan, and in great purity; copper, iron, and lead abound, but, owing to the hardships of the jungle, the fevers and cholera prevailing there, and the extreme jealousy evinced toward foreigners, the precise locality in which they are found is kept secret by the mining population of Siam, and thus their great wealth is as yet comparatively undeveloped. A beginning has at last been made in this respect by the present king. Zinc and antimony, sulphur and arsenic, are also found, and silver in combination; sapphire, ruby, spinel, corundum, amethyst, garnet, black coral, topaz, and other precious stones are found in the hills of Chantaboun, on the E. of the gulf. They are obtained by washing the alluvial soil. The mines yielding them, however, are a monopoly of the king, while those of gold, iron, copper, etc. were kept for a long time under the strict surveillance of the Siamese government, and carried on chiefly by Chinese slaves. But under the late treaties they have been thrown open to foreign enterprise, and are at this moment exciting much interest among European explorers. Salt in large and saltpetre in less quantities are manufactured by solar evaporation.

Siam has two seasons, the hot and the dry, the former beginning in April or May, and the latter in July. The mean temperature at Bangkok is 82° F., with a mean range of 13°. On the whole, the country is salubrious, but in the wet season and in marshy places ague and cholera are very prevalent. In the upper country the climate is more extreme.

The Siamese are mainly of Mongolian type, but there is also as much reason to suppose that they are closely allied to that powerful Indo-European race to which Europe owes its civilization, and whose branches are the Hindoos, Persians, Greeks, Latins, Celts, and the Teutonic and Slavonic tribes. The original site of this race was in Bactria, and the earliest division of the people could not have been later than 3000 or 4000 years before the Christian era. Comparative philology alone enables us to trace the true origin of nations of great antiquity. According to the researches of the late king, who was a very studious and learned man, out of 12,800 Siamese words more than 5000 are found to be Sanskrit, or to have their roots in that language, and the rest in the Indo-European tongues, to which are added a great number of Chinese and Cambodian terms. He says: "The names of temples, cities, and villages in the kingdom of Siam are derived from three sources—namely, Sanskrit, Siamese, and Cambodian. The names which the common people generally use are spoken according to the idiom of the Siamese language, are short or monosyllabic, and are easily pronounced; but the names used in the court-language and in the documents which receive the government seals are almost all of Sanskrit derivation. Some of our cities and temples have two, and even three, names, being the ancient and modern names, as they have been used in the court-language or that of the people." As the words common to the Siamese and the Sanskrit languages must have been used by both peoples before their final separation, we have here a clue to the origin and degree of civilization attained by the former before they emigrated from the parent stock. They are generally of medium stature, the face broad, the forehead low, the eyes black, the cheek-bones prominent, the chin retreating, the mouth large, the lips thick, and the beard scanty. In common with most of the Asiatic races, they are apt to be indolent, improvident, servile, vain, inquisitive, superstitious, and cowardly, but individual variations from the more repulsive types are happily not rare, while among their better qualities may be ranked temperance, toleration, and benevolence. In public they are scrupulously polite and decorous according to their own notions of good manners, respectful to the aged, affectionate to their kindred, and bountiful to their priests, of whom more than 20,000 are supported by voluntary contributions in the city of Bangkok alone. Besides the Siamese, a great variety of races inhabit the territories of Siam, as the Chinese, the Cambodians, the Laos, Kariens, Shans, Burmese, Peguans, and Malays. The population of Siam cannot be ascertained with correctness, owing to the custom of enumerating only the men. In 1867 the native registers gave the number of them as follows: 4,000,000 Siamese, 1,000,000 Laotians, 1,000,000 Malays and Hindoos, 1,500,000 Chinese, 350,000 Cambodians, 50,000 Peguans, and the same number of mountain-tribes; in all nearly 8,000,000. If these figures are even approximately correct (which is very doubtful, if we may judge from recent investigations: it was thought by traditional computation that the native population of Bengal amounted to 43,000,000, but by actual counting we find it to be 66,000,000; here is an error of no less than 23,000,000 = the entire population of England and Wales), and the women and children bear the same proportion to the men as in other countries, the total population of Siam far exceeds the numbers which have hitherto been assigned to it. The whole empire is divided into forty-nine provinces with their respective p'hayas or governors, and these again are subdivided into districts under inferior officers, respecting whose administration but little that is good can be said. The dress consists of a cotton waist-cloth or skirt, to which the females add a bright silk shoulder-scarf, a jacket for the cold, with a crimson or blue mantle thrown over the entire figure; the princes, kings, and nobles on state occasions wear silk and gold brocade with high conical caps. The royal robes of the supreme king are fairly ablaze with diamonds, emeralds, rubies, and other precious stones; the royal headdress is of a tapering spiral form, of pure gold, and studded with the rarest gems. Even the phra batt, or golden slippers, are tapering at the toes and wrought with costly gems. A chatiya, or tapering gold umbrella, is also the accompanying mark of royalty. The Siamese stain their teeth black, black teeth being esteemed a great beauty among them; the head is shaved regularly, but a black bristling tuft, like an inverted brush, is left on the top of the head; that of the females, whose hair is only closely cut, is encircled by a parting, which is effected by uprooting two or three hairs all round the tuft, while on either side of the cheek is left a single lock of hair. The fact is remarkable that though education in its higher degrees is neglected in Siam, there is scarcely a man or woman in the empire who cannot read and write. Though a vain people, they are neither bigoted nor shallow; and the day is not far distant when enlightening influences, accepted through

their willingness not only to receive instruction from Europeans, but even to adopt in a measure their customs and their habits of thought, will raise them to the rank of a superior nation.

The language of the people advances but slowly in the direction of grammatical perfection. Like many other Oriental tongues, it was at first purely monosyllabic, but as the Pali and Sanskrit have been literally engrafted on it, polysyllabic words have been formed. Its pronouns and particles are peculiar, its idioms few and simple, its metaphors very obvious. It is copious to redundancy in terms expressive of royalty, rank, dignity; in fact, a distinct phraseology is required in addressing personages of exalted station. Sententious brevity and simplicity of expression belong to the pure spirit of the language, and when employed impart to it much dignity and beauty; but there is no standard of orthography, nor any grammar, and but few rules of universal application. Every Siamese writer spells to please himself, and the purism of the one is the slang of the other. The Siamese write from left to right in a line unbroken by spaces, points, or capitals. When not written with a reed, using steatite or gamboge on folds of black native paper, the characters are engraved with a style on palm-leaves prepared for the purpose. The language of the court and of all the standard works is filled with entirely different terms, mostly from the Pali and Sanskrit. The more elegant books are composed of tablets of ivory or of palmyra leaves delicately prepared; the characters engraved on these are gilt, the margins and edges adorned with heavy gilding and flowers in bright colors. The sacred and scientific literature in the Pali is mostly very ancient and written on slips of palm; 4000 volumes of which, amid much that is absurd and fanciful, contain also a vast amount of what is true, real, and good in morals, philosophy, and religion. The Siamese have an extravagant fondness for the drama and for poetry of every kind. Their dramatic entertainments are mainly musical, combining rudely the opera with the ballet. Dialogue is often introduced, the favorite subjects being passages from the Hindoo Avatars, the epic *Râmâyana* and the *Mahâbhârata*, or from beautiful legends peculiar to Siam. Throughout their literature mythology is the all-pervading element; history, science, arts, customs, conversation, opinion, and doctrine are alike colored and flavored with it. The greater part of the literature of the Siamese deals principally with religious topics. The *Kamarakya*, or Booddhist ritual—a work for the priesthood only, and therefore, like others of the Vinnâyâ, little known—contains the vital elements of the Booddhist code, and, *per se*, is perfect. On this all writers, whether partial or captious, are of one mind. A sacred and mystic work, the *Parajika*, is read in the temples with closed doors by the priests and devotees exclusively; then there are the *P'hrajana paramita* (or "Transcendental Wisdom"); the *Lalita Vistara*, containing the life of the last Booddha; the *Dhamma Padam*, etc., which are freely taught in the schools attached to the monasteries. It is difficult to comprehend how the human soul, not aided by revelation, could have soared so high and approached so near the truth. Besides the five great commandments—not to kill, not to steal, not to commit adultery, not to lie, not to get drunk—every shade of vice, hypocrisy, anger, pride, suspicion, greed, gossip, cruelty to animals, is guarded against by special precept. Among the virtues commended we find not only reverence for parents, care for children, submission to authority, gratitude, moderation in time of prosperity, resignation and fortitude in time of trial, equanimity at all times, but virtues of the highest system of morality, such as forgiving insults and of rewarding evil with good. All virtues spring from *maitrî*, and this maitrî can only be rendered by charity and love. I may here add the testimony of Barthélemy Saint-Hilaire. "I do not hesitate to add," he writes, "that save the Christ alone there is not among the founders of religion a figure more pure, more touching, than that of the Booddha. His life is without blemish; his constant heroism equals his conviction; and if the theory he extols is false, the personal examples he affords are irreproachable. He is the accomplished model of all the virtues he preaches; his abnegation, his charity, his unalterable sweetness never belie themselves. At the age of twenty-nine he retires from the court of the king, his father, to become the saviour of men. He silently prepares his doctrine by six years of seclusion and meditation. He propagates it by the unaided power of speech and persuasion for more than half a century, and when he dies in the arms of his disciples, it is with the serenity of a sage who has practised goodness all his life, and knows that he has found the truth."

The most remarkable examples of Siamese art in painting are presented in the cartoons to be found on the walls of ancient temples. One that is still to be seen in the Watt Khiem Ma is especially noticeable. The practice of decorating walls and ceiling with paintings may be traced to a remote period of Siamese art, which has degenerated for want of kind fostering patrons. Nevertheless, they still paint with some cleverness on cloth, wood, parchment, ivory, and plastic material, as well as on silver and gold—a sort of enamelling; they also possess fair knowledge of effect in fresco. Their mosaics, executed in colored porcelain, glass, mother-of-pearl, and marble, represent chiefly flowers and sprays on a subdued background. The most remarkable work of this kind is that which is lavished on the temple Watt P'hra Kéau, or temple of the Emerald Idol, the walls, pillars, windows, roofs, towers, and gates being everywhere overlaid with mother-of-pearl and profusely gilt. This temple is unquestionably one of the most remarkable and beautiful structures of its class in the Orient; the lofty octagonal pillars, the quaint Gothic doors and windows, the tapering and gilded roofs, are carved in an infinite variety of emblems, the lotus and the palm predominating. The altar is a wonder of dimensions—a pyramid 60 feet high, terminating in a fine spire of gold rising to the height of 100 feet. On every side of the altar are idols, all curious and precious, from the bijou image in sapphire to the colossal statue in plate gold. The floor is paved with diamonds of polished brass, which reflect the light of tall tapers that have burned on for more than 100 years, so closely is the sacred fire watched. The floods of light and depths of shadow about the altar are extreme, and the effect overwhelming. The Emerald Idol is about twelve inches high and eight in width. Into the virgin gold of which its headgear and collar are composed must have been stirred, while the metal was yet molten, crystals, topazes, sapphires, rubies, onyxes, amethysts, and diamonds; the combination is as harmonious as it is splendid. No wonder it is commonly believed that Booddha himself alighted on the spot in the form of a great emerald, and by a flash of lightning conjured the glittering edifice and altar in an instant from the earth, to house and throne him there. The Emerald Idol, however, is a part of the loot from the great temple of Maha Naghkon Watt, already described, and a trophy of the Siamese conquest of Cambodia.

The palaces, temples, and pagodas of the Siamese resemble the ancient Egyptian architecture, both in style and manner of decoration, and are not unworthy of European art. The temple of Watt Poh, where reposes in gigantic state the great sleeping idol, is one of these. Imagine a reclining figure 150 feet long and 40 feet high, overlaid with plate-gold, the soles of its monstrous feet covered with bas-reliefs inlaid with mother-of-pearl and chased with gold, each separate design distinctly representing the many transmigrations of the Booddha whereby he attained Nirvâna. Their structures are solid and endurable. The temples are beautifully situated amid spacious parks and avenues of trees, paved and enclosed by gardens, while their tapering pyramidal roofs, sculptured façades, and lofty *prachaidi* (spires, all painted, gilded, and glazed) are made vocal with tiny air-rung bells at all hours of the night and day, and resplendent beyond description in the sunlight. In the art of sculpture and modelling the Siamese are in advance of their civilization. Their music is agreeable, unwritten, simple, and plaintive. Bands of a variety of instruments, among which the kang wong and tâkay most nearly resemble the piano, are a part of princely establishments, while the first and second kings possess each a fine band of foreign instruments, performed by natives under the instruction of a French musician.

The government of Siam is theoretically a duarchy, practically a monarchy; royalty seems to have taken such hold on their affections that it usurps the place of a religious sentiment. The person of the king is sacred. He is not only enthroned—he is enshrined. His rule is despotic, but it is tempered by law and not less revered custom. He may name his successor by will, but the royal or secret council, composed of twelve of the highest officers of state, determine whether that will shall be carried into effect. A second king, selected, like the first or supreme king, from the royal family, is also appointed by the secret council. The authority of this second king, however, is dependent on that of the supreme king, with exemption from the customary prostrations before the first king, whom he may salute by simply raising his hands and joining them above his head. But, like any lesser *ducus* of the realm, he must appear twice a year before his lord and renew his oath of allegiance by drinking of the consecrated water in the temple of the Emerald Idol. Somdetch P'hra Paramendr Ramesr Mahiswarer, who died Dec. 29, 1865, was the legitimate son of the supreme king, second of his dynasty, who reigned from 1809 to 1824; his mother was the lawful first queen consort (as there are not only dual kings, but dual queens, which name is applied to the right- and left-hand wives of the supreme king of Siam). The late se

preme king, Somdetch P'hra Paramendr Maha Mongkut, was his elder full brother. On the death of their father (in 1824), and the accession by intrigue of their elder half-brother, Maha Mongkut entered the Booddhist priesthood, but his brother took active service with the reigning king, and was appointed superintendent of the army, artillery and Malayan infantry. In 1824 he became acquainted with English merchants and American missionaries, with whom he studied English. On May 26, 1851, after the coronation of his elder brother, he was appointed second king. On the birth of the second king's first son an American missionary, who was on terms of intimacy with the father, named the child "George Washington;" and that child, the Prince George Washington (Kroma Mun Pawarwijagan), is the present second king of Siam. In his palace, which he had rebuilt after the model of an English nobleman's residence, he led the life of a healthy, practical, and systematic student. The freshest publications of London found their way to his tables, and he heartily enjoyed the creations of Dickens. Of his elder brother, the late supreme king of Siam, it may safely be said that he was the most progressive of all the supreme rulers of Siam, of whom the native historians enumerate not less than forty from the founding of Ayodhya, the ancient capital, in A. D. 1350. He labored with enthusiasm for the diffusion of religion and enlightenment, and above all to promote a higher appreciation of the teachings of Booddha. Before the arrival of the Protestant American missionaries he had acquired some knowledge of Latin and the sciences from Jesuits. But when the Protestants came to Bangkok, he at once placed himself under the tutorship of the Rev. Mr. Caswell, an American missionary, under whose instruction he made extraordinary progress in advanced and liberal ideas of government, commerce, and even religion. Several commercial treaties of the first importance were concluded with foreign powers during his reign. The Siamese government voluntarily reduced the measurement duties on foreign shipping from 1900 to 1000 ticals (a tical is a silver coin of the value of 60 cents) per fathom of ship's beam. This was a brave stride in the direction of a sound commercial policy, and has attracted enterprising traders from all parts of the world, the imports consisting of shirting, prints, fine muslins, piece goods, crockery, machinery, opium, Mexican dollars, etc., from San Francisco and New York. The old silver tical has been replaced by a new coin, with the inscription of the elephant. The rate of interest is 30 per cent. The great inland trade is carried on by boats, which are at one and the same time the shop and home of the trader. The merchant service consists of numberless junks and vessels. Steam service was opened in 1855, and is rapidly increasing. Foreign steamers ply fortnightly with the mails between Bangkok and Singapore. In 1855 a new treaty of commerce was negotiated with the Siamese government by H. B. M.'s plenipotentiary, Sir John Bowring, which proved of great advantage to both parties; in 1856 a new treaty, substantially like that with Great Britain, was procured by Townsend Harris, Esq., representing the United States; and later in the same year still another, in favor of France, through H. I. M.'s envoy, M. Montigny. Before that time Portugal had been the only foreign government having a consul residing at Bangkok.

The name of Siam was first heard in Europe—*i. e.* in Portugal—in 1511, nine years after Alfonso d'Albuquerque, the great viceroy of the Indies, had landed on the coast of Malabar with his soldiers and conquered Goa, which he made the seat of the Portugo-Indian government and the centre of its Asiatic operations; and he made the name of Portugal so feared and respected in the East that many of the potentates in that region, and among them the kings of Siam and Pegu, sent embassies to him and sought his alliance and protection. As early as the fifteenth century the celebrated German traveller Mandelslohe visited Ayodhya, the capital of Siam, and called it "the Venice of the East." The Portuguese explorer Mendez Pinto, who was in Siam in the sixteenth century, gives a very favorable account of the country. In 1632 an English vessel is said to have reached Ayodhya, and to have found it in ruins, the country having been laid waste by the successive incursions of the Burmese. Since the way was opened to admit a resident consul of each of the treaty powers, millions of dollars have flowed into Siam annually by channels through which but a few tens of thousands had been drawn before. A new and superb palace was erected after the model of Windsor Castle, together with numerous royal residences in different parts of the country. In 1862 an English school was established at the court of Siam for the royal family, under the superintendence of an English lady, as well as a private printing-office. The nobility soon began to emulate the activity and munificence of their wise and progressive sovereign. So prosperous did the country become under the benign influence of foreign trade and civilization that treaties with almost every nation under the sun were speedily concluded, and the king found it necessary to accredit Sir John Bowring as plenipotentiary for Siam abroad. Early in this reign the appointment of harbor-master at Bangkok was conferred upon an Englishman; next came a French commander-in-chief of the army, but who since the defeat of the French by the Germans has been replaced by a Prussian. The armies of Siam are raised on the spur of the moment. These recruits are clothed, equipped with arms and ammunition, and "subsisted" with daily rations, but are not otherwise paid. The small standing army consists of infantry, cavalry, elephant-riders, archers, and private body-guards, and is yearly renewed by an annual service of three months paid by every subject in some form or other to the king, save by the Chinese, who are consequently triennially taxed. The king's private body-guard is comprised of picked men, permanent in office, well paid, clothed, and quartered. A custom-house has been established, and a police force composed of trusty Malays and commanded by an Englishman.

In his daily habits the late king, Maha Mongkut, was remarkably industrious and frugal. His devotion to the study of astronomy never abated. The French government having sent a special commission to observe the great solar eclipse of the sun in Siam, the Siamese government expended not less than $100,000 on this expedition. But the extraordinary excitement and exposure to the noxious atmosphere of the jungle, where the observations were made, proved inimical to the constitution of the king. On his return to Bangkok he was seized with a fever. He rapidly grew worse, and died Oct. 1, 1868. That very night, without disorder, the Senabawdee elected his eldest son, Somdetch Chowfa Chullalonkorn, to succeed him, and the prince George Washington as second king. The late king had 81 children, of whom upward of 70 were alive at his death. Polygamy—or, more properly speaking, concubinage—is very common in the country. The number of concubines is limited only by the means of the man. As the king is the source of all the wealth and influence, kings, nobles, and princes vie with each other in bringing their most accomplished and beautiful daughters to the royal harem. But the king may have only two wives of royal blood, whose offspring alone are legitimate. The late king had two queen-consorts, but not in conjunction. His concubines were unlimited in number. Marriage takes place as early as eighteen for males and fourteen for females. The religion is pure Booddhism; nevertheless, the lower classes, and even in some respects the more enlightened, are profoundly superstitious. They have peopled their spiritual worlds with gods, demons, and goblins, and to flatter or propitiate these, especially to enlist their tutelary offices, they commit or connive at enormous crimes. The most honorable disposal of the dead is by burning. White is the badge of mourning. At the cremations of royal persons thousands of dollars are expended; on all festive occasions the coffers of the kings and nobles are freely opened for the merry-making of the people.

Bangkok, the present capital of Siam, is the Venice of the East: a large network of water or water-roads takes the place of streets, intersected with light drawbridges. A large proportion of its inhabitants live in floating houses, which line both banks of the Mèinam. The city is surrounded by a battlemented and turreted wall; the grand palaces and the royal harem are situated on the right hand as you ascend the river, which encloses it on the W., while on the eastern side it is bounded by a deep canal. This spot of ground is encompassed by two walls running parallel to each other. Within the outer of these walls are the magazines, the royal exchange, the mint, the supreme courts of justice, the prisons, temples, and fantastic pleasure-grounds of the palace, with many elegant villas, theatres, and aviaries, some of which are richly gilt and ornamented. Near this, and surrounded by a high wall, which defends it from all entrance from without, is the harem. This is a sort of miniature city, with streets, shops, bazaars, gardens; halls where women-judges administer justice; barracks of the Amazons, who are 500 in number and divided into companies of fifties under commanding officers; gymnasia and theatres, and the quarters of the women of the harem. The southern part is occupied by mechanical slaves of the wives, concubines, and princesses attached to royalty; here they ply their various trades and occupations for the benefit of their mistresses. This woman's city is almost self-supporting, and has its own laws, judges, police-guards, prisons, and executioners, all women. Into this inner city no man is permitted to enter except the king and the priests, who are admitted under guard for alms and other sacred offices to be received or administered. The population is always changing, and

varies from 5000 to 9000 souls. The slave- and trade-women are allowed to go out to visit their husbands or on business for their mistresses, but the great princesses and ladies of the harem hardly ever leave it until they have by age and position attained to a certain degree of freedom. The second king has a similar court and miniature female city, smaller in some respects, attached to his palace, which stands higher up on the same bank of the Mèinam.

Somdetch Chowfa Chullalonkorn was nine years old when he commenced his English studies, and he seemed to overcome the difficulties and obstacles he encountered with a resolution that gained strength as his mind gained ideas. He was handsome in person, modest, affectionate, and eager for knowledge. A prince in Siam, though legitimate heir to the throne, may be rejected by the secret council should they find him morally or physically incapacitated. But on the death of the late king this prince was unanimously elected to the throne, and was crowned Nov. 11, 1868. One of his first acts on coming to the throne was to liberate unconditionally all the state prisoners in his kingdom on the occasion of his father's cremation. Shortly after this he issued a remarkable proclamation giving perfect religious freedom to all his subjects. In 1871 he visited the islands of the Malayan peninsula; on his return to Bangkok he adopted several reforms, permitting those of his subjects who would wear a semi-European dress to stand erect in his presence, thus abolishing the degrading custom of prostration. From time immemorial there has existed in Siam a mixed system of slavery, in part resembling the old system of English feudal service, in part the former serfdom of Russia, and again in part the peonage of Mexico. Three-fourths of the population were either branded with the mark of their owners, or held by their creditors in a form of qualified servitude to work out a debt. On the first opportunity that offered the king urged before his secret council the abolition of slavery. In 1871 he caused a royal proclamation to be made that from Jan. 1, 1872, slavery should cease to be an institution of Siam, and that a general tax, according to the circumstances of each and every man, should be levied on the nation to remunerate the slaveholders for the loss of their slaves: since which date slavery is gradually dying out, and a new era is at hand for this nation and kingdom. To the united influence of an English education and Christian missionary zeal Siam unquestionably owes much, if not all, of her present advancement and prosperity. In this respect the Rev. Messrs. Bradley, Caswell, House, Mattoon, and Dean are entitled to special mention.

The Siamese months are lunar, and each is divided into two parts, the waxing and waning moon. Six of the months have 30, and six 29 days. They have an intercalary month of 30 days every third year, to compensate for the deficiency of 11 days required to make the full solar year, there being still a loss of about 3 days in nineteen years. This is supplied by an arbitrary addition of a day to the seventh month of some favored years. They have two cycles, one within the other; the greater is 12 and the lesser 10 years in duration. Every year in each cycle has its own peculiar name. Their sacred era is reckoned from the death of the Booddha (2415). Their civil era is reckoned from the time of its establishment (1233) by P'hra Rooang, a Siamese king of great celebrity. A. H. LEONOWENS.

Siamese Twins. See ENG AND CHANG.

Sibe'ria, the name of the whole northern part of Asia, belonging to Russia, and bounded N. by the Arctic Ocean, E. by different parts of the Pacific Ocean—namely, the Strait of Behring, the seas of Kamtchatka, Okhotsk, and Japan—and W. by European Russia, from which it is separated by the Ural Mountains and the river Ural. Its southern boundary has varied very much, as it has been thrown farther S. after every war with China and the independent empires of Central Asia. It seems now, however, to have been finally fixed, since the Russian conquests in Central Asia have been formed into a separate political division, and it follows pretty nearly the circle of lat. 50° N. The area, population, and administrative divisions of this immense territory are shown by the following table, whose figures, however, are estimates only, not actual measurements:

Provinces.	Area in Eng. sq. m.	Population.
Littoral	708,253	43,320
Amoor	107,514	22,297
Yakootsk	1,500,141	228,363
Transbaikal	210,799	350,843
Governments.		
Irkootsk	279,963	372,833
Yeniseisk	958,042	350,848
Tomsk	329,783	784,268
Tobolsk	565,920	1,105,855
Total	4,660,415	3,327,627

There is considerable difference between the eastern and western parts of Siberia, the eastern part being higher, with a more rugged surface and a more rigorous climate. While Western Siberia is one unbroken plain, the southern and eastern districts of Eastern Siberia are mountainous, covered by the Altai Mountains (which form the boundary between Siberia and Mongolia, and send numerous branches N. toward Lake Baikal) and the Stanovoi Mountains (which run N., parallel with the Sea of Okhotsk, which they face with a line of bold and precipitous rocks). These mountains, however, are not high, and in general Siberia may be described as a plain, sloping from S. to N. toward the Arctic Ocean; and a general view of the surface of this plain may be given by dividing it into three longitudinal belts. The northernmost belt, extending along the shore of the Arctic Ocean, consists of swamps frozen several feet below the surface, and for hundreds of miles the ocean is covered with thick ice, so that during winter it is impossible to ascertain where the land ceases and where the sea begins. In summer the ice of the ocean breaks up and floats in huge icebergs, which make navigation dangerous, not to say impossible, and on the mainland the sun succeeds in thawing the ground for a couple of inches, calling forth a thin cover of pale moss. Immense herds of wild reindeer inhabit the northern regions during the long, bleak summer day, when for three months the sun never sets, and turn their course toward the S. when the winter night comes, during which, for three months, no light but the cold streaks of the aurora borealis is to be seen in the sky. The polar bear and the black fox abound; the rivers teem with salmon and sturgeon, and innumerable whales and seals haunt the coast during the summer. The middle belt is one continuous forest of fir, pine, larch, and birch, feeble and stunted when it tries to creep farther N. than lat. 64°, but at lat. 62° generally of a vigorous growth, and swarming with sables, ermines, marmots, martens, squirrels, lynxes, wolves, bears, and beavers; the wild-boar, the wild-sheep, and the Caspian antelope are also found here, and here the human settlements begin. They are of course few, and hunting is the only occupation, but the furs exported from this part of Siberia form an important item in Russian trade. The southern belt is agricultural; in some parts it consists of steppes, best adapted for cattle-breeding; in others all the common European grains and fruits, even the grape, are grown with perfect success.

About three-fourths of the inhabitants of Siberia are Russians, mostly exiles and their descendants. In the seventeenth and eighteenth centuries the inhabitants of whole counties of European Russia were transferred to Siberia because they were dissenters from the Russian Orthodox Church, and settled here as regular colonists, enjoying full social liberty and prospering; meanwhile, their places on the soil of Russia were filled with German Protestants. Since then the Russian government has sent its political dissenters to Siberia, sometimes incorporating them in the Siberian army, but often putting them to work in the mines with the meanest criminals. The Ural, Altai, and Stanovoi mountains are exceedingly rich in minerals, and mines of every description, gold, silver, copper, lead, iron, salt, and coal, are extensively worked. But the greatest sufferings which modern civilization in Europe has heard of are connected with these mines, and at one time it was generally understood in Europe that more noble intellect and more mental vigor were wasted in the subterranean galleries of the Siberian mines than were employed in the governmental palaces of St. Petersburg. The most remarkable of the native tribes are the Ostiaks in the W., the Calmucks in the Altai, the Booriats, of Mongolian origin, the Toongooses, of Tartar origin, and the Tchooktchees, related to the Esquimaux, in the E. and N.; they are mostly pagans, and live by fishing and hunting.

A peculiar feature of Siberian life is its trade, very extensive as far as regards its own products—furs, skins, metals, fish, caviare, cattle, and grain—and still more extensive as a transit-trade by which large quantities of tea, silk, satin, and rhubarb from China are exchanged for metals, furs, cotton goods, and cutlery from Russia. On account of the vast dimensions and the thin population of the country it is necessary to fix times and places where buyers and sellers are sure to meet each other; and from these Siberian fairs, of which that of Kiakhta generally has transactions to the value of $15,000,000, large caravans of camels start for the S., while long trains of sledges, drawn by reindeer or dogs, set out for the N. and N. W. The commercial centre of Siberia is Tobolsk, from which the direct highway across the Ural Mountains leads to Perm, which has water-communication with different parts of the country. CLEMENS PETERSEN.

Sib'ley, county of S. Minnesota, on Minnesota River, includes Lake Minnetonka, 30 miles in length, has a rolling surface and a productive soil. Staples, wheat, Indian

corn, oats, hay, butter, and wool. Cap. Henderson. Area, about 525 sq. m. P. 6725.

Sibley, p. v., cap. of Osceola co., Ia., on Sioux City and St. Paul R. R., 76 miles N. E. of the former city, has 2 churches, 1 graded school, 2 banks, 1 newspaper, a court-house and county jail, 2 hotels, 1 grain-elevator, 3 grain-warehouses, and a park. P. about 500.

HAWXHURST & REED, EDS. "GAZETTE."

Sibley, tp., Cloud co., Kan. P. 309.

Sibley, tp., Keweenaw co., Mich. P. 47.

Sibley, p.-v. and tp., Sibley co., Minn. P. 272.

Sibley (GEORGE CHAMPLAIN), b. at Great Barrington, Mass., in 1782, son of Dr. John, a surgeon in the war of the Revolution, and grandson of Rev. Dr. Samuel Hopkins; spent his youth in North Carolina; was appointed an Indian agent by Pres. Jefferson; explored the Grand Saline and Salt mountains with a band of 100 Osage warriors, and published a report of the expedition; settled in Missouri; became a major in the regular army of the U. S.; was a commissioner to survey a trading-route from Western Missouri to New Mexico; made several treaties with the Indians; was many years a public-spirited resident in St. Charles co., and was a trustee and liberal benefactor of Lindenwood College and an outspoken anti-slavery worker. D. at Elma, Mo., Jan. 31, 1863.

Sibley (HENRY H.), son of Judge Solomon, b. at Detroit, Mich., Feb., 1811; was many years an Indian trader in the service of the American Fur Company at Mackinaw and Fort Snelling; was delegate in Congress from Minnesota Territory 1849–53; chosen first governor of the State of Minnesota 1858; became brigadier-general of volunteers Sept. 29, 1862; commanded a successful expedition against the hostile Indians on the W. frontier of Minnesota 1863; was brevetted major-general of volunteers, and was a delegate to the soldiers' and sailors' convention of 1866.

Sibley (HENRY H.), b. in Louisiana July, 1816; was graduated from the U. S. Military Academy July 1, 1838, when appointed second lieutenant of 2d Dragoons; first lieutenant 1840, captain 1847, and major 1st Dragoons 1861; served in Florida war 1838–39 and 1840–41; adjutant of his regiment 1841–46. In the war with Mexico he participated in the siege of Vera Cruz, battles of Cerro Gordo, Contreras, Churubusco, Molino del Rey, and final capture of the City of Mexico, gaining the brevet of major for gallantry in the affair at Medelin, near Vera Cruz, Mar. 25, 1847. Subsequently and prior to the civil war he was actively engaged on frontier duty and on numerous expeditions, notably the Utah expedition (1857–58, 1859–60), and that against the Navajoes (1860). The breaking out of civil war in 1861 found him in New Mexico, where he resigned from the U. S. army simultaneously with the arrival of his major's commission (May 13), and entered the Confederate service, in which he was soon a brigadier-general. Having organized a brigade in N. W. Texas, he left Fort Bliss in Jan., 1862, with between 2000 and 2500 men, to effect the conquest of New Mexico, and Feb. 16 appeared before Fort Craig, commanded by Col. E. R. S. Canby. The action of Valverde was fought Feb. 21, closing by the withdrawal of Col. Canby's troops to the fort. Albuquerque and Santa Fé were occupied by Sibley in March, but the following month he was compelled to evacuate the territory and return to Fort Bliss. At the close of the war he entered the service of the khedive in Egypt. He is the inventor of the tent known by his name. (See TENT.)

Sibley (HIRAM), b. at North Adams, Mass., Feb. 6, 1807; removed early to W. New York, and engaged in manufacturing machinery. Becoming interested in telegraph-lines, he found that they were operated under four different patents requiring several companies, and generating competition so ruinous that with $7,000,000 invested in the business no profit had accrued. He conceived the idea of consolidating all the companies into one, so as by economy and system to make the business profitable. Associating a few gentlemen with himself, he bought or leased several worthless lines, until finally over twenty corporations were merged into the Western Union Telegraph Co. He thus solved the problem of telegraphing for our country by making the business pay on the investment. Large profits resulted to the stockholders and great benefit to the community. Mr. Sibley subsequently conceived the idea of a line to California, and was mainly instrumental in carrying through Congress, in the face of the most intense skepticism, a bill which secured a line to the Pacific coast. He also completed negotiations with the British and Russian governments for a European line *viâ* Behring Strait, should the Atlantic cable have proved a failure. Few if any have surpassed Mr. Sibley in the successful efforts which first made telegraph-lines profitable and practicable, and by consequence the business and social servants of mankind. Mr. Sibley is using his wealth intelligently for benevolent ends. He has expended $25,000 in erecting a church in his native place, $100,000 in an edifice and endowment for teaching the mechanical arts in Cornell University, and $100,000 on a fireproof library building for the University of Rochester.

Sibley (JOHN LANGDON), b. at Union, Me., Dec. 29, 1804; graduated at Harvard 1825; was assistant librarian there 1825–26; ordained as a Unitarian minister at Stow, Mass., May 4, 1829; preached there until Mar., 1833; became in 1837 editor, and afterward proprietor, of the *American Magazine of Useful and Entertaining Knowledge;* was again assistant librarian at Harvard from 1841 to 1856; since which time he has been at the head of that library, the most important in America in many respects; has edited since 1841 the *Triennial Catalogues* of Harvard, and since 1850 the *Annual Catalogues;* has published a *Notice of the Triennial Catalogues of Harvard University, with a Reprint of those of 1674, 1682, and 1700* (1865); is author of a *History of Union, Me.* (1851), considered a model town-history, and has prepared copious biographies of the early graduates of Harvard, of which vol. i. appeared 1873.

Sibley (SOLOMON), b. at Sutton, Mass., Oct. 7, 1769; became a lawyer; settled at Marietta, O., 1795, at Cincinnati 1796, and at Detroit 1797; was a member of the first legislature of the North-west Territory 1799, a delegate to Congress from Michigan Territory 1820–23, and judge of the supreme court of Michigan 1824–36. D. at Detroit Apr. 4, 1846.

Sib'thorp (JOHN), M. D., F. R. S., b. at Oxford, England, Oct. 28, 1758, son of Dr. Humphrey Sibthorp, professor of botany; graduated at Oxford University about 1778; obtained a Radcliffe travelling fellowship; studied medicine at Oxford, Edinburgh, and on the Continent; made botanical researches in France and Switzerland; became professor of botany at the College of Physicians 1784; made a botanical tour in Southern Italy, Crete, Cyprus, Asia Minor, parts of European Turkey, and Greece Mar. 1786–Sept., 1787; succeeded his father as professor of botany at Oxford; was one of the founders of the Linnæan Society; was given the title of regius professor 1793; made a second and more minute botanical exploration of Greece and the Ionian Islands 1794–95; published the *Flora Oxoniensis* (1794), and d. at Bath Feb. 8, 1796. He bequeathed to the university £1200 per annum for the publication of his great work, *Flora Græca*, which was edited by J. E. Smith and John Lindley (20 vols., royal folio, with 1000 colored plates, 1807 *seq.*).

Sib'yl [Gr. σίβυλλα] was the common name given by the Greeks, and subsequently by the Romans, to all old women who were believed to be possessed of prophetic gifts, and whose advice and help were consequently eagerly sought by superstitious persons. The most famous of these women was the Cumæan sibyl, so called after Cumæ, in Campania, where she resided. She brought nine books of oracles and prophecies to Tarquinius Priscus, king of Rome, but the price she asked for them was so enormous that the king declined to buy them. She then burned three of the books, but asked the same price for the remaining six. When the king still refused to pay the price, she burned three more books, and he now paid for the last three the sum originally demanded for nine. These books were preserved in the temple of Jupiter Capitolinus, and were held in great respect. But in 83 B. C. they were destroyed by fire, together with the temple. A collection of sibylline oracles was then made in Italy, Greece, Asia Minor, Egypt, and Libya, and having been thoroughly sifted by a committee of knowing men, it was deposited in the new temple of Jupiter Capitolinus, where it was destroyed by Stilicho in the fifth century A. D. Under the title of *Sibylline Oracles* there still exists a collection of Greek verses of Jewish, Christian, or pagan origin, probably made in the second or third century A. D. It was edited with a Latin translation by Alexandre (2 vols., Paris, 1841–53). (See Ewald, *Abhandlung über Entstehung, Inhalt und Werth der sibyllischen Bücher*, 1858.)

Sicard' (ROCH AMBROISE CUCURRON), b. at Fousseret, department of Haute-Garonne, France, Sept. 20, 1742; studied theology and took holy orders at Toulouse; was sent by the archbishop of Bordeaux to Paris to study the method of Abbé de l'Epée; became director in 1786 of a school for deaf-mutes at Bordeaux; succeeded De l'Epée in 1789 as director of the school of Paris; was imprisoned as a royalist in 1792, and barely escaped with his life during the September riots; was again suspended by the Directory in 1795 from his position as editor of *Annales catholiques*, but resumed his office in 1799. D. at Paris May 10, 1822. He wrote *Mémoires sur l'Art d'instruire les Sourds de Naissance* (1789), *Catéchisme à l'Usage des Sourds-muets* (1796), *Cours d'Instruction d'un Sourd-muet* (1800),

and *Théorie des Signes pour l'Instruction des Sourds-muets* (1808).

Sicil'ian Vespers, the name usually given to the outbreak of the insurrection of the Sicilian people against the French usurper, Charles of Anjou, at Palermo on Easter-day, Mar. 30, 1282. Pope Urban IV. had deposed the infant sovereign of the Two Sicilies, and in 1265 bestowed that kingdom upon the bigoted Charles of Anjou, who was as notorious for his vices as his brother, King Louis IX. of France, was conspicuous for his virtues. Charles took forcible possession of the kingdom, suppressed the provincial and municipal jurisdictions in Sicily, superseded the native authorities by French favorites and adventurers, and converted the government into an oppressive and unmitigated despotism. This was long borne without organized resistance, but the brutality of a French soldier toward a young lady in a religious procession to a sanctuary at Monreale, at the hour of sounding the vesper-bells on the festival above mentioned, produced an explosion of popular resentment which began by the instant massacre of the French soldiery present, and ended with the slaughter of most of Charles's foreign and native adherents throughout the island, and the final overthrow of his domination in Sicily. This is the received account, which differs, however, in some respects from the results arrived at by historical research. (See Amari, *La Guerra dei Vespri Siciliani*, Palermo, 1842, 2 vols.; many times reprinted.)

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Sic'ilies, The Two [*Reame*, or *Regno Delle Due Sicilie*], the legal designation of a political state popularly called the kingdom of Naples, founded by the Norman dynasty in the Middle Ages, and comprising the S. E. provinces of Italy, Sicily, and some smaller islands near the coast, among which Ischia, Procida, Capri, in the Parthenopaean group, the Lipari or Æolian and the Egadi archipelagoes, and Pantellaria, are the most conspicuous. The mainland provinces composed what were styled the *dominio al di quà del Faro*; Sicily and the adjacent islands were called the *dominio al di là del Faro*, Faro ("lighthouse") being the name commonly given to the Strait of Messina, 2 miles wide at its narrowest point, which divides Calabria from Sicily. The possessions of the state, which had no foreign dependencies, lay between N. lat. 36° 45′ and 42° 52′ and E. lon. 11° 55′ and 18° 32′, and contained about 33,000 sq. m., or not far from two-sevenths of the superficial extent of the present kingdom of Italy. (For the description and special history of the insular portion of the kingdom of the Two Sicilies see SICILY, ISLAND OF.) The continental territory of the Two Sicilies embraced the foot and ankle of the *stivale* (or "boot") to which the form of the Italian peninsula is compared. It was bounded N. W. by the Pontifical States, from which it was separated by the Liri or Garigliano on the Tyrrhenian, by the Tronto on the Adriatic coast; N. E. by the Adriatic; S. E. by the Ionian; and S. W. by the Tyrrhenian Sea. It included a considerable part of the first and fourth, and the whole of the second and third, *regions* into which Augustus Cæsar divided Italy, or the southern portion of Latium, Somnium, and Picenum, and the entire districts of Apulia, Lucania, and Bruttium. (A description of the maritime outline will be found in the article ITALY.) In the long period between the downfall of the Roman and of the Napoleonic empires its various provinces underwent many changes of boundary, designation, and government. At the establishment of the Hohenstaufen dynasty almost the whole soil was absorbed in the duchies of Spoleto and Apulia, and Calabria; under Napoleon I. it became the kingdom of Naples; and at the general pacification of Europe in 1815 it was reunited with Sicily under the ancient style of the kingdom of the Two Sicilies, which it retained until, by the *gran dono* of Garibaldi to Vittorio Emanuele II. in 1860, it was incorporated, with the other possessions of the dynasty of Savoy, into the kingdom of Italy. The old peninsular territory of the Two Sicilies is now divided into 16 provinces grouped in 5 compartments: Abruzzi and Molise, Campania, Apulia, Potenza or Basilicata, and Calabria. (For the names, areas, and population of the provinces in 1861 and 1871 see ITALY.) The territory of these provinces consists chiefly of the main and subordinate chains of the Southern Apennines and their lateral ramifications, with valleys, plateaus, morasses, and lakes interspersed between the mountain-ridges. A considerable part of both the eastern and the western coasts has been shoaled, and the harbors which once indented the sea shore filled up by mineral and vegetable matter brought down by the numerous torrents, aided by sand washed in by the sea, and the overflowing mountain-streams have often spread out in their lower courses wide expanses of fluviatile deposit rich in the elements of vegetable life, but exhaling pestilential miasmata which render them unfit for the abode of man. (See the official report of Rafaele Pareto, *Sulle Bonificazioni, Risaie e Paludi del Regno d'Italia*, 1865.) There are, however, in the continental territory of the Two Sicilies great plains of a different origin and character. Thus, the ancient Campania, corresponding in part to the modern Terra di Lavoro, though broken by Vesuvius and other eruptive elevations, is in great part level, composed of volcanic soil of exuberant fertility and enjoying a not insalubrious climate. There is also the Tavoliere, or plateau of Apulia, on the N. E. slope of the Apennines, with a comparatively level general surface, and forming a sort of vast common of pasturage. The Tavoliere belongs chiefly to the public domain or to great proprietors, and its administration has been a source of much embarrassment to the successive governments of this part of Italy. The Neapolitan Mountains are higher and generally with broader bases than those of Central and Northern Italy. Monte Corno, or the Gran Sasso d'Italia, near the former pontifical frontier, rises to the elevation of 9312 feet, and is the loftiest peak in the whole chain of the Apennines. Monte Amaro is 9131 feet high, and Monte Velino measures 8180 feet; Monte Meta, 7835, and Monte Pellino, 7070, are also loftier than any of the Apennine summits in Central and Northern Italy. The height of Vesuvius is variable, because the great central cone of eruption sometimes rises 300 feet above the lip of the crater, sometimes sinks 2000 feet below it. The Punta del Palo, a rock on the northern edge of the crater at the height of 3944 feet above the sea, appears to be substantially stable, and when the volcano is at rest is the highest point of the mountain. The eruptive rock from Vesuvius, and from other now inactive volcanoes in the same region of comparatively late geological date, like Vesuvius itself, have given a special character to the surface of a large district, of which Naples is approximately the centre; and though the peninsular territory of the Two Sicilies is very irregular in outline, as well as in hypsometric configuration, it has no very marked great geographical divisions, if we except that between the volcanic district, of recent origin, and the regions of older geological formation.

Although there are extensive forests in various parts of the kingdom, the woods have been generally felled in the easily-accessible regions, and fires, with the pasturage of black cattle and goats, have reduced most of the remainder to a perishing condition. The soil has thus been deprived of its natural protection, and the winter rains have bared much of the mountainous territory of the kingdom not only of herbaceous vegetation, but of the earth which once covered the rocky hills. From the same cause the permanent mountain-springs have been dried up, the pastures have lost their old luxuriance, and the upland plateaus of the interior are without water for irrigation, which, in that climate, is a prime necessity of agriculture.

The most important lake is, or rather was, the Fucino or Lago di Celano, lying 50 miles E. from Rome, at the height of 2200 feet above the sea, and covering some 40,000 acres, lately drained and converted into a vast expanse of most productive soil by the enterprise of Prince Alessandro Torlonia. (See FUCINO.) There are also some large fresh and many salt water lagoons along the coast, especially on the Adriatic shore. (See the report of Pareto, above referred to.)

The width of the Neapolitan territory, measured normally to its length, scarcely anywhere exceeds 100 miles, and the watershed of the Apennines, which, though with many sinuosities, runs in general approximately parallel with the coasts, has few interruptions, and lies everywhere at a considerable elevation. From this configuration of surface the course of the rivers which drain, but can hardly be said to water, the soil is generally short and rapid. Hence, their volume is not considerable except in the rainy season, when they often swell to formidable torrents. The chief rivers, besides the boundary-streams, the Tronto and the Garigliano or Liri, are the Pescara, the Sanaro, and the Ofanto, emptying into the Adriatic; the Bradano, Vasenti, and Agri, which discharge their waters into the Gulf of Taranto; and the Volturno and Sele, tributaries of the Tyrrhenian. The Garigliano is boatable below Pontecorvo, but otherwise none of these rivers are in any way navigable, though the estuaries of some of them form small ports or anchorages; and neither the Garigliano nor the Volturno, the two largest, and which flow for a considerable distance in valleys parallel with the coast, has a total length of more than 100 miles.

The general traits of the geology and mineralogy of Southern Italy are sufficiently well known, but the difficulty of penetrating the inhospitable interior districts has prevented much special examination of the stratigraphy of the inland territory, and the superior attractions of the Vesuvian regions, the great volcanic laboratory of continental Europe, have almost exclusively absorbed the atten-

tion of scientific investigators. In the northern provinces the central mountains are of calcareous and serpentine formation or of arenaceous and conglomerated rock, and with overlying Jurassic strata. Great beds of gypseous rock and much sulphur also occur. On the lower elevations rest extensive Tertiary strata, containing, among their fossils, shells apparently identical with existing species. Further to the S. the mountains are granitic, with Secondary deposits. The volcanic rocks, derived not only from Vesuvius, but from other long extinct craters, belonging to the same system, are extensive, and the frequency of the eruptions of Vesuvius and the accessibility of all the deposits of volcanic origin have offered such facilities for the study of eruptive phenomena as do not exist elsewhere in Europe. The volcanic character of Vesuvius was hardly suspected by the ancients until the destructive eruption of A. D. 79 suddenly revealed its true nature, and there have since occurred long periods of rest during which the external slopes, and even the interior walls of the crater, have been covered with woods and pastures. But for the last two centuries and a half eruptions have been frequent, and several of them, as in 1822 and in 1872, have been of extraordinary violence. The volcanic ashes of ancient eruptions have been spread over a wide extent of plain as arable soil or hardened into tufaceous rock, sometimes by rain and other atmospheric agents on the surface, at others by the action of sea-water into which the eruptive matter fell. In some cases these deposits appear to have been of submarine ejection, in others they have been submerged, and again raised by the alternate subsidence and elevation of the land, which is so strikingly exemplified at Pozzuoli. The fact of the occurrence of sea-shells in these strata is not always conclusive evidence that they were ever covered by the sea; for if we are to believe the reports of Braccini and Father Ignatius, marine shells were thrown out from the crater in the eruption of 1631, having been drawn into the abyss from the sea with the water, the absorption of which into the focus of the volcano is counted by some among the causes of volcanic outbreaks.

Among the phenomena allied to volcanic energy which occur in this territory we may mention mineral springs, very various in composition and temperature of water, gaseous exhalations, and especially the earthquakes, which are more frequent and destructive than is generally known abroad. The earthquake of 1783 is widely celebrated both from its violence, and from the fact that its force was chiefly exerted in easily-accessible and familiarly-known provinces; but that of 1857, which laid waste an inland territory lying mainly in the province of Potenza, was not less violent, and was perhaps equally destructive, though it did not attract the general attention of Europe in so high a degree. Examples of almost all known volcanic products are found among the ejections of Vesuvius or in those of older date, distinguished as belonging to Somma. (On this subject see Phillips, *Vesuvius*, London, 1869, and later editions, and in the article VOLCANOES.) The mineral resources of Southern Italy have not yet been thoroughly explored, and, though very various, they are not relatively of great present economical importance. Ores of iron, copper, lead, and silver occur; petroleum is obtained in Calabria by sinking wells; lignite, manganese, sulphur, salt, marbles, ceramic clays, and aluminiferous rock are abundant, and many of the deposits of these minerals are utilized to an extent not only sufficient to meet the domestic demand, but to furnish considerable contributions to commerce.

There are few animal or vegetable species peculiar to the Neapolitan territory, though strong-winged birds, properly African in *habitat*, are not unfrequently seen in Southern Italy, and the bear and some other of the larger quadrupeds, very rare in the more cultivated regions of the peninsula, still furnish sport for the chase. The markets of Naples and other southern cities are remarkable for abundance and variety of fish. Sardines, anchovies, and the tunny are cured in great quantities. The *Pinna marina* is common on the S. E. coasts, and its silky filaments have a certain value as a beautiful material for knit-work and even woven tissues. The red or precious coral occurs in Neapolitan waters, though most of the coral, as well as turtle-shell, so skilfully wrought by Neapolitan artisans, is from the African coasts. The only European palm, *Chamærops humilis*, is thought to be indigenous in the southern provinces of the kingdom of Naples.

The elevation of the mountains of the interior of course occasions a great range of climate. Monte Corno is said to be covered with snow nine months in the year, but the cooling influence of this and other high inland peaks and ridges is modified by the sea-breezes to which every portion of the narrow peninsula is more or less accessible, and the climate everywhere partakes of an insular character. There are very few meteorological stations in the interior, and the mean temperature and precipitation are scarcely known except at one or two observatories. From 1866 to 1872, at Catanzaro in Calabria, 10 miles from the Ionian coast, at an elevation of 1000 feet above the sea, the mean temperature was 60½° F., the extremes 26½° and 93½°; at Naples the mean was 63½°, the extremes the same as at Catanzaro; the mean precipitation at Naples was 35½ inches. (See ITALY.) Upon the whole, the climate of the Neapolitan territory cannot be said to be more unhealthy than that of other countries in the same latitude, though extensive districts in the southern provinces, anciently salubrious and densely populated, are now malarious and no longer habitable.

The agricultural products of the Neapolitan provinces are those of the peninsula generally, corn, wine, and oil being the most important. Madder and liquorice are largely grown. The almond, important for its oil as well as its kernel, the peach, the fig, and the other fruits of the cooler temperate zone are also abundant. The lemon, orange, citron, and lime, in their hundredfold varieties, grouped by the Italians under the general name of *agrumi*, have far greater prominence in rural industry than in Central and Northern Italy, where, except in some favored localities, these fruits must be treated as exotics. The culinary vegetables, which, though of great moment in domestic economy, figure little in public finance, grow luxuriantly, and Naples supplies *primeurs*, or first fruits, not only to Northern Italy, but to countries far beyond the Alpine frontier. It is an important characteristic of Neapolitan agriculture that the dryness of the summers makes irrigation necessary for almost every cultivated crop.

The clothing, furniture, and ordinary tools and implements of labor of the mass of the population are largely the product of household industry, and the laborer has few wants which his native soil does not supply; while the upper classes derive the necessaries, the comforts, and the elegancies of life in great proportion from the same industrial sources as the rest of civilized Europe. There are, however, at Naples and some other points important foundries, forges, and other mechanical and chemical establishments, which not only render the southern provinces in a certain degree independent of foreign supplies of such products, but furnish important material, among which blue vitriol and sulphuric and other acids deserve special mention, for commerce.

The seaports and the adjacent territories of the Neapolitan provinces were occupied at the earliest period of which we have precise historical knowledge by Greek colonists. The extent of these settlements was such that, though they do not seem ever to have been united in a common political organization, or to have enjoyed full possession of the inland districts, the whole of Southern Italy was regarded as essentially Greek, and was vaguely known by the general designation of Magna Græcia. Many of the cities of Magna Græcia rose to great wealth and high social culture, but internal dissensions and wars with the aboriginal populations and with each other, together with earthquakes, pestilence, and other natural calamities, reduced their power after a comparatively brief period of opulence, luxury, and strength; they became involved in entangling alliances and hostile conflicts with foreign powers, and their participation in the Pyrrhic and the Punic wars, whether as allies or as enemies of Rome, opened the door for the intervention of that powerful people in their political affairs, and finally to their conquest and incorporation into the great Italic republic. From this period they became Roman provinces, and for centuries had no longer a special common history. After the Moors had conquered Sicily, they reduced a considerable part of the southern provinces of the Italian peninsula, and plundered many rich towns, sometimes acting independently, and sometimes as condottieri or mercenary allies of the native princes and barons. The Normans tore Sicily from the Mussulmans and established themselves under different leaders in Lower Italy. In 1059 the Norman Robert Guiscard made himself duke of Apulia and Calabria. In 1130, Roger, of the same family, was crowned at Palermo king of the Two Sicilies, and soon reduced to submission the cities and provinces of Southern Italy, which had still maintained an independent government. The most noteworthy points of historical interest in the chaotic era which preceded the consolidation of the kingdom under Roger are the rise of the rocky nook of Amalfi to the rank of a great commercial state, which it held till the loss of its independence in 1059 and the contemporaneous rivalry of Pisa reduced it to insignificance; the establishment of the great medical school of Salerno, due, in part at least, to the diffusion of Saracenic culture; and the foundation of the celebrated monasteries of Monte Casino and La Cava, the important archives of both of which are now in course of publication. In 1194 the emperor Henry possessed himself of the kingdom, and it remained in the family of the Hohenstaufens till 1266, when

Manfred, the occupant of the throne and uncle of the lawful heir, Conradin, was defeated and slain by Charles of Anjou, upon whom Pope Urban IV. had bestowed the crown. Conradin was taken prisoner, and in 1268 put to death by Charles, bequeathing his kingdom to Pedro III. of Aragon, son-in-law of Manfred. The history of the war waged by Peter for the recovery of the bequest, which resulted in the expulsion of Charles and his adherents from the island of Sicily, is most picturesquely narrated by the Catalan chroniclers Ramon Muntaner and D'Esclot, and in a more philosophical spirit by Amari, in *La Guerra dei Vespri Siciliani*. The Angevine dynasty, restricted to the *dominio al di quà del Faro*, was dispossessed in 1442 by Alfonso V. of Aragon, who bestowed this territory on his natural son Ferdinand. Charles VIII. and Louis XII. of France successively attempted the recovery of the kingdom, with partial success, but in 1504, Sicily was again united with Naples under the Spanish crown, and governed by viceroys until 1713, with the exception of a short interval when a successful revolt under Masaniello temporarily liberated the Neapolitan provinces from foreign rule. The Peace of Utrecht gave Naples to the emperor Charles VI., but it was recovered by Spain in 1734 and given to the Infant Don Carlos under conditions which virtually separated it for ever from the Spanish crown. The long reign of Ferdinand IV., the successor of Don Carlos, was marked by the expulsion of the Jesuits, the conquest of the kingdom, and its erection into the Parthenopæan republic by the French, the restoration of Ferdinand, his second expulsion from his continental states, though retaining Sicily, the successive accessions of Joseph and of Murat, Ferdinand's return to Naples in 1815, and the revolt of 1821, which was suppressed by Austria. The reign of Ferdinand, though useful reforms were adopted at its commencement, was characterized by an unenlightened policy, by tyranny, by political corruption, and by cruelty in the suppression of discontents and the punishment of the instigators of revolt. After the suppression of the insurrection of 1821 the Austrian troops remained as an army of occupation until 1827, and a separate administration was created for the island of Sicily. Ferdinand, who died in 1825, was succeeded by Francis I., and in 1830 the crown passed by inheritance to Ferdinand II., popularly known as "King Bomba," from the bombardment of Messina and other towns on occasion of a revolt in 1837 and the following years. In 1847 a formidable insurrection in the southern provinces and in Sicily led to royal concessions, but which were not satisfactory. In the revolutionary year 1848 Ferdinand granted a liberal constitution to his people, which, however, he soon revoked and resumed his despotic autocracy, which he exercised with unrelenting severity, notwithstanding serious warnings and earnest remonstrances from several European powers. In 1857 a new insurrection broke out, but soon met a bloody repression. Ferdinand died in 1859. His successor, Francis II., continued his father's system of misgovernment and tyranny, but in 1860, Garibaldi, having first overcome opposition in Sicily, crossed over to the mainland, where he met little or no resistance; Francis fled from Naples, and Garibaldi on Sept. 7 entered the city as dictator, unarmed and without a military escort. The battle of the Volturno on Oct. 1 decided the fate of the kingdom, which indeed was before hardly doubtful; Victor Emmanuel II., king of Sardinia, took possession of the capital Nov. 7; the strong places remaining in the hands of Francis were soon reduced; the kingdom of the Two Sicilies ceased to exist; the annexation of its territory to the dominions of King Victor Emmanuel was sanctioned by a popular vote; and it became an integral part of the new kingdom of Italy. No satisfactory general history of the kingdom of the Two Sicilies exists, and in fact, under the former jealous governments of that country, none could be written. The historical authorities oftenest cited are Giannone, *Storia di Napoli*, of which there are numerous editions, and Colletta, *Storia del Reame di Napoli dal 1734 al 1825*, both highly meritorious works. The history of Naples must therefore be studied in the annals of foreign nations having political relations, amicable or hostile, with that state, in general histories of Italy, and in documentary collections. These, indeed, are fragmentary sources of information, and they are too numerous and diversified to be here enumerated. GEORGE P. MARSH.

Sic'ily, Island of [It. *Sicilia*; Lat. *Sicilia*, *Sicania*, *Trinacria*], the largest and most important island of the Mediterranean, lying near the centre of that sea, between N. lat. 36° 41' and 38° 18', E. lon. 12° 30' to 15° 40'. Sicily belongs to the kingdom of Italy, from which it is separated by the narrow Faro or Strait of Messina. It forms a nearly isosceles triangle, the shortest side or base fronting the E., and contains about 11,300 sq. m., or an area not far from that of Maryland in the U. S. Besides Ustica, lying 50 miles from the N. coast, and Pantellaria, 80 miles from the S. W. coast, there are two archipelagos belonging to Sicily, of which the Æolian or Lipari, consisting of twelve small islands near the N. E. extremity of the main island, has acquired celebrity from its volcanic character, Stromboli, one of the group, having been constantly in eruption during the whole historic period. The Egadi (*Ægates*), a group of three islands near the westernmost point of Sicily, are important for their fisheries.

For administrative purposes Sicily is divided into seven provinces—Caltanisetta, Catania, Girgenti, Messina, Palermo, Syracuse, and Trapani; but the island has no separate political organization, and is in all respects an integral part of the kingdom of Italy. In 1861 the population was estimated at 2,391,802, which is probably below the truth. According to the census of 1871, it was then 2,584,099.

The coast has a total development of about 700 miles. Though diversified in outline, it has few harbors suitable for vessels of great burden. Commencing at the N. E., the N. coast trends generally S. E. to near Termini, but the regularity is broken by the capes of Milazzo, Calaria, Orlando, and Cefalù. From the Bay of Termini it stretches N. W., rounding the capes of Zaffarana and Mongerbino, to the Capo di Gallo, then S. W. to the Bay of Castellamare, then N. W. to the point of the long promontory of San Vito, then by a winding course S. W. to Capo Boeo at the extremity of the island. The S. W. coast is more regular, and presents no very conspicuous salient or retreating angle. The E. coast is indented with the harbors of Syracuse, Agosta, Catania, and Messina, which latter, and Palermo on the N. coast, are the most important ports of the island, though a large trade is carried on at the small harbors of Trapani and Marsala on the W. and the roadstead of Licata on the S. W. coast. The S. E. point of the island is called Capo Passero—the N. E., Capo del Faro. Near the N. E. point of the island commences a chain of mountains of ancient geological formation, corresponding to those of Calabria. Its general direction is S. S. W. to Taormina, then turns to the W., and runs about parallel with the N. coast, and in general very near it, attaining a height of from 2000 to 3500 feet, to its culmination nearly S. from Cefalù in the Madonia Mountains, the highest summit of which, the Pizzo dell' Antenna or Pizzo di Case, rises to the elevation of 6478 feet, and the Monte San Salvatore is but 200 feet lower. There the chain breaks up, or rather divides, into three ridges, running, with diminishing height, S. W., S., and S. E., toward the southern coast of the island; but these ridges are so often interrupted that they compose rather a series of detached mountains than continuous elevations. The northern scarp of the coast-mountains is abrupt, the S. much more gradual; and in fact the general surface of the island may be considered an irregular plateau, descending from the N. or coast chain to the S. E. The S. E. portion of the island consists of gypseous and cretaceous mountains and plateaus, nowhere rising above 3000 feet, and generally much lower, and it is in this region that the famous sulphur-mines of Sicily are found.

Mount Etna is an isolated volcanic peak, resting on a base about 30 miles in diameter, and rising to the height of 10,935 feet, but the great cone is subject to change of form by eruptions, and therefore its elevation, like that of Vesuvius, is variable. The slopes are studded with cones of eruption, hundreds in number, and sometimes of considerable dimensions. One of the most remarkable features of the surface of Etna is the Val del Bove, a tremendous chasm 2000 feet deep on the E. flank of the mountain. (See ETNA, and the great monograph of Sartorius von Waltershausen on this mountain.) The Macaluba, or mud volcano, near Girgenti, and various phenomena observed on the southern coast (see SCIACCA) point, as some geologists suppose, to a renewal of volcanic activity in that region.

The minerals of Sicily correspond to the geological formations of which the island is composed. Metallic ores occur, but hardly in such quantities as to be worth elaboration. The marbles, jaspers, and agates are fine. Lignite is found, and a certain quantity of alum is produced. Amber, generally of a transparent yellow, but sometimes blue or green in color, is collected on the eastern coast, but sulphur is economically the most valuable mineral product of Sicily; and since the appearance of the oidium of the grape, against which sulphur is if not the only at least the most effectual remedy, the demand for this article of export has immensely increased.

The general surface of Sicily is very irregular, and there are no plains of any considerable extent, that of Catania being the largest. There are few lakes or ponds in the island. There is a small lake near Castro Giovanni, the ancient *Enna*, and the Lake of Lentini, though larger, is but an inconsiderable sheet of water. The flanks of Etna, and indeed of all the Sicilian mountains, were rich in

forests, but these have been greatly reduced in modern times. Eruptions—as, for example, that of 1868—have been very destructive to the forests of Etna, but those in other parts of the island, where not protected by inaccessibility of position, have been chiefly destroyed by improvident felling and abuses of the right of pasturage. The southern mountain slopes are in general bare and arid, and furrowed with channels cut by the heavy winter rains, which give rise to numerous swift torrents, *fiumare* or *ciumare*, but are neither absorbed by the soil nor collected in natural or artificial receptacles for a supply in the dry seasons. The Giarretta, formed by the confluence of the Simeto and the Gurnalunga, the Fiume Salso, the Platani, and the Belici are the principal rivers. The streams of smaller volume are altogether too numerous to be designated, though very many of them are serious obstacles to internal communication from the violence of their currents in winter, and the extreme difficulty of constructing secure bridges over them.

The slope of the surface of Sicily toward the S., and its consequent exposure to the winds from the neighboring continent of Africa, might be expected to create for it a tropical climate, but the evaporation from the surrounding seas mitigates the heat, and its condensation on the mountains of the N. coast-range furnishes a supply of water, which, badly economized as it is, serves in some degree to protect the soil from the effects of the droughts of summer. The temperature is not subject to extremes; it is agreeable except during the prevalence of the depressing sirocco; and in general it is not unhealthy, though many localities are rendered almost uninhabitable by malaria. The soil, whether of volcanic or of sedimentary origin—for alluvial formations can hardly be said to exist—is of exuberant fertility wherever a moderate quantity of water can be secured for irrigation. The agriculture generally is of the rudest and most primitive description, and the great insecurity of life and property is an almost insuperable objection to the investment of capital in rural improvements. Breadstuffs, and especially wheat of excellent quality, and leguminous vegetables are the most important articles of cultivation. The vine thrives almost everywhere, and the varieties of Sicilian wines, some of which are in great demand for exportation, are numerous. Of late years the stronger sorts are largely employed for *coupage*, or mixing with the wines of France, to which they give body and flavor. Hemp is grown in considerable quantities. Saffron and sumach, the latter especially, are of some importance in commerce. The mulberry is cultivated for the silkworm. Much manna is collected from incisions in the bark of a species of ash. The almond is extensively cultivated, as is also the olive, and the figs are good for the table, but as an article of commerce do not rival those of Smyrna. The prickly pear thrives, and its fruit enters into the regular diet of the poorer classes. In favorable situations the *agrumi*, or lemon and orange tribe, are said to be the most profitable objects of cultivation, and as the agave flourishes luxuriantly, there seems to be no reason why it should not be regularly cultivated for the beverage it yields, as in Mexico. The date palm is grown, but not for profit. The sugar-cane was introduced by the Moors, and much sugar was manufactured from it by that industrious people. In all probability the sugar-cane, as well as a great number of other sub-tropical vegetables, might again be advantageously cultivated, and substituted for tobacco, which is an economically profitable, though certainly not otherwise useful, crop.

The manufactures are not of great importance, but extensive enough and various enough for the supply of most articles of consumption required by the laboring classes. The fisheries are prosecuted with more energy than most branches of Sicilian industry. The tunny is taken and cured at various points along the coast, and sardines and anchovies are shipped to foreign ports in great quantities. The precious coral occurs, but is not abundant, and many small vessels visit the Tunisian Sea in pursuit of it.

Besides a few great highways, most of the roads in Sicily are mere bridle paths, and many large towns in the interior are not accessible by wheel carriages. A railway from Palermo to Girgenti, by way of Termini, is far advanced; another from Messina to Syracuse is completed; and another from Catania, to connect with the Palermo-Girgenti road, will be opened in the course of a few months. These will but partially supply the wants of the people, and a long time must elapse before the traveller can penetrate the greater part of Sicily without great discomfort and personal risk.

In spite of the devastations of earthquake, volcano, and malaria, few regions of the earth are more favored by nature than this island, but from moral causes these advantages have been turned to little practical account, and the populace is deplorably ignorant, indolent, and vicious. The present government of Italy has done what was practicable for the diffusion of instruction. In the larger towns the facilities for education are respectable, and it may be hoped that from these centres redeeming influences will radiate.

The Sicilian dialect much resembles that of Calabria, and indeed there is a certain family likeness in all the popular speeches of Southern Italy. The points which first strike the ear of a stranger acquainted with Tuscan are the very frequent substitution of *u* for the *o* final; the change of *ll* into *dd*, as *beddu* for *bello*; and the omission of the *u* sound after *q*, as *chistu* for *questo*. The Sicilian dialect is agreeable to the ear, and though it generally agrees with the Tuscan in vocabulary, it has nevertheless many words peculiar to itself, some borrowed from Arabic, and others from unknown sources. It can hardly be said to be a literary language, but it has ancient chronicles in the popular speech, and the modern poems of Meli, not to speak of other works *in dialetto*, are justly admired. It was long maintained that poems alleged to be the work of Sicilian bards of the twelfth and thirteenth centuries—such, for example, as those ascribed to King Enro, to the emperor Frederic, and to Ciullo d'Alcamo—written substantially in the Tuscan dialect, were the earliest existing specimens of the *lingua commune* of Italy; and that the literary tongue originated not in Tuscany, but at the court of Palermo. But we have no contemporaneous copies of these ancient poems, and the better opinion seems to be that, as we possess them, they are, if genuine, later Tuscan *rifacimenti* of Sicilian originals. (On the existing folklore of Sicily see Pitrè, *Biblioteca delle Tradizioni popolari Siciliana* (Palermo, 1875, 7 vols. 12mo), a work of much interest and value.)

The classic authors have preserved us many traditional accounts of the earliest inhabitants of Sicily, but the proper history of the island goes no further back than the colonization of the coasts by Greek adventurers, beginning, it is alleged, in the eighth century B. C., and continuing for more than 150 years, and all the civilization and culture of ancient Sicily was doubtless of Greek origin. Bucolic poetry is said to have originated in Sicily. Bion long resided in the island, and his pupil and follower, Moschus, as well as Theocritus, was a Sicilian by birth. Many of Pindar's poems belong, in subject, to Sicily. (On the relations of Sicily to Greek literature, and on the early history of the island, see T. W. Lloyd, *History of Sicily*, London, 1872, 8vo.) The Greek colonists were from many different states, and, like the emigrants of the same race in other countries, inclined little to unite in a common or national organization. The cities and their respective territories were governed by oligarchies or tyrants, and, though often at war with each other, gradually rose to great wealth and power. Near the end of the fifth century B. C. the Carthaginians, who already had trading establishments in Western Sicily, were invited by an expelled despot to interfere in Sicilian affairs, and they sent a great army to lay siege to Himera, but were defeated. In 415 B. C. Athens, which had on a former occasion taken part in the intestine dissensions of Sicily, sent a powerful force to the island, really with a view to its conquest and subjugation, though ostensibly for the protection of its allies in Sicily. The Athenians were totally defeated. The Carthaginians now invaded the island, and soon made themselves masters of a great part of it. Peace and war with the remaining territory alternated for a long time, and about the year 278 B. C. Syracuse invoked the aid of Pyrrhus, then at war with Rome, who was victorious against the Carthaginians. A few years later the Mamertines, who had possessed themselves of Messina and of much of the interior, invited the Romans to protect them against the Carthaginians. The Romans consented, and their interference in B. C. 264 was the occasion of the First Punic war. All Sicily became involved in the struggle, and the Romans soon reduced the whole island, with the exception of the Syracusan territory, which was spared by Rome for a time, but succumbed at last to that power, after a war ending with the memorable siege and capture of Syracuse in 212 B. C., when Archimedes, whose engineering skill had so long delayed the conquest, lost his life.

Sicily shared the fortunes of the other Roman provinces until the downfall of the Empire. It then passed under the dominion of the Goths, from whom it was conquered by Belisarius, and it remained a Byzantine possession till the ninth century, when a new African invasion subjected it to the Saracens. The Mussulmans held the island till it was torn from them by the Norman invasion, commencing under Robert Guiscard in 1061 A. D., and ending thirty years later by the submission of all Sicily to Duke Roger of the same family, whose son, Roger II., conquered a part of Southern Italy, and was crowned king of the Two Sicilies in 1127. On the failure of the Norman line, the

pope bestowed this kingdom on Charles of Anjou, who was expelled by the revolt of the Sicilian Vespers in 1282, and succeeded by Peter III. of Aragon. The Aragonese dynasty reigned until 1576, when Sicily, with its other possessions, was transferred to the Spanish crown. In 1706, Austria obtained possession of Sicily. The Peace of Utrecht in 1713 gave the sovereignty to Victor Amadeus of Savoy, who re-ceded it to Austria in 1717 in exchange for the island of Sardinia. In 1734, Spain obtained possession of Sicily, and in 1736 the island was reunited with Naples under Don Carlos as king of the Two Sicilies, and continued to be ruled by the same dynasty until its liberation in 1860. The possession of the island by the Neapolitan government was maintained during the wars which followed the French revolution by the fleets and armies of England, and British influence secured some improvements in its government. There were many revolutionary movements after this period, and various changes were made in the administration of its government. The revolts of 1847, 1848, and 1849 were suppressed by violence, and till the final overthrow of the Neapolitan dynasty nothing substantial in the way of reform was effected. On May 16, 1860, Garibaldi, at the head of 1000 volunteers, landed at Marsala, on the 27th entered Palermo, and captured Milazzo, after an obstinate defence, on July 20, after which he met with no serious resistance, and he soon after crossed over into Calabria and marched upon Naples. The expedition of Garibaldi was not, at its organization, avowedly a movement in behalf of the king of Sardinia; but if any doubt existed before as to its objects, they were speedily dissipated by a proclamation from the "dictator," and Sicily hastened to annex itself to the dominions of the house of Savoy.

Passing by the few remains of pre-historic constructions, the oldest of the successive Sicilian civilizations has left more abiding and magnificent memorials than any of its successors. The temples of Selinus and of Agrigentum are of a very early style of Greek architecture, and are of great interest in the history of that art. Many ruins of Greek temples are found in other parts of the island. There is little which can be ascribed to Carthaginian architects, and most of the works of Roman art have perished or been so far transformed as to render it difficult to determine their origin. The Saracenic influence is very visible in many constructions at Palermo and elsewhere, and the Normans erected or modified many churches in accordance with their peculiar taste. If, then, we cannot affirm the existence of a special Sicilian style in art, Sicily at least shows a skilful local adaptation of several foreign styles, and many of her religious and other public structures exhibit features of great excellence.

(For the history of Sicily see the authors referred to at close of article SICILIES, THE TWO, and the following, relating more especially to the island: The article "Sicilia," *Dictionary of Geography;* Pietro San Filipo, *Compendio della Storia di Sicilia* (1857); G. E. di Blasi, *Storia del Regno di Sicilia* (3 vols. 8vo); Amari, *Storia dei Musulmani di Sicilia* (Florence, 3 vols. 8vo, 1854-72); La Lumia, *Studi di Storia Siciliana* (2 vols. 12mo, Palermo, 1870); Di Giovanni, *Filologia e Letteratura Siciliana* (2 vols. 12mo, Palermo, 1871); Lo Faso, Duca di Serradifalco, *Antichità di Sicilia* (5 vols. folio). Of the older Sicilian historical writers, Fazellus, *De Rebus Siculis Decades Duæ*, is important.) GEORGE P. MARSH.

Sic'kingen, von (FRANZ), b. Mar. 1, 1481, in his ancestral castle of Sickingen, near Carlsruhe, in the present grand duchy of Baden, was one of the wealthiest and most powerful knights of his time, and was treated with much regard both by Charles V. and by the French king, Francis I. He spent all his time in feuds with his neighbors, and, having come into contact with the new religious ideas through his friend Ulrich von Hutten, he formed a plan of carrying through the Reformation by force. As the despoiling of the Roman Catholic Church of all its property, and the distribution of its estates among the knights, formed the principal points of his plan, he expected support from the nobility, and pamphlets were written and spread among the peasantry in order to arouse them too against their ecclesiastical lords. But the attempt entirely failed. One after another his castles were taken, and at last he was compelled to surrender himself, together with his last castle, Landstuhl, near Kaiserslautern. He d. immediately after, May 7, 1523. There is still one line of the family flourishing, the counts of Sickingen-Hohenburg.

Sick'le [from the root of the Lat. *seco*, to "cut"], a reaping-hook; a curved knife, usually with a toothed or serrate edge, used for cutting grain and the like. The sickle has been mostly superseded by the scythe attached to the *cradle*, and the cradle in turn has given place to the reaping-machine and the header, implements drawn by horse-power.

Sick'les (DANIEL E.), b. in New York Oct. 20, 1822; was educated at the University of New York, but, without graduating, studied law, and was admitted to the bar in 1843. He soon became identified with politics, and in 1847 was elected to the State legislature as a Democrat. In 1853 he was appointed corporation attorney of New York City, and the same year accompanied Mr. Buchanan to England as secretary of legation. Returning in 1855, he was elected State senator, and the following year was chosen member of Congress from New York City, and re-elected in 1858 and in 1860. On Feb. 27, 1859, he shot and killed Philip Barton Key in Washington for improper intimacy with his wife, and was placed on trial for murder, but acquitted. On the outbreak of civil war he raised the Excelsior Brigade, and in June, 1861, was appointed colonel of one of its regiments, the 70th New York. In Sept., 1861, he was nominated a brigadier-general of volunteers. The appointment was at first negatived by the Senate, but subsequently confirmed to date from original appointment. In the Virginia Peninsular campaign his brigade was attached to Hooker's division of the 3d corps, to the command of which corps he succeeded in Apr., 1863, having been commissioned major general of volunteers Nov. 29, 1862, and was distinguished at the battle of Chancellorsville, May 3-4. At Gettysburg he lost a leg early in the second day's fight. In 1866-67 he commanded the military district comprising North and South Carolina. On the 28th of July, 1866, he was appointed colonel of the 42d Infantry of the regular army, and in Apr., 1869, was retired from active service upon the rank of major general. In the latter year he was appointed U. S. minister to Spain, which position he resigned in 1874. He received the brevets of brigadier and major-general U. S. A. for gallantry.

Sicoliana, or **Siculiana,** town of Sicily, province of Girgenti, about 8 miles N. W. of Girgenti, in a district fertile in all the usual productions of the island. P. 5665.

Sic'yon, an ancient city of Greece, was situated in the northern part of Peloponnesus, near the Corinthian Gulf, on a steep hill surrounded with strong walls. It was originally a Dorian settlement, and sided in the Peloponnesian war with Sparta. Aratus, the famous general of the Achæan league, was born here; also Leucippus and Apelles. The city was celebrated as one of the principal seats of the fine arts in Greece. In the beginning of the Christian era it fell into decay, and very few remains are now left of it.

Sid'dons (SARAH), daughter of Roger Kemble, b. in Brecon, South Wales, July 5, 1755. She had traditions of the stage behind her inherited dramatic genius, and was familiar with theatres and theatrical people from infancy; played as a girl in her father's company; married Mr. Siddons, an actor, at the age of eighteen; made her first appearance at Drury Lane, with Garrick, as Portia in *The Merchant of Venice*, in 1775, but made no mark: retired in disappointment, but reappeared in 1782. This time she made a deep impression as Isabella in *The Fatal Marriage*, and began her career of extraordinary success. For thirty years, until her retirement in 1812, she was, in spite of jealousies, intrigues, and controversies, the queen of the English stage. Her favorite and famous characters were Lady Macbeth, Queen Constance, Queen Catharine, Jane Shore, Isabella, Ophelia, Desdemona, Portia, and Imogen—impersonations of tragic pathos and majesty. Comedy she did attempt in parts like Rosalind, but without distinguished success. To her contemporaries she was a prodigy of genius. She seemed to them on the stage a being almost supernatural. Yet in the opinion of judges her ordinary recitation was imperfect. Her effects were produced by presence, mien, attitude, expression of voice and countenance, and by intense concentration of feeling, which lifted and dilated her form, transporting her audience as well as herself. Her stature was not above that of ordinary women. Her form was beautiful, her countenance expressive, her coloring effective from the contrast of her pale complexion with her black hair and dark eyes; and all worked together in her moments of passion. The public readings she gave from Shakspeare after her withdrawal from the stage were interesting, but did not add to her fame. Her last appearance as an actress was in 1818, when she played for Charles Kemble's benefit. Thenceforth she lived in retirement, honored as a woman of stainless reputation, and respected in all the relations of life. D. in London June 8, 1831. Her portrait was painted by Sir Joshua Reynolds; her *Life* was written by Thomas Campbell. O. B. FROTHINGHAM.

Sidell, tp., Vermilion co., Ill. P. 1165.

Sidell (WILLIAM H.), b. in New York Aug. 21, 1810; was graduated from the U. S. Military Academy, sixth in his class, July, 1833, when assigned to the 1st Artillery as brevet second lieutenant, which position he resigned the

following October, and adopted the profession of civil engineering. For a time he was a city surveyor of New York and an assistant engineer on the Croton aqueduct, Brooklyn dry dock, etc., until 1837, when he became principal assistant to Capt. Talcott in the hydrographic survey of the delta of the Mississippi River, on which duty he continued two years. Subsequently he was extensively engaged in the laying out and construction of railroads in various parts of the U. S., and in 1851–52 was assistant to Maj. (now Gen.) J. G. Barnard in the exploration and survey of a railway route across the Isthmus of Tehuantepec. This work had been nearly completed when in 1852 the action of the Mexican authorities caused the withdrawal of the surveying party. In 1858, however, the Louisiana Tehuantepec Co. resumed the work, and appointed Sidell chief engineer, in which capacity he completed the location for a railway and constructed a carriage-road 110 miles long from Salina Cruz on the Pacific to Suchil on the Goatzacoalcos River. This route was operated for several months in the transportation of passengers and mails from New Orleans to San Francisco in connection with the Gulf and Pacific steamers. On the outbreak of civil war he relinquished his profession and accepted (May 14, 1861) the commission of major of the 15th U. S. Infantry, but without joining his regiment was at once assigned to duty as mustering officer in the department of the Cumberland. In July, 1862, he was detailed as acting assistant adjutant-general of that department, continuing as such until transferred to Louisville, Mar., 1863, as acting assistant provost-marshal general of Kentucky, resuming soon after the duties of general superintendent of recruiting and chief mustering officer of the State, which important offices he continued to fill until 1867, when he joined his regiment, the 10th Infantry (to the lieutenant-coloneley of which he had been promoted in 1864), with which he served in Dakota Territory until 1869, when placed in charge of the dépôt of the general recruiting service at Fort Leavenworth, Kan. While thus engaged he was stricken with paralysis, and Dec. 15, 1870, retired from active service. Returning to New York City, he lingered until July 1, 1873, when his death occurred. For meritorious and faithful services in the war he was brevetted colonel and brigadier-general U. S. army.

Sidereal System. See ASTRONOMY, by PROF. S. NEWCOMB; and STARS, by P. A. SECCHI.

Sidereal Time. See DAY.

Sid'erite [Gr. σίδηρος, "iron"], the mineralogical name for spathic iron ore. (See IRON, ORES OF.)

Si'di-Bel-Abbes, town of Algeria, province of Oran, has good bazaars and large barracks. The surrounding districts are very fertile. P. 7500, of whom about 3000 are Europeans.

Sid'i Moham'med, b. in 1803, the eldest son of Abderrahman, succeeded his father in 1859 on the throne of Morocco, and was immediately involved in a war with Spain on account of the piracies which prevailed along the coasts of his dominions; he was compelled to cede to Spain some territories and pay a very heavy war-indemnity. Another policy was now adopted. He formed alliances with the European powers, concluded commercial treaties, and attempted to introduce reforms among his subjects. But these exertions resulted only in exasperated and very dangerous insurrections. D. Sept. 20, 1873, and was succeeded by his son, Meley Hassan.

Sid'mouth (HENRY **Addington**), VISCOUNT, b. at Reading, England, May 30, 1757, son of Dr. Anthony Addington, author of some medical treatises and family physician to the earl of Chatham; educated at Winchester School and at Brasenose College, Oxford; studied law; was admitted to the bar 1784; entered Parliament the same year through the influence of the younger Pitt, who had been his friend and companion from boyhood, and to whom he gave an efficient support during his administration; was Speaker of the House of Commons from 1789 until 1801, when, on the resignation of Pitt as prime minister, he formed a new ministry, accepting the posts of chancellor of the exchequer and first lord of the treasury; directed the negotiation of the Peace of Amiens 1802; supported a war policy 1803; resigned office 1804; was raised to the peerage and made president of the council Jan. 12, 1805; was lord privy seal in the Grenville and Fox ministry 1806–07; was secretary of state for the home department 1812–22, and a member of the cabinet without a portfolio 1822–24, after which he retired from active public life, and spent his later years at Richmond Park, where he d. Feb. 15, 1844.

Sid'ney, p.-v. and tp., Champaign co., Ill., on Toledo Wabash and Western R. R. P. of v. 480; of tp. 1560.

Sidney, p.-v. and tp., cap. of Fremont co., Ia. P. of v. 817; of tp. 2521.

Sidney, p.-v. and tp., Kennebec co., Me., on Kennebec River. P. 1471.

Sidney, p.-v. and tp., Montcalm co., Mich., on Stanton branch of Detroit Lansing and Lake Michigan R. R., includes part of Stanton, the county-seat. P. 611.

Sidney, p.-v. and tp., cap. of Cheyenne co., Neb., on Lodge Pole Creek and on Union Pacific R. R., has a round-house, a repair-shop, a hotel, and a small military post. Sheep-farming is a leading industry in this vicinity. P. 369.

Sidney, p.-v. and tp., Delaware co., N. Y., on Susquehanna River. P. 2597.

Sidney, p.-v., cap. of Shelby co., O., at the junction of Dayton and Michigan and Cleveland Columbus Cincinnati and Indianapolis R. Rs., has 2 banks, several factories, a bell-foundry, flouring-mills, 2 newspapers, machine-shops, and waterworks. P. 2808.

JAS. S. VAN VALKENBURGH, ED. "DEMOCRAT."

Sidney, or **Sydney** (ALGERNON), b. about 1622, was a son of the earl of Leicester, his mother being daughter of the earl of Northumberland; in 1632 accompanied his father, who was appointed ambassador to Denmark, and four years later to France. In 1641 he served as captain of a troop of horse in Ireland, of which his father had been made lord lieutenant. When the great rebellion broke out, he and his elder brother set out to join the royal army in England; were arrested at Liverpool by order of Parliament; King Charles I. believed that this was done by their own procurement, and sharply censured them, upon which the brothers joined the Parliamentary army, Algernon being made a captain of horse in the regiment of the earl of Manchester. He was severely wounded at the battle of Marston Moor May, 1644; and in Apr., 1645, was made colonel of a regiment. In 1646 his brother, Lord Lisle, was appointed lieutenant-general of Ireland, and he was made lieutenant-general of horse and governor of Dublin; in that year he was chosen as member of Parliament for Cardiff; in 1647 he received the thanks of the House for his services in Ireland, and was made governor of Dover. In 1648 he was one of the judges at the trial of Charles I., but was not present when sentence was passed, and did not sign the warrant for the execution, though he afterward characterized it as "the justest and bravest action that ever was done in England or anywhere else." Being opposed to the protectorate of Cromwell, he retired from Parliament in 1653, but when the Long Parliament was restored in 1659, he resumed his seat, and was named one of the council of state, and was sent as one of the English commissioners to negotiate a peace between Sweden and Denmark. He was absent from England at the time of the Restoration, and not acceding to this, he lived abroad in exile for nearly eighteen years, and was often in great pecuniary straits. He labored all this time to bring about the establishment of a republic in England. In 1677 he received a pardon from the king, with permission to return to his native country; was an unsuccessful applicant for a seat in Parliament, and was considered as being in league with Monmouth, Essex, William Lord Russell, and other popular leaders. The discovery of the Rye House plot in 1683 gave the court an opportunity of ridding itself of so dangerous an opponent. He and Russell were arrested and committed to the Tower on a charge of high treason. The only witness as to the main facts charged was Lord Howard of Escrick, who by his own confession had been a party to the plot, and was ready to swear away the lives of his associates in order to save his own. The law required two witnesses to prove the alleged crime, and under the decision of the infamous chief-justice, Jeffreys, the other witness was found in a manuscript on government which had been discovered among the papers of Sidney, in which it was maintained that a people had the right to depose an unworthy sovereign. The trial was opened Nov. 7, 1683; sentence was pronounced on the 26th; and on Dec. 7 he was beheaded on Tower Hill, London, the disembowelling and quartering, which were a part of the sentence, being remitted at the last moment. Upon the scaffold he declined to speak to the people, saying that he had made his peace with God, and had nothing to say to man; but he delivered a paper to the sheriff, in which he said that he died a witness for the truth, and for that old cause in which he had been engaged from his youth. The reversal of the act of attainder was one of the earliest acts of the first Parliament of William and Mary. His *Discourses concerning Government* were published in 1698, and a 4th ed., with some miscellaneous writings, in 1772. The *Life* of Algernon Sidney has been written by Meadley (London, 1813) and Van Santvoord (New York, 1851).

A. H. GUERNSEY.

Sidney, or **Sydney** (SIR PHILIP), b. at Penshurst, in Kent, Nov. 9, 1554, was the son of Sir Henry Sidney, the

favorite of Edward VI., his mother being a daughter of the duke of Northumberland and sister of Robert Dudley, the favorite of Queen Elizabeth. At the age of ten he was placed at school in Shrewsbury, where he became noted for gravity and intelligence beyond his years. He studied at Oxford, and afterward at Cambridge, and in 1572 received a special license from the queen to go beyond the sea in order to perfect himself in foreign tongues. In Paris he was received with great favor by Charles IX., who gave him a court appointment. He came near being involved in the massacre of St. Bartholomew, and was obliged to take shelter with the English ambassador, Sir Francis Walsingham. He then visited Belgium, Germany, Hungary, and Italy, in all of which countries he was noted for his skill in knightly exercises, as well as for his fondness for literature and art. He returned to England in 1572, and, aided by the influence of his uncle, now earl of Leicester, rose to high favor at court. In 1576 he was sent on a mission to Vienna, nominally to console with the emperor Rudolph on the recent death of his father, but really to urge an alliance of all the Protestant states against the overshadowing power of Spain. Upon his return he found Elizabeth meditating a marriage with the French duke of Anjou, and addressed to her a spirited remonstrance against the match; the queen apparently took no offence at this, although many others who had opposed it were severely punished; but it would appear that his favor declined, and not long after the queen sharply rebuked him for having had the presumption to quarrel at tennis with the earl of Oxford, a nobleman, while he was only a simple gentleman. Sidney withdrew from court, retiring for a time to the seat of his brother-in-law, the earl of Pembroke, where he devoted himself mainly to literary pursuits, in which he was joined by his sister, Mary, countess of Pembroke, who aided him in a metrical translation of the Psalter, and after his death wrote an elegy upon him. Here he wrote his pastoral romance *Arcadia*, which, however, was never completed, and his *Defence of Poesie*, upon which his literary fame mainly rests. In the mean time, the queen's favor for him revived, and he took a prominent part in all pageants of the court. He fell deeply in love with Lady Penelope Devereux, whom he celebrated under assumed names in his *Arcadia* and in numerous amatory verses. In 1583 he was knighted, and married the daughter of Sir Francis Walsingham. In 1585 he wished to join Sir Francis Drake in his second expedition against the Spaniards in the West Indies, but the queen forbade this, fearing, as she said, "lest she should lose the jewel of her dominions." It is said, probably without good grounds, that the crown of Poland was offered to him. The war was now raging between Spain and the Netherlands, and Elizabeth made some show of assisting the Dutch. In 1585, Sidney was appointed governor of Flushing, and soon after was made general of horse under his uncle, the earl of Leicester, in which capacity he gave promise of much military ability. On Sept. 22, 1586, he encountered a body of the Spaniards under the walls of the town of Zutphen. Sidney had a horse shot under him, and in the third and decisive charge received a musket-bullet in the thigh, and was borne from the field. Almost fainting from loss of blood, he called for drink: a bottle of wine was brought, but as he was about to drink he saw a wounded soldier eagerly looking at the bottle. Without even tasting of it, he gave it to the soldier, saying, "Thy necessity is yet greater than mine." He was carried to Arnheim, where he d. Oct. 7, a little more than a fortnight after receiving his wound. His body was conveyed to England, where it lay in state for several days, and a general mourning, the first of the kind in English history, was observed. Sir Philip Sidney is perhaps the best English model of knightly virtues, and his character has always been a favorite theme with poets. His writings had great celebrity in their day, but they are marked by the strained and artificial style of the period. His *Arcadia* was first published soon after his death as the production of his sister, the countess of Pembroke. His *Complete Works* appeared in London in 3 vols. in 1725; his *Miscellaneous Works*, with a memoir, were published at Oxford in 1826, reprinted at Boston in 1860; his *Complete Poems*, edited by Rev. A. B. Grosart, were published at London in 1873.

A. H. GUERNSEY.

Sidney Plains, p.-v., Sidney tp., Delaware co., N. Y., on Susquehanna River, at the junction of New York and Oswego Midland with Albany and Susquehanna R. R., has 1 weekly newspaper. P. 405.

Si'don, or **Zidon,** an ancient city of Phœnicia, on the coast of the Mediterranean, in lat. 33° 34′ N., near the site of the present *Saida*, attained by its manufactures and commerce very early such a celebrity that its name was transferred to the whole country and to the nation. It had commercial stations in Sicily, Sardinia, Spain, and on the northern coast of Africa; it made expeditions to the British islands and into the Baltic; and the fame of its purple, glass, linen, gold, silver, and ivory ware was of a thousand years' standing. Its most brilliant period seems to have been between 1600 and 1200 B. C. It was afterward superseded by its own daughter-city, Tyre. It still flourished under Persian rule, but after an unsuccessful revolt against Artaxerxes Ochus in 351 B. C. it was nearly destroyed, and although it was rebuilt, it never again reached its former splendor. During the Greek, Syrian, and Roman dominion it sank more and more. During the Crusades it was alternately held by the Christians and the Saracens. In 1291 Malek Ashraf razed it.

Sidonius Apollinaris. See APOLLINARIS SIDONIUS.

Sidra, Gulf of. See SYRTIS.

Sie'bold, von (PHILIPP FRANZ), b. at Würzburg, Bavaria, Feb. 17, 1796; studied medicine and natural science; went in 1822 to Batavia as a physician in the Dutch service; accompanied in 1823 the Dutch embassy to Japan, where he stayed several years, and was enabled by his connections with Japanese officials and scientists to undertake comprehensive researches; returned to Europe in 1830; published *Nippon, Archiv zur Beschreibung von Japan* (20 vols., 1832–57), *Fauna Japonica, Flora Japonica, Bibliotheca Japonica* (6 vols., 1833–41); made a new journey to Japan 1859–62; entered on his return into communications both with the Russian and the French governments concerning their relations with Japan; founded the Japanese museum at Munich. D. Oct. 18, 1866. He also published *Urkundliche Darstellung der Bestrebungen Niederlands und Russlands zur Eröffnung Japans* (1854).—His brother, KARL THEODOR ERNST VON SIEBOLD, b. at Würzburg Feb. 16, 1804, studied medicine, physiology, and zoology; practised as a physician at Königsberg and Dantzic; was appointed professor in physiology and comparative anatomy at Erlangen in 1840, at Breslau in 1850, and at Munich in 1853; and wrote *Lehrbuch der vergleichenden Anatomie der wirbellosen Thiere* (1848; translated into English in 1854), *Wahre Parthenogenesis bei Schmetterlingen und Bienen* (1856), and *Die Süsswasserfische von Mitteleuropa* (1863). In 1849 he founded, together with Kölliker, *Zeitschrift für wissenschaftliche Zoologie*.

Siedl'ce, town of Russia, kingdom of Poland, the capital of the government of the same name, has a fine palace surrounded with beautiful gardens, distilleries, sugar-refineries, and manufactories of agricultural implements. P. 10,013. The government of Siedlce, comprising an area of 5534 sq. m., with 543,392 inhabitants, is situated to the W. of the river Bug, between the governments of Lomza, Warsaw, Radom, Lublin, Volhynia, and Grodno, and occupies nearly the same territory as the old palatinate of Podlachia.

Siege [Fr. *siège*]. Modern fortresses are of two general types—single fortresses, consisting of an enceinte and its outworks (see FORTIFICATION), and intrenched camps, consisting of the former combined with detached works. (See INTRENCHED CAMPS.) The latter may be defended simply by its garrison, or by a large army in addition to the garrison. The methods of attack will vary with these different circumstances, and may be classified as (1) siege of a single fortress; (2) siege of an intrenched camp defended by its garrison simply; and (3) siege of an intrenched camp occupied by an army.

I. The method perfected by Vauban in the latter half of the seventeenth century applied to the first case, and under ordinary circumstances, with the proper force—five or six times the garrison—was almost certain of success. This method has been employed without essential change for 200 years, and it is only within a very brief period that military engineers have found it necessary to introduce some modifications in order to adapt it to modern instruments of war. It consists, in brief, in taking up a strong intrenched position in front of the work, beyond the range of its artillery, and clearing a path thence to the interior. To do the latter it is necessary to subdue the fire of the work, to batter down a portion of the scarp, and to excavate a path by which troops can advance under cover. The occupation of the ground is called the investment. The intrenchments on the side of the work are called lines of countervallation. Sometimes defences are thrown up to guard against attack from the exterior; these are called lines of circumvallation. The covered roads constructed toward the work are called approaches, zigzags, or boyaux. To prevent their being enfiladed, they are run in a zigzag direction, each branch being so placed that its prolongation shall fall outside the salients of the collateral works. Whenever it is practicable several zigzags are pushed forward simultaneously from different points, and converge toward the point of attack. During the earlier

portions of the siege these approaches are constructed by digging a trench and throwing the earth up on the side toward the enemy, thus forming a simple trench. When within easy range of artillery, cover is more quickly obtained by placing a row of gabions and filling them with earth; this is called a flying sap. During the latter portions the excavation is pushed forward by sappers, foot by foot, under the cover of a rolling shield called a sap-roller; it is revetted with gabions, and is called a full sap. As the heads of these approaches offer an easy prey to sorties, they are united from distance to distance by lines of trench running nearly parallel to the front of attack. These are called parallels. They are arranged for infantry defence something like rifle-trenches (see FORTIFICATION), but their terre-pleins are made wider to afford means for the free circulation of troops. Each parallel should be nearer to the preceding one than it is to the work attacked, and must be within easy supporting distance from it. The number of parallels therefore depends upon the distance of the first one from the work, and that depends upon the range of the artillery. In Vauban's time there were usually three; at Sevastopol in 1854–55 there were seven. When the approaches have advanced within easy artillery-range—about the second parallel—batteries are constructed to silence the artillery of the work. When practicable, they are placed on the prolongation of the faces of the work. The artillery fire having been subdued, the approaches are pushed forward toward the crest of the glacis. In the old method, when within a short distance from it, mounds of earth, called trench cavaliers, were thrown up to command the covertway, and served to drive out the defenders. Their construction is now considered impracticable. The occupation of the crest of the covertway is called the crowning of the glacis. Here, in the old method, breaching batteries were constructed to batter down the scarp, and a gallery was excavated (see MINES, MILITARY) to lead into the ditch, the advance through the ditch and breach being continued with the full sap or by assault. In these operations the miner goes hand in hand with the sapper. He searches out and destroys the countermines, creates large craters in which the sapper can make lodgments, and is frequently employed to make the breach.

The driving of a full sap, and the establishment of these breaching batteries, in the later stages of the siege, always difficult, may be said to have become of late years impracticable, assuming always that the defence is vigorous. At Sevastopol the fortifications were not strong, their profile being that of field-works. At the siege of this place, which lasted eleven months, during which the French executed 42 miles and the English 8 miles of trenches, the approaches never reached the ditch. At the final assault the ramparts were intact, and the troops had to advance without cover, at some points more than 200 yards. The assault failed at six points out of seven, and it was the opinion of Gen. Niel, commandant of the French engineers, that the place would have been impregnable if it had been provided with good revetted scarps. This opinion, however, assumes that the scarps remained unbreached, and it is qualified by the statement that the place possessed an armament such as is only found in a great maritime arsenal, and a garrison perpetually replenished by communication kept open with the interior of Russia. Since that date further great improvements have been made in the calibre, range, and accuracy of artillery fire, as well as in small arms. It has become possible to effect the breach by indirect fire from a distance, while the difficulties of the assault have been proportionately increased. The introduction of the Gatling gun and of the breech loading musket, by means of which a thin line of troops can keep up a steady sheet of fire, has rendered impracticable the *open* assault of even slight intrenchments if resolutely defended. It has fair chance of success, however, when made from a point close up to the works, and against a garrison worn out with the labors and anxieties of a long siege, or when following closely after the explosion of a mine.

The prompt capture of many of the single fortresses of France during the Franco-German war of 1870–71 has but little bearing on the subject, as many of them were of an ancient pattern, none were in a complete state of preparation, the artillery was inferior to that of the enemy, and the defence was often lukewarm or unintelligent, or both. The method of the Germans was to observe the places by detachments until operations in the field afforded leisure for a serious effort against them, and then to plant powerful batteries at distances varying from 1 to 2 miles, and bombard them until they capitulated. The bombardment of Schlettstadt lasted 5 days; of Neu-Brisach and Fort Mortier, 5 days; of Thionville, which had been blockaded three months, 2 days; of Montmédy, after four weeks' investment, 2 days; of Longwy, which had been invested seven weeks, 9 days; of Mezières, after being observed by detachments three months, and regularly invested ten days, 1½ days; of Rocroi, 7 hours with field artillery; of Toul, after being observed four weeks by a brigade and closely invested by a division eleven days, 8 hours; of Soissons, 4 days; of La Fère, after ten days' investment, 30 hours; of Peronne, after six days' investment, two of them employed in bombardment with field guns, 7 days, etc. These facts do not militate against the value of these fortifications in themselves. Even defended as they were, they caused great annoyance and delay to the invaders, and they enabled the hastily-organized armies of France to make a defence of which otherwise they would not have been capable. Phalsburg required a blockade of over four months for its reduction, and Bitche held out to the end of the war. Verdun resisted a *coup de main* Aug. 24, was observed by detachments until Sept. 23, when it was closely invested, resisted a bombardment of 54 hours from captured French guns Oct. 14–16, but surrendered Nov. 8 without standing a regular siege, after preparations had been made for carrying it on with Prussian artillery. Strasbourg, with a garrison of 17,000 men, resisted for 51 days a besieging army of about 60,000. The attack was by regular approaches, the outworks being breached by distant fire and by mining, and the main rampart by the fire of batteries in the second parallel. These batteries, called demolition batteries, were about 800 yards from the place, and effected their purpose by indirect firing, the masonry not being visible. The crowning of the glacis was successfully accomplished, followed by the descent into the ditch. The ditches, being filled with water, were crossed by dams, or, where the water was deep, by floating bridges of barrels floored over with planks. Everything having been prepared for the assault, the garrison capitulated without waiting to receive it.*

In a vigorous defence of a single fortress the enemy will be kept at a distance as long as possible by the occupation of favorable points on the exterior. His approaches and other works will be harassed or destroyed by a concentrated artillery fire, with occasional sorties in large bodies. Counter-approaches will be run out to obtain favorable positions for enfilading his lines, and sharpshooters will be posted in small pits—called rifle-pits—well to the front, to pick off his gunners. Countermines will be prepared, and sprung at the proper time. Damage to the works suffered during the day will be repaired at night. Débris will be removed from the foot of the breach, and when the latter has become practicable it will be obstructed by crows'-feet, chevaux-de-frise, or other obstacles, and intrenchments will be thrown up to command it. If the garrison has not been overworked, the assault should be repulsed.

II. The siege of an intrenched camp, defended simply by its garrison, may take the form on an enlarged scale of the operations described above, or of a blockade. In the former case one or two of the detached works are selected for attack, and proceeded against until their capture, the difficulties being greatly magnified by the position of the artillery of the place. The siege of Belfort (Nov., 1870, to Feb., 1871) is an illustration. The works planned for the defence of this place were not all completed at the breaking out of the war, and some of the points selected for the detached works were occupied by field fortifications of the semi-permanent type. These were selected by the Germans as the point of attack. The investment was completed Nov. 3, the garrison consisting of 16,000 and the attacking force of 30,000 men, increased about the middle of January to 80,000. A bombardment was opened Dec. 3, and continued night and day until Feb. 13, during which time more than 500,000 projectiles were thrown into the place. In five days nearly every house in the city had been struck. The defence, under Col. Denfert-Rochereau, was gallant and skilful. For many weeks he kept the enemy at a distance by first occupying exterior positions, and then freely using his projectiles at long range. This kept the line of investment so attenuated that the attacking force was inadequate. Moreover, the latter was compelled to throw up lines of circumvallation against the threatening force under Gen. Bourbaki, and to use part of its artillery in defending them. The detached fieldworks were finally evacuated Feb. 3–8, the approaches having reached the ditch. Thus, after 98 days' investment and 68 of bombardment, the attack found itself just where it would have been on the first day of the siege had it not been for these fieldworks.

* European sieges have been selected for illustration in this paper rather than American, for the reason that the former were conducted against permanent fortifications constructed at great cost and intended to resist land-attacks, while the latter were conducted against earthworks or seacoast fortifications. These will be noticed further on (Section IV.).

Further operations were to be pushed against the main works, but the garrison was ordered out of the place by the French government, and turned it over to the Germans Feb. 17 and 18, Paris having capitulated Jan. 28.

III. When the intrenched camp is occupied by an army, the difficulties of forcing an entrance are greatly magnified; and if the army is not very much inferior to the attacking force, they will probably be insuperable. The method of blockade may then be resorted to, with a view to exhausting the supplies of the besieged of ammunition and provisions. Here the attack and defence consist at first of a struggle for the possession of the communications with the place. These being once all secured by the attack, their further operations consist mainly in harassing the garrison by a distant bombardment while vigilantly guarding against the introduction of supplies or reinforcements. The defence consists in keeping up a fire upon the enemy, with occasional sorties in large bodies, the object of which is to make a permanent break in the cordon, with a view to its destruction or to cover the introduction of reinforcements. The sieges of Atlanta and Richmond in the war of secession, and of Metz and Paris in the Franco-German war, are illustrations. In the cases of Atlanta and Richmond the operations were confined to the preliminary struggles for the communications. Having lost these, the defenders withdrew at their last opportunity, preferring the immediate loss of the place to the sacrifice of both place and troops a few weeks later. At Metz, although the army of Bazaine was driven into the fortress and kept there against its will, and weakened the fortress for resistance to blockade, nevertheless it offered an immense obstacle to a forced entrance. The general method of occupying the ground by the Germans was about the same both around Metz and Paris. A first line of outposts was established from half a mile to a mile from the works. These were intrenched, and were strong enough to resist small parties of the enemy, but not a heavy force. Behind these was a carefully-selected position, forming the main line. Its distance from the works depended upon the nature of the ground, and varied from 1 to 3 miles, the normal distance being 2¼ miles, or a little more than the effective range of the guns of the enemy. It was fortified by rifle-trenches and gun-emplacements of the strongest profile, strengthened by abattis or other obstacles, with occasionally an enclosed work capable of offering independent resistance. Farther to the rear central points were selected and fortified, at which the reserves were posted, and upon which the troops were to rally in case of the enemy's success in breaking through the cordon. The length of the line of investment of Metz was 24 miles, and of that at Paris 45 miles. In each case the besieging force was about 200,000 men. The holding of such lines by such numbers would have been utterly impracticable previously to the recent improvements in small-arms and the introduction of the free use of continuous lines of intrenchments. As it is, when the investment is once closed the besieging army has a great advantage over the defenders, since it can accomplish its purpose without leaving its works. The rôles are reversed, and the besieged are compelled to throw themselves against the intrenchments, where they are so sure to meet with destruction. The army in Metz was 173,000 strong, and that in Paris 500,000, many of the latter, however, worthless as soldiers. The former capitulated after 70 days' blockade, and the latter after 129 days'. The operations about these cities, especially Metz, give rise to the curious but essential question, Can one army invest and besiege another of equal magnitude? (See Bazaine.) The object of the sorties from Metz was to break through the cordon and get away with the active army, leaving the place to be held by its garrison. The fortifications aided such attempts; and if they had been mere field intrenchments which were being evacuated, the beleaguered army would have had still less chance of success. The answer, then, seems to be, Let an army somewhat demoralized by defeat simply lie dormant for a while, and it may be invested by equal numbers and taken by siege.

The blockade may be applied to a single fortress, but its chances of success will then be less favorable, for the reason that the number of mouths in the place being comparatively small, the stock of provisions may be such as to enable it to hold out longer than the requirements of the besieger will permit.

IV. For a long period in the early history of war, when the arms employed were slings and arrows, the high and thick walls of fortresses offered insuperable obstacles to a forced entrance. Sieges then were simple blockades. At a later date mining was resorted to (see Mines, Military); ramps of earth and wood were thrown up, beginning beyond the range of an arrow, and sloping upward to the top of the wall; or the battering-ram was employed to effect a breach. The method of carrying on the operation among the Greeks and Romans was as follows: The place was surrounded by a strong continuous intrenched line. In front of the point of attack a covered gallery was established parallel to the work, composed of vines. A vine was a sort of hut on wheels, about 8 feet wide, 20 feet long, and 7 feet high, with a double-sloped roof strong enough to resist anything the besieged could throw upon it, and covered with raw hides or clay to protect it from fire. It was closed in front with wickerwork (from which its name) provided with loopholes. From this parallel gallery several similar galleries were run forward, the head of each being occupied by a special vine, having an overhanging roof projecting about 10 feet to the front, under cover of which workmen levelled the ground or built up the ramp. Through these galleries the material was carried forward to fill up the ditch. When the wall was reached, the battering-ram was brought up, covered by a long hut of a construction similar to that of the vines. In great sieges these attacks were supported by square wooden towers, which were either moved up to the walls on wheels or put together on the spot; in their lower stories they contained rams; in the middle, drawbridges, which could be lowered upon the walls; and in the upper stories, parapets of hides, wickerwork, or cordage to protect slingers and archers. They were sometimes as much as 150 feet high, and had from ten to twenty stories. Towers of these dimensions, however, could not be moved. The besieged endeavored to retain a commanding position. When the ramp rose, they raised the wall opposite to it; and when the towers were constructed, they increased the height of those on the ramparts. They opposed the enemy's works by mining and inundations and by fire.

The invention of gunpowder rendered the wooden approaches and the towers useless, and the vines were at once replaced by trenches. The change in the character of fortifications (see Fortification) rendered the defence a more active one. The garrison could sally and easily envelop the head of the approach. If an outwork were taken, it was difficult to hold it, for the reason that the supports were at a distance. (At the siege of Candia an outwork was taken and retaken thirty-six times.) During the youth of Vauban the approaches were generally pushed forward to the glacis when the covered way was assaulted. A covered descent was then made into the ditch, and a breach was made by the miner. This also was assaulted. After the capture of the outworks the main work was breached and assaulted, and then the interior retrenchments. These operations were bloody and precarious. Vauban rendered them sure and comparatively safe. He secured his approaches from being enveloped by the introduction of parallels, and, avoiding assaults, accomplished his purposes by well-directed manual labor, establishing the method sketched at the beginning of this paper.

The principal siege operations during the civil war in America were the following: At Yorktown, Va. (April and May, 1862), a parallel was constructed about a mile from the works, and heavy siege batteries were established, but the enemy evacuated before the latter opened fire. This siege is interesting from the fact that it was the first struggle of earthwork against earthwork in that war. At Vicksburg the investment was closed May 19, 1863, and an assault was made and repulsed in the afternoon of the same day. A vigorous assault on the 22d having failed, it was determined to make gradual approaches. There were no engineer troops in the command, and only four regular engineer officers. Every graduate of the Military Academy below the grade of general was detailed for engineer service; practical miners were selected from the different regiments for mining; and the sapping, fabrication of gabions, fascines, etc. were executed by some pioneer companies and by details from the line. The artillery was simply the field artillery of the army and a heavy battery borrowed from the navy. There being no light mortars, wooden mortars were made by shrinking iron bands upon cylinders of tough wood and boring them out for 6 or 12 pound shells. The broken nature of the ground gave ample protection to the attack up to within 600 yards, and often to within 400 yards of the works. By the 30th of June 220 guns were in position. A line of circumvallation was thrown up to oppose the efforts of Gen. Johnston to relieve the place. On June 25 a heavy mine was sprung under one of the salients. The crater was assaulted and occupied, but the besieged, having been warned, had prepared an inner line, to which they retired. Another mine was at once begun, which was sprung July 1, blowing up an entire redan with its defenders; but the interior line was not destroyed, and no assault was made. The besieged attempted to obstruct the advance by countermines, but obtained only slight success. Occasional sorties were also made, and at one point 90 yards of trench were run out as a counter-approach. By July, the approaches had in many places reached the ditch. Orders were given to prepare the heads of approaches for the easy debouch of troops,

to widen the main approaches so that men could easily move by fours, and to prepare planks and sandbags for crossing the ditches. On July 4 the place capitulated with over 30,000 men. (For operations against MORRIS ISLAND and FORTS SUMTER and WAGNER, see those heads; also BOMBARDMENT.) In the operations against Richmond in 1864 it was found necessary to occupy Petersburg. Desperate assaults were made June 15, 16, 17, and 18, but only an outer line of intrenchments could be taken. A mining gallery was commenced June 25, and a regular siege was determined upon July 9, and work commenced July 11. Gradual approaches were attempted, but the difficulties of pushing them against a long line of strong works, which could not be enveloped and were defended by forces nearly equal to the attack, were found to be so great as to offer small chance of success. The mine was sprung July 30, the main gallery being 510 feet long, and its two branches 37 and 38 feet respectively, and the charge 8000 pounds of powder. It was followed by a badly-managed assault, which failed. Gradual approaches were now abandoned, and steps were taken to prepare the lines of investment to be held by a small force, with a view to moving the main body upon the communications which were still held by the enemy. The latter operations gradually extended the lines until in October their length was 32 miles, comprising thirty-six forts and fifty batteries. The system consisted of enclosed fieldworks placed in commanding positions at intervals of about 600 yards, connected by strong rifle-trenches, well protected by obstacles in front. Many of the enclosed works were provided with bombproofs in addition to the magazines, etc. In some parts small redoubts were placed 300 or 400 yards in advance of the main line, to ensure time for manning the latter in case of assault, the ordinary pickets not being deemed sufficient. The line extended from the Appomattox southerly and westerly, embracing two sides of Petersburg, and thence back as a line of circumvallation to the James River, thus enclosing the Army of the Potomac in a loop. The movements of the forces operating upon the communications finally rendered an assault practicable by drawing a large part of the defenders away from their works. It was given Apr. 2, 1865, and a large part of the works were captured, the defenders evacuating the city during the night which followed. The fall of Petersburg necessitated the evacuation of Richmond. In the pursuit which followed, the whole Confederate army of Northern Virginia was captured. Mention may be made of the sieges of Fort Pulaski, Ga. (see BOMBARDMENT), Apr., 1862; Corinth, Miss., May, 1862; Port Hudson, La., May, 1863; Forts Gaines and Morgan, Mobile, Ala., Aug., 1864; and Fort Blakely and Spanish Fort, Mobile, Ala., Apr., 1865. O. H. ERNST.

Sieg'en, town of Prussia, province of Westphalia, on the Sieg, has extensive manufactures of cloth, leather, paper, tobacco, iron, and steel goods. P. 11,070.

Sieg'ert (KARL AUGUST), b. at Neuwied, Rhenish Prussia, in 1820; studied painting at Düsseldorf 1837–46; travelled, and became professor at the academy in 1851. Several of his *genre* pictures—*Dinner Hour*, *Sunday Morning*, etc.—attracted much attention and became widely known.

Sie'mens (ERNST WERNER), b. at Leuthe, near Hanover, Dec. 13, 1816; was educated in the gymnasium of Lubeck and in the school of artillery and engineering at Berlin; entered the Prussian army as an officer of artillery in 1838; studied chemistry and electro-magnetism; took out a patent for electro-plating and gilding in 1841, and laid in 1848 the first submarine mines exploded by electricity; left the army in 1849, and founded, in connection with Halske, a telegraph-building establishment in Berlin, which built the telegraph lines of Russia, Spain, Brazil, Northern Germany, etc. Among the many inventions and improvements which are due to him, and of which he generally gave an account in Poggendorf's *Annalen*, are the method of determining the position of injuries in subterranean and submarine lines, of examining insulated wires, of charging subterranean and submarine conductors in order to lessen the disturbing influences of induced currents in the cables. —His brother, KARL WILHELM SIEMENS, b. at Leuthe Apr. 4, 1823, was educated at Göttingen; settled in 1843 in London as a civil engineer, and founded there in 1853 a branch of the Berlin house, with immense telegraph-building establishments at Woolwich and extensive steelworks at Landore in Wales. He invented the regenerating gas furnace, the bathometer, a pyrometer, etc., and published *On a Regenerative Condenser* (1850), *On the Conversion of Heat into Mechanical Effects* (1853), *On a Regenerative Steam-engine* (1856), and *On the Increase of Electrical Resistance in Conductors, with Rise of Temperature, and its Application to the Measure of Ordinary and Furnace Temperatures* (1871).

Sie'na [*Sena*], city of Italy, chief town of the province of the same name, covering a beautiful hill, a spur of the Chianti chain, which divides the valley of the Ombrone from that of the upper Arno. It lies in lat. 43° 22′ N., lon. 11° 11′ E., and is connected with Florence (60 miles N.) by a railway that now extends to Rome. The fine views from Siena (1100 feet above the sea) embrace a very wide and broken tract of hilly country, for the most part either highly cultivated or covered with forest-growth; but the character of the soil is such as to be readily affected by heavy rains or by the flow of torrents, and deep ravines are in this way cut in every direction through the hills, which are themselves not unfrequently washed quite bare. The climate of Siena is colder than that of most Italian towns in the same latitude, the prevailing wind being from the N. E., but it is considered very favorable for persons of strong constitutions, though not well suited to invalids. The walls are about 4 miles in circumference; the citadel occupies the N. W. corner of the town, which is entered by nine gates; and the principal streets radiate in irregular lines from the Piazza Vittorio Emanuele, a fine large open space nearly in the heart of the city. The public buildings of Siena are very remarkable. The Duomo, or Chiesa Metropolitana, one of the wonders of Italy, stands on an elevation not far from the centre of the town. The original plan of this edifice, begun early in the thirteenth century on a stupendous scale, has not been carried out, the present church being only a transept of the first design, but as it now stands it is one of the finest existing specimens of Italian Gothic architecture. Its length is about 300 feet, with a mean width of 120 feet. The western façade, especially, is of great richness; and, indeed, Italian genius has lavished all its resources both on the external and internal decoration of this magnificent temple. The effect of the interior is peculiarly picturesque, partly from the horizontal layers of black and white marble of which not only the walls, but even the columns, are composed, and partly from the roofing, which is a vault of blue studded with stars. The pavement is also a remarkable feature. It is of marble inlaid in various styles, the work of different artists from the fourteenth to the sixteenth century, the most distinguished of these being Beccafumi (1517). He produced figures of surprising grace and beauty by using white marbles for his lights, gray marbles for half-tints, and black for dark shadows. The marble pulpit is adorned with some of the finest reliefs of N. Pisano and his school. The bronze tabernacle, the intarsia of the stalls and about the high altar, the pictures by Duccio (1300), several early works of Michelangelo, the celebrated frescoes of Pinturicchio (1502) representing scenes from the life of Pius II., the fonts, the vases for holy water, the large collection of old choir-books exquisitely adorned with miniatures, may be mentioned from among the countless other objects of the highest interest to the student of art. Nor is the artistic wealth of Siena limited to the Duomo. In the church of S. Agostino and in several others, in the ex-convent of S. Domenico, and in many private palaces there are choice pictures by Spagnoletto, Perugino, Lippo Memmi, Salimbeni, Baltasar Perruzzi, etc., and above all by the celebrated Sodoma or Bazzi, whose works are nowhere so well studied as in Siena. Among the palaces should be noticed the P. Tolomei (1205) and the P. del Governo, one of the grandest in Tuscany. The Academy of Fine Arts is very rich, especially in pictures of the Sienese school; Segna, Duccio, the two Memmi, Lorenzetti, Sano, Signorelli, Beccafumi, Sodoma, Pinturicchio, are all seen here to great advantage. The University of Siena shows its records as far back as 1240, and claims a still earlier origin.

Siena (*Sena*), though settled at a remote period, remained an obscure village until about the time of the emperors, when it was raised to the dignity of a *colonia*, with the name of *Sena Julia*. As early as the reign of Charlemagne it was governed by a count. In the disputes between the papacy and the German emperors Siena at first took the side of the former, and, like its neighbors, Florence and Pisa, developed into an independent commonwealth. Its internal history also exhibits the same struggle on the part of the nobles for power and of the people for liberty, as they understood it, and the same deadly feuds between the aristocratic families themselves. In the beginning of the twelfth century the chief authority was exercised by the bishop in conjunction with one consul; but soon after, the number of consuls was increased, and by degrees the whole power was vested in them. The first of the many wars between Siena and Florence occurred in 1141–45 for the fortress of Marturi (Poggibonsi), and though the Florentines were the victors, Siena still continued to increase rapidly in population and wealth. In 1186, Siena joined the other large Tuscan commonwealths in their resistance to Henry, son of F. Barbarossa, but after some brilliant successes was reconciled to the emperor with large privileges, and thence-

forward it continued, for the most part, steadfastly Ghibelline. Not long after this, a successful democratic movement was made to compel the selection of a certain proportion of the consuls from among the *guilds*, and a powerful party was thus formed against the aristocracy. The prosperity of the city, however, advanced rapidly and steadily. In 1220, Siena contained 11,800 families, and in the course of the two following centuries the population is said to have risen to 200,000 persons. In 1260 took place the famous battle, at Montaperti, between the rival republics of Florence and Siena, where the latter won a victory which the Sienese of to-day talk of with pride. The consuls were succeeded (1233–40) by a governing body called the Twenty-four. These were followed (1285) by the Nine, who after seventy years became odious in their turn, and a magistracy of Twelve was appointed (1355). So detested was the rule of the Nine by the citizens that after their fall the use of the numeral 9 was forbidden, 4 + 5 being substituted for it. In the mean time, quarrels among the nobles themselves were growing more and more bitter, thus adding to the already existing confusion. An awful plague, known as the "black death," broke out in 1348, and continued to reappear until toward the close of the century. During the first year of this frightful malady 80,000 persons are said to have perished in the city and territory of Siena. After various other changes in the names and powers of the chief magistracy, the government of the commonwealth fell into the hands of Pandolfo Petrucci (1480), who continued successfully to direct public affairs until 1512. After his death, his family were not strong enough to contend against the overwhelming power of the Medici, who by the help of the Spaniards annexed Siena to the territory of Florence. From this time its history is almost one with that of the rest of Tuscany. There is at present little activity of any kind in Siena, and its actual population numbers only about 23,000. CAROLINE C. MARSH.

Sien'na [It. *terra de Siena*, "earth of Sienna"], an ochreous earth which when ground forms an excellent pigment called raw sienna, and when burnt assumes a still richer orange-red tint. It is brought from Italy.

Sier'ra, county of N. E. California, adjoining Nevada, watered by North and Middle forks of Yuba River, consists chiefly of mountains and elevated valleys of the Sierra Nevada, has several peaks above 8000 feet in height, contains vast masses of volcanic scoria and heavy forests of redwood and pine, and important gold-mines, quartz-mills, and a few saw-mills. Agriculture is little practised. Cap. Downieville. Area, 830 sq. m. P. 5615.

Sierra City, p.-v., Sierra co., Cal. P. 686.

Sier'ra Leo'ne, a British possession and colonial settlement on the western coast of Africa, in lat. 8° N., consists of some islands and a peninsula, bounded N. by Sierra Leone River and S. by the Bay of Yawry. Its boundary toward the interior is somewhat undefined, yet its area is given at 468 sq. m. P. 55,374. The soil is fertile, especially in the low coastland, but the climate is extremely hot and unhealthy, especially in the wet season, when there falls more rain in two days in Freetown, the capital of the colony, than in a whole year in England. All tropical plants and fruits grow luxuriantly, and palm oil, pepper, ginger, gum-copal, groundnuts, etc. are exported. Sugar, coffee, indigo, and cotton have been introduced, and succeed well. The settlement was made in 1787 with a merely philanthropic purpose, the idea being to form a home, or at least a place of refuge, for free negroes, but in spite of its climate, which is very unhealthy for Europeans, the colony is steadily growing. The total value of its exports amounted in 1872 to £328,000, and of its imports to £306,000.

Sier'ra Ma'dre, the name of one of the principal mountain-ranges of Mexico, commencing a little N. of the City of Mexico and extending from lat. 19° to 25° N. Between lat. 26° and 32° N. is found an extensive depression, which by some is considered as forming the division between the Sierra Madre and the Rocky Mountains. Yet the range extending in New Mexico between lat. 34° and 38° N. still bears the name of Sierra Madre. As a whole, these ranges are not well explored; in some places they contain very rich silver deposits.

Sier'ra More'na, a mountain-range of Spain, separates the basin of the Guadiana from that of the Guadalquivir, and extends between lon. 3° and 4° W. Its aspect is generally rugged and sombre; its highest peak is Aracena, 5500 feet high.

Sier'ra Neva'da, a mountain-range of Southern Spain, extends between the basin of the Guadalquivir and the Mediterranean. Its highest peaks are Mulhacen, 11,658 feet, and Veleta, 11,387 feet, and it has received its name from its being covered on many of its peaks with everlasting snow and ice. Its southern slopes are clad with chestnut forests, olive and orange groves, and vineyards.

Sier'ra Neva'da [Sp. for "snowy range;" the word *sierra* means "saw," and refers to the notched outline of the mountains as seen against the sky], a range of mountains in California, continuous northward with the Cascade Mountains, and southward of the San Joaquin Valley, uniting near the Tejon Pass with the Coast Range. The Sierra Nevada extends along the E. border of the State. It is not a single range, but an aggregate of ranges, on an average some 70 miles wide. The principal lines of crests are distinguished. Numerous peaks reach an elevation of 10,000 or 15,000 feet. Among these are Lassen's Butte (10,577 feet), Pyramid Peak Mountains, Whitney (15,088), Dana (13,227), Brewer (13,886), Tyndall (14,386), Lyell (13,217), Shasta (14,444), Williams (14,500), and many others. The Sierras are remarkably broken by cañons. Quartz-mining for gold, the cutting of timber, and the pasturage of sheep are important industries in these ranges. The Sierras are crossed by Central Pacific R. R., and are famous for their wonderfully sublime scenery.

Sieyès' (EMMANUEL JOSEPH), commonly known as the **Abbé Sieyès,** b. at Fréjus, department of Var, France, May 3, 1748; was educated for the Church at the seminary of St. Sulpice, Paris; took orders and became vicar-general and chancellor to the bishop of Chartres in 1784. He had attained some reputation in the circles to which he belonged as an enlightened mind and an acute thinker when suddenly, in Jan., 1789, he attracted the attention of the French people by his celebrated pamphlet, *Qu'est ce que le Tiers État?* and having been elected a member of the States General by Paris, he became for some time the actual leader of the Assembly and originated some of the first and most decisive steps toward the Revolution. He proposed that the three estates should examine their credentials in common, that the third estate should constitute itself as a national assembly, etc.; and his pamphlet, *Reconnaissance et Exposition des Droits de l'Homme et du Citoyen* (July, 1789), was the precursor and immediate occasion of the declaration of the rights of man. The new administrative division of France into departments and the abolition of the old provincial system, with its many feudal remnants and artificial barriers, were also due to him. Nevertheless, as the Revolution ceased to be a philosophy and became a passion, Abbé Sieyès lost his influence. In the Convention he sat silent, though he voted for the death of Louis XVI. without any appeal to the people, and during the Reign of Terror he entirely disappeared from public life. After the fall of Robespierre he returned, was successfully employed in several diplomatic negotiations, and became a member of the Directory May 16, 1799; and it was he, as much as if not more than Gen. Bonaparte, who prepared and carried through the revolution of Nov. 9, 1799, by which the Directory was overthrown and the consular government instituted. Very soon, however, after the accomplishment of the Revolution he discovered that the military force which he had called to his aid felt and acted as the real victor, and of his elaborate constitution, the work of all his wisdom, the pride of his whole life, very little notice was taken. In order to avoid any further humiliation he retired from his consulship and took part henceforward very little in politics. Napoleon made him rich, a count, a senator, etc., and seemed to have partiality for this *idéologist*. After the Restoration, Sieyès was banished from France as a regicide, and removed to Brussels. After the revolution of 1830, he returned to Paris, and d. there June 20, 1836. Boulay published in 1836 *Théorie constitutionelle de Sieyès*, drawn from his *Mémoires inédits*. There are also *Études Sieyès* by Mignet (1836) and Beauverger (1851).

Si'gel, p.-v., Big Spring tp., Shelby co., Ill., on Chicago division of Illinois Central R. R.

Sigel, tp., Huron co., Mich. P. 181.

Sigel, tp., Brown co., Minn. P. 379.

Sigel, tp., Chippewa co., Wis. P. 123.

Sigel, tp., Wood co., Wis. P. 219.

Sigel (FRANZ), b. at Zinsheim, Bavaria, Nov. 18, 1824; graduated in the military school at Carlsruhe; became an officer in the army of the grand duke of Baden, in which he attained the rank of adjutant 1847; took part in the revolutionary movement of 1848; resigned his rank in the army; was appointed minister of war by the revolutionary authorities June 1, 1848; took part in the unsuccessful campaign against the Prussians; concentrated the demoralized remnants of his forces in the fortress of Rastadt; withdrew into Switzerland on the dissolution of the provisional government July 11, but, being expelled by the Swiss government, embarked for the U. S.; was for some years teacher of mathematics in an academy in New York,

and became major of the 5th regiment of New York militia; settled in St. Louis, Mo., 1858, as professor in a college; was commissioned early in 1861 colonel of the 3d Missouri Vols.; took part in the capture of Camp Jackson; fought the desperate battle of Carthage July 5; was second in command under Lyon at Wilson's Creek, Aug. 10; conducted the retreat from Springfield to Rolla; was thereupon commissioned brigadier-general to date from May 17; commanded a division under Fremont in his campaign in Southern Missouri; took an active part in the battle of Pea Ridge, Mar. 6-8, 1862; tendered his resignation in May, in consequent of unpleasant relations with Gen. Halleck, in command of the district; was summoned to Washington; made major-general, dating from Mar. 21; was placed in command of Harper's Ferry June 2; succeeded to the command of Gen. Fremont's army corps June 26; served under Pope in his Virginia campaign, taking a prominent part in the second battle of Bull Run, Aug. 29–30; was placed in command of the 11th army corps Sept. 14, 1862; became commander of the department of West Virginia Mar., 1864; was defeated by Breckenridge at Newmarket May 15; relieved from command shortly afterward by Gen. Hunter. Since the war he has resided in New York City, where he was chosen register Nov., 1871, and has taken part in the political movements of 1876.

Sigh'ing. The act of sighing consists of a full, long, and slow inspiration, which is immediately followed by a more rapid expiration unusually prolonged, and characterized by the presence of the sound of the air as it passes out of the mouth. Although usually a reflex act, excited by a slight and almost imperceptible sensation due to imperfect aëration of the blood, sighing is often voluntarily performed. It ordinarily takes place about once in every six respirations, but when the attention is concentrated upon some subject of great interest, the reflex excitability is diminished for the time being, and then, when the mind becomes disengaged, the act of sighing is so prominent as to attract at once not only the notice of the individual, but of those around him. The object of sighing is therefore to aërate the blood more perfectly than ordinary respiration, and through it the lungs are more effectually filled and emptied than would be the case were the breathing uniformly regular. Sighing is also a means of expressing certain emotions, particularly those of a sorrowful and tender character. In this relation it is to a certain extent under the operation of the will, and may be assumed, like smiles and tears, for purposes of deception. Figuratively, the act of sighing is often associated in our minds with desires, and we are said to sigh for the objects of our wishes. But the connection is in reality not primary. We sigh not because we desire anything, but because during the concentration of the mind upon a subject or object of engrossing interest, we are for the time incapable of appreciating the sensation which prompts us to inspire air until it becomes overwhelming, and then the long-drawn sigh takes place. Sighing is not peculiar to the human species, but is a normal phenomena of respiration in all mammals, and perhaps in other classes of animals.

William A. Hammond.

Sight. See Vision, by Pres. F. A. P. Barnard, and Ophthalmology, by C. R. Agnew, M. D.

Sight, Defects in. See Appendix.

Sigilla'ria [Lat. *sigillum*, a "seal," referring to the numerous marks left by the leaf-stalks], a genus of fossil trees of the coal-measures of the true Carboniferous era. Trunks have been found 5 feet in diameter and 70 feet long. There is some doubt as to whether it was a cycad, a tree-fern, or a giant club-moss, but the latter opinion prevails at present. The roots called *Stigmaria* belong, at least in some instances, to this genus.

Sig'ismund, emperor of Germany 1411–37, the last of the house of Luxemburg, b. Feb. 14, 1362, a son of the emperor Charles IV.; received after his father's death (1378) the margraviate of Brandenburg, while his elder brother, Wenceslas, king of Bohemia, succeeded as emperor. Having been betrothed to Maria, the eldest daughter of Louis the Great, king of Hungary and Poland, he became heir-apparent to these two crowns. But on the death of Louis (1383) the Poles chose his younger daughter, Hedvig, queen, Charles Durazzo seized the regency in Hungary, and Maria was kept in captivity by John Horvath, ban of Croatia. Sigismund succeeded, however, in rescuing and marrying her, and was crowned king of Hungary in 1387. He now undertook a war against the Turks, supported by the German and French chivalry, but was completely routed at Nicopolis (1392) by Bajazet, fled to Greece, and found, when in 1401 he returned to Hungary, his queen dead, his throne occupied by Ladislas of Naples, and his brother deposed in Germany, and vindicating himself only with difficulty in Bohemia. Nevertheless, he succeeded once more in turning his fortune. In 1403 he expelled Ladislas, and again took possession of the throne of Hungary, and in 1410 was even elected emperor of Germany. In 1414 he induced Pope John XXIII. to convoke an œcumenical council at Constance in order to reconcile the Hussite party with the Church. He gave Huss a safe-conduct to the council, but he broke it: Huss was burnt, and the Hussite war commenced, which did not end until shortly before his death (Dec. 9, 1437). His uncontrollable impetuosity and entire lack of consistency spoiled even his good plans, and drove him into senseless and infamous undertakings. He was succeeded by his son-in-law, Albert II. of Hapsburg.

Sigismund, the name of three kings of Poland of the Jagellonian dynasty: Sigismund I., the Great, b. Jan. 1, 1467, a son of Casimir IV., was chosen duke of Lithuania in 1506, and succeeded in the same year his brother Alexander on the Polish throne. He was very successful in repelling the invasions along the eastern and southern frontiers by the Russians, Tartars, Moldavians, and Wallachians, defeating them severely time after time. No less successful was his internal administration. He understood how to curb the arrogant nobility; was prudent in his expenses, and a patron of literature, which flourished highly under him and his son; and he favored the Reformation, which from Germany spread rapidly among the Poles. After the death of his first wife, Barbara Zapolska, he married Bona Sforza of Milan, an intriguing, avaricious, and licentious creature, who exercised great influence on him, and partly averted the love of his subjects from him. D. Apr. 1, 1548, and was succeeded by his son, Sigismund II., Augustus, b. Aug. 1, 1520, who, although educated purposely by his mother in effeminacy and dissoluteness, turned out much better than was expected, and especially opposed the ambitious schemes of the queen-dowager with great decision. In 1553, Bona left Poland, carrying with her an immense treasure, but was cheated out of her money; thus, Philip II. of Spain borrowed 320,000 ducats of her, which he never repaid; and in 1555 she was poisoned at Bari, Italy, by one of her paramours. At the Diet of Lublin (1569) Sigismund succeeded in uniting Lithuania firmly to Poland, and at the Diet of Warsaw (1572) he granted religious liberty. Volhynia and Podolia were also incorporated, and his reign was, in both external and internal respects, a period of great prosperity. D. July 18, 1572, and with him the male line of the Jagellonian dynasty became extinct. But his sister, Catharine, who was married to John III., king of Sweden, had a son, Sigismund, who with a view to the Polish succession was educated in the Polish language and the Roman Catholic faith. After the death of Stephan Báthori (1587) he also succeeded in being elected king of Poland as Sigismund III., and was crowned at Cracow; but the great expectations which the Polish people connected with this the last scion of the Jagellonian house were sorely disappointed. He was proud, dull, sour, and lived in indolence and seclusion, surrounded by Jesuits. His only passion was to unite Sweden and Poland, in order to re-establish Romanism in the former and suppress the Reformation in the latter. In 1592, John III. died, and Sigismund succeeded him as king of Sweden, but in 1604 he was formally deposed by the Swedish estates, and his uncle, Charles IX., raised to the throne. Unwilling to give up his claims, he then began that long series of wars with Sweden which contributed not a little to the final ruin of Poland. His relations to Russia, where he supported the false Demetrius; to the Cossacks, whom he attempted to convert to the Roman Catholic Church; to the Turks, whom, however, he defeated at Choczim in 1621, were equally awkward, and in the interior his fanaticism and violence called forth one dangerous insurrection after another. D. Apr. 30, 1632.

Sigmaringen. See Hohenzollern.

Sign [Lat. *signum*], in algebra, a symbol indicating a relation subsisting between two quantities or an operation to be performed; of the latter, those most commonly used are: $+$, denoting addition; $-$, subtraction; $\times$, multiplication; $\div$, division; $\sqrt{\ }$, square root; $\sqrt[3]{\ }$, cube root; $\sqrt[n]{\ }$, *n*th root, etc. The signs denoting relations are: $=$, equal to: $>$, greater than; $<$, less than, etc. (See Algebra.)

Sign, in astronomy, a portion of the ecliptic, containing a twelfth part of the complete circle, or thirty degrees. The first sign commences at the point of the equator through which the sun passes at the time of the vernal equinox; and the signs are counted onward, proceeding from W. to E., according to the annual course of the sun around the circle. The signs and their characters are as follows:

♈, Aries, *Ram.*	Spring.	♋, Cancer, *Crab.*	Summer.
♉, Taurus, *Bull.*		♌, Leo, *Lion.*	
♊, Gemini, *Twins.*		♍, Virgo, *Virgin.*	

♎, Libra, *Balance.* ♏, Scorpio, *Scorpion.* ♐, Sagittarius, *Archer.*	Autumn.	♑, Capricornus, *Goat.* ♒, Aquarius, *Waterman.* ♓, Pisces, *Fishes.*	Winter.

The first character, ♈, indicates the horns of a ram; ♉, the head and horns of a bull; ♊, the ancient statues of Castor and Pollux; ♋, the claws of a crab; ♌, a corruption of the Greek letter Λ, initial of Λέων, "lion;" ♍, corruption of παρ for παρθένος, "virgin;" ♎, scales; ♏, the tail of a scorpion, or the legs and tail; ♐, an arrow; ♑, for τρ, initials of τράχος, "goat;" ♒, running water,; ♓, two fishes joined. (See ZODIAC.)

Si'gna, town of Italy, province of Florence, on the Arno, about 11 miles W. of the city of Florence. It was fortified as early as the fourteenth century; the walls and turrets are still standing. P. 7222.

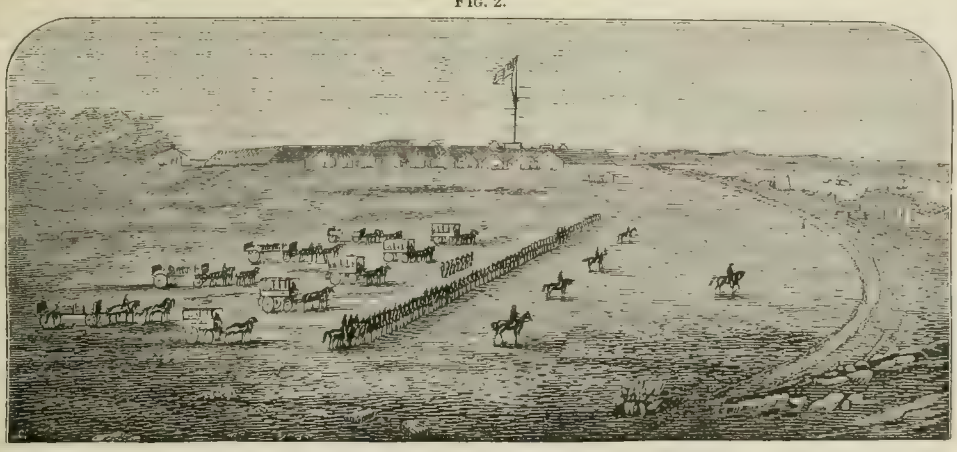
Signal Service. The necessity of some means of communication in military service at distances beyond the reach of the human voice led to the organization of signal corps at very early periods. Polybius, about 200 years B. C., refers to the wonderful skill attained by the signal service of his day. At a later period semaphores were adopted for use with armies, and systematized codes of flag-signals for use with fleets. The invention of the electric telegraph greatly developed organizations of this description, and telegraph corps are now attached to almost all armies, and field-signals are widely used as an indispensable auxiliary. Under the system adopted for use in the army and navy of the U. S., devised by Gen. Albert J. Myer, messages written in words or characters in any language or of any description can be sent by signals by day or night as far as one man can be made by any means (by the use of the telescope or by being placed on high towers, etc., erected for the purpose) to see another. The apparatus used in the signal service of the U. S. army is light and portable; it can be carried in the hand, on foot, or on horseback. Signals conveying messages are made by motions of flags by day or by torches by night; heliographs, for signalling by sun-flashes, are used also, or many varieties of apparatus may be employed. Fig. 1 represents a signal soldier equipped ready for work.

To transmit a message of any character by the use of flags or torches a distance of 10 miles would now be considered easy. Ranges of from 16 to 20 miles are often reached, and on the Western prairies messages have been transmitted from 25 to 30 miles by flags. Ranges of 90 miles have been attained in British India by means of the heliograph. In times of war, systems of reports are organized to cover extensive sections of territory. In some instances communication can be had from stations on elevated points over the heads of an enemy.

FIG. 1.

The general service of a signal corps should be so conducted that it may offer a body of educated and skilful officers, practised in the duties of reconnoissance, the studies that pertain to them, and the habit of making condensed reports; skilled also in the arts of cryptography, telegraphy, and semiology. Signal parties should be armed as cavalry; and as cavalry has been styled the eyes and ears of an army, men of the signal service should aim to make themselves the army's eyes and ears and tongue. The chief signal officer with an army ought to stand in the light of a confidential secretary to the general commanding.

FIG. 2.



In time of war the signal service of the U. S. army is equipped to maintain communication by signals, by telegraph, or by semaphores between different portions of an army or armies, or between armies and fleets. The field-telegraph trains of the signal service are organized for use with armies; they are managed by soldiers, who are drilled to march with, manœuvre, work, and protect them. The train carries light or field telegraph lines, which can be very quickly erected or run out at the rate of 2 or 3 miles per hour: they can be put in use for any distance, and be as rapidly taken down, repacked, and marched off with the detachment to be used elsewhere. Fig. 2 represents a train ready for movement.

In time of peace, the signal service transmits intelligence in reference to storms or approaching weather-changes by the display of signals of warning and by reports posted in the different cities and ports of the U. S. Maps showing the state of the weather over the U. S. are exhibited at board-of-trade rooms, chambers of commerce, and other places of public resort. Bulletins of data for all the stations are also prominently displayed and distributed without expense to the leading newspapers.

Signal stations are also established in connection with the life-saving stations. These stations are connected by telegraph, and, in addition to displaying storm-warning signals and making the usual meteorological reports, make special reports upon the temperature of the water, tempests at sea, the sea-swell, etc. They also summon assistance to vessels in distress from the nearest life-saving stations or from the nearest port. Fig. 3 represents one of these stations.

Stations for river reports, to give notice of the conditions of the rivers affecting navigation and floods, are also established on the principal interior rivers and their tributaries.

The officers and men of the signal service are instructed for the different branches of the service at Fort Whipple, Va., and at the central office in Washington, D. C. They are taught signalling in all its branches, telegraphy, the use of the various meteorological instruments, the modes of observing, and the forms and duties required at stations of observation; the force is also drilled with arms, with the field-telegraph train, the construction of permanent telegraph lines, and in the usual duties of soldiers. For the duties of the observation of storms and for the display of storm-signals all stations communicate directly with the signal-office in Washington over telegraphic circuits arranged with the different telegraph companies, or connecting with the office at fixed hours each day and night. Each station is equipped with the following instruments: barometer, thermometer, maximum thermometer, minimum thermometer, Robinson's anemometer with electrical attachment and self-registering

apparatus, hygrometer, wind-vane, rain-gauge, and at stations located on rivers, lakes, or sea-coasts, thermometers

FIG. 3.

for taking the temperature of water at different depths. The readings of these instruments, made three times a day at fixed hours, are reported to the central office in cipher. These reports from the stations of observation, extending over territory reaching from the Atlantic to the Pacific oceans and from the Capes of Florida into British America, are not unfrequently concentrated at the central office in the space of forty-five minutes. The stations at which cautionary signals are displayed are equipped with flags and apparatus for exhibiting the cautionary day or night signals.

Four graphic charts are prepared at the central office on the receipt of each report, as follows:

I. A chart of barometric pressures, temperatures, and winds, together with the wind-velocities at the different stations, and the precipitation occurring: it exhibits the barometric pressures and the temperatures in their relation to districts and to each other by a system of isobaric and isothermal lines, and the wind-directions by arrows at the different stations.

II. A chart of the cloud-conditions prevailing over the U. S., on which the different varieties and amount of clouds visible at the different stations appear by symbols; on this chart is also indicated the weather as reported at each station, the direction of movement of upper and lower clouds, and each morning the minimum temperature of the preceding night in relation to districts of territory.

III. A chart showing the relative humidities over territorial districts with the temperature at the several stations; this enables studies to be made for territorial sections, the difficulties attending studies of this character being obviated to a very considerable degree by the inter-corrections of the stations among themselves, and by the great extent of the regions over which the readings are simultaneously made.

IV. A chart of barometric pressures, exhibiting, for purposes of reference, by lines of no variation, the districts of territory over which the barometric pressure has increased, and those over which it has diminished in each average period of eight hours in the twenty-four hours, terminating at the hour of the report.

In the study of the charts for the reports the well-known rules and generalizations established by the experience of meteorologists are used. The published office report, based upon each general report of observations, consists of a synopsis of the meteoric conditions prevailing over the territory of the U. S. at the time of the report, and a statement of the changes likely to occur within the next twenty-four hours. For the purposes of convenient study and of condensed description the territory of the U. S. is arbitrarily divided into districts. These districts are described and named as follows, and the italics are those names used in the press reports of the "weather probabilities:"

Maine, New Hampshire, Vermont Massachusetts, Connecticut, and Rhode Island as the *New England States*.

New York, New Jersey, Pennsylvania Delaware, Maryland, District of Columbia, and Virginia as the *Middle States*; and that part of those States lying E of the Alleghanies as the *Middle Atlantic States*.

North Carolina, South Carolina, Georgia, and Northern and Eastern Florida as the *South Atlantic States*.

Eastern Mississippi, Alabama, and North-western Florida as the *Eastern Gulf States*.

Western Mississippi, Louisiana, and Eastern Texas as the *Western Gulf States*.

Sometimes the South Atlantic States, Eastern Gulf, that portion of Mississippi not included in the Eastern Gulf States, with Tennessee and Kentucky, are grouped together as the *Southern States*.

Lower Lakes means Lakes Erie and Ontario, with adjacent territory.

Upper Lakes means Lakes Superior, Huron, and Michigan, with adjacent territory.

The *Lake region* includes the Upper and Lower Lakes.

The *extreme North-west* includes that portion of Dakota lying W. of the Missouri River, and the eastern portion of Wyoming and Montana Territories.

The *North-west* means the country lying between the Mississippi and the Missouri rivers.

The *South-western States* means that portion of the Western Gulf States lying W. of the Mississippi River, and including Arkansas.

Pacific States includes California, Oregon, and Washington Territory.

The *Ohio Valley* includes the belt of country about 200 miles broad from Pittsburg to Cairo.

The *Upper Mississippi Valley* includes the belt of country about 200 miles broad from St. Paul to Cairo.

The *Lower Mississippi Valley* includes a belt of country 200 miles broad from Cairo to Vicksburg. Below Vicksburg the character of the country so changes that it is no longer described as a valley.

The *Missouri Valley* includes a belt of country 200 miles broad from Fort Sully to St. Charles, Mo.

The *St. Lawrence Valley* includes a belt of country 200 miles broad from Lake Ontario to the mouth of the St. Lawrence River.

The extensions "from Missouri to Ohio," etc., etc., refer to areas reaching to and including the central portions of the States named. Thus a report, "Westerly winds extending from Iowa to Pennsylvania," would signify that those winds would be felt in the interior of those States, as well as over the territory lying between them of the respective States.

In "*the Coasts, etc.*" is included the land between the coasts and the parallel range of coast-hills or mountains. In Texas, Louisiana, and Northern Florida a belt of land extending 100 miles inward would be included.

The reports are those of readings of the different meteorological instruments, made as nearly simultaneously as possible. The reports from all the stations, received at the central office thrice daily at intervals of about eight hours, are at once entered graphically upon synoptic charts (the weather-maps), and from the study of these charts a deduction is had as to probable weather-changes within the ensuing twenty-four hours. This deduction is furnished to the press, and is telegraphed to twenty-one centres of distribution in bulletin form for the use of farmers, besides being given to the Associated Press for distribution throughout the U. S. The bulletins distributed to the twenty-one centres are displayed at post-offices in numerous villages in the agricultural districts. In the case of serious storms noticed as approaching the lakes or threatening any part of the sea-coast, cautionary signals are ordered at the central office to be displayed at the different lake- and sea-ports and upon the coasts as a warning to mariners. The cautionary signal is a red flag with a black centre by day, and a red light by night. This signal when displayed signifies (1) that from the information had at the central office in Washington a probability of stormy or dangerous weather has been deduced for the port or place at which it is displayed, or in its vicinity; (2) that the danger appears to be so great as to demand precaution on the part of navigators and others interested, such as an examination of vessels or other structures to be endangered by a storm, the inspection of crews, rigging, etc., and general preparation for rough weather; (3) it calls for frequent examination of local barometers and other instruments by ship-captains or others interested, and the study of local signs of the weather, as clouds, etc. etc. By this means those who are expert may often be confirmed as to the need of the precaution to which the cautionary signal calls attention, or may determine that the danger is over-estimated or has passed. The fortunate position of the territory of the U. S., and its great extent, enable a service of this kind to be conducted with especial advantage. The movements of the storms over the continent can be traced upon the chart from report to report, and the direction and rate of their progress, together with their intensity, be noted in time to give warning of their approach.

Floods occurring upon the Western rivers can be traced sometimes from the fall of rain within the respective water-sheds and along the course of the different confluent streams until culminating in the dangerous flood of the principal river. In nearly the same manner that storms can be traced upon the charts, approaching changes of temperature and rainfall can be foreseen, and notice is frequently given in time to prevent injury to agricultural and other interests.

In the analyses of the official deductions of the signal office, or the "probabilities," the annual percentage of ver-

ifications is found to have been as follows: 1872, 76.8 per cent.; 1873, 77.6 per cent.; 1874, 84.4 per cent.; 1875, 87.4 per cent. While storms of a limited extent, such as squalls, tornadoes, etc., may spring up suddenly or pass between stations in such a way that their coming or courses cannot be foreseen, extensive and well-defined disturbances can, as a rule, be readily traced in time to forewarn the coasts or districts threatened.

Arrangements have been made with the chiefs of meteorological services in Europe, in accordance with the recommendation of the Vienna conference of meteorologists (1873), providing for the exchange daily of one report taken at the same instant over all the territories of the U. S., nearly all Europe, extending through Russian Asia to the Pacific coast, and in the northern portion of Africa. These exchanges are made every fifteen days by mail, and the reports thus received from 260 foreign stations are published as an *International Bulletin* at the Washington office. Besides the daily bulletins and weather-maps, the signal-office publishes a weekly review of the weather, which is furnished to the press, and a monthly review, accompanied with charts, showing the isobaric and isothermal lines, the prevailing winds, the tracks of low barometer, and a precipitation-chart for the month.* H. W. Howgate.

Signals, Fog. See Fog Signals, by J. Henry, LL.D.

Signals, Naval. See Naval Signals, by Capt. S. B. Luce, U. S. navy.

Sig'nature, in the old system of medicine, was some physical peculiarity of a drug which was supposed to indicate its use. Thus, because the euphrasy or eye-bright has a flower with an eye-like mark, it is good for the vision; the rock-liverwort was thought to be shaped like the liver, hence it is good for diseases of that organ. This belief prevailed not only among herbalists and pretenders, but among the best-trained physicians of the time.

Signatures. See Printing, by W. S. Paterson.

Sig'ourney, p.-v. and tp., cap. of Keokuk co., Ia., on Chicago Rock Island and Pacific R. R., has 5 churches, 2 newspapers, 1 woollen and 1 planing mill, a cheese-factory, 1 foundry, and a carriage-factory. Deposits of coal exist. P. of v. 992; of tp. 1637.

W. R. Hollingsworth, Ed. "Review."

Sigourney (Lydia Howard **Huntley**), b. at Norwich, Conn., Sept. 1, 1791; began to write verses at the age of seven years; established a select school for young ladies at Norwich 1809, and at Hartford 1814; published a volume of *Moral Pieces in Prose and Verse* (1815), which brought her into favorable notice, and obtained for her invitations to write for several periodicals, and was thenceforth through a long life one of the most popular of American female poets. She published 59 volumes of poems, essays, and letters, chiefly on moral or religious themes. In 1819 she married Charles Sigourney, a merchant at Hartford, visited Europe 1840, and d. at Hartford June 10, 1865. Among her works were *Letters to Young Ladies* (1833), *Zinzendorff, and other Poems* (1835), *Pocahontas, and other Poems* (1841), *Pleasant Memories of Foreign Lands* (1842), *Past Meridian* (1854), and a posthumous autobiography, *Letters of Life* (1866). Two volumes of her selected poems appeared in London 1841, and a choice edition, illustrated by Darley, was published at New York 1848.

Siguen'za y Gongora, de (Carlos), b. in the City of Mexico in 1645; educated in the university of that city; became chaplain to the archbishop of Mexico; was for twenty years professor of astronomy and mathematics, acquiring so great a reputation for erudition as to be honored with the title of royal cosmographer; wrote several treatises on Mexican history and antiquities; was director of the military school at Mexico; accompanied the expedition of Andrés de Pés against the French establishments in Louisiana and Florida 1693; planned the fortifications of Pensacola; published maps of the Florida coast, a description of the Bay of Galveston, brief histories of Texas and New Mexico, of the city of Queretaro, and of the University of Mexico, a topography of Mexico, and several volumes of poems of a highly ornate character, all in Latin, and left many works in MS., some of which were destroyed by a fire in June, 1692. He entered the order of Jesuits 1693. D. in Mexico Aug. 22, 1700. His name is the most famous one in the literary annals of New Spain during the colonial period, but his works are now rarely to be seen in Mexico, and are rapidly becoming forgotten.

Sikhs, the "disciples" (so the name imports) of certain religious teachers in Upper India who have played a notable part in Indian history during the last 100 years.

Modern Hinduism has not universally remained the dead level of idolatry that it is often conceived. All over India, and at various times in the last 800 years, there have been movements towards some sort of spiritual revival, originating generally with brooding individuals of the unlearned classes, who hungered for something better than the popular superstitions. Abandonments of caste and of idol-worship have been frequent, but not universal, characters of these reforms. Most of them have been connected (it is not easy to say why) with what is called *Vaishnava* doctrine. Some of these dissentient bodies have died away, but yet have left a permanent leaven in the shape of innumerable popular verses; some have hardened into mere sectarian idolatries; others have settled into Quietist societies; none have developed into a nation but the Sikhs. The original founder of the Sikh doctrine was Nának, born near Lahore in 1469, of the Khatri caste, warriors once, but then and now oftener traders. He is alleged to have roamed not only over India, but through Persia to Mecca. At last he returned home to resume his place in the household, and passed the rest of his life in preaching fervently, if somewhat vaguely, to Hindu and Mohammedan alike, the worship of one God, virtue, and tolerance. He did not apparently claim a miraculous commission, nor did he attempt to change social usages; he appeared to recognize both Mohammed and the Hindu incarnations as bearing divine missions; he gave no encouragement to asceticism, and he retained ordinary Hindu language as to transmigration and kindred tenets. Nának died in 1539. A line of Gúrús, or chief teachers, succeeded him, and the belief was held, on the traditional deathbed assurance of Nának, that the spirit of the latter became immanent in each of the line successively. Hargovind, the sixth of the Gúrús, was the first to become a man of war and of the chase. His descendant, Tegh Bahádur, the ninth of the line, was executed by the Moghul's government in 1675. When led to death he girt the sword of Hargovind upon his own young son, Govind, the tenth and last and most memorable of the Gúrús. Govind not only deepened the warlike stamp already for some time impressed on the "disciples," but deliberately fixed his aim in the destruction of the hated Mohammedan power, and strove to recast and inspire the Sikh organization as a militant Church and nation devoted to that task. Govind died (1708) by an act of private revenge; his own children had been butchered by the Mohammedans; he named no successor; he declared (the Sikh tradition says) that the fated ten had come, and thenceforward the Gúrú would be present with the community in spirit only.

Neither Nának nor Govind formally abolished caste, but practically their institute, receiving disciples from all classes, wrought in that direction. Govind enjoined that God was to be worshipped without images, but beheld in the body of the *Khálsa* or Congregation of the Faithful. All Sikhs were to be initiated by one rite; they were to be entirely at the disposal of the Faith and of the Gúrú. They were to honor Nának and his successors; to bow in reverence only before the holy *Grant'h* or Book; to bathe in the holy pool of Amritsar; to look to war as their occupation and field of desert. Steel was to be their sacred emblem; sweetened water stirred with steel in the presence of five Sikhs, and then partly sprinkled on the novice, partly drunk by him, formed the initiatory rite. Each initiated Sikh was to assume the title of *Singh* (*Sinha*, "a lion," "a champion"), to keep his locks unshorn, and dress in blue, to abstain from tobacco; and their salutation was to be "Victory to the Gúrú!" The toleration of Nának, at least as regarded Mohammedans, formed no part of Govind's teaching.

We have mentioned the Book. The *Ádi Grant'h*, or First Sacred Book, was compiled by Arjún, the fifth Gúrú, about the year 1600. It is a miscellany of verses, moral and mystical, ascribed in part to Nának and his successors, in part to earlier teachers. A supplementary work, compiled by Govind, known as the *Grant'h* of the tenth king (or pontiff), is a stranger hotch-potch, embracing prayers and hymns, narratives of Govind's own history and exploits, mythological legends, and several series of stories, one of which would seem to be that known in mediæval Europe as the Tale of the Seven Masters.†

Amritsar, "the Lake of Ambrosia," was dug by Rám Dás, the fourth Gúrú. Round it has gathered a large and busy city, now holding more than 100,000 souls. In the centre of the pool stands the most sacred edifice of the Sikhs, the Hari-Mandir, enshrining the holy original Grant'h. The building, thickly gilt all over, is joined to the quays by a marble bridge, and the porches and quays are the haunt of the *Akális* or "servants of the Eternal." This order claims its origin from Govind. They are, or were, devotees and fanatics of an active kind, who denied

* This article has been read and approved by Gen. Albert J. Myer.

† An English version of the Sikh sacred books is in preparation by the Rev. E. Trumpp, a German missionary, to be published at the expense of the India office in London.

all earthly masters, and went about with naked swords, the self constituted and irascible champions and censors of the Khálsa. They alone keep up the blue dress; they carry the holy steel generally in the form of a sharp discus round the peaked turban.

Besides the warlike disciples of Govind and his forerunners, there was a class of Sikhs which at an early period disapproved of the secular turn taken by the majority, and gave themselves more strictly to devotion, claiming Sri Chand, Nának's son, as their teacher. Representatives of these are found in many Indian cities, sometimes gathered in convents and devoting their time to theistic worship and the perusal of the *Adi Grant'h*. The bulk of the Sikh converts was derived from the great Jat race, which forms a large part of the population in N. W. India and of the dry countries near the Indus. The special nurseries of the Sikhs have been (N. of the Sătlej) the districts round Lahore and to the N. of that city; (S. of the Sătlej), the districts of the Patiála state. The former, often called *Mánjha* or Midland, became the seat of greatest Sikh power; the latter, sometimes called *Málwa*,* is the seat of largest Sikh population.

The Sikhs present a striking instance of the effect of moral causes on the outer man. From a sect they have become a nation, not only with a national spirit, but with a strongly characteristic physique and physiognomy. Among all the bronze-tinted races they present probably the finest examples in existence of manly beauty and dignity of aspect, whether as princes or warriors. Three kindred chiefs of the Málwa Sikhs, the rájas of Patiála, Jhínd, and Nába, who were present at a state reception by the governor-general (Lord Canning) in 1860, have left a deep impression on the present writer. All three were tall men, the first two gigantic. Jhínd was advanced in life, but Patiála, in his prime, flashing in steel and gold cloth, was the ideal of a Hindu Phœbus. The moral repute of the Sikhs is not high, but in valor they are not below their looks, as they have often shown in fighting both against and in the British line of battle. The whole body drew extraordinary spirit and life from the pride and union inspired by Govind's *Institutes*.

We revert to history. The Sikhs, after Govind's death, were sorely crushed, and for years little heard of. But the crumbling of the Moghul power, and the repeated invasions of India, first by Nádir Sháh, and then by Ahmed Sháh the Afghan, favored their revival and trained them in war. In 1763 we read of 40,000 Sikhs defeating the Afghan governor of Delhi near Sirhind. Tradition tells how the dispersing victors, as they rode through the land, stripped raiment and accoutrements to cast into the villages, marking them as prize. By 1785 the Sikhs, forming a rude confederacy, with annual diets at Amritsar, were predominant from the Indus to the Ganges, and their armed force was not less than 70,000, all horsemen.

Ranjít Singh, a boy of extraordinary daring and genius, succeeded his father, the Sikh chief of Gujránwála, in 1792. Ranjít was already a personage to be negotiated with when Lake, in hot pursuit of Jeswant Rao Holkar, first showed British colors on the Sătlej in 1805. At the same period was held the last diet of the Sikh commonwealth. The European power barred Ranjít S. of the Sătlej, but beyond that river his dominion extended rapidly. By 1823 he ruled as king the whole Panjáb, including Multán, with Kashmír and the Afghán province of Peshávar. He had long established a disciplined infantry, for which the Sikhs afforded excellent material, and about 1822 he had been joined by several able officers of the Bonaparte school (Ventura, Allard, Court, Avitabile). In 1838 the English governor-general (Lord Auckland), moved by apprehension of Russian intrigue, took up the ill-fated scheme of displacing the *de facto* rulers in Afghánistán and setting up Sháh Shúja, an ex-king of Ahmed Sháh's family. In this scheme Ranjít was reluctantly associated. He died whilst the expedition was still advancing on Kábul, June 27, 1839, in age fifty-nine years, but older in constitution. He had always been apt to plunge into fits of debauchery, and such habits grew on him in later life. His civil rule preserved a rough order and security, but the energies at his disposal were mainly devoted to war, and instead of the undisciplined horsemen of his youth, he left behind him a trained army of 50,000 disciplined soldiers, besides as many more well-armed irregulars, and 300 field guns. He had always managed to keep peace with England, though suspicion was often rife on both sides.

Under Ranjít the most prominent figures long were three Rájput brothers, who had risen by assiduity and his favor to the rank of rája and the possession of the important fief of Jámú. By their head, the wily Gúláb Singh, the Sikh dominion had been in 1835 extended to Ladák, and even (in 1840, after Ranjít's death) to Bálti, both in the Tibetan region. Gúláb Singh's captain, Zoráwar Singh, then advanced beyond the Indus sources to the holy lakes of Mansarowar, near which his force was surrounded, in midwinter and 12,000 feet above the sea, by Tibeto-Chinese troops from Lhassa, and overpowered. The leader slain, the officers taken, the mass perished; and a few frost-maimed wretches, sole relics of this adventurous band, brought the tale to the British post at Almora, having fled across passes 16,000 feet high. This episode seemed to deserve record, but such adventurers employed few, and the gathered mass of military energy, having no field abroad, spent itself in strife at home. Ranjít's son, Kharak Singh, an imbecile person, succeeded him, but died a year later (Nov. 5, 1840), and the same day saw Kharak's son and successor perish by the fall of a gateway. Sher Singh, a disowned son of Ranjít, was proclaimed by aid of the soldiery, now the real masters. He was murdered in 1843, and succeeded by a child, Dhalíp, ascribed to Ranjít's latter days. A régime of donatives, conspiracies, murders, and all-but anarchy dragged on for two years more. The English government dreaded to precipitate collision by ample preparations, and yet what was actually done in preparation armed and stimulated the Sikh army, which at last (Dec. 11–14, 1845) poured across the frontier river Sătlej. An attack made by the British (Dec. 21–22) on the Sikh camp (at P'hírushahr, more commonly since written Ferozshahr, 10 miles from Ferozpur), partially intrenched and strongly armed, was in the end successful with the capture of 70 guns; but the success was hard to win. The skill of the Sikh artillery and the firmness of the infantry surprised the British officers and shook the Sepoys. After some minor actions the new position which the Sikhs had intrenched at Subraon on the Sătlej, covering a boat-bridge, was stormed (Feb. 10, 1846), and the Sikhs driven into the river with great carnage.

Treaties which followed kept up Sikh rule in the name of Dhalíp Singh, with a British resident in supervision. Two years of this ended in another war, which began with the revolt of the governor of Multán and the murder of two British officers there. After the capture of Multán and several pitched battles the strength of the Sikhs was broken at Gujerat (Feb. 21, 1849), and the whole territory was annexed to British India, except Kashmir, which had been made over to Gúláb Singh in 1846.† The ablest men were selected for the administration of the new province, headed successively by the brothers Henry and John Lawrence, and unusual liberality of expenditure was allowed on works of improvement. These things made due impression, and eight years later (1857), when a day of trial came for the British in India, the stability of this new province became a base for the first steps toward the recovery of power in the Ganges valley. The Sikhs were eminently loyal to their new rulers, and many of them did noble service in the suppression of the revolt. Many since then have served well beyond sea—*e. g.* in China and in Abyssinia.‡

Powerful as the Sikhs became on their native soil, alike from union and from character, they never formed more than a fraction of the population of their own territory. Their present number is about 1,000,000 on both sides of the Sătlej, and these appear to form about one-seventh of the population of those districts which contain Sikhs in any numbers.

Ranjít's reign had already tended to weaken some of the stronger elements in Sikhism, and under the impartial level of English rule its spirit has been still further weakened. The political bond and aspirations that invigorated the Khálsa no longer exist; and as regards religious enthusiasm, the tendency of the educated few is to latitudinarianism, and that of the mass of yeomen to lapse more and more into ordinary Hindu superstitions. The number of initiations at Amritsar has diminished, and though the Sikh landholders are waxing richer, the amount of voluntary offerings at the holy places has greatly declined. Should the British rule continue for two or three generations, it seems probable that the Sikhs will have become practically reabsorbed in Hinduism. Should any calamity to that power (which God forbid!) open a political field before this reabsorption, the Sikhs may still play an important part in Indian history. H. YULE.

Sik'kim, a district in the Eastern Himalaya (Bengal presidency, British India), due N. of Calcutta, of 1234 sq. m., with, in 1872, 94,712 inhabitants, among which are 16,709 Boodhists from the Leptsha tribe of Tibetan origin. Chief place, Darjiling, with an elevation of 7168 feet, a mean

* Not to be confounded with proper Málwa, in Central India.

† The young Mahárája Dhalíp Singh was consigned, with a settlement of £20,000 a year, to an English guardian. He spontaneously became a Christian, and has long lived in England.

‡ In 1858 there were nearly 21,000 genuine Sikhs serving under the British colors. There are now about 14,000.

annual temperature of 54.4°, and a rainfall of 130 inches; it is 78 miles from the foot of the hills, and is reached from Calcutta in a journey of from three to four days. Originally a convalescent dépôt for sick soldiers, Darjiling is now a flourishing civil station with numerous European residents, situated on a spur of the gigantic mountains, exceeding 28,000 feet, which cover the northern part of the district. The planting of tea and cinchona proved extremely profitable. In 1841 was made the first trial with the tea-plant; now 58,496 acres are held as tea-gardens, of which 13,305 have been brought under cultivation, and in 1874 the produce was 3,600,000 pounds. The plantation of cinchona had full success; 3,000,000 red-bark trees and 5,000,000 other sorts have been planted, which in 1874 produced 39,405 pounds of dry bark. The district was acquired in 1835 from the native state of Sikkim, and extended in 1849–61 in the treaties with the raja of Sikkim, whose dominions are now reduced to an area of 2544 sq. m., with a population of 7000 souls. Rice, millet, oranges, and some sorts of a common Tibetan cloth are the principal articles of production; the revenue of the raja is supposed to amount to 7000 rupees, exclusive of the heavy transit-duties and tolls to be paid on crossing rivers spanned by bridges. EMIL SCHLAGINTWEIT.

Sila'nion [Σιλανίων], b. at Athens, flourished about B. C. 320, a self-taught statuary (Müller from Pliny) of the school founded chiefly by SCOPAS (which see). Among his works may be named a figure of Theseus, a statue of Plato, one of Corinna, one of Sappho, and particularly a *Jocasta at the Point of Death*, where the deathly pallor of the countenance was produced from mixing silver with the bronze of the statue. (O. Müller, *Ancient Art*, § 306, 3; Sillig, *Dict. Artif.*, s. v.) H. DRISLER.

Sile'nus, in Grecian mythology, a son of Pan and Gea, or of Hermes, and the chief of the Sileni, a group of satyrs; educated the young Bacchus, and accompanied him afterward on his campaign against the giants, when he slew Enceladus. When he was drunk and asleep, he had the power of prophecy, and a temple was erected for him at Elis. In art he is always represented as an old man, bald, with goat's ears, drunk, riding on an ass or borne by satyrs. In the oldest comic plays in Greek he seems to have played a very prominent part.

Sile'sia, province of Prussia, S. of the provinces of Brandenburg and Posen, bounded E. by Poland, S. by Moravia and Bohemia, and W. by Saxony. Area, 15,547 sq. m. P. 3,707,167, of whom 1,760,341 are Protestants, 1,896,136 Roman Catholics, and 46,629 Jews; about two-fifths speak the Polish or other Slavic languages, the rest German. Along the southern and western boundaries the country is mountainous and rugged, but the whole central part is flat, traversed by the Oder and its tributaries. The soil is generally fertile and well cultivated. Grain, flax, hemp, oil-plants, tobacco, beets, and hops are extensively cultivated. An excellent breed of sheep is kept, yielding a very fine wool, and important manufactures of linen and woollen fabrics are carried on. The mineral wealth of the province is considerable, lead, copper, and coal being abundant. Cap. Breslau.

Silesia was from the sixth century inhabited partly by German, partly by Slavic tribes, and formed a fief or—as it was divided between several dukes—several fiefs, first of the Polish, then of the Bohemian crown. In 1537 the duke of Liegnitz and the elector of Brandenburg made an agreement that if either of the two reigning lines became extinct its possessions should fall to the other. In 1675 the ducal family died out, but the German emperor refused to acknowledge the validity of the agreement of 1537, and incorporated Liegnitz and the other ducal possessions as a lapsed fief of Bohemia into the Austrian empire. In 1740, Frederick II. marched, without declaring war, into Silesia, and seized the dominions which according to the agreement of 1537 were his, and after three bloody wars with Austria (1740–42, 1744–45, and 1756–63), kept them. Under the Prussian government the province has developed greatly, and it forms now one of the richest provinces of the kingdom.

Silesia, Austrian, province of Austria, between Prussia and Moravia, comprises an area of 1963 sq. m., with 513,352 inhabitants, of whom 434,750 are Roman Catholics and 72,318 Protestants. The northern part is covered by the Sudetes; the rest is flat, though high. The climate is somewhat rigorous, but healthy. Good crops of rye, barley, and oats are raised, cattle, sheep, and bees are extensively reared, and copper, lead, iron, and coal are mined. Cap. Troppau.

Sil'houette [named from M. de Silhouette, a parsimonious French statesman of the last century; hence, cheap, plain], a figure in profile cut out of black paper with the scissors. Silhouette-work has of late years been elevated to the rank of meritorious art by the late Paul Konewka and others, figures of a surprising degree of naturalness being produced in solid black. There are also relics of similar work of much merit done by the ancients.

Sil'ica, or **Silicic Acid** [old name, *silex*; Lat. *silex*, "flintstone;" Ger. *Kieselerde*, *Kieselsäure*; Fr. *silice*, *acide silicique*], the dioxide of the element *silicon*, which, next to oxygen, is the most abundant of the elements that make up the solid crust of the earth. The abundant mineral *quartz* is pure silica, and the great mass of rocks and soils is made up of different compounds of silica with metallic bases. Among the commonest minerals, the *micas* vary from *biotite* and *phlogopite*, magnesia micas (40 and 41 per cent. of silica), up to *muscovite*, or potash mica (46 per cent.); the *pyroxenes* vary from 50 to 55 per cent.; the *amphiboles* from 50 to 58 per cent.; the *feldspars* from *anorthite*, or lime-feldspar, 43 per cent., and *labradorite*, or lime-soda feldspar, 53 per cent., and *orthoclase*, or potash feldspar, 65 per cent., to the soda-feldspars, *oligoclase* and *albite*, which contain respectively 62 and 69 per cent. Among other common silicates are the *epidotes*, averaging in percentage of silica about 37; the *tourmalines*, 38; the *garnets*, 40; the *serpentines*, 44; the *kaolins*, 46; the *talcs*, 62, etc. The composition of silica is SiO_2—

Containing silicon	46.67
And oxygen	53.33
	100.00

(See SILICON.)

Quartz, which occurs in crystalline form in granites and other rocks, also makes up sea-sand (true), sandstones, and a large portion of most soils, gravels, and pebbles. Quartz crystallizes in the rhombohedral or hexagonal system, occurring usually in six-sided prisms, terminated by six-sided pyramids. Its exact density at zero, when pure and homogeneous, is 2.662, as first determined by the writer. (C. Deville gives 2.663; Breithaupt's maximum figures, at normal temperatures, are 2.658 and 2.659; mean, 2.66.) Its hardness is between those of feldspar and topaz. It polarizes light in the manner called *circular* polarization. (See LIGHT.) Quartz presents a good many minor varieties, some of which may possibly be *allotropes* (see *Amorphism*, under ISOMERISM), but it is more probable that the amorphous forms, like *agates*, *chalcedonies*, *hornstones*, *flints*, etc., which are often but slightly soluble in caustic alkalies, and have densities approaching to quartz, are mixtures, or quartz itself in a *crypto-crystalline* condition. *Amethyst*, the common gem, is one of the colored varieties of quartz, the cause of the color of which is not yet settled, some attributing it to manganese, some to titanic acid, and some to iron. *Rock-crystal* includes the transparent, colorless, crystalline varieties, which are sometimes used for making lenses and spectacles, also for prisms, the hardness being a great advantage as a safeguard against injury. Groups of transparent rock-crystals are among the most beautiful objects presented to us by nature, and when large are often valued at large sums. Rock-crystal is often found enveloping, or enclosing within it, other beautifully crystallized minerals, sometimes in slender needles of great length penetrating regular transparent quartz-crystals of great size through and through, proving that they existed before the quartz was concreted around them. We also often find cavities within such crystals containing liquids, sometimes water, sometimes a saline solution, and sometimes hydrocarbon compounds of great volatility which boil below the normal temperature. Some believe they have observed *liquid carbonic acid* in these cavities. All these facts demonstrate the fact of the crystallization of quartz *from solution* in water or other liquid medium, and the existence of enormous compression at the time of the process. *Milky quartz* is a variety exceedingly common as a gangue or vein-stone of metallic sulphides, and therefore generally constituting *gold quartz*, as the gold of this either exists in combination with such metallic sulphides or has been set free by their decomposition and removal. There are other important varieties of this mineral quartz, which will be found described in works on mineralogy. (See, for example, Dana's *System of Mineralogy*, pp. 189–198.)

Tridymite.—A species of mineral silica, crystallizing in the same system as quartz, but so far below it in density, this being about 2.3, as to constitute an undoubted allotropic form of silica. It was discovered by Von Rath.

Asmanite.—Meteoric quartz; another crystalline silica allotrope, observed by Maskelyne in the meteorite of Breitenbach. Its crystallization is right-rhombic, and its density about 2.25.

Amorphous Forms of Silica.—Silica when precipitated from solution, and when fused (to accomplish which requires an intense heat like that of the oxyhydrogen flame), assumes the density 2.225, and in this form is highly soluble in caustic alkalies—to a small extent in many saline solutions, and even in pure water. This is the form in which silica is left in the decomposition of many natural

silicates by alkaline waters, and it is therefore present in most soils. There is another amorphous kind of silica which has a higher density, called by Dana *jenzschite*.

Hydrates of Silica (Opals, Tripoli, Hyalite, Silicious Sinters), etc.—These are native compounds, whose compositions are not very definitely known. An analysis of a very pure opal by Von Rath gives the formula $3SiO_2.H_2O$, with the density 1.99, corresponding to 9.84 per cent. of water. Some of these hydrates, however, contain as much as 13, 16, and even 21 per cent. of water, and some opals as low as 5 or 6 per cent. only. This indefinite character of opal is probably due sometimes to admixture with quartz or other forms of silica, a variable insoluble residue being generally left on boiling with an alkali. *Tripoli*, or *Infusorial Earth*, which often occurs in quite extensive beds, is made up chiefly of microscopic silicious shells. (See INFUSORIA, where some of these are pictured.) Silica, in the form of hydrates, enters more or less into solution in all river-waters, and is thus continually flowing into the ocean, in the water of which analysis indicates its presence in minute proportion. This proportion is, however, kept from increasing by a constant process of depletion that is going on through the agency of *life*. The superficial waters of the ocean are indeed populated with minute beings, either animal or vegetable—it is not certain which, though most probably the latter—which possess silicious skeletons (similar to the Infusoria above referred to). These continually die and sink to the bottom, so that the floor of the deep ocean is continually accumulating, in this form of organized matter, the silica brought down by rivers from the land. The relations of silica to life upon the land are highly important. Of the animal kingdom it is but a very trifling, and possibly wholly unimportant, constituent, but to many plants silica has just the same relation that *tricalcic phosphate* has to most animals—that is, silica is the main material of the *plant-skeleton*. Of the ashes of plant-stems, particularly, silica is often found to be a large constituent; thus, in ash of rye-straw is found 65 per cent., of potato-stems 36 per cent., and of wheat-straw as much as 73 per cent. Hence the importance of the existence in soils, for growing this class of plants, of silica in such form that it may pass in solution into the roots—namely, in the form of soluble silica, or more probably that of hydrated silica. Many soils are doubtless barren from lack only of silica, their most abundant constituent, in its *soluble* forms.

Silicic hydrates may be obtained artificially by several methods. If solutions of soluble glass (see WATER-GLASS) are treated with acids, hydrate of silica precipitates in gelatinous form. This, if well washed and dried over oil of vitriol, gives, according to Doveri, a product of the composition $3SiO_2.2H_2O$, which was converted at 212° F. into $3SiO_2.H_2O$, the same as Von Rath's native opal, referred to above. Hydrate may also be obtained by the action of the gaseous *fluoride of silicon* (see SILICON, COMPOUNDS OF) on water. Fuchs obtained thus the above trisilicic monohydrate, and another, a tetrasilicic monohydrate ($4SiO_2.H_2O$). Ebelmen also obtained a definite hydrate ($2Sio_3.3H_2O$) as a transparent solid glass by the action of air upon *silicic ether*. Unfortunately, no record exists of the *densities* of any of these definite hydrates, which would have been of great value in relation to the study of the opals, tripolis, sinters, and other *native* hydrates. The investigations of Graham upon the hydrates and upon solutions in water of silica are of exceeding interest and importance. By DIALYSIS (which see) the great English chemist obtained a solution of 5 per cent. of silica in pure water, which may be boiled rapidly down to 14 per cent. if no gelatinization is allowed on the edges. This solution is tasteless, with a feeble acid reaction. In the course of a few days it passes spontaneously into a transparent jelly. Addition of a little muriatic acid or an alkali tends to preserve it. Carbonic acid coagulates it, also alkaline and earthy carbonates in minute proportion. Added to a solution of *gelatine*, this precipitates, *together with the silica*, about in equal parts. This solution evaporates to a lustrous transparent glass of composition $SiO_2.H_2O$, containing 22 per cent. H_2O. Density not stated. (For the relations of silica in soils to organic matter see HUMUS, last paragraph.) H. WURTZ.

Silicates, Chemistry and Classification of. The number of mineral silicates is very large, and materials are included therein of the greatest importance to mankind. Their study is therefore equally important. This study includes, of course, as one of its most essential departments, the grouping and classifying of silicates. No promise of success has ever attended, or is ever likely to attend, any system for such classification which is not fundamentally based upon chemical composition, relations, and derivation. This remark applies broadly to all mineral bodies, as well as silicates, and at the present day is not likely to be impugned by any of those qualified to form a judgment in the case. The systems of classification in use, therefore, at the present time are wholly based upon chemical composition by weight—that is, the relations of chemical combining proportions to *centripetal force;* the other great class of quantitative relations—namely, those to *space* or volume—not having been hitherto sufficiently well comprehended to furnish a basis. (See VOLUMES, MOLECULAR.) The chief standard and authoritative work of reference for this subject, as for others in the science of mineralogy, is the *System of Mineralogy* of James D. Dana of New Haven. Dana divides silicates first into *anhydrous* and *hydrous silicates*.

ANHYDROUS SILICATES.—These have three subdivisions: I. *Bisilicates*, containing for 2 equivalents of oxygen in silica—that is, for each equivalent of silica—1 of oxygen in bases, or basic oxygen; II. *Unisilicates*, 2 equivalents of oxygen in silica to 2 in bases; III. *Subsilicates*, 2 equivalents of oxygen in silica to more than 2 in bases—mostly 2 to 3, but also 2 to 4, and other ratios. The oxygen here called basic oxygen may belong to protoxides, sesquioxides, or dioxides, or to all three at once, *the sum of the whole oxygen* being counted; and this oxygen may be distributed among a large number of basic metals without departure from the type, so long as the same total ratio to the oxygen of the silica remains.

I. *Bisilicates.*—Among these there are 3 groups, comprising in all 25 species and sub-species. (1) The *Amphibole Group*, which includes the species *pyroxene, enstatite, hypersthene, diaclasite, wollastonite, rhodonite, spodumene, amphibole, kupferite, anthophyllite, crocidolite,* and others, divided into several sub-groups—all *anisometric*, but belonging to several systems of crystallization. (2) The *Beryl Group*, consisting of *beryl* and *eudialyte*—hexagonal. (3) *Pollucite* or *pollux*, the celebrated cæsium silicate of Breithaupt, which is made a sub-group by itself—regular system.

II. *Unisilicates.*—Of these Dana makes 13 groups, comprising 62 distinct species in all; many of which species, however, contain two or more distinct derivatives, so that there are in all about 90 species and sub-species. (1) *Chrysolites*, under which is *forsterite* (di-magnesium unisilicate), *chrysolite* (magnesium-iron unisilicate), *fayalite* (di-iron unisilicate), *tephroite* (di-manganese unisilicate), *knebelite* (manganese-iron unisilicate), and others more complex in basic constitution—orthorhombic. (2) *Phenacites*, including *phenacite* (di-glucinum unisilicate), *willemite* (di-zinc unisilicate), and *meliphanite*—hexagonal. (3) *Helvites*, containing glucinum—regular. (4) *Garnets*, of which there are 10 varieties, dependent on the variation of the basic constituents, these being *lime, magnesia, ferrous* and *manganous oxides*, as well as sesquioxides, *alumina, ferric*, and (in *ouvarovite*) *chromic oxide*—regular. (5) *Vesuvianites*, including *vesuvianite, zircon*, and *melilite* (or *humboldtilite*)—tetragonal or dimetric. (6) *Epidotes*, including ordinary *epidote*, whose bases are chiefly lime and alumina, with some ferric oxide, *piedmontite, allanite* (in which cerium replaces calcium), these three being monoclinic; also *zoisite* (chiefly lime and alumina), *gadolinite* (yttrium replacing calcium), *mosandrite, ilvaite*, etc.: these latter being orthorhombic. (7) *Axinites*, borosilicates, including *axinite* and *danburite*—triclinic. (8) *Iolite*, magnesia or ferrous oxide, with alumina—orthorhombic. (9) *Micas*, including *phlogopite* (right-rhombic magnesia-mica), *biotite* (hexagonal magnesia-mica), *muscovite* (common mica or right-rhombic potash-mica), *lepidolite* (lithia partly replacing potash, and right-rhombic like muscovite). (10) *Scapolites*, including 8 minerals, some of which vary considerably from the unisilicate ratio. The most important are *meionite* (lime and alumina), *wernerite* (the same, with more silica), *ekebergite* (a wernerite, with some soda replacing lime), *dipyre*, and *marialite*. All the scapolites are dimetric. (11) *Nepheline* (soda and alumina, usually with some potash)—hexagonal. (12) *Leucites*, including the interesting species *leucite, sodalite, lapis-lazuli, haüynite, nosite* (*nosean*)—all in regular system. (13) *Feldspars*. This group includes at least 7 highly-important species, which agree generally in several characters. Their

	Bases.	Crystals.	Total oxygen in MO & M2O :	M2O3 :	SiO2.
Anorthite	Al_2O_3, with CaO	Triclinic	1 :	3 :	4
Labradorite	" " " and some Na_2O	"	1 :	3 :	6
Hyalophane	" " BaO, " K_2O	Monoclinic	1 :	3 :	8
Andesite	" " CaO, and Na_2O	Triclinic	1 :	3 :	8
Oligoclase	" " Na_2O, and some CaO	"	1 :	3 :	9
Albite	" " Na_2O, almost solely	"	1 :	3 :	12
Orthoclase	" " K_2O, "	Monoclinic	1 :	3 :	12

densities are below those of most other unisilicates, generally below 2.8; their hardness below quartz; their fusibility easy; the crystallization clinohedral, either monoclinic or triclinic; and they have two cleavages easily obtained, one of which, at least, is brilliant, with a peculiar lustre, and readily recognizable by the practised eye. The preceding table gives an interesting and useful view of the feldspars in condensed form.

III. *Subsilicates.*—Dana makes three divisions of these, according to the oxygen-ratios between bases and silica. In all there are 17 species. A. (Ratio, 4 : 3.) *Chondrodite* and *tourmaline*, which are right rhombic and hexagonal. In chondrodite, Dana considers the fluorine present as *replacing oxygen*; and in tourmaline, the oxygen of the boric oxide as basic oxygen. B. (Ratio, 3 : 2.) This division includes the greater part of the subsilicates, and is separated into five groups: (1) *Gehlenite*—dimetric. (2) *Andalusite Group*, including *andalusite* (macle), *kyanite* (called by Dana *cyanite*), and *fibrolite* (*sillimanite*), these three having essentially the same composition, $Al_2O_3.SiO_2$ (alumina 63.2 per cent. and silica 36.8 per cent.), but each crystallizing in a different system, thus constituting a set of *trimorphs*. (According to computations of the writer, founded upon new discoveries in molecular chemistry (see VOLUMES, MOLECULAR), there should be two normal *andalusites*, having the precise densities at zero 3.079 and 3.146; while normal *fibrolite* should have 3.21; *sillimanite*, 3.276; *rhætizite* (white kyanite), 3.578; and two normal kyanites, 3.635 and 3.687.) *Topaz* is also placed in the andalusite group, being regarded by Dana as having the above formula, with fluorine substituted for oxygen in the silica. It is orthorhombic, like *andalusite*. (3) *Euclase Group*, containing *euclase* and *datholite*, the first of which contains glucina as a base, and the second, boric oxide. The 3 : 2 ratio is made out in both these cases only by computing the oxygen of the 5 or 6 per cent. of *water*, which both these minerals contain, as *basic oxygen*. (4) *Guarinite*, a silicate of lime and titanic dioxide, having the same composition as *sphene* or *titanite*, but dimetric in crystallization, while titanite is monoclinic. (5) *Titanite Group*. Titanite itself has the composition $CaO.TiO_2SiO_2$, in which the 3 : 2 ratio is apparent if the oxygen of the titanic dioxide be counted as basic. In this group are also placed *tscheffkinite* and *keilhauite*. C. (Ratio, 2 : 1.) Only two species, *staurolite* and *schorlomite*, are placed here.

HYDROUS SILICATES.—Of these Dana makes three sections, two of which he designates as the *zeolites* and the *margarophyllites*, while to another (which he puts first in order) he gives no distinctive name, calling it the *general section*, or simply the *first section*. Of these three divisions the margarophyllites are much the most numerous, comprising about 75 species; while of the zeolites there are only about 20; and the general section, including all others, numbers about 30 species. In his attempt to subdivide the hydrous silicates upon the same scheme which he has adopted for the anhydrous compounds—according to the relative proportions of oxygen supposed to be associated with the basic and acidic elements—Dana recognizes a great and indeed, in the present state of chemical science, an insuperable obstacle. This consists in the determination, in numbers of cases, whether the water is in the condition of *basic water* or of *water of crystallization* only, or, when it occurs in both forms, in ascertaining how much of it is basic or *constitutional*, and how much is only crystal water. A criterion has been lacking for the determination of this ruling question in the majority of cases. The writer has to say that such a criterion may be expected to arise out of his own discoveries of the geometrical relations of chemical combining proportions to space. (See VOLUMES, MOLECULAR.)

First, or General Section.—These are subdivided like the anhydrous silicates. I. *Bisilicates.*—Three groups, *pyroxenoids*, *berylloids*, and *picrosmines*. (1) *Pectolites*, or *Hydric Pyroxenoids*. Three important species, with others, come under this head—*pectolite*, *okenite*, and *laumontite*. Pectolite, which is monoclinic, like the anhydrous bisilicate *wollastonite*, was made to agree in constitution with the latter (by Frankenheim) by regarding all its water as basic, or (which is similar in effect) *all its hydrogen as metalloidal*, or interchangeable with Ca and Na (in accordance with our present views of equivalence, however, H_2 replacing one equivalent of the dyadic metals). In the case of *okenite*, which is (probably) orthorhombic, if *half the water* be basic, we get an assumed isomorphism likewise with the orthorhombic anhydrous bisilicate *enstatite* (calcium and hydrogen replacing magnesium, and the other half of the water being crystal-water). *Laumontite*, which is monoclinic, with crystals closely similar to those of the anhydrous bisilicate *pyroxene*, Dana brings into relation with the latter by regarding all its 15–16 per cent. of H_2O as *crystal-water*—a view which receives some support from the facts that about one-fourth of the water escapes over oil of vitriol, and a further quantity, up to about one-half in all, at a heat even below 212° F. Nevertheless, it must be admitted that the other half of the water escapes only on incandescence. As yet, we know too little, in an *experimental* way, about the *precise* behavior of hydrous silicates under the influence of heat to settle these questions with any certainty. To illustrate: there has been no research to determine the questions of the *changes of density*, and therefore of equivalent volume, accompanying the dehydration of such silicates. When these data shall have been procured, we shall at last have some points of departure for computation, inductive generalization, and analogical reasoning. In this connection it may be pointed out that Dana, in adopting the principles above involved in his classification, recognizes the probability of the proposition that additions of crystal-water do not necessarily change molecular types and crystal-systems among silicates. This is in some measure in accordance with views put forth more than twenty years ago by Sterry Hunt, who suggested that the mode of derivation in *progressive series*, discovered by James Schiel (see HOMOLOGY and SERIES IN CHEMISTRY), should be found in mineral as well as in organic chemistry. Though the cases cited by Hunt—the variations in *chabazite* (see below) from $5H_2O$ to $6H_2O$, the hydrous iolites or *fahlunites* and others—may not really be satisfactory cases in point, yet his conception will unquestionably turn out justifiable by facts, in a way which will be found explained under VOLUMES, MOLECULAR. This conception was that H_2O could play a part similar to that of H_2C in homologues, and form *series* belonging to the same molecular family. Hunt conceived also that the *feldspars* (see above) had to each other a relation similar to that of a series of homologues, and that they all contained the same nuclear collocation of oxygen-atoms, associated with varying numbers of equivalents of the more basic elements, the latter playing a part similar to the H_2C (homologen) in homologues. He even demonstrated the sound physical and mathematical origin of the conception in his mind by endeavoring to find evidence of it in the relations of the *equivalent volumes* of the feldspars (*Am. Journal of Science*, Sept., 1854). This view—which was appropriated ten years later by the mineralogist Tschermak, and brought forward without crediting to Hunt—will be found to have a certain justification, in so far as the volumic relations of the *most basylic metals* in the feldspars are concerned—a point which has not yet been specially examined. (2) *Dioptase Group*, or *Hydric Berylloids*. *Dioptase*, a hydrous copper-silicate, with 11–12 per cent. of H_2O, has the hexagonal crystallization and the composition of beryl (copper replacing glucinum), if all the water be considered as crystal-water and outside of the (assumed) essential molecular nucleus. This is a case similar to that of *laumontite*, above. *Catapleiite* and *chrysocolla* are placed here with dioptase. (3) *Picrosmine*, a hydrous magnesian silicate, which, if one-fourth of its water or hydrogen is basic, may be a bisilicate. With it is placed *spadaite*.

II. *Unisilicates.*—Six groups: (1) *Calamines*, or *Hydric Chrysolithoids*. Besides *calamine* itself, we have here *prehnite*, *chlorastrolite*, and *villarsite*, all orthorhombic, and nearly isomorphous with *chrysolite*, and made to approximate thereto in constitution by the same process as above, of supposing the water to be outside the essential molecule, as crystal-water, except in the case of *prehnite*, where part of it is made basic. (2) *Thorites*, or *Hydric Helvitoids*. *Thorite*, *cerite*, and *tritomite*, isometric minerals like the anhydrous *helvite* above, containing the rare metals as bases. (3) *Pyrosmalite*, which contains *chlorine*, supposed to replace basic oxygen. (4) *Apophyllite*, a hydrous lime-potash silicate containing a little *fluorine*. (5) *Gismondine* and *edingtonite*. (6) *Carpholite*.

III. *Subsilicates.*—Among these are *allophane* and other amorphous minerals.

Second, or Zeolite Section.—This important and interesting class of silicates has been supposed to have some relations in composition and in oxygen-ratios to the feldspars, but Dana prefers to consider them as *unisilicates* and *bisilicates*. By making certain proportions of the water basic, he classes as unisilicates *thomsonite*, *natrolite*, *scolecite*, *mesolite*, and *levynite*; and as bisilicates, *analcime*, *chabazite*, *gmelinite*, *phillipsite*, *harmotome*, *stilbite*, *heulandite*, *brewsterite*, and others. The zeolites are characterized by rarely or never containing magnesia or iron, their bases being earthy and alkaline.

Third, or Margarophyllite Section.—This large section has its name from being generally (at least those which crystallize) foliated or micaceous in structure, with the same prismatic angle (120°) as the micas, and usually with a *pearly* lustre. A majority of them are, however, almost always amorphous or massive in structure. Dana again resorts, in classifying them, to the oxygen-ratio, consider-

ing more or less of the water as basic, although he admits that such views are chiefly hypothetical, and without much satisfactory control from other known relations.

I. *Bisilicates.*—There are three groups—*talcs*, *sepiolites*, and *chloropals*. (1) *Talc Group*, including *talcs* and *pyrophyllites*—both orthorhombic in crystallization. They are hydrous silicates of magnesia. (2) *Sepiolite Group*, including both magnesian and aluminous silicates, which are only known in massive forms, like *meerschaum*, which is a sepiolite. *Smectite*, or "fuller's earth," is another of this group. (3) *Chloropal Group*. These also are massive or earthy. They are characterized by the basic constituent being chiefly iron oxide, either ferric or ferrous. *Glauconite* or green-sand, the curious silicate which is found fossilizing small rhizopod shells, is one of this group. *Nontronite* and *pinguite* are varieties of chloropal. The latter contains as much as 25 per cent. of water.

II. *Unisilicates.*—Five groups—*serpentines*, *kaolins*, *pinites*, *margarodites*, and *hisingerites*. (1) *Serpentine Group*, *serpentine* and its varieties, *deweylite*, *cerolite*, *hydrophite*, *genthite* (nickel-gymnite), and *saponite*. These are all magnesian, ***hydrophite*** **containing about one-third ferrous** oxide, and *genthite* about two-thirds niccolous oxide. (2) *Kaolinite* or *Clay Group*, *pholerite*, *kaolinite*, *halloysite*, and *samoite*, hydrous silicates of alumina, samoite containing, by B. Silliman's analyses, over 30 per cent. of water, and giving the formula $2Al_2O_3.3SiO_2.10H_2O$. *Kaolinite*, which forms most clays, kaolins, lithomarges, etc., is $Al_2O_3.2SiO_2.2H_2O$. Dana makes it a unisilicate by supposing half the water to be basic. (3) *Pinite Group*. These are amorphous hydrous silicates, which contain alkalies as bases, together **with alumina. Their content of water is generally far less** than that of the previous (or clay) group. Dana places the *palagonites*, or basaltic tufas, here. There are many obscure species and varieties, including *gieseckite*, a Greenland pseudomorph after nepheline, found also at Diana, N. Y.; ***agalmatolite*** **and *pagodite* ("figure-stones"), from** which the Chinese carve images; *gigantolite* and many others. Jackson's *catlinite*, or Indian pipe-stone, also probably falls among the pinites. (4) *Margarodite Group*. This includes a great number of varieties, products of alteration of various anhydrous silicates. The *fahlunites*, products of hydration chiefly of *iolite*, include many varieties, such as *pyrargillite*, *aspasiolite*, *huronite*, *chlorophyllite*, etc. Also *margarodite* (derived from ordinary *muscovite*, or potash-mica, and therefore retaining the potash in its constitution), in which Dana regards the water as all basic. ***Damourite*** **is another hydrous mica, closely related** to margarodite. *Euphyllite* and *Cookeite* (containing lithia) also belong here. (5) *Hisingerite Group*. These are chiefly amorphous hydrous silicates of iron and manganese, some containing a little magnesia.

III. *Subsilicates.*—Three groups—the *chlorites*, *chloritoids*, and *seybertite*. (1) *Chlorite Group*. These are mostly **crystalline micaceous minerals, and comprise very important** and interesting species; among them *pyrosclerite*, which includes ***vermiculite*, famous for its wonderful exfoliation** when heated. This, with *penninite* and *ripidolite* (*clinochlore*), contains as bases chiefly alumina and magnesia, while *chlorite* (now called *prochlorite* by Dana) has but about one third magnesia with two-thirds ferrous oxide; and *cronstedtite*, another of the group, contains almost wholly ferrous oxide in place of magnesia, and ferric oxide in place of alumina, being rich enough in iron to be regarded as an iron ore (45 to 48 per cent. of metallic iron). (2) *Chloritoid Group*, includes *corundophilite*, *chloritoid*, *margarite* (J. L. Smith's *emerylite*), and *thuringite*.

There have been attempts to formulate silicates upon the present prevailing *type-theories*, on the types of several associated molecules of water. Dr. Odling made this attempt first in 1857. For example, Dana's bisilicates, which Odling called *metasilicates*, he derived from two molecules **of water, H_4O_2, by supposing them to contain a dyadic** compound radical or "residue," SiO. *Enstatite* would then be $(Mg.SiO)O_2$, the SiO replacing H_2, and the dyad Mg the other H_2. *Pyroxene* would be derived in the same way from eight molecules of water H_8O_4; thus, $(CaMg.2SiO)O_4$. *Dioptase* he derived from four molecules, as $(Si.Cu.H_2)O_4$, the tetrad Si, and the dyad Cu, with H_2, making up the H_8. This system is ingenious, like many other type-hypotheses, but will not carry us very far with satisfaction.

HENRY WURTZ.

Silico-Fluorides. See FLUOSILICIC ACID, by PROF. CHANDLER.

Sil'icon, sometimes called **Silicium** [from Lat. *silex*, "flint-stone"], one of the elements, which, next to oxygen, is the most abundant one in the solid part of the earth's crust. Quartz, sand-stones, and other forms of SILICA (see this head) contain over 45 per cent. of their weight of silicon. Granite and gneiss rocks will average 35 per cent. **of silicon, slates 30 per cent., and trap-rocks 23 per cent. Silicon is therefore many times more abundant than any** other *solid* element; and it is one illustration of the comparatively slight mastery obtained so far by man over nature that for this superabundant element no direct use has been **found, it being as yet but a rare curiosity of the laboratory** and museum. Silicon was first obtained by Berzelius in 1823 from the silicofluoride of potassium (see FLUOSILICIC ACID) by the action of fused potassium thereon. It appears, when thus obtained, as an amorphous allotrope, a powder of a dull-brown color, which smears the fingers like **lampblack. It does not conduct electricity; is not acted on by mineral acids, except hydrofluoric, but dissolved by** potash solution. Heated in air or oxygen, it burns **brilliantly with a heat sufficient to melt the silica formed. Its** density, in this allotropic modification, does not appear to **have been determined. Silicon may be obtained in this form also by the action of potassium or sodium on gaseous fluoride or vaporous chloride of silicon; also by the elec-**trolysis of fused silicofluorides, according to Ulik. **A second allotrope, or set of allotropes, of silicon is obtained by exposure of the above to strong heat, which causes it to** become denser and pass into what is called *graphitoid silicon*. Of this there are at least three distinct modifications, marked by their densities—2.025 and 2.201, as determined **by Winkler, and 2.51 by Wöhler and Harmening. The last allotrope has exactly the molecular volume of cast** *aluminum*. (See VOLUMES, MOLECULAR.) This allotrope was obtained in hexagonal tabular crystals by Wöhler by fusing silicofluoride of potassium with an excess of metallic aluminum, which reduces the silicon, and dissolving out the **aluminum from the metallic button obtained, with acids. Another form is fused silicon, which was obtained by De-**ville by heating above the melting-point of steel. This is dark steel-gray in color and hexagonal in crystallization; density not stated. Deville and Caron obtained cast ingots weighing near a pound. In this modification it will not burn, even in oxygen gas at a white heat.

Adamantoid Silicon.—This is obtained by passing vapor **of chloride of silicon over fused aluminum. From the** aluminum, when saturated, the silicon begins to crystallize out in large brilliant rhombic (?) prisms of the color, lus**tre, and iridescent appearance of some kinds of specular iron, and hard enough to cut glass like the diamond. Its** density is unknown in this form again. It is also obtained **in the diamond modification, more cheaply, by crystallization from melted zinc, substituting for aluminum in the** above process an alloy of zinc and sodium.

The silicon-allotropes offer a remarkable parallelism with those of carbon; and, indeed, there are no elements, of such **widely different functions in nature, which present so many** extraordinary analogies as carbon and silicon, the first being a characteristic element of the organic kingdom, and the last **of the inorganic. Silicon is more electro-positive or basylic than carbon, at least at high temperatures, and will even decompose carbonate of potash when fused with it, setting carbon free, with vivid incandescence, silicate of potash being formed. It is therefore a more powerful agent in smelting** reduction than carbon, and if it were cheaply procurable would have valuable practical applications in this way. **Silicon combines with iron at high temperatures, and pig** irons often contain it. Indeed, its practical preparation, when needed, may probably be founded on the power of **fused metallic iron to reduce silica at very high temperatures in the absence of air. It will be easy to remove the** iron by solvents. One function of the basic slags which **are always formed during the smelting of iron ores is to** prevent the formation of such compounds of elemental **silicon with the iron, these being highly detrimental to the** latter. The definite compounds of silicon with iron are as yet unknown.

HENRY WURTZ.

Silicon, Compounds of. SILICA (see this head), its compound with oxygen, with the *hydrates* thereof, have **been already described; and SILICATES also under that head. Hydrogen forms a curious gaseous compound, sometimes called *siliciétted hydrogen*, which has not been yet obtained free from excess of hydrogen. It is *spontaneously combustible* in the air, even when largely diluted with hydrogen. Wöhler and Buff obtained it by the electrolysis of common-salt solutions, when the positive pole was an alloy of silicon and aluminum. There are other methods. Some suppose** it to have the composition SiH. *Tetrachloride of silicon* ($SiCl_4$) is a transparent, colorless, volatile liquid, of density **at zero 1.5161, boiling at 122° F., decomposed by contact with water into hydrochloric acid and silica, the latter** partly in the form of a soluble hydrate which remains in **solution. Sodium acts upon the liquid chloride with ex-**plosive violence, setting silicon free. It is formed by heat**ing either elemental silicon or a mixture of silica and char-**coal in a current of chlorine gas.

***Disulphide of silicon* is a product of the action of the**

vapor of disulphide of carbon on a mixture of carbon and silica at a high heat. It is solid, presenting the aspect of asbestos, and volatile in a current of hydrogen gas. Moist air decomposes it into anhydrous silica and sulphuretted hydrogen, but in cold water it dissolves completely, a hydrate of silica being formed in solution: and on spontaneous evaporation sulphuretted hydrogen passes off, and a transparent opal-like mass is left.

The *tetrafluoride of silicon* (SiF_4) is one of the most important and interesting of its compounds. The affinity of fluorine for silicon is so great that hydrofluoric acid cannot be kept in glass vessels; and this is the main reason why the element fluorine is almost unknown, as no transparent apparatus can be made to hold or preserve it, through which it can be inspected and its chemical behavior made visible. This compound and its derivatives will be found described by Prof. Chandler under the heads FLUORIDE OF SILICON and FLUOSILICIC ACID.

HENRY WURTZ.

Silico-Nitrohumic Compounds. See HUMUS.

Silis'tria, town of European Turkey, eyalet of the same name, on the Danube, is poorly built, mostly consisting of crooked, narrow, and filthy streets lined with houses of wood or huts of mud. Nevertheless, it contains 12 fine mosques, many public baths, a well-stocked bazaar, several manufactories of leather and cloth, and carries on an important trade in timber and grain. Its chief importance, however, is derived from its being a fortress of first rank. It is surrounded by walls of solid masonry and defended by a line of detached forts of immense strength. P. 23,000.

Silk, and Silk Manufacture. After wool and linen, silk seems to have been, in the remote East, one of the earliest of textile industries. The Chinese records agree that Hoang-Ti, the third emperor of China, charged his first or principal wife and queen, Si-Ling-Chi, to examine the silkworms and test the practicability of using the thread from the cocoons. In her zeal she collected large numbers of the worms, fed them herself, and discovered not only the means of rearing them, but also the method of reeling the silk and of employing it to make garments. The period when this beneficent discovery was made is left as vague as the rest of the Chinese chronology, and European writers have differed in regard to the date all the way between 2700 B. C. and 1700 B. C. Other particulars in the long and useful reign of Hoang-Ti enable us to fix somewhat more definitely the period in which he flourished, and render it probable that he ruled over China during the greater part, and perhaps the whole, of the century 1800 to 1700 B. C. This would make him a contemporary of the patriarch Joseph. The Chinese say that the empress Si-Ling-Chi was deified for this meritorious act, and that she has ever since received divine honors under the name of "the goddess of silkworms." The wild silkworms—or at least some of the numerous genera and species of the Bombycidæ—were found in great numbers in other countries of Southern or Eastern Asia; they inhabited the jungles of India, Pegu, Siam, and Cochin-China; but for many centuries the only use made of their cocoons was by carding and spinning the silk, very much as spun silk is now produced. Meanwhile, the Chinese kept their methods of rearing the silkworms and reeling the silk a profound secret for nearly 2000 years. During this period the silk-culture had made a little progress westward; some of the nations of Central Asia who were under the sway of the Chinese were rearing silkworms under rather rigid restrictions; and Persia was for nearly 1000 years the common carrier of silk between the Chinese and the Western nations, without knowing, perhaps without caring to know, how or from what silk was made. Aristotle was the first European to learn the true origin of the wrought silk brought to him from Persia on the return of the victorious army of Alexander from that country. He described the silkworm as a horned insect, passing through successive transformations, and producing *bombykia*, the name he gave to the silk. The prevalent theory of the origin of silk among the Greeks and Romans for at least 500 years after this time is given with all seriousness by Ammianus Marcellinus, in the first century after the Christian era, in the passage in which he represents the *Seres*, or silk-growers, as "a sedate and gentle people, passing their happy days in the most perfect tranquillity and delightful leisure, amid shady groves, fanned by gentle breezes: these groves produced fleeces of downy wool which, after being sprinkled with water, is combed off in the finest threads and woven into *sericum*" (the Latin name of *silk*). Virgil also says in reference to silk, "*Velleraque ut foliis depectant tenuia Seres*" ("The Seres comb the delicate fleeces from the leaves"). Probably, both writers had confounded the gathering of the silk-cotton from the silk-cotton tree (*Bombax*) of the East with the production of silk. In Aristotle's time Pamphila and her associates in the island of Cos (or possibly Ceos, the modern *Zea* in the Ægean Sea) had imported silk goods, or possibly raw silk, from Persia, and, unravelling it, had woven from the single and delicate threads a silken gauze, which from its transparency received the name of "woven wind." Her example was followed somewhat later by the Roman ladies, who, however, used the silk only for the warp of these delicate tissues, while the weft or filling was of fine threads of linen or cotton. The Phœnicians of Tyre, Sidon, and Berytus also procured raw silk from the Persians, and wove silk goods for Corinth and Rome. The latter city under the emperors indulged freely in the costly luxury of silk attire. It became the favorite dress of both sexes, and sumptuary laws were passed to restrict its use to women, and to the wealthy among these, under the reigns of Tiberius, Vespasian, and Diocletian. Heliogabalus, among his other extravagances, wore garments made wholly of silk, though these were valued at more than their weight in gold. The emperor Aurelian refused to his empress a silken robe, on the ground of its great costliness. Silk in its raw state was still imported through the Persians, and continued to be till the time of Justinian in the sixth century of the Christian era. That emperor, having engaged in war with Persia, found his supply of silk cut off and the manufacturers in great distress. He attempted some very foolish legislation in regard to it, but was saved from the consequences of his folly by the arrival at Byzantium of two Nestorian monks from China, who brought with them the seeds of the mulberry and communicated to him their discovery of the mode of rearing silkworms. The exportation of the eggs of the silkworm or of the unreeled cocoons from China was at this time forbidden under the pain of death; but, stimulated by the persuasions and liberal promises of Justinian, the two monks returned to China, and in 555 came back, by way of Persia and Bokhara, to Byzantium or Constantinople, bringing with them a quantity of silkworm eggs concealed in the hollow of their pilgrims' staves. From this small beginning the culture of silk spread rapidly over Greece and Syria. It was introduced into Spain and Portugal in 711 by the Saracens, into Sicily and Naples in the twelfth century, and probably in the thirteenth into Genoa and Venice. It was not generally extended throughout Italy and Piedmont till the sixteenth century. It did not take root in France till the latter part of the sixteenth and the beginning of the seventeenth century, but during the latter century it made great progress there, as well as in Belgium and Switzerland. The manufacture of silk had begun earlier in France and Germany, and to some extent in England. It is worthy of notice that from the sixth to the seventeenth century the choicest silks, under the names of *samite* (*examitum*, or six-threaded), *cendal*, *siglatoun* or *cyclatoun*, *dyaspres* or *diaper*, *escaraments*, *baudequin* or *baldaquin*, and cloth of gold, were woven first for the churches and cathedrals and for the hierarchy of the Church, next for kings and emperors, and finally for the higher nobility and the wealthier knights of the age of chivalry. Up to the close of the twelfth century these magnificent silks—some of them with raised woven figures of Oriental patterns, but the best, embroidered by hand with years of labor—were brought first from the East, from Persia and China, and later from Greece, where the art of weaving and embroidering these rich textiles was kept a profound secret; still later from Spain, where the Saracens had introduced these arts; and from about the middle of the twelfth century from Sicily, where the Saracens had at first transported their skill from Spain, but were superseded by Greek silk-weavers whom Roger, king of Sicily, had brought as captives from Corinth, Thebes, and Athens to his own island. Some of these early silks surpass in beauty any of the productions of the manufacturers of modern times. In another hundred years the manufacture of silk had extended to Lucca, and thence, about sixty years later, to Venice, Florence, Milan, Genoa, and Bologna. The manufacture of silk goods was brought from Lucca to Lyons probably as early as the fifteenth century, but it made little progress until silk-culture and the production of the cocoons and raw silk were established at the beginning of the seventeenth century. In England the manufacture had made a little progress in the fifteenth and sixteenth centuries, but all attempts at silk-culture had failed. In Austria, Germany, Switzerland, and the Low Countries there were manufactories of silk, but very little silk was grown.

The first attempts to introduce silk-culture into America were made very early. James I. having been foiled in his efforts to establish the rearing of silkworms in England, and having learned that the climate of Virginia was favorable for silk-culture, sent over, in 1622, silkworm eggs, white mulberry trees, and printed instructions; he also gave special directions to the earl of Southampton to urge the cultivation of silk in the American colonies in preference

to tobacco, to which His Majesty had a strong aversion. Large bounties were offered for the production of the raw silk, and fines were imposed on every planter who failed to plant a certain number of mulberry trees to every 100 acres of land in his possession. At first the enterprise bid fair to prove successful, but it was neglected by the company and thrown upon the planters before it was fully established, and hence failed. Some silk was exported to England for several years, but after a time the attention of the planters was turned wholly to tobacco. At the time when the colonies of Georgia and the Carolinas were founded the effort was made to revive the culture of silk there, and under vigorous protection and encouragement from England it was for a period of perhaps twenty-five or thirty years very successful. The first shipment of silk from Georgia consisted of eight pounds, and was made in 1735. From this small beginning there was a steady increase to 1759 or 1760. A filature, or establishment for reeling the silk from the cocoons, was established about 1750 at Savannah, and in 1755 reeled and exported over 100 pounds of raw silk, worth about $6.50 per pound; in 1758, over 700 pounds; and in 1759, over 10,000 pounds, the export of that year realizing over $75,000. From this time the culture of silk declined, and did not probably yield more than $75,000 to $80,000 in the next twelve years. During the Revolutionary war the production in Georgia was made up into sewing silk and sold at home. After the war there were some efforts made to revive the exportation, and some small parcels were exported as late as 1790. The culture of silk was not attempted in Connecticut till about 1760, but it was carried on there more extensively and persistently than anywhere else in the U. S. For eighty-four years silkworms were reared there in considerable numbers, in Windham, Tolland, Hartford, New Haven, and Fairfield cos. Rev. Dr. Stiles, president of Yale college from 1778 to 1795, was a zealous silk-culturist, and among his manuscript diaries, now in Yale college library, one volume is devoted to the rearing of silkworms. His commencement gown or robe was made of silk grown, reeled, thrown, dyed, and woven in his own family. The silk produced in Connecticut, which for many years amounted to $100,000 or $200,000 per annum, was seldom exported, but was made up into sewing silk and occasionally into woven silk goods in the domestic way, until about 1828 or 1829, when some efforts were made to introduce machinery for its manufacture. Much of it was sold in barter. The rearing of silkworms was also attempted with some success from 1769 to 1775 in Pennsylvania, New Jersey, New York, Rhode Island, and Massachusetts. In most of these States it was given up during and after the Revolutionary war, and was not revived again till about 1825 or 1826, when the large importation of silk goods and the favoring circumstances of the time led to a most determined effort to resuscitate the culture of silk. The venerable and learned Peter S. Duponceau, then president of the American Philosophical Society, took the lead in this movement, and a *protégé* of his, M. J. D'Homergue from Lyons, who was thoroughly conversant with the whole processes of silk culture and production, published a volume of essays on the culture of silk, to which Mr. Duponceau contributed an introduction. Mr. Duponceau next brought the subject before Congress, and a committee was raised who reported in 1826, and directed the secretary of the treasury (Mr. Richard Rush) to have a manual of silk-culture prepared, giving also the statistics of silk-growing in the U. S. This was prepared by Dr. James Mease of Philadelphia; it was a very able and exhaustive document. Mr. Duponceau next memorialized Congress to make a moderate grant for the purpose of establishing a model filature in Philadelphia under M. D'Homergue's instruction, to instruct a large number of young men or young women in the art of reeling the silk from the cocoon. This matter was laid over at two sessions of Congress, and finally failed by a very small majority. Meantime, Mr. Duponceau had established at his own expense a small filature at Philadelphia, and exerted himself in all ways, by his letters, publications, and reviews, to excite public interest in the subject. He was to some extent successful; several of the States offered premiums and bounties for the cultivation of the mulberry and the production of raw silk. Silk societies were established and books on silk-culture multiplied: Dr. F. Pascalis in New York, Hon. Gideon B. Smith in Baltimore, Mr. Jonathan H. Cobb in Massachusetts, Judge F. G. Comstock in Connecticut, and Mr. Vernon in Rhode Island, published volumes of considerable value on the subject. There seemed to be a favorable opportunity to test the question of the practicability of silk-growing in this country, and the manufacturers of silk were all ready to follow. New machinery for reeling, throwing, and weaving silk was invented and put in operation; and as the supply of American-grown raw silk was not sufficient to meet the demand, a moderate quantity was imported. But amid all this excitement the imports of manufactured silks constantly increased, and very soon a new disturbing element was introduced which eventually brought great disaster to the whole movement. The silkworms had hitherto been fed, generally, on the leaves of the white mulberry (*Morus alba*; see SILKWORM), though in a few instances the leaves of our indigenous mulberry (*Morus rubra*), and even lettuce-leaves, had been used in feeding. But subsequently to 1830 a great effort was made to introduce the so-called Chinese mulberry (*Morus multicaulis*) in the place of the white mulberry, on the grounds of its more rapid growth, its yielding two crops of leaves in a season, and these very abundant and succulent. It was objected that it was not hardy, and not relished by the silkworms as well as the *Morus alba*, but all argument seemed to be useless; a sudden infatuation seized the people, and they began to speculate in the *Morus multicaulis*, till the price of the little twigs or cuttings was far beyond the value of all the silk that could be produced from them in twenty years. By the spring of 1839 this infatuation had reached such a height that twigs less than two feet in length and of the size of a pipe-stem were sold at $2, $3, or $5, and many people had given up all other business to buy and sell these twigs; one nurseryman had sent an order to France for 5,000,000 young *multicaulis* plants, his agent taking $80,000 in specie to bind the bargains. In the autumn of 1839 the bubble burst, ruining thousands of persons, and in the spring of 1840 the *multicaulis* trees were offered at two or three cents each, but found no purchasers. In 1844 a severe winter destroyed most of the *Morus multicaulis* trees that remained, and blighted in the Northern States generally the white mulberry; and for the second time in its history the rearing of silkworms was practically abandoned throughout the whole country. Even Mansfield, Conn., and the towns adjacent, which had for eighty-four years hardly known any other industry, gave up their cocooneries and turned their attention to other pursuits. Writers on the subject, like William Kenrick, John Clarke (whose *Treatise on the Mulberry Tree and Silkworm* is to this day the most satisfactory book on the subject), Hon. John S. Skinner, and Rev. I. R. Barbour, and practical silk-growers like the Cheney Brothers, Gideon B. Smith, Edmund Morris, Jonathan H. Cobb, Dr. David Stebbins, and Samuel Whitmarsh, were compelled to admit that they had put too much confidence in the *Morus multicaulis*.

Yet great good resulted, in the end, from this apparent disaster. The men who had devoted so much attention to silk-culture, finding the rearing of silkworms unprofitable, now turned their energies to the manufacture of silk. From the commencement of the century there had been some importation of raw silk, mostly for the fringe and dress-trimming manufacturers, and to some extent also for exportation; in some years it had amounted to $100,000, $200,000, and in one year to $600,000. These new manufacturers now began to import raw silk from China, from Turkey, and from Italy; and though they had to contend with unfavorable tariffs, with the general prejudice in favor of imported goods, and with the difficulties attendant upon the employment of unskilled and incompetent workmen, they persevered. In 1850 the Cheney Brothers at Hartford and South Manchester, Conn., and several manufacturers at Mansfield, at Newton, Groton, Northampton, and other points in Massachusetts, in Philadelphia, Baltimore, and New York, were doing a fair and increasing business in the manufacture of sewing silk and twist. Messrs. Horstmann & Sons, who since 1815 had maintained the even tenor of their way in the manufacture of dress and upholstery trimmings, military goods, etc., partly or wholly of silk, in Philadelphia, now began to enlarge their business. As yet, there was little done save in sewing silks, dress trimmings, and a few styles of ribbons. But in the next decade (1850–60) the demand for sewing-machine silk and twist began to increase, and by this time it was found that the best brands of American sewing silks were superior in quality, evenness, strength, and color to the best Italian; pongees, Japanese silks, and other mixed goods were made of as good quality as the imported; handkerchiefs, ribbons, and a few pieces of broad goods were put upon the markets, and were creating a demand for more; and after years of experiment, on the part of the Brothers Cheney, the spun silks made from silk waste, pierced cocoons, etc. were coming into use, and greatly reducing the cost of those goods of which they could form a part. As yet (in 1860) American silk-manufacturers had received no protection or aid from the government; indeed, they had been hindered rather than helped, since the moderate duties on manufactured silks were more than counterbalanced by the duty on the raw silk, which they needed to have free. But in 1861 the exigencies of the war required the raising of a large

revenue, and a heavy duty (40 per cent., afterward raised to 60 per cent.) was imposed on manufactured silk, while raw silk was admitted duty free. Here was the opportunity for the silk-manufacturers, and they improved it. In every direction their enterprise was manifest. Paterson became to some degree the Lyons of America, and its forty or fifty silk-houses were active and wide awake. In Philadelphia, New York, Boston, and Baltimore, as well as in numberless smaller towns and cities, one form or another of the silk industry was established and profitable work furnished to many thousands of busy workers. The sewing silk and machine twist still continued to be in great demand, and since 1870 has been sold in Europe as well as in other countries; ribbons and scarfs of all kinds are manufactured here, and are crowding out the foreign goods; dress trimmings, from the simplest fringe and the plainest buttons to the richest marabout trimming and bullion fringe, and the costliest of silk buttons are now manufactured here better and cheaper than the imported goods; lace, in all the varieties of which silk is a constituent—scarfs, veils, nets, etc.—is contesting in our markets the palm with the choicest products of the looms of Nottingham and St. Gall. But the greatest advance has been made in what are known as broad goods—dress silks of all colors, fancy and brocaded silks wrought by the improved Jacquard looms, millinery silks, foulards, and spun silks of slight lustre, but of great durability and beauty, and at the same time so moderate in price as to be within the reach of all. In color, quality, and durability, as well as in beauty, the American silks surpass the French silks of the same grade, with two additional advantages—they are not weighted with dyestuffs, as are the same grade of foreign silks, and hence are often more durable and of more enduring colors, and they are lower in price. Much of this success in broad goods and ribbons is due to the enterprise, persistency, and progressive spirit of the Cheney Brothers, who for nearly twenty years struggled almost alone against European competition in these goods. They are now reaping a generous reward, which others have come in to share, but in some descriptions of silks they are still the leaders of the American trade. The intense competition and the present low price of raw silk have brought down the prices, notwithstanding the duties, to such a degree that at no time in the present century, even when there was a merely nominal duty on manufactured silks, has it been possible to buy silks of the better grades so low as they can be purchased to-day. As yet, our manufacturers are doing but little in the very highest grades of dress silks, now generally woven by hand in Lyons, nor are they attempting the production of the heaviest silk velvets, but they will ere long produce both, and weave them on power-looms.

With a few words on the processes employed in the manufacture of silk we pass to the statistics of its production. The cocoons (see SILKWORM) after their completion, generally in six or eight days from the time the worms commence spinning, are ready to be gathered. Those intended for seed—*i. e.* for the hatching out of the butterfly or silk-moth—are first selected with care, and the remainder are subjected to some one of the several processes for destroying the life of the chrysalis, as otherwise the moth would force its way out through the cocoon and spoil it for reeling. Some prefer the heat of the sun at noon, others baking in a moderately hot oven, others the fumes of camphor, etc. etc. The cocoons, which are then called dry cocoons, are next assorted, those as nearly of a size as possible being put together, and the largest by themselves. The small cocoons are much less valuable, and the *dupions* or double cocoons are generally rejected, as there is difficulty in reeling them. All soft or imperfect cocoons are also rejected. When thus assorted they are ready for reeling. The floss or coarse loose silk is taken off, and the cocoons put, eight or ten at once, in a kettle or pan of quite warm but not boiling water, and stirred with a bit of broom or a whisk lightly and gently till the silk fibre is loosened and can be caught up. A fibre from each cocoon is then passed through the holes of the brass plate which covers the pan or kettle, and thence repeatedly crossed and carried forward to the reel. The reeling process requires great skill to keep the thread even, as the amount of silk on each cocoon varies, and it is constantly necessary to be joining new threads. The threads are also of different degrees of fineness on different portions of the same cocoon. The threads thus united on the reel form what is known as *raw* silk. This is imported from China and Japan, from Turkey and Italy, in hanks or large skeins. Much of the Chinese and Japanese silk is not well reeled, and there is a large amount of waste, often from 25 to 30 per cent., in working it. The *raw* silk or *hard* silk, as it is called before it goes into the dyer's hands, is now ready to be thrown (Ang.-Sax. *thrawan*, "to twist"). For this purpose it is re-reeled, doubled, cleaned, doubled again, spun, twisted, and, if to be used for weft or filling, four or six threads are twisted together and finally reeled again into hanks or skeins for the dyer. The dyer on receiving it boils it for two or three hours in soap and water, then rinses in clear water, and, drying it, proceeds to give it the required color. By this boiling good silk loses about 23 or 24 per cent. of its weight, and just here comes in the opportunity for deception or fraud. If the silk receives what is called a pure dye, only a fraction of an ounce in every pound of the loss from the boiling which removed the gum and impurities of the silk is restored, but the silk remains soft, will not crack or fade, is stronger, though somewhat finer, than before it was dyed. If, on the contrary, the dyer is so disposed, he can cause the silk to absorb the dyestuff and swell with it till its weight has been increased one-fourth, one-half, three-fourths, or double, triple, and even quadruple, its original weight. The silk thus treated has a good lustre, but is stiff and brittle; if a dress silk, it is liable to crack and fray, and does very little service; while the silks which are of pure dye are soft, bear any amount of folding or crumpling, will not crock, break, or crack, and are very durable. The silk when dyed is either reeled or spooled, according to the use to which it is to be put. The process of throwing the silk is carried to different degrees, according to the purpose for which it is to be used. If wound, cleaned, and twisted, or thrown, without doubling, it is called *dumb singles*, and is used for making gauze veils, etc.; if doubled once as it comes from the reel, cleaned, and thrown, it is called *thrown singles;* if wound, cleaned, doubled twice or more, and twisted or thrown, it is called *tram*, and is used as the weft or filling of silk goods. Sewing silk goes through the same process, but, except in the case of embroidery and saddlers' silks, is not doubled so many times; when intended for twist, it is twisted or thrown twice (after each doubling), the second reversing the first twist; if wound, cleaned, spun, doubled, and thrown, it is called *organzine*, and is used for the warp or chain of broad silk goods. The weaving may be by hand-looms, power-looms of different kinds, gang-looms for ribbons, or power-looms with the Jacquard attachment where the goods are to have figures wrought in them; for laces there are still other looms; and if the lace is figured, Jacquard attachments to these. (For a description of these different looms see the article LOOM.) Recently, a new loom for weaving silks has been introduced, the Earnshaw needle-loom, improved by Greenleaf. This uses an eye-pointed rod or needle instead of the shuttle, the filling being fed continuously from a large cop at the side of the loom, and the selvedge being made by interlocking the filling on one side with a small shuttle carrying a fine warp thread and running parallel with the warp. It is claimed that this makes a smoother and stronger fabric, that there is no danger of overshot work, and that it accomplishes from one-third to one-half more work per day.

On Jan. 1, 1876, there were in the U. S. 213 silk manufacturing establishments in 15 different States. These establishments employed 18,007 hands, of whom 4733 were men, 8739 women, 2409 boys, and 3126 girls under 16 years of age; they paid, in the year 1875, $6,390,356 wages, reported a capital of $17,913,858 invested in the business,

COUNTRIES.	Production of raw silk in 1874, pounds.	Production of raw silk in 1874, values.	Export of raw silk in 1874, pounds.	Export of raw silk in 1874, values.	Imports of raw silk in 1874, pounds.	Imports of raw silk in 1874, values.
China	23,232,000	$92,928,000	8,492,000	$33,968,000		
Japan	4,950,000	19,800,000	1,533,400	6,033,600		
Italy	9,875,000	79,000,000	7,338,980	58,711,840	1,419,000	$5,676,000
Switzerland	381,194	3,049,552				
Austria-Hungary	514,600	4,116,800	....	....	350,000	2,800,000
Spain and Portugal	314,000	2,198,000	297,000	2,079,000		
Turkey in Europe	1,320,000	7,920,000	792,000	4,752,000		
Russia, the Caucasus, etc.	2,420,000	14,520,000	966,800	5,800,800	1,518,000	5,373,800
Persia, Toorkistan, etc.	1,100,000	6,050,000	55,000	302,500		
India	8,800,000	26,400,000	1,069,200	3,741,200		
Anam, Cambodia, and Cochin-China	500,000	2,000,000	220,000	880,000		
France	5,207,800	41,662,400	1,183,920	9,461,360	....	80,800,000
Great Britain	....	....	....	....	3,752,540	18,763,000
United States	....	....	....	....	1,159,420	4,504,306
Totals	58,614,594	$299,646,752	21,958,300	$125,830,300	8,198,960	$117,917,106

COUNTRIES.	Production of manufactured silks in 1874, values.	Exports of manufactured silks in 1874, values.	Imports of manufactured silks in 1874, values.
France	$116,400,000	$95,400,000	$12,693,570
Italy, estimated	....	35,000,000	
Great Britain	....	17,730,725	49,276,320
Germany	38,000,000	19,300,000	
Switzerland	16,000,000	13,400,000	
Austria	12,000,000	4,712,000	
Russia	10,600,000		
Belgium	15,130,000	11,248,095	
Sweden and Norway	320,000		
United States	21,120,428	40,878	23,996,782
Total exports	....	$196,731,698	

and produced silk goods to the amount of $27,158,071. These silk goods were thus divided: thrown and spun silks, $5,931,558; sewing silks and machine twist, $6,420,833; broad goods (including dress and fancy silks) and ribbons, $10,261,814; laces, braids, and trimmings, $4,543,866. The gold value of the raw silk imported during the same year was $5,[illegible], and of the imported manufactured silk goods, $24,292,757; so that in a year of great depression of business and low prices the value of American manufactured silks was just about equal to the importations, when the gold value is reduced to currency. The American manufacturers of sewing silks have completely driven the foreign article from the markets, and are now exporting sewings and twist to Europe. In ribbons they have sold about four-sevenths of the whole quantity sold, and are selling nearly as many dress and fancy silks as the importers, while the greater part of the foreign dress goods have been sold at a loss. The preceding table, prepared from the most authentic sources, gives the importation, exportation, and production of raw silk in pounds and values, and the production, exportation, and importation of manufactured silk in 1874 by the principal countries of the world. L. P. Brockett.

Silk Association of America. On June 12, 1872, a circular was issued by the Silk Industry Association of Paterson, N. J., stating that there was a generally-expressed desire of silk manufacturers to form a national association, and calling on those who would be likely to take an interest in the matter to hold a meeting with reference thereto. The benefits of such union had already been partially demonstrated during the existence of a society called "The National Association of Silk Manufacturers for the Exposition of 1869." Forty-four firms engaged in the business responded to the call of the Silk Industry Association, and held a meeting in New York June 26, 1872. The inception of the undertaking was largely due to the energetic efforts of the late William J. Horstmann of Philadelphia, although he did not live to see the association formed. The result of the meeting was the organization of the Silk Association of America. Its specific objects are to obtain, classify, and publish complete and authentic statistics of the silk trade and manufacture in all their branches, going into detail as to capital and labor employed, conditions and growth of the industry, and amounts of imports; to secure united action in such measures as may be needed to advance the interests of the silk industry in the U. S.; to take steps toward preventing the adulteration of raw silk in China and Japan, and to improve the methods of reeling silk in those countries; and to establish a silk-conditioning house for testing and assaying silk. Mr. John Ryle of Paterson, N. J., was the first president of the association; Mr. B. Richardson acted as secretary *pro tem.* until the selection of a permanent secretary in October following, when Mr. Franklin Allen was appointed. The branches of industry now represented in the association are as follows: importers, dealers and brokers in raw silk, throwsters of and dealers in gum silk, manufacturers of sewing silks and twist, weavers and dyers, manufacturers of fringes, braids, trimmings, etc. The roll of membership Jan. 1, 1876, embraced 81 individuals and firms, whose business, carried on in New York, New Jersey, Pennsylvania, Massachusetts, and Connecticut, employed a capital amounting to $12,350,000. The revenues of the association have been in the first six months ending May, 1873, $3000; in the year ending May, 1874, $5400; in the year ending May, 1875, $7450; in the year ending May, 1876, $6050. It was incorporated Apr. 11, 1876, under the general laws of the State of New York. On Mar. 22, 1876, the association suffered the loss of a trusted leader and wise counsellor by the death of its president, Ward Cheney, who had been for many years among the most prominent of the silk-manufacturers of America, and not less noted for his success in business than for the fatherly care and interest with which he sought the practical welfare of the large force of work-people employed by his firm (Cheney Brothers) at South Manchester, Conn. The officers of the association (elected Apr. 26, 1876) are—president, Frank W. Cheney of Hartford, Conn.; vice presidents, Thos. N. Dale of Paterson, N. J., A. B. Strange and William Ryle of New York; treasurer, John N. Stearns; and secretary, Franklin Allen of New York. The directors are—F. O. Horstmann, Pa.; William Strange, C. Greppo, I. A. Hopper, and C. Lambert, N. J.; Ira Dimock, William Skinner, and J. W. C. Seavey, Mass.; Frank Cheney and Milo M. Belding, Conn.; B. Richardson, George B. Skinner, A. Soleliac, Seth Low, George H. Burritt, L. Bayard Smith, D. O'Donoghue, A. G. Jennings, Louis Franke, and John T. Walker, N. Y. The office of the association is at 93 Duane street, New York. Franklin Allen.

Silk, Chemistry of. The fibres of silk are mainly composed, together with some albumen, of a substance called *sericine*, coated with a yellowish wax, which must be removed before dyeing the silk. Sericine (from Lat. *sericu*) is a name given by Schlossberger to the silk-substance, which had been previously called *fibroine*, and supposed to be identical with the substance of sponges. Spider-webs, according to the same chemist, are also sericine. It is obtained pure by successive boiling with alcohol, water, acetic acid, and water again. The pure sericine is white and lustrous like silk itself, and sinks in water. It is not turned yellow by nitric acid, with formation of *xanthoproteic* acid, like skin and other albuminous tissues of animals. Dilute caustic alkalies do not affect it, but when strong they dissolve it, and on adding water the sericine is again precipitated—according to some authorities unchanged, and even assuming curiously again its former *fibrous* structure! In composition sericine is not very unlike the Albuminoids (which see), though so different in properties. Mulder found carbon 49.11, hydrogen 6.5, oxygen 26.72, and nitrogen 17.67. There is no sulphur, however. For distinguishing silk-fibre from cotton and flax, chemically, two reagents are available, one of which is a concentrated solution of oxide of nickel in ammonia, which forms a brown-yellow solution in the cold; the other is hot basic chloride of zinc, which first gelatinizes, then dissolves the silk (but if *too strong* or *too hot* will also gelatinize the other fibres). Picric acid will also distinguish the silk-fibres in a mixed tissue by dyeing them yellow. Henry Wurtz.

Silk Cotton, the cottony down of many sterculiaceous trees of Africa, India, and South America of the genera *Bombax, Eriodendron, Chorisia, Salmalia,* etc. This beautiful cotton grows wild in great quantities, but thus far it has been found not to spin well, and not to wear well. It might perhaps be used for gun-cotton or for paper-stock. The trees are mostly very large, with very soft wood.

Silk-Printing. See Appendix.

Silk Spider [*Nephila plumipes*, Koch], a geometric spider of the family Speiridæ, discovered by Prof. Burt G. Wilder on the Sea Islands of South Carolina in 1865. It produces two kinds of strong, fine silk—yellow and white—which wind to a length of nearly two miles, and it is claimed that this substance may be made available for the arts. Its hearing and touch are acute, but its sight defective; it prefers the sunlight.

Silkweed, also called **Milkweed** [botanically, *Asclepias Syriaca*], the common American silkweed, is an exceedingly abundant wild plant over a great part of the U. S. The silky fibre with which the seed-pods are filled has a very beautiful lustre, but is too brittle and destitute of strength to be of value except for merely ornamental uses. The milky juice—of which large quantities could be procured during the season, particularly if the plant be cultivated, which brings it to a very large size—contains 5 per cent. of the valuable substance *caoutchouc*, which may readily be coagulated in the fresh juice and separated by proper manipulation from the other matters present; and, considering the present high price and increasing scarcity of caoutchouc, this abundant North American source of it ought to receive proper attention. H. Wurtz.

Silkworm. See Appendix.

Silkworm Gut, used by anglers in attaching the hook to the line, is prepared in Spain and Italy from the silkworm, just as it is ready to begin spinning its cocoon. The material is precisely that which becomes silk if the worm is allowed to spin. The worm is soaked in vinegar for some hours, and the secretion is then removed, stretched, and dried for use.

Sill (Joshua W.), b. at Chillicothe, O., Dec. 6, 1831; graduated at the U. S. Military Academy July 1, 1853, when appointed a second lieutenant in the ordnance corps. After a brief service at the Watervliet arsenal, he was recalled to West Point, where he served until 1857 as assistant professor of geography, history, and ethics; subsequently in command of Vancouver ordnance dépôt, Wash. Terr., and Leavenworth dépôt, Kan. In Jan., 1861, he resigned from the army, and accepted the chair of mathematics and civil engineering in the Brooklyn Polytechnic Institute. On the outbreak of civil war he was tendered the colonelcy of a New York regiment, and proceeded to Ohio, where he served as assistant adjutant-general of the State in organizing volunteers, and in the field at the battle of Rich Mountain. In Aug., 1861, he accepted the colonelcy of the 33d Ohio Vols., and was engaged in the occupation of Bowling Green, Ky., and Nashville, Tenn., Feb., 1862, and in Gen. Mitchel's expedition to Huntsville, Ala., and seizure of the railroad from Stevenson to Decatur, thus regaining control of Northern Alabama, most of which time in command of a brigade. In July, 1862, he was commissioned brigadier-general of volunteers, and commanded a division in the Army of the Ohio at the battle

of Perryville, Oct. 8, and subsequent pursuit of the Confederate army. In the battle of Murfreesboro', Dec. 31, 1862, he was killed at the head of his brigade, which led a gallant charge and drove back the enemy's hitherto victorious columns across an open field into their intrenchments beyond.

Sillagin'idæ [from *Sillago*, the typical genus], a family of fishes of the order Teleocephali and sub-order Acanthopteri, peculiar to the Asiatic and Polynesian seas. The body is elongated, slightly compressed, and more or less plane below; the scales ctenoid and of moderate size; lateral line continuous to the caudal fin; the head elongate-conical, and excavated by cavities; the opercular bones unarmed, except the operculum, which has a spine; mouth small and terminal; upper jaw little protractile; teeth on the jaws and vomer; branchial apertures continuous below; branchiostegal rays six on each side; dorsal fins two, the first short, the second long; anal with one or two spines; pectorals with branched rays; ventrals thoracic, each with a spine and five rays. The species are rather small, and of no special economical importance. About a dozen species are known. THEODORE GILL.

Sil'lig (CHARLES JULIUS), b. at Dresden May 12, 1801; studied philology in the universities of Leipsic and Göttingen; in 1825 was appointed teacher in the Kreuzschule at Dresden, with which institution he remained connected until his death, Jan. 14, 1855, having attained the position of associate rector. Much of his literary labor was bestowed on the explanation of ancient art, and on mythology as illustrated in art. Among his chief productions are—*Epistola Critica de Catulli Carminibus* (1822), followed by an edition of *Catulli Carmina* (1824); *Catalogus Artificum Græc. et Rom.* (1827; translated into English by Rev. H. W. Williams 1837); *Plinii Historia Naturalis*, with critical commentary (8 vols., 1851–58). He also edited Böttiger's *Opuscula et Carmina* (1836), *Kunstmythologie* (1836), and *Kleinere Schriften archæol. u. antiq. Inhalts* of the same scholar (1837–38, 3 vols.). Sillig was a frequent contributor also to the archæological and classical journals. H. DRISLER.

Sil'liman (BENJAMIN), M. D., LL.D., b. at North Stratford (now Trumbull), Conn., Aug. 8, 1779, son of Gold Selleck Silliman (1730–90), a lawyer and colonel of Connecticut cavalry during the Revolution; graduated at Yale College 1796; was a tutor there 1799–1804, studying law in the mean time; was admitted to the bar 1802, and in the same year chosen professor of chemistry in Yale College; spent a part of the years 1802–04 at Philadelphia, preparing for his professorship under the guidance of Dr. James Woodhouse of the University of Pennsylvania; gave his first full course of lectures on chemistry at Yale in the winter of 1804–05; spent fourteen months in England, Scotland, and Holland 1805–06, engaged in the prosecution of his studies; made a geological survey of a part of Connecticut, the first exploration of the kind in America; published a memoir with an analysis of the fragments of the celebrated Weston meteorite of Dec. 14, 1807; aided Dr. Robert Hare in his experiments with the compound blowpipe, with which instrument he demonstrated the fusibility of several bodies never before fused; secured for Yale College the valuable mineralogical and geological cabinet of Col. George Gibbs 1812; founded in 1818 the *American Journal of Science and Arts*, of which he was sole editor until 1838, and senior editor, along with his son, 1838–46; made a series of important observations on the transference of carbon particles from the positive to the negative pole, while experimenting with a voltaic deflagrator 1822; was an eloquent lecturer on scientific topics before popular audiences, having been perhaps the first to give such courses in the principal cities of the U. S.; made a second visit to Europe 1851; resigned his professorship 1853, and was made professor emeritus, but at the request of his colleagues continued to lecture on geology until June, 1855, when he retired from active labors, but spent the closing years of his long life amid the society of colleagues and former pupils, by whom and by the country at large he was honored as the "Nestor of American science." D. at New Haven Nov. 24, 1864. Author of *Journal of Travels in England* (New York, 2 vols., 1810; 2d ed., New Haven, 3 vols., 1820), *Elements of Chemistry* (1830), *A Narrative of a Visit to Europe* (2 vols., 1853), and several minor publications; he also edited Henry's *Chemistry* (1814) and Bakewell's *Introduction to Geology* (1829). An interesting *Life* was prepared from his MS. reminiscences, diaries, and correspondence by Prof. George P. Fisher (New York, 2 vols., 1866). PORTER C. BLISS.

Silliman (BENJAMIN), M. D., son of the preceding, b. at New Haven, Conn., Dec. 4, 1816; graduated at Yale College 1837; became associate editor of Silliman's *Journal of Science* 1838, and associate proprietor (with Prof. J. D. Dana) 1846; was an instructor in chemistry, mineralogy, and geology in Yale College 1838–46; became professor of applied chemistry 1846, and successor to his father in the chair of chemistry 1851, which position he still (1876) holds. In 1847, in connection with the late Prof. John P. Norton, he established the Yale Scientific School, which has since grown into the Sheffield Scientific School. He was also professor of medical chemistry and toxicology in the University of Louisville, Ky., 1849–54; visited Europe with his father in 1851; was a director in the departments of chemistry, mineralogy, and geology in the "Crystal Palace" world's fair at New York 1853, and prepared (with C. R. Goodrich) the *Illustrated Record* of that exhibition, and the monograph on the *Progress of Science and Art* published in the same connection; was for many years secretary of the American Association for the Advancement of Science, in which capacity he edited the annual volumes of *Proceedings*; has written *First Principles of Chemistry* (1846 and 1854) and *Principles of Physics* (1858–61); contributed many papers to scientific societies, besides the large number published in his own *Journal*; has been a popular lecturer on scientific subjects; and became State chemist of Connecticut 1869.

Sil'loth, a seaport and watering place of England, Cumberland co., on the Solway Frith, 20 miles W. N. W. of Carlisle. It has steam communication with Liverpool, Ireland, and the Isle of Man. P. 5000.

Sil'loway (THOMAS WILLIAM), b. at Newburyport, Mass., Aug. 7, 1828; received a good education, especially in the arts of design; devoted himself as a specialty to the preparation of architectural plans for public buildings, in which business he established himself at Boston in 1851, and in the course of twenty years built or repaired more than 200 church edifices, besides many other public buildings, including the new capitol at Montpelier, Vt. (1859), and Buchtel College, Akron, O. (1872). Since 1852 he has occasionally officiated as a Universalist preacher, and was ordained in 1862. He has written or edited several works on architecture, carpentry, warming and ventilation, and church music.

Silo'am [Heb. *Siloah*, a "sending" or "sent;" Arab. *Silwan*]. (1) The name of a pool, or rather both a fountain and a pool, in Jerusalem, on the southern edge of Ophel, about 1200 feet S. S. W. of the Fountain of the Virgin, with which it is connected by an underground winding passage. The fountain proper, hewn out of the solid rock, is about 6 feet in breadth. Like the Fountain of the Virgin, it is intermittent. The lower basin is about 50 feet long, 17 broad, and 19 deep, but now holding only 3 or 4 feet of water. It was once arched over. Jewish writers say it furnished the water used in sacrifice on the last great day of the Feast of Tabernacles. This most famous of all the pools in or about Jerusalem is mentioned only three times in the Bible (Isa. viii. 6; Neh. iii. 15; John ix. 7), but frequently by Josephus. A stream still goes "softly" from the pool down into the Kedron.—(2) The name of a little straggling, dirty village occupying an old quarry on the E. side of the Kedron, overlooking the Pool of Siloam. R. D. HITCHCOCK.

Sil'phium [Gr. σίλφιον, a large resin bearing plant], a genus of perennial plants of the family Compositæ, comprising twenty species, many of which are found in abundance on the prairies of the U. S., in the Southern States, and in other parts of North America. They are very hardy and coarse, bear large flower-heads, and exude a plentiful resin-like juice, whence the commonest species (*S. laciniatum*) has received the name of rosin-weed. The stem sometimes exceeds ten feet in height. Both the resin and the leaves are much employed by farriers for asthma in horses, and a tincture has sometimes been found useful as a tonic and diaphoretic. This species is known by the names of compass-plant, pilot-weed, and polar-plant, from a reputed tendency to point its leaves N. and S. The prairie burdock (*S. terebinthinaceum*) and the singular cup-plant (*S. perfoliatum*) belong to this genus.

Sils'bee (NATHANIEL), b. at Salem, Mass., in 1773; became a distinguished and successful shipping-merchant in that city; served frequently in both branches of the State legislature; was a member of Congress 1816–20; president of the State senate 1823–26, and U. S. Senator 1826–35, and was a firm supporter of the administration of Pres. John Quincy Adams. D. at Salem July 1, 1850.

Silt [Prov. Eng. *sile*, "sediment"] is the fine mud which is transported by rivers and deposited in lakes and estuaries. The same term is applied to any sediment which accumulates in harbors or river-channels, which, as they are filled, are said to be "silted up." J. S. NEWBERRY.

Silu'rian System, the name given by Sir Roderick Murchison to a series of fossiliferous strata which under-

lie the Devonian rocks in portions of England and Wales, anciently inhabited by the Silures. This group is now divided into the Upper and Lower Silurian systems, which are underlaid by the Cambrian rocks of Sedgwick. The line of separation between the Cambrian and the Silurian is not definitely settled, some geologists referring all the oldest unchanged fossiliferous rock to the Silurian, while others, and the larger party, include in the Cambrian all the rocks which contain the "primordial fauna" of Barrande. In the U. S. the base of the Silurian system is the Potsdam sandstone, the Trenton limestone series being the central mass, the Hudson River group the summit. The Upper Silurian series is formed by the Medina sandstone at the base, the Clinton and Niagara limestones in the centre, and the Helderberg group at the top. (See GEOLOGY.) J. S. NEWBERRY.

Silu'ridæ [from *Silurus*, the Latin name of the European catfish], an extensive family of fishes of the order Nematognathi, and that comprising the catfishes of Europe and North America. The body is moderately elongated and tapers backward from the shoulders; the skin is naked; the head more or less depressed; the operculum developed; the mouth terminal and transverse; barbels, especially maxillary, well developed; teeth variable; branchial apertures confluent below, the membrane being free at its posterior margin; branchiostegal rays exposed and in moderate or considerable numbers; dorsal fin near the head and belonging to the abdominal region (sometimes atrophied); anal fin of considerable size; pectorals and ventrals normally developed; the anterior vertebræ are co-ossified and much modified; the inferior pharyngeal bones distinct. As thus defined, the family corresponds with the second and fourth sub-families of Siluridæ in Dr. Günther's arrangement—*i. e.* (2) Siluridæ heteroptera, including his Silurina; and (4) Siluridæ proteropteræ, embracing his Bagrina, Pinetodina, Ariina, and Bagarina. It is the richest in number of species and diversities of structure in the order. Most of the species are inhabitants of lakes and rivers, but a number of its representatives are habitual denizens of the salt waters. Species are found in almost all temperate and tropical regions; Europe has the fewest, only one species (*Silurus glanis*) being found in the rivers of Central and Northern Europe; North America is well provided with forms, at least four genera being represented in the fresh waters N. of Mexico—viz. (1) *Amiurus*, including the common chubby catfishes of the Eastern streams; (2) *Ictalurus*, represented by graceful fork-tailed fishes in the great lakes and Western rivers; (3) *Hopladelus*, and (4) *Noturus*. Two salt-water species also visit the Eastern coast—viz. *Ælurichthys marinus* and *Ariopsis Milberti*. The fresh-water species have the anterior and posterior nostrils far apart from each other, and barbels are developed from the edge of the posterior, while in the salt-water forms they are close together and destitute of barbels. The species, so far as known, take care of their young, and peculiar provision is made for the protection of the eggs in the mouth of several genera found in tropical waters. THEODORE GILL.

Silva. See SELVA.

Sil'ver [Ang.-Sax. *silfor*], one of the precious metals, has been known from remote ages, and much used for ornaments, household vessels, and for money. With the Romans it was known as *argentum*, and among the alchemists as *luna*. Its chemical symbol, Ag, is derived from the Latin name. It is the whitest of the metals, and takes a brilliant mirror-like polish. In hardness it is intermediate between gold and copper, and is very malleable and ductile. It may be beaten into foil or leaves 0.00001 of an inch in thickness. A grain weight of the metal may be drawn out into a wire 400 feet in length. If repeatedly heated it becomes brittle. The specific gravity of silver ranges from 10.1 to 11.1, according to its condition and purity. Karsten found the gravity of fused silver to be 10.4382; G. Rose gives 10.57 for hammered silver, and 10.92 for precipitated silver. The metal fuses readily on charcoal before the blowpipe or in a crucible in a forge or furnace fire. It expands forcibly upon cooling, and thus solid pieces will float in molten silver as ice floats in water. It may be vaporized by the burning lens or by the oxyhydrogen blowpipe or strong electrical currents. The vapors are white. When pure, the molten metal absorbs from twenty to twenty-two times its bulk of oxygen gas, according to various authorities, but the presence of a small percentage of copper or lead greatly diminishes or prevents this absorption. The absorbed gas is, however, given off at the moment of solidification, and with considerable force. If the surface of a globule or bar of silver has cooled while the interior is fluid, the expansion breaks the crust and more or less of the fused metal is projected through the cracks, and forms an arborescent growth generally known as "sprouting," and, when it is projected with violence, as "spitting." This mechanical projection of a portion of a globule of silver cooling upon a cupel is a frequent source of loss in assaying. The absorption of oxygen and the subsequent spitting may be prevented to a great extent by the use of charcoal powder upon the melted metal. Absorption of oxygen is also prevented by fusing it under a layer of salt. The use of nitre in the crucible causes a large absorption of the gas. The vapor of water is decomposed by silver at a white heat, oxygen being absorbed and hydrogen liberated. Silver is a good conductor of heat and of electricity. It is capable of being welded. It alloys freely with gold, copper, and several other metals. It crystallizes in forms of the monometric system, generally in octahedra.

Silver is abundantly distributed in nature, particularly among the metallic minerals. Malaguti and Durocher give a table of 122 substances, chiefly mineral species, in which silver has been found by assay. It exists in sea-water in the ratio of 1 milligramme to 100 kilogrammes. Assuming that there is 1 centigramme of silver per cubic mètre of water, it has been calculated that the oceans of the globe contain not less than 2,000,000 tons of silver. The metal has been found in small quantity also in rock-salt in the mines of the department of the Meurthe, France. All native gold contains from .016 to 16 per cent. of silver, but generally from 5 to 13 per cent.; California gold averages about 12 per cent. of silver. It occurs also nearly pure in masses and irregular grains, but it is not as generally distributed in this form as gold, and is seldom found in placers or alluvial deposits, but is confined rather to the vicinity of the outcrops of veins, and is not water-worn and rounded by attrition. It is usually in irregular, ragged masses, or in thin sheets coating surfaces of the vein-stone, or filiform, as if drawn out into wire; hence the name "wire silver" applied to such specimens, whether the filaments are coarse as a knitting-needle or as fine as hairs. This wire-like form of silver is of frequent occurrence in the cavities of veins. The filaments sometimes reach the length of a foot or more, but are generally much curled up and interwoven or matted together, looking like bunches of hair or wool. At Kongsberg in Norway the metal has been found massive and in large and perfect crystals, which retain their white color without tarnishing in a remarkable degree. One mass taken from these mines and preserved in the Royal Museum at Copenhagen weighs upward of 500 pounds; two other masses weigh, respectively, 238 and 436 pounds. Large amounts of native silver have been obtained in Mexico and South America. One mass in Peru is said to have weighed 800 pounds. Large masses have been reported from the northern portion of the Mexican state of Sonora. It is not uncommon, though not in large masses, in the upper portions of the silver-bearing veins of the Western States and Territories of the U. S. It is found also in a vein upon Silver Islet in Lake Superior, and associated with the native copper of the Keweenaw Point mines. Some of these specimens are remarkable for being completely joined to the copper, without any intermingling of the metals; one-half of a mass may be silver and the other half copper. Jewelry and ornaments are frequently made by local jewellers, one-half being copper and the other half silver, the line of union being sharply defined, while the two metals are perfectly united.

Specimens of silver when taken from mines are usually tarnished a dull-brown color, or even black, this color being caused generally by the presence of sulphurous vapors either from the constituents of the vein or the combustion of powder. Such vapors rapidly tarnish silver. Silver ware and silver plate, it is well known, are rapidly tarnished and turned black by the gases of bilge-water, and also by the tainted atmosphere about drains and vaults, and the sulphurous gases from burning coal. The peculiar whiteness of the Norwegian native specimens is supposed to be due to the presence of a portion of mercury. Native silver is rarely pure. The cupriferous variety sometimes contains 10 per cent. of copper. With gold the proportions are variable. (See GOLD.) The *electrum* of Pliny contains one-fifth of silver. The pale gold of Transylvania contains from 35 to 38 per cent. of silver. The native alloy in the great Comstock Lode of Nevada contains about 43 per cent. of silver, as shown by Attwood, the rest being gold. Native amalgams have been found in Chili, containing from 52 to 64 per cent. of silver. The metal is also found combined with sulphur, antimony, arsenic, tellurium, etc., and with chlorine, bromine, and iodine, giving a great variety of interesting species. The chief ores are the sulphide, containing 86 per cent. of silver; the brittle or antimonial sulphate, with 68.5 per cent. of silver; gray silver ore, with 23 per cent. of silver; dark-red silver ore, with 60 per cent.; and the light-red silver ore, with 64 per cent. This last is generally known as "ruby silver,"

from the brilliant ruby-red color of the crystals by transmitted light. In the upper portions of silver-bearing veins, where air and moisture have had access, a certain amount of decomposition has taken place among the minerals, especially if they consist of the above-mentioned species, and new combinations have been formed, which may be called *secondary ores*. These are generally oxides, chlorides, bromides, and iodides, and are more earthy and highly-colored than those in the deeper parts of the vein, being intermingled with oxides of copper, lead, and iron. They are also softer than the unchanged ores below, and are more easy to work. Such ores are known in Mexico as *colorados*, especially if red, and in Peru as *pacos*. The ores from a greater depth in the mine, which have not been acted upon by the air, are more compact, brilliant, and darker in color, and are called *negros*. The green "bromide ores" are known in Zacatecas, Mexico, as *plata verde*. Chloride of silver is common in the upper portions of rich silver-bearing veins, and usually forms thin dark-colored crusts or films upon the gangue. It is easily identified by its wax-like hardness, and by giving a globule of silver when fused in the flame of a candle.

A large class of the metallic minerals contain silver in varying proportions, especially galena, which is rarely free from a portion of silver. The greater portion of the silver produced in Europe is extracted from argentiferous galena. The galenas of England and of the Hartz Mountains carry from .03 to .05 per cent., and those of Tuscany from .03 to .07 per cent. The galena ores of the U. S., with the exception of those of the Mississippi Valley, nearly all contain silver in larger quantities, the percentage ranging from .10 to 1.85 and 3.0, but the quantity of these rich ores is seldom large in the Eastern States. Sixty ounces to the ton of lead ore is a very fair yield in silver. Formerly lead ores containing less than this could not be profitably worked for silver, but since the discovery by Mr. Pattinson of England in 1829 of the process which bears his name, lead which does not hold over 0.009 per cent. of silver can be profitably worked. By this process an annual saving of over 200,000 ounces of silver, formerly thrown away, is effected, and the cost of separating silver from lead is greatly cheapened. Lead containing only three ounces of silver to the ton can now be worked with profit.

The antiquity of silver coinage is very great. The most ancient coins known were struck in silver by Phidon, king of Ægina, B. C. 869. After the conquest of Egypt by Cambyses, about 540 years before Christ, a great improvement appears to have been made in the purification of silver, for that which was produced under Aryandes was celebrated for its purity and fineness. The alloy in the Greek silver coinage generally appears to have been lead, which had not been removed for want of the requisite skill in refining. The Athenian currency was noted for its purity, and Xenophon mentions the profit with which it could be exported. Silver currency was adopted by the Roman republic about 269 B. C., and its standard was as high as the Greek, but it rapidly fell. Under Vespasian the alloy was one-eighth, under the Antonines one-fourth, under Severus about one-half, after which there does not appear to have been a fixed standard. (*King*.) After the loss of Spain, from which the chief supply of silver was drawn, the silver currency vanished, and was replaced by *billon* denarii, holding only one-fourth part of silver. According to Pliny, Antony alloyed denarii with iron, apparently to harden the coin. The denarii of Justinian and the Italian Goths weigh about 15 grains troy, and are the reputed direct antecedents of the Anglo-Saxon silver penny.

Silver was largely used by the Romans for household plate and table decoration. It was elegantly chased and embossed by Grecian artists in the repoussé style. The wealthy Romans vied with each other in possessing the most massive dishes. Of such dishes, weighing 100 pounds or more, there were 150 in Rome before the first civil war. Pliny cites the existence of one dish weighing 500 pounds, with eight plates to match, weighing together 250 pounds. The old chased plate of the Grecian artists was valued as a curiosity in Pliny's time. The ornamentation of silver, known as *niello*-work, originated in Egypt, and was revived and carried to great perfection by the Florentine silversmiths. Cellini gives a recipe for the fusible argentiferous compound used to fill the engraved design. This art was applied to the decoration of armor as early as the days of Homer. Agamemnon's breastplate was thus inlaid. In mediæval times massive plate was in great favor, and the chief form of investment for the noble-born and wealthy. Its extensive use for ecclesiastical decoration is also to be noted.

In modern times solid silver ware has been to a great extent replaced by nickeliferous alloys and britannia ware, covered with a layer of pure silver by the galvanoplastic method. Silver may, by this method, be deposited to any desired thickness, thus giving all the appearance of solid silver, and its utility for most purposes. The annual consumption of the metal for this purpose alone is very large. Silver thus deposited is pure, but solid silver ware and coin contain a portion of alloy, generally copper. In the U. S. and in France the standard fineness is one-tenth of alloy, or 900 parts of silver and 100 of copper, the mixture being denominated .900 fine. In Great Britain the standard is higher, being 925 of silver and 75 of copper, or .925 fine. This is the fineness of "sterling silver ware."

The value of silver relatively to other objects obviously depends upon two chief conditions—the demand and the supply. The variations in the demand are sufficiently indicated by the preceding references to its use in historic times. The supply, as will be seen by consulting the following article upon SILVER-MINES, is also variable, and at times excessive. The production of silver in the large way, owing to its mode of occurrence and mineralization, is more dependent upon the use of mechanical power (steam or water) than upon the labor of men. There may therefore be a large production of silver in sparsely populated regions and within a short period of time. With gold the conditions are different: the bulk of the product is derived from *placers*. It is so much more generally distributed in the earth that an unlimited number of men may be engaged together in its production. No expensive preparations or chemical operations requiring large capital and great skill are required to obtain the metal in a merchantable form. Gold is therefore a much better measure of human labor than silver.

The value of silver relatively to gold has greatly changed within historic times, and it has been different in different countries. Commerce has tended to equalize this difference. King justly observes that in the ancient world silver was to the same extent the peculiar production of Europe that gold was of Asia. It follows naturally that the estimation of silver relatively to gold was higher in Asia than in Europe—a condition prevailing until within a recent period. Sir Isaac Newton in 1717 showed that the ratio in weight of equal values of the two metals, silver and gold, in China and Japan was as 9 : 1, while it was as 15 : 1 in Europe. Perhaps the earliest recorded ratio is found inscribed at Karnak, the tribute-lists of Thutmosis (1600 B. C.) giving 13.33 : 1. The same ratio is shown by cuneiform inscriptions on plates found in the foundations of Khorsabad and on ancient Persian coins. It was reported by Xenophon (400 B. C.) as the ratio in Asia. Toward the Christian era gold fell in value relatively to silver. As early as about 189 B. C. the Romans coincided with the Greeks in estimating the value of gold compared with silver as 10 : 1. Upon Cæsar's return to Rome gold became so abundant that the ratio for a time was as $7\frac{1}{2}$: 1. A century later the ratio was as $12\frac{1}{2}$: 1, where it remained for 150 years or more. When guineas were first coined in 1663, the value of fine gold compared with that of fine silver was rated in the English mint at about 14 : 1. In 1805 the ratio was nearly as 15 : 1, and in other countries gold was rated higher. In the Middle Ages the ratio varied from 9 : 1 to 12.8 : 1. At the date of the discovery of America the ratio was about 11.30 : 1, since which, up to the discovery of gold in California and Australia, it gradually rose to 15.83 : 1 in the year 1850. In 1874 the ratio became 16.15 : 1. The extraordinary production of silver from the mines of the Comstock Lode, Nev., together with the demonetization of silver in Germany, has had a great effect upon the price of silver in the market. In Jan., 1875, when an act was passed by Congress providing for the resumption of specie payments in Jan., 1879, the price of fine silver in London averaged about 57 pence per ounce. In Mar., 1876, the price had fallen to $52\frac{5}{8}$ pence per ounce. During the year nearly $13,000,000 in silver was purchased by the U. S. mint at an average of 111.4 cents per ounce, the equivalent nearly of $56\frac{1}{2}$ pence per ounce in London. The fineness of standard silver coin, to which all London quotations are referred, is $\frac{111}{120}$. The penny sterling is valued at $2.0277\frac{1}{3}$ cents of the U. S. gold standard, the pound sterling being rated at $4.86656 in U. S. gold dollars. To obtain the value in U. S. (gold) money of a given weight of silver, say 25 grammes of $\frac{9}{10}$ths fineness, the price in pence of the ounce of the British standard should be multiplied by 1.585778, or it may be obtained by dividing the price in pence by 0.6306052. For example, the quotations in London in the early part of the year 1876 vary from $52\frac{1}{2}$ to $53\frac{1}{2}$ pence per ounce, British standard. The value of 25 grammes of silver $\frac{9}{10}$ths fine therefore varies from $52\frac{1}{2} \times 1.585778$ to $53\frac{1}{2} \times 1.585778$ cents U. S. gold; that is, from $83.2515 cents to $84.8403 cents. W. P. BLAKE.

Silver City, p.-v., cap. of Owhyhee co., Id., centre of rich silver-mines, has several quartz-mills, and 1 newspaper with daily and weekly editions. P. 599.

Silver City, p. v., Lyon co., Nev., in the vicinity of productive gold and silver mines, has a number of quartz-mills and a tri weekly newspaper. P. 879.

Silver Compounds, Chemistry of. Silver forms a number of compounds of more or less practical importance and scientific and technical interest. We may class them, for convenience and conciseness, into *halogen-*, *oxygen-*, and *amphigen* compounds.

(1) *Halogen-Compounds of Silver.*—*Chloride of silver* is an important substance, which is found native as a very valuable silver ore called *horn-silver*, *kerargyrite* (or *cerargyrite*, as Dana prefers to spell it). The latter name is from κερας, "horn," and ἄργυρος, "silver." This ore is very readily recognizable by those who know its chemical and physical characters. It is usually translucent, sometimes transparent and colorless, of the softness of talc, sectile like wax and similar in lustre, and of very great density, the latter ranging from 5.19 to 5.687 at zero centigrade, there being four allotropic modifications of differing densities. If occurring in particles too small to be certainly recognizable by these characters, the following method is valuable: A piece of sheet zinc is scraped bright, the mineral in coarse powder spread over it and moistened with water. The particles of silver chloride will soon be reduced to metallic silver, and on rubbing the powder between two pieces of glass, or with a knife-blade, the white lustre of the metal will become distinguishable. When crystalline, it is found to belong to the regular system. It contains 75.3 per cent. of silver, the rest being chlorine, and has the formula $AgCl$. It is totally insoluble in all acids, but soluble in ammonia, from which it is again thrown by an acid as a curd-like precipitate. This may also serve as a ready mode of detecting it in ores. The absolute insolubility of silver-chloride causes its production, by adding a solution of a chloride, to be an excessively delicate test of the presence of silver in a solution. Gay-Lussac's volumetric method of silver-assay, in use in all our mints, depends on the use of a standard solution of common salt to precipitate the silver as chloride. Silver-chloride melts at about 500° F. to a clear liquid. On exposure to light and moisture it undergoes a change the nature of which is not yet well settled, but most probably to be attributed to the formation of a *hemichloride of silver* (Ag_2Cl). A darkening of color occurs, and, according to Karsten, an increase of density to 5.567. When any organic matter is present, as when the chloride is applied to *paper*, this action of light is far more powerful. Photographic methods are chiefly founded upon these kinds of changes of the halogen-compounds of silver by light, the dark compound formed under the influence of the light being insoluble in *hyposulphite of soda* and other *fixing* agents, while the unchanged chloride, iodide, or bromide of silver remains soluble, and is therefore easily removed from the paper, leaving the picture, composed of the changed dark-colored compound, attached thereto. *Bromide of silver* ($AgBr$) constitutes the mineral *bromyrite* or *bromargyrite*, which is regular in crystallization, yellow or amber colored when pure, much harder than the chloride, ranging in this respect between gypsum and calcite, sectile, and heavier than the chloride, when pure weighing at zero from 5.892 (native, Berthier) up to 6.525 (precipitated, Schröder), there being, as with the chloride, *four allotropes* within this range. Bromide of silver contains 57.4 per cent. of the metal. It is found as an ore in Mexican and Chilian localities, and at Huelgoat in Brittany. At some of the Chilian mines, as in Chanarcillo and in Copiapo, another silver mineral is much more abundant than either the chloride or bromide, which is a combination of the two in varying proportions, called *embolite*. *Iodide of silver* (AgI) forms the mineral *iodyrite*, found in Mexico, Chili, Spain, and Arizona. It is sulphur-yellow in color when pure, very soft, sectile, with densities ranging from 5.071 (native, Karsten) to 5.791 (precipitated, Deville), comprising *six allotropes*. It contains 46 per cent. of silver, and is hexagonal in crystallization. Both bromide and iodide of silver, when precipitated, are much more sensitive to light than the chloride, and are hence used in photography, in most cases, instead thereof. They are much less soluble in ammonia than the chloride, but are reducible by zinc to metallic silver when moist, just like the latter. *Fluoride of Silver.*—This differs from the other halogen silver-compounds in being soluble in water. It forms hydrated crystals, obtained by dissolving the oxide of silver in hydrofluoric acid and crystallizing. *Cyanide of silver* belongs properly among its halogen-compounds. It is obtained by precipitating a silver-solution by cyanide of potassium, and much resembles the chloride, but is not blackened by light, and is soluble in hot nitric acid. When heated it is decomposed, leaving metallic silver.

(2) *Oxygen-Compounds of Silver.*—Oxides of silver are three in number—*argentous oxide* (Ag_4O), *argentic oxide* (Ag_2O), and the *peroxide* (Ag_2O_2). The first has not acquired much importance. Ag_2O is the base of the common silver-salts. It is a brown or black substance, of density 7.249 (Boullay) and 8.286 (Karsten), indicating at least two allotropes, slightly soluble in water, according to Bineau (3000 parts), to a solution of alkaline reaction and metallic taste. Heat readily dissociates it into oxygen and metallic silver, some oxygen being given off even at 212° F. Its unstable character is shown by its exploding when rubbed together, even very gently, with many substances, such as red phosphorus, precipitated sulphur, selenium, some metallic sulphides, and tannic acid. Some organic liquids, as *creosote*, are set on fire by dry argentic oxide. Notwithstanding its instability, it is a very powerful base, neutralizing acids completely. On contact with ammonia it forms Berthollet's *fulminating silver*, the nature of which is not yet well understood. Ag_2O_2 may be obtained in crystals by electrolysis of a concentrated solution of nitrate of silver, forming on the anode, while metallic silver forms on the cathode. It is a curiously unstable substance, one of its most remarkable properties being that of reacting with peroxide of hydrogen (see HYDROGEN, PEROXIDE OF), so that water and metallic silver are formed, with evolution of oxygen gas. *The oxygen-salts of argentic oxide*, of much practical interest, are only two in number—the nitrate and the sulphate. *Nitrate of silver*, known also by its ancient name of *lunar caustic* (see CAUSTIC), is the most interesting compound. This very beautiful salt is an article of enormous manufacture, owing to its important applications in medicine and in the arts of photography and electro-plating. It crystallizes very easily, and is largely introduced into commerce in crystalline form, though the *lunar caustic* for medicinal use is generally fused and cast into sticks or pencils. The crystals are anhydrous, of composition $Ag_2O.N_2O_5$, and soluble in their own weight of cold water. (See NITRATES.) *Sulphate of Silver.*—This salt is also anhydrous, of quite difficult solubility in cold water, requiring 87 times its weight.

(3) *Amphigen-Compounds of Silver.*—These comprise the *sulphide*, *selenide*, and *telluride*, of which the sulphide only is of practical importance. *Sulphide of silver* (Ag_2S), in pure state, constitutes the mineral species *argentite* or *silver-glance*. This is a lead-gray mineral, which has a regular crystallization, but is often crypto-crystalline or amorphous. It varies in density from 7.02 to 7.365, and there is doubtless a series of allotropic modifications. The hardness is about that of gypsum, and one of its most characteristic properties is a high degree of *sectility*, the mineral often cutting almost like metallic lead. It contains, when pure, no less than 87 per cent. of silver, being, in fact, the richest of all silver ores. It is common among the ores of the celebrated Comstock Lode, as well as in many other American localities. Sulphide of silver forms, in combination with other metallic sulphides, a large number and variety of argentiferous minerals and ores. With sulphide of arsenic it forms the mineral *proustite* ($3Ag_2S.As_2S_3$), containing 65.4 per cent. of silver. This is a magnificent carmine-red colored mineral, of adamantine lustre when crystallized, the crystals being rhombohedral. *Pyrargyrite* ($3Ag_2S.Sb_2S_3$), containing 59.8 per cent. of silver, is also a splendid red rhombohedral mineral, of a darker shade of color than proustite, hence sometimes called "dark-red silver ore." "Ruby silver ore" is also a name applied to both the arsenical and the antimonial species. Proust first showed the true difference between them, as implied in the above formulæ, in 1804. Proustite is abundant in Mexican, Peruvian, and Chilian mines, but rare in the Comstock Lode and most North American silver-districts. It was found, however, very fine and in immense masses, with pyrargyrite, in the Poorman Lode in Idaho. *Stephanite* ($5Ag_2S.Sb_2S_3$), containing 68.5 per cent. of silver, is an iron-black ore, right-rhombic in crystallization, found sparingly in the Comstock Lode and in many other North American regions. It is sometimes called "brittle silver ore." *Stromeyerite*, *sternbergite*, *polybasite*, and *freieslebenite* are other double sulphides of silver, for which reference may be made to Dana's *System of Mineralogy*. *Selenide of silver* (see SELENIDES); *Telluride of silver* (see TELLURIDES). HENRY WURTZ.

Silver Compounds, Medicinal Uses of. Argentic oxide and nitrate are the only compounds of silver used in medicine. Argentic nitrate is locally irritant and astringent, and, applied in the solid state or concentrated solution, is also superficially caustic, producing upon a mucous membrane or raw surface a white eschar of albuminate of silver. It is extensively used in surgery as a caustic and as a means of promoting absorption, as of exuberant granulations; of inducing healthy action on the part of indolent or morbidly-disposed ulcers or sores; and of controlling or aborting catarrhs of mucous membranes. The oxide, from its insolubility, is quite devoid of the above properties. Internally, in large dose or concentrated form, silver nitrate

is an irritant poison, but in medicinal dose both the nitrate and oxide may improve the tone of the stomach and allay the nausea and pain attending organic diseases of the same. In case of acute poisoning by silver nitrate, the antidote is common salt, which immediately forms the insoluble chloride of the metal. Slowly introduced into the system, silver affects the nervous system, and if too long continued will cause an indelible bluish-black discoloration of the skin and mucous membranes, and may further induce a general poisoning of the blood and tissues. Silver compounds are used internally for their local effects in gastric and intestinal affections, and were at one time vaunted as powerful remedies in epilepsy and other spasmodic nervous disorders, but other drugs have almost wholly superseded them in the latter employment. EDWARD CURTIS.

Silver Creek, tp., Stephenson co., Ill. P. 1309.

Silver Creek, tp., Clarke co., Ind. P. 1116.

Silver Creek, tp., Mills co., Ia. P. 1019.

Silver Creek, tp., Pottawattamie co., Ia. P. 231.

Silver Creek, tp., Cass co., Mich. P. 3084.

Silver Creek, p.-v. and tp., Wright co., Minn. P. 285.

Silver Creek, tp., Randolph co., Mo. P. 1831.

Silver Creek, tp., Burt co., Neb. P. 271.

Silver Creek, p.-v., Hanover tp., Chautauqua co., N. Y., on Lake Erie and on Lake Shore and Michigan Southern R. R., has 2 churches and several manufactories. P. 666.

Silver Creek, tp., Burke co., N. C. P. 1314.

Silver Creek, tp., Greene co., O. P. 1701.

Silvered Glass. See SPECULUM, by H. DRAPER, M. D.

Silver Hill, tp., Davidson co., N. C. P. 975.

Silvering. See MIRRORS, by PROF. C. F. CHANDLER.

Silver Lake, tp., Arkansas co., Ark. P. 702.

Silver Lake, p.-v. and tp., Worth co., Ia. P. 354.

Silver Lake, p.-v. and tp., Shawnee co., Kan., on Kansas River and Kansas Pacific R. R. P. 159; of tp. 1416.

Silver Lake, tp., Martin co., Minn. P. 487.

Silver Lake, p.-v. and tp., Susquehanna co., Pa. P. 1079.

Silver-Mines. See APPENDIX.

Silver Mountain, p.-v., Alpine co., Cal., in a rich mining-district of the Sierra Nevada.

Silver-Plating. See ELECTRO-PLATING.

Silver Run, tp., Russell co., Ala. P. 4305.

Silverside, or **Silver Fish.** See ATHERINE.

Silver Spring, tp., Cumberland co., Pa. P. 2259.

Silver Stick, in the English court, a title borne by the lieutenant and the standard-bearer of the corps of gentlemen-at-arms; also by the field officer commanding any of the guard regiments. (See GOLD STICK.)

Sil'verton, p.-v., cap. of San Juan co., Col.

Silverton, tp., Barnwell co., S. C. P. 1513.

Silver-Work. See REPOUSSÉ, in APPENDIX.

Sil'veyville, v. and tp., Solano co., Cal. P. of v. 279; of tp. 1583.

Simaruba. See QUASSIA and SIMARUBACEÆ.

Simaruba'ceæ [name from *Simaruba*, the typical genus], a small natural order of exogenous polypetalous plants, all trees or shrubs, and mainly tropical or subtropical, distinguished from the rutaceous order principally by the dotless leaves, remarkable for the potent bitterness of all the parts, especially of the wood. This property is best represented by QUASSIA (which see), or bitter wood, which is derived from two or three trees of this family. To it belongs the ailanthus, a hardy shade tree. ASA GRAY.

Simbirsk', government of European Russia, on the Volga, S. of Kazan, E. of Nizhnee-Novgorod, comprises an area of 18,778 sq. m., with 1,205,881 inhabitants, of whom 76,500 are Mohammedans and 2000 pagans. The surface is level and the soil fertile. Agriculture, breeding of cattle and horses, fisheries, and manufactures of coarse woollen and linen fabrics are the principal branches of industry. Rye, wheat, buckwheat, hemp, flax, and tobacco are the common crops.

Simbirsk, town of European Russia, capital of the government of Simbirsk, on the Volga, in lat. 54° 13' N., manufactures leather, soap, and candles, and has an important annual fair, held in February. In 1851 it had 35,171 inhabitants, but in 1861 and 1865 it was almost destroyed by fires. P. 24,607.

Sim'coe, county of Ontario, Canada, bounded on the N. W. by Georgian Bay, Lake Huron, and on the E. partly by Lake Simcoe; traversed by the Northern Railway. Much of the soil is fertile. The lumbering and shipping interests are important. Cap. Barrie. P. 57,389.

Simcoe, p.-v., cap. of Norfolk co., Ont., Canada, on the river Lynn, 8 miles W. of Port Dover. It has a fine court-house and jail, 2 weekly newspapers, and some manufacturing interests, and is in a fertile region. P. 1856.

Simcoe, a lake of Ontario, Can., situated between Lake Ontario and Georgian Bay, 30 miles long and 18 miles wide, and about 170 feet above Lake Huron, into which it discharges itself through Lake Gougichin, the Severn, and Georgian Bay. The banks are generally clothed to the water's edge with wood, fine white fish are taken in its waters, and it contains many islands, one of which, Snake Island, is inhabited by Indians.

Simcoe (JOHN GRAVES), b. near Exeter, England, Feb. 25, 1752; served in the war of the American Revolution; raised and commanded the battalion of loyalists or Tories known as the "Queen's Rangers," with which he rendered effective service in the Southern campaigns with the rank of lieutenant-colonel; was with Cornwallis at Yorktown; wrote and printed for private distribution a *History of the Operations of a Partisan Corps called the Queen's Rangers* (Exeter, 4to, 1787; reprinted with a memoir of the author at New York, 1844); was governor of Upper Canada 1791-94, where he was accused of promoting Indian hostilities against the U. S. in the Northwestern Territory; was governor of St. Domingo under the brief English domination 1796-97, and became lieutenant-general 1798. D. at Torbay, England, Oct. 26, 1806. A lake of considerable size in Ontario, Canada, bears his name.

Sim'eon, the second son of Jacob and Leah. The tribe of Simeon numbered 59,300 at the Exodus, but only 22,200 at the entrance into Canaan. Its territory was scattered, comprising districts wholly within the territory of the tribe of Judah, and tracts in Mount Seir and Gedor. The tribe sank into obscurity.

Simeon (CHARLES), b. at Reading, England, Sept. 24, 1759; educated at Eton and at King's College, Cambridge, where he obtained a scholarship 1779 and a fellowship 1782; took holy orders in the latter year; was appointed vicar of Trinity church, Cambridge, Jan., 1783, a post which he retained through life; became distinguished as a leader of the Evangelical party in the Church of England, and exerted a great influence in the training of candidates for the ministry at Cambridge, meeting with great opposition, and even ostracism, from the "High Church" party, and enjoying the sympathy and respect of the great body of dissenters, though he never abandoned any of the distinctive doctrines or practices of the Church of England. He was active in the promotion of missionary enterprise, and organized a successful scheme for the purchase of "advowsons" or presentations to benefices in the Church of England, in order to secure their being conferred upon "evangelical" preachers, the fund established by him still having control of some sixty livings. After a ministry of fifty-four years, having long been senior fellow of his college, he d. at Cambridge Nov. 13, 1836. His *Works* were edited by Rev. T. H. Horne in 21 vols. (1832-33), the best known being several series of "skeleton sermons." His *Life* was written by Rev. William Carus (1846).

Sim'eon Styli'tes, b. at Sesan in the northern part of Syria about 390; grew up in solitude as a shepherd in the mountains of Amanus, but received so overwhelming an impression when, in his thirteenth year, he for the first time attended divine service in a Christian church, that he left his herds and entered a monastery at Teleda, where he distinguished himself by the severity of his ascetic practices. Finding the rules of the monastery too lenient, he afterward removed to Telanissa, in the vicinity of Antioch, where he built a hut and determined to live as an anchorite. But soon his fame for holiness attracted swarms of visitors, and in order to escape their intrusion he placed himself on the top of a column, where he spent his days and nights, always standing, never resting, exposed to the severities of the climate, nourished by what was brought to him, and occupied in religious exercises. The first column he occupied was only ten feet high, but the last was sixty feet, with a platform four feet in diameter, and here he is said to have lived for about thirty years. He d. Sept. 2, 459, and was buried in Antioch; and his example, which gained for him much admiration and even power during his lifetime, found many imitators after his death. The so-called pillar-saints, air-martyrs, or stylites were numerous in the Eastern countries, and did not wholly disappear until the twelfth century. Wulfailich, near Treves, on the Moselle, in Rhenish Prussia, about 550, was the only stylite in the West. Simeon's biography was written by his disciple Antonius, contained in the first volume of *Acta Sanctorum*, and by a contemporary admirer, Cosmas, presbyter of Thanir in Cœlesyria, contained in Asseman's *Acta Martyrum*. He is also mentioned with

much praise by Theodoret in his history of the Christian Church, translated into English in Bohn's *Ecclesiastical Library*.

Simfero'pol, town of European Russia, in the Crimea, capital of the government of Taurida, is beautifully situated on the Salghir, in a picturesque valley surrounded with gardens and orchards. It consists of a modern part, built by the Russians, and the old Tartar town, with its mosques, Tartar schools, and bazaars. P. 17,797.

Simi'idæ [from *Simia*, the old Latin name of the ape, and the family termination *-idæ*], a family of mammals of the order Primates and sub-order Anthropoidea, containing the mammals most closely related to man. The family name has been variously employed, even by recent writers, most extending it to include all the apes and monkeys of the Old World, and others (*e. g.* Huxley, Gill) restricting it to the large apes. In its widest sense the family is distinguished by the following characters, in which it contrasts on the one hand with man (family Hominidæ), and on the other with the monkeys of the New World. The species resemble man in general form and in the freedom of the limbs from the abdominal integument; the fore limbs are, however, employed more or less in progression throughout life, and the body is generally carried prone, and is only exceptionally erect; the skin is protected by a well-developed and dense coat of hair; the feet have the pollex or great toe more or less abbreviated, but thickened and thumb-like, and opposable to the others; the teeth do not form an uninterrupted series, but, on account of the considerable development and projection of the canines, there is a diostema or interval between the canines and the incisors in the upper jaw, and between the canines and premolars in the lower; the molar series, as in man, has five teeth in each jaw on each side—viz. two premolars and three true molars; the nose has a thin and narrow median septum, and the nostrils are correspondingly approximated; a bony external auditory meatus is developed, and at its bottom is the membrana tympani. Such are the diagnostic characters of the group; with these are associated other minor and less universal characters, and certain negative ones contrasting with some exemplified in the New-World monkeys. Thus, the tail, although often long, is never prehensile; callosities are frequently developed on the buttocks; cheek-pouches also exist in many forms. In other respects—in their skeleton, their nervous system, and especially the brain, the muscles, the digestive system, and the generative system—there is an essential agreement between man and the Simiidæ, the differences being only those of degree, and of the same kind as exist between the different members of the family itself. Within the limits above admitted there are two paramount grades of organization, the differences between these indicating the degrees of their relationship to man. To these two grades have been attributed family value by some writers.

The Simiidæ proper, or large apes, are distinguished by a form considerably like that of man, but the anterior limbs are very elongate and the posterior relatively short; the spinal column has a slight sigmoid curve; the lumbar as well as dorsal neural spines are directed more or less backward; the sacrum is large and solid, composed of four or five vertebræ, and tapers gradually backward; they are as entirely destitute of a tail as is man himself; the sternum is broad and short. By all these characters the species are approximated to man. To this group belong two types—one containing large, robust species—*i. e.* the chimpanzee, gorilla, and orang-outang, constituting the sub-family SIMIINÆ (which see)—and the other comparatively small, slender species—*i. e.* the gibbons, or sub-family HYLOBATINÆ (which see).

The Cercopithecidæ or Cynopithecidæ—*i. e.* ordinary or tailed monkeys—are characterized by the more quadrupedal form; the anterior limbs are generally shorter than the posterior; the spinal column has typically a simple and not sigmoid curvature; the neural spines of the lumbar as well as last dorsal vertebræ are inclined forward; the sacrum is moderate, composed generally of three vertebræ, and does not taper gradually backward; a tail is more or less developed, although sometimes reduced to a slight rudiment; the sternum is narrow. Such are the distinctive features of the monkeys of the Old World. These are quite numerous, and are naturally divisible into two sub-families: (1) Cercopithecinæ, in which the stomach is a simple sac, as in man, and cheek pouches are developed; and (2) Semnopithecinæ, in which the stomach is complex and sacculated, and the cardial portion dilated, and the pyloric elongated, and no cheek-pouches exist.

As already indicated, the Simiidæ are peculiar to the Old World, all the monkeys of the New World belonging to a quite different group, and, according to most systematists, constituting two families—the Cebidæ and Mididæ—peculiar to America. The Simiidæ are now confined mostly to the tropical countries of Africa and Asia, but one species (*Inuus caudatus*) extends into Spain, and is well known as an inhabitant of the rock of Gibraltar, and two other species, lately discovered (*Rhinopithecus Roxellanæ* and *Macacus Thibetanus*), are found in the district of Moupin, Thibet, where the winter is quite severe.

No representatives of this group have been yet found in rocks older than the Miocene age. In that and the Pliocene epochs species existed in Europe of several genera distinct from any now living. Thus, at St. Gaudens in France the remains of a species supposed to be allied to *Hylobates*, and called *Dryopithecus Fontani* by Lartet, have been exhumed; at Sanson (France) those of another type (*Pliopithecus*), also referred near *Hylobates* (*P. antiquus*, Lartet); and in Zurich those of a congeneric species (*P. platyodon*, Biedermann) have been obtained; the lower jaw of another form, believed to be one of the Simiidæ, has been found at Monte Bamboli in Tuscany, and named by Gervais *Oreopithecus Bambolii;* and, finally, numerous bones of a monkey (*Mesopithecus*), apparently intermediate between the *Macacus* and *Semnopithecus*, have been dug out at Pikermi, Greece. Other fossil remains have been obtained both in Europe and India.

Although the range of structural differences within the limits of the family Simiidæ is not very great, there is a very considerable diversity in outward appearance. Thus, in most forms (*e. g.* Simiinæ and small monkeys) the face is not very much more projecting than in man, but in a few (baboons) it protrudes to such an extent as to resemble a dog's. In most, too, the thumb is quite well developed, but in others it is much reduced (*e. g.* orang-outang) or almost wanting (*e. g.* Semnopithecinæ). Again, the tail is quite long in many forms (*e. g.* Cercopithecus), but in others closely related otherwise (*e. g. Macacus* and *Inuus*) it is quite short or almost wanting. The genera are based on differences of such kind, as well as the number of tubercles on the molar teeth and the development of the ischiatic callosities. These differences, however, are not co-ordinated with others—are of much less importance than the characters already indicated as distinctive of the several subfamilies. THEODORE GILL.

Simi'inæ [from *Simia*, the generic name of one of the genera, and *-inæ*, the suffix indicating sub-family rank], a sub-family of the family Simiidæ, including the large apes, and contrasting with the sub-family Hylobatinæ, embracing the small apes or gibbons. The form is robust; the ilia broad and alate; the cerebrum projects backward over the entire cerebellum; the molars of the upper jaw have each an oblique ridge running from the front inner angle of the tooth outward and backward to its hinder outer angle; the buttocks are destitute of callosities. In all these characters the apes agree with man, and differ from the gibbons, to which in other respects they most nearly approach. The species are divisible into three genera, which are again combinable into two groups. Two of these genera are peculiar to the forests of tropical Africa, one (*Mimetes* or *Troglodytes*) embracing the chimpanzee, and the other (*Gorilla*) the celebrated gorilla; these have a moderate face, the fore limbs do not reach down to the ankles when the animal is erect, and the thumb and great toe are well developed. The remaining genus (*Simia*) is limited to the orang-outang of Borneo and Sumatra; in this form the face is very deep and projects downward, the fore limbs are very elongated, the hands touching the ground when the animal is erect, and the thumb and great toe are small or imperfectly developed. (See, also, CHIMPANZEE, GORILLA, ORANG-OUTANG, and SIMIIDÆ.) THEODORE GILL.

Similitude, Axes of, and **Centres of.** See RADICAL AXIS, by GEN. J. G. BARNARD, LL.D.

Sim'la, principal town in the English Himalaya, in the Pandschab province of British India, was acquired after the Gorkha war (1816) from the raja of Bassahir (Bisser), together with an area of 18 sq. m., and contains as a district 33,995, as a town 7037 souls. The distance from Ambala, on the Delhi-Lahore Railway, is 98 miles. Simla is the permanent abode of numerous European residents, and during the summer the head-quarters of the government of British India. The houses are not massed together, the town being built according to the cottage system; the lowest house stands at 6617, the highest at 8008 feet. The annual mean temperature has been calculated at 57.8°. There are splendid warehouses, good hotels, and 8 schools for European children—excellent institutions which are in a flourishing condition. During the summer Europeans come from all parts of British India. Splendid entertainments and balls are given by the viceroy and high functionaries who pass the summer here. Simla has 4 periodicals, a theatre, a concert-room, Episcopal churches, and one Roman Catholic church. (See

Times of India; Handbook of Hindostan, ch. vii., Bombay, 1875.) EMIL SCHLAGINTWEIT.

Sim'mons (JAMES F.), b. at Little Compton, R. I., Sept. 10, 1795; was a farmer and manufacturer; served in the general assembly of Rhode Island 1828–41, and was U. S. Senator 1841–47, and again 1857–63. D. at Johnson, R. I., July 14, 1864.

Simmons (JOHN), b. at Little Compton, R. I., in Oct., 1796; became a wealthy merchant at Boston, Mass., where he d. Aug. 29, 1870, providing by his will for the founding of the Simmons Female College.

Simmons (SENECA G.), b. in Vermont Jan., 1809; was graduated from the U. S. Military Academy, and appointed brevet second lieutenant of infantry July 1, 1834, first lieutenant 1837, captain 1847, major 1861. Prior to 1861 he served mainly on frontier duty and in garrison; in Florida against the Seminoles; and in the war with Mexico. In June, 1861, he was appointed colonel of the 34th Pennsylvania Vols., which he commanded at the battle of Dranesville, and in the Virginia Peninsular campaign of 1862 at the battles of Mechanicsville, Gaines's Mill, and Glendale, where he met his death, June 30, 1862.

Simmons (WILLIAM HAYNE), M. D., b. in South Carolina about 1812; studied medicine at Philadelphia, but never practised; published anonymously at Charleston an Indian poem, *Onea*, and was also author of a *History of the Seminoles*. He became a resident of East Florida.—His younger brother, JAMES WRIGHT, was educated at Harvard; travelled in Europe, and settled in one of the Western States. He published at Boston in 1852 a poem, *The Greek Girl*, and has since written a series of metrical tales, *Wood-notes from the West*. Some graceful verses from the pens of both the brothers Simmons may be found in Duyckinck's *Cyclopædia of American Literature*.

Simms (WILLIAM GILMORE), LL.D., b. at Charleston, S. C., Apr. 17, 1806; received but a limited education, but acquired a remarkable fund of knowledge by miscellaneous reading; began to write verses at eight years of age; was for several years clerk in a drug-store in Charleston; studied law, and was admitted to the bar 1827, but abandoned that profession for literature and journalism, publishing in the same year two volumes of *Poems*; became in 1828 editor of the Charleston *City Gazette*, a political journal of Union proclivities, which was discontinued during the nullification excitement of 1832, after involving him in pecuniary ruin; resided at Hingham, Mass., 1832–33; wrote there his longest and best poem, *Atalantis, a Story of the Sea* (New York, 1833), and his earliest novel, *Martin Faber, the Story of a Criminal* (New York, 1833); returned soon afterward to South Carolina and settled at Woodlands, near Medway; wrote a successful connected series of romances founded on Revolutionary incidents in South Carolina, *The Partisan* (1835), *Mellichampe* (1836), *The Kinsmen, or the Black Riders of the Congaree* (1841; afterwards republished as *The Scout*, 1854), *Katherine Walton, or the Rebel of Dorchester* (1851), *The Foragers* (1855), and its sequel, *Eutaw* (1856), and *The Sword and the Distaff*; romances of colonial life, *The Yemassee* (1835) and *The Cazique of Kiawah* (1859); a series of border romances, *Guy Rivers* (1834), *Richard Hurdis* (1838), *Border Beagles* (1840), *Confession* (1841), *Beauchampe* (1842), and *Charlemont* (1856); several historical romances on Spanish or other foreign subjects, *The Damsel of Darien* (1839), *Pelayo* (1839), *Count Julian* (1845), *The Lily and the Totem, or the Huguenots in Florida* (1850), and *Vasconcelos* (1853); 11 volumes of novelettes, collected tales, and essays; 2 volumes of *Views and Reviews in American History, Literature, and Fiction* (1845–46), collected from a large number contributed to the leading magazines and periodicals; a *History of South Carolina* (1840), a *Geography of South Carolina* (1843), and *South Carolina in the Revolution* (1854); biographies of Marion (1844), Captain John Smith (1846), *Chevalier Bayard* (1848), and *Gen. Greene* (1849); 12 volumes of poems, none of which were equal in merit to his romances; 2 dramas of considerable merit; several political and controversial pamphlets, and a considerable number of biographies of Southern statesmen in Appletons' *New American Cyclopædia*. He was also editorially connected with the *Southern Literary Gazette*, the *Cosmopolitan*, the *Magnolia*, the *Southern and Western Monthly Magazine and Review*, and the *Southern Quarterly Review*; delivered numerous orations and lectures, and published an edition of the *Seven Dramas* doubtfully attributed to Shakspeare. Mr. Simms was the most voluminous and successful Southern writer, and as a novelist contested the palm with Cooper. He was several years a member of the South Carolina legislature, and filled other political offices. D. at Charleston, S. C., June 11, 1870. His best works of fiction were republished by Redfield, New York, in 19 vols., 1853–59 (new ed., 17 vols., 1865), under the title *Revolutionary and Border Romances of the South*, with illustrations by Darley. A copious selection of his *Poems* appeared in 1864.

PORTER C. BLISS.

Simoda, town of Japan, at the southern extremity of Cape Idzu, in lat. 34° 39′ N., was almost entirely destroyed by an earthquake in 1854, but has since been rebuilt. In 1857 its harbor was opened to foreign commerce. P. 7000.

Si'mon (JOHN), M. D., b. in England in 1816; became honorary fellow of the Royal College of Surgeons 1844; was afterward professor in King's College; surgeon to King's College Hospital and to St. Thomas's Hospital; was the first appointed medical officer to the general board of health of the privy council, in which capacities his annual reports on sanitary science, dealing with the most vital questions of the day in medicine, have been of extraordinary interest and value. His *Physiological Essay on the Thymus Gland* (1845) gained the Astley Cooper prize of £300. Among his works are *Aims and Philosophic Method of Pathological Research* (1848) and *Lectures on General Pathology* (1850). He has contributed largely to the *Cyclopædia of Anatomy and Physiology* and to scientific and medical periodicals, and edited (with a prefatory memoir) Dr. J. H. Green's *Spiritual Philosophy, founded on the Teachings of the late Samuel Taylor Coleridge* (2 vols., 1865).

Simon' (JULES), (JULES FRANÇOIS SUISSE-SIMON), b. at Lorient, department of Morbihan, France, Dec. 31, 1814; succeeded Cousin as professor of philosophy at the Sorbonne in 1839, but was dismissed in 1851 on account of his opposition to the *coup d'état*; lectured in 1855 and subsequently on philosophy in various cities in Belgium; was elected a member of the Legislative Assembly for the department of Loire in 1863; offered a strong opposition to the policy of Napoleon III., the plébiscite of 1870, the declaration of war against Prussia, etc., and was a member of the government for the national defence established on Sept. 4, 1870, and of the government of Thiers, Feb. 19, 1871–May 24, 1873, as minister of public education. During his term of office he carried through a law which makes school attendance compulsory. All his writings are distinguished by clearness and precision both of style and ideas, and some of them are the result of very comprehensive studies. The most remarkable are—*Histoire de l'École d'Alexandrie* (2 vols., 1844), *Le Devoir* (1854), *La Religion naturelle* (1856; translated into English by I. W. Cole, London, 1857), *La Liberté* (2 vols., 1859), *L'Ouvrière* (1863), *Le Travail* (1866), *La Politique radicale* (1868), *Le Libre-échange* (1870), and *Souvenirs du 4 Septembre* (1874).

Simon (RICHARD), b. at Dieppe, France, May 13, 1638; entered the congregation of the Oratory in 1659, but left it again in 1678; was for a short time priest at Belleville, but retired in 1682 to his native city; devoted himself exclusively to literary pursuits. D. Apr. 11, 1712. His writings—*Fides Ecclesiæ Orientalis* (1671), *Histoire critique du Vieux Testament* (1678), *Histoire critique de la Créance et des Coutumes des Nations du Levant* (1684), *Histoire critique du Texte du Nouveau Testament* (1689), *Histoire critique des Principaux Commentateurs du Nouveau Testament* (1692), *Nouvelles Observations sur le Texte et les Versions du Nouveau Testament* (1695)—form the first and, both on account of the consistency of the ideas and on account of the learning of the argumentation, one of the most powerful manifestations of that theological standpoint afterward known as rationalism. They were violently attacked by the Port-Royal, Bossuet, and other theologians.

Simonianism, Saint. See SOCIALISM.

Simonians. See SIMON MAGUS.

Simon'ides, b. at Iulis, island of Ceos, about 556 B. C.; lived at the court of the Pisistratidæ in Athens, at that of the Scopads in Thessaly, during the Persian wars alternately in Athens with Themistocles and in Sparta with Pausanias, and went about 476 B. C. to Sicily, where he lived at the court of Hiero in Syracuse, and d. about 467 B. C. A contemporary of Anacreon and Pindar, he was probably the most celebrated lyric poet of his age; his poem on those who fell in the battle of Marathon took the prize in a contest with Æschylus. But he was accused of avarice, and scandalized people by writing for hire. Of his poems only a few fragments are extant; edited by Schneidewin (Brunswick, 1835) and Bergk (Leipsic, 1853).

Simonides, generally known as **Simonides of Amorgos**, b. at Samos, but led a colony to Amorgos, one of the Cyclades, where he flourished as a satirical poet in the middle of the seventh century B. C. The existing fragments of his poems were edited by Welcker (Bonn, 1835). *Simonidis Amorgini Iambi quæ supersunt*, and are also contained in Schneidewin's and Bergk's collections.

Simonin' (LOUIS LAURENT), b. at Marseilles in 1830; studied at the mining school of St.-Étienne; undertook comprehensive geological explorations in France, Italy,

California, the island of Réunion, and Madagascar; was appointed professor of geology at the central school of architecture in 1860, and wrote, besides numerous travelling sketches in the *Revue des Deux Mondes* and other periodicals, *La Richesse minérale de la France* (1865), *L'Etrurie et les Etrusques* (1866), *La Vie souterraine* (1867), *L'Histoire de la Terre* (1867), *La Toscane et la Mer tyrhénienne* (1868).

Si'mon Ma'gus, a Samaritan of the apostolic age, b., Justin Martyr says (*Apol.*, i. 26), at Gitton, which has been identified with *Kuryet Jît*, a village near Nablus. He is described in Acts viii. 9–24 as a sorcerer, called by the people "the great power of God," who was converted by the preaching of Philip, and sought to purchase with money the power of imparting the Holy Ghost; whence the expression *simony*. Of his subsequent history the ancient accounts are utterly discordant. The Simonians, one of the earliest of the Gnostic sects, lasting for several centuries, took their name from him, and he became a sort of archetype of heresy. R. D. HITCHCOCK.

Simonose'ki, town of Japan, at the south-western extremity of the island of Nipon, in lat. 33° 56′ N., is the entrepôt for European goods coming from Nagasaki and destined for the interior of Japan. It commands the Strait of Simonoseki, which forms the western entrance from the open ocean to the inland sea of Japan. P. 10,000.

During the summer of 1863 three vessels, American, Dutch, and French, were fired upon from batteries on the shore of the Simonoseki Strait; this assault was returned soon after by American and French war-vessels, and in 1864, by agreement of the diplomatic representatives, a combined fleet of U. S., Great Britain, France, and Holland men of war bombarded and destroyed the town. In a subsequent convention the sum of $3,000,000 was demanded by these four powers in compensation for "damages resulting to the interests of treaty powers" and for expenses of the expedition. The final instalments of this indemnity were paid by the Japanese government in 1874.

Si'monton (JAMES W.), b. in Columbia co., N. Y., in 1824; educated in the public schools of New York City; became law-reporter for a city newspaper 1845; was shortly afterward sent to Washington as Congressional reporter for the *Courier and Enquirer;* went to California 1850, and was for a time one of the editors of the San Francisco *Courier*, but soon returned to New York; was one of the original staff of assistants to Henry J. Raymond at the establishment of the New York *Times* Sept., 1851, and for seven years was Washington correspondent of that paper; was influential in the exposure of several noted cases of bribery and corruption on the part of members of Congress 1857, at which time he was kept in custody several weeks for declining to give further information on that subject; again went to California, and engaged there in journalism 1859; was a war-correspondent 1861–65, and became manager of the Associated Press 1866.

Si'mony, in canon law, denotes the buying or selling of ecclesiastical offices or benefices, and received its name from Simon Magus, who wished to buy of the apostles, for gold, the power of conferring the Holy Ghost (Acts viii. 18–24). By all Christian denominations simony is considered and denounced as a great crime, but in the Roman Catholic Church it was nevertheless, at various periods, an almost universal practice.

Simoom' [from the Arabic *samma*, to "hurt," to "poison"], the name of a hot, scorching wind which rises in the sandy deserts when intensely heated by the sun, and blows, loaded with fine sand and dust, over Palestine, Syria, and Arabia. It generally occurs at the time of the equinoxes, and lasts for several hours. It is much dreaded, as it often proves fatal to animal life, partly on account of its heat, which rises to 126°, partly on account of the suffocating dust with which it is filled. Similar winds are the khamsin of Egypt, the samiel of Turkey, the sirocco of Italy, the solano of Spain, the harmattan of Guinea and Senegambia, etc.

Simplicidenta'ti [Lat. *simplex*, "simple," and *dentatus*, "tooth"], a sub-order of mammals of the order Rodentia or Glires, contradistinguished from the Duplicidentati (*duplex, duplicis*, "double," and *dentatus*, "toothed"] by the presence of only two incisor teeth in the upper as well as lower jaw. It comprises all the families of rodents except the Leporidæ and Lagomyidæ (which constitute the Duplicidentati), the most prominent of which are the Muridæ, containing the mice, rats, and allied forms, the Sciuridæ or squirrels, marmots, etc., Hystricidæ, or porcupines, and Castoridæ, or beavers. THEODORE GILL.

Simpli'cius, a Neo-Platonic philosopher, native of Cilicia, flourished in the first half of the sixth century A. D. Nothing is known of his personal history except that he had as teachers Ammonius and Damascius, that he taught at Athens, and that he was one of the philosophers who, after the edict of Justinian (A. D. 529) closing the schools of philosophy at Athens, emigrated, at the invitation of King Khosru Nushirvan, to Persia, where their high hopes were doomed to such disheartening disappointment, and whence they soon returned to Athens, to enjoy liberty of thought indeed, but not liberty to teach. Simplicius is known principally as a scholarly and conscientious commentator on Aristotle. Of his commentaries we still possess those on the *Categories*, the *Physics*, the *De Cœlo* (see *Philological Museum*, vol. ii. pp. 588 *seq.*), and the *De Anima* of Aristotle, and one on the *Enchiridion* of Epictetus. Besides these, he is known to have written one on Aristotle's *Metaphysics*. Like most philosophers of his school, he makes no claim to originality. Adopting unquestioningly the doctrines of Plato, he endeavors to bring those of Aristotle into harmony with them by showing that, however much they may conflict in appearance, they do not do so in reality. He was a great admirer of Chaldæan and Orphic lore. THOMAS DAVIDSON.

Sim'plon [It. *Sempione;* Ger. *Simpeln*], village and mountain-pass near the boundary between Valais and Piedmont, is famous for the military road which Napoleon I. built here from 1800 to 1806. That much-admired piece of engineering, extending from Brieg to Domo d'Ossola, 42 miles long and 30 feet wide, with several long tunnels, 611 bridges, and 10 houses of refuge, was, after the Brenner Pass, the first carriage-road across the Alps. The culminating point is 6218 feet above the sea. Near by, at the base of the majestic Monte Leone (10,977 feet), a hospice has been erected for the gratuitous accommodation of travellers. The scenery on the southern slope is grand and severe in the extreme. In the village of Simplon, at an altitude of 4340 feet, the winter lasts fully eight months. A. GUYOT.

Simp'son, county of S. Kentucky, adjoining Tennessee, watered by tributaries of Big Barren and Red rivers, has a generally level surface and a productive soil, and is traversed by Louisville Nashville and Great Southern R. R. Staples, tobacco, Indian corn, wheat, oats, sorghum-molasses, butter, and wool. Swine and sheep are numerous. Cap. Franklin. Area, 375 sq. m. P. 9573.

Simpson, county of S. Mississippi, on Pearl and Strong rivers, has a flat sandy surface and extensive pine forests. Staples, Indian corn, cotton, sweet potatoes, rice, butter, and wool. Cap. Westville. Area, 625 sq. m. P. 5718.

Simpson, tp., Grant co., Ark. P. 311.

Simpson, tp., Johnson co., Ill. P. 916.

Simpson, tp., Harrison co., West Va. P. 1474.

Simpson (EDWARD), U. S. N., b. Mar. 3, 1824, in New Jersey; entered the navy as a midshipman Feb. 11, 1840; became a lieutenant in 1855, a commander in 1865, a captain in 1870; actively engaged on the W. coast of Mexico during our war with that country, and in 1857 participated in the capture of the Barrier Forts, China; during the civil war commanded the iron-clad Passaic in all of the engagements with the defences of Charleston harbor from July, 1863, to 1864, and highly commended for "gallantry, skill, and sound judgment." Capt. Simpson has written two valuable works on ordnance, and stands prominently forward among the men who have done good service to the country and the navy. FOXHALL A. PARKER.

Simpson (Sir GEORGE), b. at Lochbunn, Ross-shire, Scotland, about 1796; was engaged in commercial pursuits in London 1809–20; accompanied the earl of Selkirk to Canada 1820, and was employed by that nobleman in the establishment of his Red River colony; pushed his settlements northward to Athabasca Lake in rivalry with the Hudson's Bay Company, and after the two companies had coalesced (1821) received the appointment of governor of Rupert's Land and of general superintendent of the affairs of the Hudson's Bay Company. In that capacity he planned the successful expedition under his nephew, Thomas Simpson, 1836–39, which traced the coast of the Arctic Ocean from the mouth of Mackenzie River to Point Barrow, and from the mouth of Coppermine River to the Gulf of Boothia. He made an overland journey around the world 1841–42, of which he published a *Narrative* (1847); was knighted in 1855. D. at La Chine, near Montreal, Canada, Sept. 7, 1860.

Simpson (JAMES H.), b. in New Jersey Mar., 1813; was graduated from the U. S. Military Academy July 1, 1832, when appointed brevet second lieutenant of artillery. With the exception of a brief term of service in Florida on the staff of Gen. Eustis, he was mainly in garrison until 1838, when transferred to the topographical engineers with rank of first lieutenant, and was thenceforward engaged on the survey and improvement of lakes and harbors, and on lighthouse and Coast Survey duty until 1858, when ap-

pointed chief topographical engineer of the army of Utah, and while serving in this capacity explored and opened a wagon-route from the valley of Great Salt Lake across the Great Basin of Utah, by which the journey to the Pacific coast was shortened some 200 miles; a report of which he submitted early in 1861. In the early days of the civil war he served as mustering officer in Ohio and chief engineer of department of the Shenandoah. He was appointed colonel of the 4th New Jersey Vols. in Aug., 1861, and in the Virginia Peninsular campaign led his regiment in the action at West Point and in the battle of Gaines's Mill, where taken prisoner and held until Aug. 12. On Aug. 27 he resigned his volunteer commission, and thereafter served as chief engineer of the department of the Ohio and of district of Kentucky (having general charge of the fortifications in Kentucky), and as engineer agent for the Western armies. In Aug., 1865, he was detailed as chief engineer of the department of the interior on proposed change of route of the Union Pacific R. R., W. from Omaha, and served as government commissioner of that road until 1868, since which time he has been engaged in the regular line of duty with his corps, in which he attained the rank of colonel in 1867. For faithful and meritorious services during the rebellion he was brevetted colonel and brigadier-general.

Simpson (Sir James Young), Bart., M. D., D. C. L., b. at Bathgate, Scotland, June 7, 1811; educated at the University of Edinburgh and at the medical school of the same institution, taking his degree 1832; lectured there on pathology 1836; became professor of midwifery 1840; introduced the use of chloroform as an anæsthetic 1847; became president of the Royal Society of Physicians at Edinburgh 1849, and of the Medico-Chirurgical Society 1852; foreign associate of the French Academy of Medicine 1853; received the Monthyon prize for his introduction of anæsthesia 1856; was made a knight of a Swedish order about 1854; created a baronet 1867, and enjoyed an enviable reputation not only as a skilful medical practitioner, but as an eminent antiquarian. D. at Edinburgh May 6, 1870. Author of numerous professional works and miscellaneous writings, including *Homœopathy, its Tenets and Tendencies* (3d ed. 1853); *Obstetric Memoirs and Contributions* (2 vols., Edinburgh and Boston, 1855-56), which included several previous tracts on anæsthesia, and *Acupressure, a New Method of arresting Surgical Hæmorrhage and of accelerating the Healing of Wounds* (1864). In 1871 his principal works were collected under the titles *Selected Obstetrical Works, Anæsthesia and Hospitalism,* and *Clinical Lectures on the Diseases of Women*; and his *Archæological Essays* appeared in 1872. A *Memoir*, by J. Duns, D. D., was published in 1873.

Simpson (Josiah), b. at New Brunswick, N. J., Feb. 27, 1815; graduated from Princeton College in 1833, and pursued his medical studies at the University of Pennsylvania, graduating in 1836; was appointed assistant surgeon U. S. army July 11, 1837, and promoted to be surgeon 1855; brevet lieutenant-colonel and colonel U. S. A., Mar., 1865. As surgeon of the 6th Infantry he served through the Florida war, being present at the battle of Okeechobee, Dec., 1837. In 1846 he accompanied the regiment by way of San Antonio and Saltillo to Vera Cruz, and thence on to the City of Mexico, serving through the battles of Cerro Gordo, Churubusco, and Chapultepec, and present at the triumphant entry into the City of Mexico; attending surgeon with head-quarters in New York and post surgeon at Bedloe's Island 1848-55; was medical director of the department of the Pacific 1855-58; middle department and department of the Tennessee, 1858-67. Transferred to Baltimore as attending surgeon in 1867, he continued to attend faithfully to his duties, though enfeebled in health, till within a short time of his death, which occurred at Baltimore, Md., Mar. 3, 1874.

Simpson (Mathew), D. D., LL.D., b. at Cadiz, Harrison co., O., June 21, 1810; graduated at Madison College 1829; studied medicine and received the degree of M. D. 1833; was licensed the same year in the ministry of the Methodist Episcopal Church; became vice-president and professor of natural science at Allegheny College 1837; president of Indiana Asbury University at Greencastle, Ind., 1839; editor of the *Western Christian Advocate* 1848, and was elected bishop 1852. He has been prominent in educational and missionary labors and organizations; was an intimate friend of Pres. Lincoln, at whose request he devoted much of his time during the civil war to the maintenance of public sentiment in behalf of the Union by his eloquent addresses in many Northern cities, being also employed by the government in several important confidential commissions. In 1863-64 he made an extended tour of inspection of the missions of his Church in Syria and the East generally, and travelled through several countries of Europe upon a similar errand, contributing at the same time to enlighten public sentiment on American affairs. He visited the Mexican missions 1874, and the European mission conferences 1875, and on his return became a resident of Philadelphia. At the inauguration of the Centennial Exhibition, May 10, 1876, Bishop Simpson made the opening prayer. Author of *A Hundred Years of Methodism* (1876).

Simpson (Stephen), b. at Philadelphia, Pa., July 24, 1789; wrote against the U. S. Bank in the *Aurora*; was engaged in the battle of New Orleans; became a prominent journalist in Philadelphia, where he was editor and proprietor of the *Portico* and editor of the *Columbian Observer*, a Jacksonian organ. D. at Philadelphia Aug. 17, 1854. Author of *Life of Stephen Girard* (1832), etc.

Simpson (Thomas), F. R. S., b. at Market-Bosworth, England, Aug. 20, 1710; was in early life a weaver, but became an accomplished mathematician by private study; was for some years a teacher at Derby and at London; was professor of mathematics in the Royal Military Academy at Woolwich 1743-61, and published many ingenious papers on pure mathematics and physical astronomy. D. at Market-Bosworth May 14, 1761.

Simpson's Creek, tp., Horry co., S. C. P. 945.

Simp'sonville, p.-v., Shelby co., Ky., on Shelbyville division of Louisville Cincinnati and Lexington R. R. P. 239.

Simpsonville, tp., Rockingham co., N. C. P. 1590.

Sim'rock (Karl), b. at Bonn Aug. 28, 1802; studied jurisprudence in his native city and in Berlin; entered the Prussian civil service, but was dismissed in 1830 on account of a song he wrote on the revolution of July in Paris; devoted himself to literature, and studied especially the old German language and literature, of which he was appointed professor at Bonn in 1850. He translated the *Nibelungenlied* into modern German (1827), several works of the Minnesingers, the *Edda* (1851), *Beowulf* and *Heliand*, Shakspeare's *Sonnets* (1867), and Tegnér's *Frithiof's Saga* (1863). He also published a *Handbuch der deutschen Mythologie* (1864), *Die Rheinsagen, Deutschen Volksbücher* (1839-67), *Quellen des Shakspeare* (1831), etc. D. July 18, 1876.

Sims, tp., Grant co., Ind. P. 841.

Sims (Edward Dromgoole), b. in Brunswick co., Va., Mar. 24, 1805; graduated at Chapel Hill in the University of North Carolina in 1823, and became a tutor in that institution. He was the principal of an academy at La Grange, Ala., and on the establishment of La Grange College he filled the chair of mathematics and natural philosophy; travelled two years as a minister in the Tennessee conference; then was professor of languages in Randolph-Macon College, Va.; spent two years at the University of Halle, Germany, and another year in an extensive European tour. At the close of 1838 he returned to Virginia, and filled the chair of English literature in Randolph Macon College, and in Dec., 1841, was elected to the same department in the University of Alabama. His learning was extensive and accurate; he was deeply versed in both ancient and modern languages and literature. He was preparing for publication a work on English grammar, and another on Anglo-Saxon, to which language he had devoted great attention. He was a model professor. As a preacher his sermons were distinguished for profound thought and perspicuous statement, but not for eloquence; though he had mingled in courtly society, he was unpretending in his manners, simple in his tastes, and devout in his spirit. He was greatly beloved for his generous, noble traits of character, to which a beautiful tribute was paid at his funeral by the Rev. Dr. Manly, who was then president of the University of Alabama. D. in Tuscaloosa, Ala., Apr. 12, 1845. His early removal was deplored by all, but especially by his colleagues, one of whom was the editor in-chief of this Cyclopædia. T. O. Summers.

Sims (James Marion), M. D., b. in Lancaster co., S. C., Jan. 25, 1813; graduated from South Carolina College, Columbia, 1832; studied medicine at Charleston and Philadelphia, graduating M. D. at Jefferson Medical College 1835; in 1836 entered upon the practice of his profession at Montgomery, Ala.; in 1845 called attention to his new theory of the nature and origin of *Trismus Nascentium*, publishing a series of articles on this subject 1848 in the *American Journal of Medical Sciences*. In 1845 his attention was also especially directed to the subject of *Vesico-vaginal Fistula*, which previous to this time had been considered incurable. Establishing a private hospital at Montgomery for the treatment of this disease, Dr. Sims commenced a series of experiments, conducting them with intense earnestness during a period of four years (entirely at his own expense), which were crowned with success. His discovery was based on the use of silver sutures, the invention of a speculum which bears his name, and a great

number of new and ingenious instruments by which alone his operation is or can be performed, and are now in general use throughout the world by all surgeons of note. He has since extended the use of metallic sutures to every department of general surgery, their superiority being universally recognized. In 1852 he published a full account of his discovery in the *American Journal of Medical Sciences*. In 1850 his health failed, and he came North, and in 1853 settled permanently in New York. His investigations into the extent and character of diseases peculiar to woman early led him to perceive the importance and necessity of establishing a great permanent woman's hospital in the city of New York for the exclusive treatment of this formidable and very numerous class of affections. To accomplish this purpose he delivered an address (May 18, 1854) in the old Stuyvesant Institute to an immense gathering of the profession. His clearly-defined ideas, practical suggestions, and evident sincerity and earnestness carried conviction to all who heard him. The audience, wholly professional, at once on the close of his address appointed a committee to aid in carrying out his views. A suitable building was secured by Dr. Sims on Madison avenue, the common council appropriated $2500, and a temporary hospital was opened in May, 1855. Dr. Sims was elected attending surgeon, with Drs. Mott, Francis, Stevens, Green, and Delafield as a consulting board. The hospital was immediately filled with patients from all parts of the country. The success attained not only demonstrated the benefits of, but the necessity for, a large and permanent institution. In 1857–58, Dr. Sims obtained from the legislature a charter for the Woman's Hospital of the State of New York; he also obtained a grant of land from the city of New York as a site for the hospital, 200 by 400 feet, near Central Park, opposite Columbia College, consisting of thirty-two lots, now valued at $500,000. The hospital is on the pavilion plan. One pavilion, containing seventy beds, was finished and occupied in 1866. The Woman's Hospital is supported mainly by voluntary contributions. Dr. Sims obtained two appropriations for it from the State, amounting to $60,000, the balance being raised by private subscription. A second pavilion has been erected, and will be open during the present Centennial year, and is of the same capacity as the first. In 1861, Dr. Sims went abroad, and was invited to perform the peculiar operations associated with his name and discoveries by the profession wherever he appeared. He operated in Dublin, in London, in nine different hospitals in Paris, and, by special invitation, at the hospital in Brussels. His success was so decided that he received decorations from the French, Italian, Spanish, Portuguese, and Belgian governments as a public benefactor. As an author Dr. Sims is known by his papers on *Trismus Nascentium*, *Silver Sutures in Surgery*, *The Microscope in the Sterile Condition*, on *Ovariotomy*, on *Intrauterine Fibroid Tumors*, and by his clinical *Notes on Uterine Surgery*. Dr. Sims's European practice became very extensive, especially in France and England, he having many patients from all parts of the world. In 1868 he returned to New York, and resumed his practice during a part of the year, his family remaining in London and Paris, where his children were at school. In 1870, on the breaking out of the Franco-Prussian war, Dr. Sims organized in Paris the "Anglo-American Ambulance Corps," took charge of it as surgeon-in-chief, and went with it to Sedan, arriving there just as the great battle commenced (Aug. 31) which ended in the downfall of the Second Napoleonic empire. He remained at Sedan a month, having charge of a large hospital in the city, and establishing branch ambulances in the suburbs, aiding about 3000 of the wounded of both armies. Soon after this, Dr. Sims returned with his family to their home in New York, where he now resides. To the labors and discoveries of Dr. Sims are mainly due the development and establishment of the science of gynecology as a new department in medicine, recognized by a special professorship in all well-organized medical colleges. Dr. Sims is a corresponding member of many learned societies at home and abroad, notably of London, Edinburgh, Berlin, Christiania, etc., and of the Royal Academy of Medicine of Brussels. He was elected president of the American Medical Association at its meeting at Louisville, Ky., and presided over that learned body at its annual meeting (June 6, 1876) in Philadelphia, and delivered the Centennial annual address. H. L. Stuart.

Sims (Richard), b. at Oxford, England, in 1816; educated at New College School, Oxford; became in 1841 an employé in the manuscript department of the British Museum; was appointed transcriber 1859, and subsequently junior and senior assistant in the same department. Author of an *Index to the Heralds' Visitations* (1849), *A Handbook to the Library of the British Museum* (1854), *The Autograph Miscellany* (1855), *A Manual for the Genealogist, Topographer, Antiquary, and Legal Professor* (1856), *The Handbook to Autographs* (1860–61), and *The Autograph Souvenir* (1864–65). He has announced for publication *A Classed Catalogue of Manuscripts relating to British Heraldry and Topography deposited in the Public and many of the Private Libraries of the Kingdom.*

Sims'bury, p.-v. and tp., Hartford co., Conn., on New Haven and Northampton and Connecticut Western R. Rs., formerly the seat of the Connecticut State prison. P. 2051.

Sim'son (Robert), b. at Kirton Hall, Ayrshire, Scotland, Oct. 14, 1687; educated at the University of Glasgow with a view to the ministry; studied medicine, but never practised; was distinguished for classical and mathematical attainments, and was professor of mathematics at Glasgow University 1711–61. D. at Glasgow Oct. 1, 1768. He restored and edited the *Loci Plani* of Apollonius (1746) and the first six books of Euclid's *Elements* (1756), and Earl Stanhope published after his death his treatises on Porisms, an edition of Pappus, and other mathematical treatises.

Simulta'neous Equa'tions [Lat. *simul*]. Two or more equations are *simultaneous* when the value of each of the unknown quantities is the same in all of the equations. A single equation containing more than one unknown quantity is indeterminate; that is, it can be satisfied by an infinite number of sets of values of the unknown quantities that enter it. Any two such equations may be made simultaneous, and by their combination one of the unknown quantities can be eliminated. The act of combining two or more equations implies that they are simultaneous, and the result of the combination will depend on the relative number of equations and of unknown quantities. If the number of equations is equal to that of the unknown quantities, the resulting values of the unknown quantities will be the only ones that will satisfy all the equations of the group. If the number of equations is less than that of the unknown quantities, the result of the combination will be a single equation containing two or more unknown quantities, and consequently indeterminate. If the number of equations is greater than that of the unknown quantities, the unknown quantities may all be eliminated, and there will result one or more equations between the known quantities, which must be satisfied in order that given equations may be simultaneous; these equations are called *equations of condition*. If these are satisfied, some of the given equations must be dependent on some of the others, so that there are in reality no more independent equations in the group than there are unknown quantities.

W. G. Peck.

Si'nai [Heb. *Sina*, which means, according to Fürst, "jagged," "full of clefts"]. (1) A triangular peninsula of Arabia Petræa, between the gulfs of Suez and Akabah. The apex of the triangle points southward; its base is 150 miles across from gulf to gulf; its western side 186 miles long, its eastern side 133, and its area about 11,500 sq. m. First comes the wedge-like protrusion of the limestone plateau known as the Desert of the Wandering, then a sandstone belt, and finally the mountain-masses of granite and porphyry, flanked right and left by narrow strips of lowland bordering the gulfs. These mountains may be divided into three groups, the highest peaks of which, respectively, are Serbal (6734), Catharine (8526), and Shomer (8449). The ancient Egyptians called this peninsula "the land of the gods." Its solitary grandeur impresses all travellers alike. Mines of iron, copper, and turquoise were once worked here. It is still the home of about 5000 Bedouin. The curious inscriptions, found mostly on the western side of the peninsula, are still an unsolved problem.—(2) Used in the Old Testament interchangeably with Horeb to designate the Mountain of the Law. Lepsius and some others have tried to identify it with five-peaked Serbal, the most picturesque of all the mountains of the peninsula. But the true Sinai is a gigantic mass, about 2 miles long from N. to S., and about half a mile wide from E. to W. Its S. E. peak, called Jebel Musa, is the traditional scene of the giving of the Law. But there was not open space enough on the S. side of the mountain to accommodate the Hebrew host. Its N. W. peak, called Sufsafeh, overlooks three wadies (Rahah, Deir, and Leja), which might easily have held 3,000,000 or 4,000,000 people; and there is no other such spot anywhere in the whole peninsula. The watershed at the foot of Sinai is 5140 feet above the sea, Jebel Musa 7359, Sufsafeh a little lower. The famous convent of St. Catharine, in whose library Tischendorf discovered the Sinaitic Codex of the Scriptures (in 1844 and 1859), is on the E. side of the mountain. R. D. Hitchcock.

Sinaloa. See Cinaloa.

Sinalun'ga, or **Asinalunga,** town of Italy, province of Siena, pleasantly situated in a fertile tract on the eastern slope of Monte di Collalto, in the Val di Chiana, about 26 miles S. E. of the city of Siena. The churches contain some

fine pictures by Lodoma and other great Sienese painters. The present name of this town first appears in the twelfth century. P. 8898.

Sin'apine [Lat. *sinape* or *sinapi*, "mustard-seed"], a vegetable alkaloid found, in combination with *sulphocyanic acid*, in the seed of *Sinapis alba*, or white mustard. Its composition is $C_{16}H_{23}NO_5$. It has not yet been obtained in solid form in pure state, being decomposed by evaporation of its solution. The latter has the interesting property of precipitating metallic gold from the chloride. The characteristic principle of mustard, *sulphocyanate of sinapine*, may be obtained crystallized in colorless glassy rectangular prisms. It is inodorous, but has the bitter and hot taste of mustard. It dissolves to yellow solutions in water and alcohol, and is soluble also in ether, disulphide of carbon, and essential oils. The smell which mixed mustard (as a condiment) acquires on standing is due to products of decomposition of this very unstable substance. H. WURTZ.

Sinapis. See MUSTARD and SINAPINE.

Sincere Brethren, a former secret society of Mohammedans, called also **True Friends.** The society sprang up in the Motazilite sect in the latter part of the tenth century. Its great work was philosophical and literary. The brethren produced fifty-one treatises designed as an encyclopædia or statement of all the scientific knowledge of the time. They taught a kind of Pythagorean philosophy, and their real object, we are told, was to reform the corrupt moral tone of the Mohammedan world at that period. They also were bound to befriend each other in all circumstances. They were unpopular in their day, and were charged with being trimmers and compromisers on important moral questions.

Sin'clair (CARRIE BELL), b. at Milledgeville, Ga., May 22, 1839, is a niece of Robert Fulton the inventor, and daughter of a Methodist minister; spent her childhood at many different places in North Carolina, South Carolina, and Georgia, and finally became a resident of Augusta, Ga., where in 1860 she published a volume of *Poems* containing many graceful verses. During the civil conflict she wrote several war-songs, which were set to music. They have been published, with other pieces, in a volume entitled *Heart-Whispers, or Echoes of Songs*.

Sinclair (CATHARINE), daughter of Sir John, b. at Edinburgh, Scotland, Apr. 17, 1800; acted as amanuensis to her father during his later years, and after his death wrote several novels which enjoyed great popularity both in Great Britain and the U. S. Among them were *Modern Accomplishments* (1835), *Holiday House* (1839), *Modern Flirtations* (1841), *Jane Bouverie* (1845), *Beatrice* (1852), and *Torchester Abbey, or Cross Purposes* (1855). She also wrote books for the young, and took an active interest in philanthropic and educational projects. For some years she was directress of a charitable institution for widows of officers of the army, and equipped at her own expense a volunteer corps of young artisans. D. at Kensington, London, Aug. 6, 1864.

Sinclair (GEORGE), b. in Scotland about 1625; became professor of philosophy in the University of Glasgow 1654; was a zealous Covenanter, and consequently ejected from his chair after the Restoration 1662; became an engineer; was employed in constructing waterworks and in draining mines; was restored to his university chair 1688, and became also professor of mathematics 1691. D. at Glasgow in 1696. He was a zealous experimenter in natural science, and published works on mathematics, hydrostatics, and astronomy, but is chiefly remembered for his maintenance of the reality of witchcraft in a curious book long popular among the Scottish peasantry, *Satan's Invisible World Discovered, or a Choice Collection of Relations anent Devils, Spirits, Witches, and Apparitions* (1685).

Sinclair (SIR JOHN), BART., LL.D., b. at Thurso Castle, Caithness, Scotland, May 10, 1754; received a careful education at the universities of Edinburgh, Glasgow, and Oxford; became a member of the Faculty of Advocates at Edinburgh 1775; was called to the bar at Lincoln's Inn 1782, in which year he printed tracts on parliamentary reform and on the naval strength of the British empire, as well as a philological treatise entitled *Observations on the Scottish Dialect*; published a learned *History of the Public Revenue of the British Empire* (3 vols., 1785–89); travelled extensively in the north of Europe 1786; was made a baronet the same year; introduced great improvements in agriculture and wool-growing on his immense estate of 100,000 acres; built up the port of Thurso; was influential in reviving the coast fisheries and in the establishment of the Scottish Society of Wool-growers (1791) and board of agriculture (1793), of both which associations he was the first president; maintained an extended correspondence with Gen. Washington, chiefly on agricultural topics (printed in engraved fac-simile, London, 1800; reprinted at Washington, D. C., 1844 and 1847); raised two battalions of fencibles for the national defence; sat in Parliament with brief interruptions from 1780 to 1811; became a member of the privy council 1810; compiled a herculean work which has been called the "Scottish Doomsday Book," *A Statistical Account of Scotland, drawn up from the Communications of the Ministers of the Different Parishes* (Edinburgh, 21 vols. 8vo, 1791–99); printed the alleged Gaelic originals of *Ossian's Poems*, with a preliminary dissertation maintaining their genuineness, and for fifty years issued an incessant stream of publications, 367 in number, covering almost the whole range of literature, being aided therein during his later years by his daughter CATHARINE, who became eminent as a novelist. D. at Edinburgh Dec. 21, 1835.—His eldest son, SIR GEORGE, b. at Edinburgh Oct. 23, 1790, was for some years a member of Parliament, and wrote several works against Roman Catholicism. D. at Edinburgh Oct. 9, 1868.—Another son, JOHN, b. at Edinburgh Aug. 20, 1797, graduated at Pembroke College, Oxford, 1819; took holy orders; became examining chaplain to the bishop of London 1839, vicar of Kensington 1842, and archdeacon of Middlesex 1843; published *Memoirs* of his father (2 vols., 1837), and many theological treatises; was many years an active worker in behalf of education as secretary to the National Society, and visited the U. S. in 1853 in behalf of the Society for the Propagation of the Gospel. D. in London May 22, 1875. Just before his death he published an entertaining book filled with curious reminiscences, *Sketches of Old Times and Distant Places* (1875). PORTER C. BLISS.

Sin'clairville, p.-v., Charlotte tp., Chautauqua co., N. Y., on Dunkirk Allegheny Valley and Pittsburg R. R., has 4 churches and several mills. P. 575.

Sinde, Scinde, or **Sindh,** British province, forming part of the northern division of the presidency of Bombay, in British India, lies between 23° and 28° 32′ N. lat. and 66° 43′ and 71° E. lon. (Greenwich); bounded on the S. by the Runn of Cutch and the Arabian Sea; on the W. by the Hala and Suliman Hills, belonging to Beloochistan (Kelat); on the N. by the British province of the Panjaub; and to the E. by the native states of Rajputâna. Area, exclusive of the native state of Khairpoor, 97,175 sq. m., and (in 1872) a pop. of 2,192,145. The centre of the province, consisting of the valley of the Indus, is rich and, where irrigated, highly cultivated. Toward the W. the valley rises, in parts somewhat abruptly, into barren and rugged uplands, a country of pasture inhabited by wandering tribes of shepherds. On the left bank the plain, unbroken save by natural or artificial canals—among which the Mitsaw Canal, 200 miles in length, for providing a sufficient supply of water to the Fulailee or Gunee river, is the greatest work—stretches toward the Eastern Nara, an offshoot of the Indus, whose course for upward of 100 miles runs nearly parallel to the main stream. Beyond the Nara the country, passing through different stages of fertility, is finally absorbed into the Great Desert, an extensive tract studded with ridges of sand which run parallel to the course of the Nara, varying in height from 80 to 100 feet. In the S. the more recently-formed portions of the Indus delta, consisting of salt-impregnated clay, are a waterlogged, unwholesome, thinly-populated region, nearly devoid of vegetation. The climate shows an extreme of heat. In Upper Sinde the dryness and heat, combined with the aridity of a sandy soil, make up a climate resembling that of the sultry deserts of Africa. The mean maximum height at Hyderabad, in Lower Sinde, during the hottest month of the year, has been given at 98° 5′ in the shade, and the water of the Indus reaches blood heat; but in Upper Sinde it is even hotter, and the thermometer has been known to register 130°. In the low lands lying near the coast the climate is more agreeable, and Kurrachee is one of the best places in India to mass European troops, the mean temperature amounting to 77.7°. The quantity of rain is exceedingly small. The monsoon rains exert no influence. The average of the rainfall varies from 9.25 inches in Upper to 7.35 in Lower Sinde. Geologically, the rocks of Sinde are only partially represented in the Indian peninsula, and must rather be considered as belonging to continental Asia, having been shown to be continuous with the formations found in Persia and Arabia. The province contains in all 32,750,000 acres, of which no less than 25,500,000 are returned unculturable, while of the remainder little more than 2,000,000 are under cultivation. The principal agricultural products are, for the autumn (kharif) crop, rice, millet, panic (*Panicum spicatum*), and cotton, and for the spring (rabi) crop, wheat, barley, oil-seeds, and tobacco; wheat and oil-seeds go to England. Camels are very numerous, horses few, small, but very hardy; bullocks are reared in great numbers and exported to Guzerat. Though

chiefly an agricultural and pastoral country, the pottery, the leatherwork, and the carpets of Sinde are, in design and finish, of superior excellence. The population gives 47.05 persons per sq. m. Islamism is the prevailing religion, 72.4 per cent. being returned as Mussulmans; the Hindoos have adopted Mussulman customs so far as to dress in Mohammedan fashion and to wear the beard. The people are very peaceable and well-disposed, though far less civilized than the generality of Indian populations. Among the Mohammedans there are no castes; among the Hindoos of a notable character are the Amils, who are the best-educated class and the most generally employed in government service. Ethnologically, the population belongs to the great branches of Beloochees who entered the province from Beloochistan, and the Sindhis of Hindoo (Indian) origin. The languages are Sindhi, a dialect of the Aryan family, and not yet very remote from the Sanskrit, and Beloochee, of the Dravidian group, being a mixture of Persian, Sindi, Hindi, and Sanskrit; both languages are written with Persian characters. The literature is poor, chiefly translations from Persian, Sanskrit, and modern Indian dialects; newspapers are not published in any of them. About 35 per cent. of the population are engaged in agriculture; only 16.3 per cent. are returned as proprietors, the others as tenants or laborers; half the entire number of holdings do not exceed 5 acres in area; not more than a quarter exceed 50 acres. Hereditary tenancy is only found in some of the northern districts.

In ancient times the Hindoo nationality ruled the province under Brahman dynasties; successive waves of Mohammedan invasion and conquest passed over Sinde, which under the Mogul dynasties at Delhi became the playground for ambitious Arab governors. Shortly after the beginning of the present century, four brothers of the Talpoor family assumed the government and held the land, with the title of emirs, under a military despotism. The progress of British power in Northern India was accompanied by certain complications with the emirs; but while the questions in dispute were still under negotiation, peace was broken by the emirs' troops. Recourse to arms could no longer be avoided, and after a brief though well-contested campaign the province was, in 1843, conquered by Sir R. Napier and became part of the British empire in India. For administrative purposes the province is divided into the five districts of Upper Sinde frontier in the N., Thar and Parkar in the S. E., and Kurrachee, Hyderabad, and Shikarpoor, which are the three richest, in the centre. These central districts are administered according to the regulation system—viz. the administration of civil justice is entrusted to four grades of courts, whilst the original criminal work is disposed of by the executive officers; in the non-regulated districts these officers hold both civil and criminal functions. The revenue administration is carried on by a staff of collectors and subordinate officers (natives), and yields from 6,000,000 to 7,000,000 rupees. Under the British government the province is making rapid advancement in every direction, not overlooking education; in 1874 there were 227 schools. The principal town is the seaport Kurrachee, terminus of the Indian-European telegraph and of the Sinde Railway, running up to Kotree, opposite to Hyderabad, and under construction to Sakkar, so as to meet the Indus Valley Railway; its pop. is 56,753; its external annual trade amounted in 1873 to 3.7 million rupees, 1874 to 3.9 million rupees. In 1873, 4407 ships entered and cleared the harbor; 31 steamers left for London *viâ* the Suez Canal; the difficulties in entering the harbor are removed. Post and passenger steamers from Aden do not yet run to Kurrachee.

EMIL SCHLAGINTWEIT.

Sin'dia, the dynastic name of the most powerful of the present native Mahratta princes of India, having their capital at GWALIOR (which see). The family took its rise in the person of RANOJEE SINDIA, a low-caste retainer of the Mahratta peishwa, who rose to a high rank in the bodyguard, and in 1743 received as a fief half of the province of Malwa.—His son, MADHAJEE SINDIA (d. 1794), joined the Mahratta confederacy; fought against the Afghans at the great battle of Panipat (1761); became a useful ally of the emperor of Delhi; expelled the Sikhs from Central India, and became virtual ruler of the empire; fought against the British 1779–82; was confirmed in his possessions by the treaty of 1782; captured Gwalior 1784; seized on Delhi and Agra; reduced the Rajpoot states, and formed a vast army, well disciplined by French adventurers.—His grandnephew and successor, DOWLUT RAO SINDIA, ruled from 1794 to 1827; waged war with varying success against the rival family of Holkar; was defeated by Wellington at Assaye and by Lord Lake at Laswaree, and submitted to British influence, but retained his capital and a portion of his territories.—The present ruler, BHAGERUT RAO SINDIA, was a loyal and useful ally of the English during the great mutiny of 1857–59.

Sine [Lat. *sinus*], in trigonometry, the distance of one extremity of an arc from the diameter through the other extremity.

Sin-Gan-Foo, city of China, capital of the province of Shen-Si, and formerly capital of the empire, on the right bank of the principal western tributary of the Hoang-Ho, contains a population variously estimated at from 100,000 to 200,000, is enclosed by strong walls, was long the principal military dépôt for the N. W. of China, and has been for several years the stronghold of the Mohammedan rebels or "Nien-Fei," who have established an imperial government, have overrun several provinces, and now (1876) menace the integrity of the empire. Sin-Gan-Foo is also celebrated for the discovery, a few years since, of a Syriac inscription recording the establishment of Christianity there by the Nestorians in the fourth century A. D., the authenticity of which was formerly much disputed, but has been placed beyond doubt by Col. Yule's careful researches in his 2d ed. of the *Travels of Marco Polo* (1876).

Singapore', or **Singapur,** an island on the extremity of the Malayan peninsula, bearing the town of the same name, founded by the Malays 1283, ceded 1819 to the English by the raja of Johor, and rendered a free port in order to strike a blow at the Dutch; became in 1853 the capital of the Straits Settlements. The area of the island is 222 sq. m.; the surface varies from 20 to 30 feet above the sea-level; low hills are numerous, varying from 50 to 200 feet; Bukemata, a hill in the centre of the island, has a height of 517 feet. The climate is agreeable to Europeans; the mean annual temperature is 80.7° F.; during the day the heat is intense; the atmosphere is very moist, there being usually a fall of rain every week. The drainage of the town, formerly as bad as possible, has been considerably improved. The seamen's hospital is an excellent building, well adapted for its purpose and well attended to. From the census of 1871 the population of the islands has been computed to be 97,111. Chinese and Javanese are numerous. The city was once a dreaded lurking-place for pirates, but developed into a great commercial centre of the Malayan Archipelago, doing an annual business in native produce and foreign goods of $70,000,000. But it seems, in this respect, to have reached its point of culmination. Numerous harbors on the Malayan peninsula, especially Pulo-Penang, in Borneo, and Sumatra, in Siam and Cochin China, formerly traded exclusively through Singapore, but have now begun to establish direct connections. About 1330 vessels, among which are 460 steamers, annually enter and clear the port. The value of the exports to the U. S. of America in 1869 was estimated at $2,100,000; that of the imports at $38,380. It is connected by telegraph with Madras, Java, Australia, and Japan.

E. SCHLAGINTWEIT.

Sing'er (SAMUEL WELLER), b. in England in 1783; author of one or two original works on antiquarian subjects; was chiefly known as an industrious editor of numerous old English authors, among which were Fairfax's *Tasso* (2 vols., 1817), Spence's *Anecdotes* (1820), Sir Thomas More's *Richard the Third* (1821), Cavendish's *Life of Wolsey* (2 vols., 1825), Herrick's *Poetical Works* (2 vols., 1846), and various works of Clarendon, Roper, Selden, Shakspeare, and Bacon. D. in London Dec. 20, 1858.

Singers Glen, p.-v., Rockingham co., Va., on Baltimore and Ohio R. R., 8 miles N. E. of Harrisonburg, has 1 church and 2 large publishing-houses. P. about 100.

ALDINE L. KIEFFER, ED. "MUSICAL MILLION."

Singha'ra Nut, the kernel produced by *Trapa bispinosa*, a halagoreaceous water-plant, which, like *T. bicornis* of China and *T. natans* of Europe, is cultivated for its fruit, which is a very useful food, especially important as growing in shallow waters, which would otherwise be unproductive. The Cashmerians obtain a large part of their food from this plant.

Singh, Runjeet. See RUNJEET SINGH.

Sing Sing, p.-v., Westchester co., N. Y., incorporated in 1813, 33 miles N. of New York City, on New York Central and Hudson River R. R., is spread out over the eastern slope of the Hudson, extending back from the river nearly a mile, being about 2 miles in length from N. to S. Its streets and avenues, rising one above another to the height of from 200 to 300 feet, afford the most delightful views of the lovely scenery of the Hudson from its source to its outlet. The river is wider at this point than at any other; the broad Tappan Zee and Haverstraw Bay are separated by the long peninsula known in Revolutionary times as "Teller's Point" (where the Vulture waited for Arnold and André), and now, as Croton or Underhill's Point, famous for its vineyards. These expansive bays, the mountains on the western border, with Mount Taurn, 640 feet high, Teller's, Verplanck's, and Stony Points, all of his-

toric memory; the villages of Piermont, Nyack, Rockland, and Haverstraw all in view,—combine to make a landscape of surpassing loveliness. Sing Sing is noted for its salubrity as a summer resort, for its far-famed military schools, and for the number and beauty of the private residences in and immediately around it—for the whole town of Ossining, with its 8000 inhabitants, is but a suburb of this its chief village. It has several fine churches—2 Episcopal, 2 Methodist, 1 Presbyterian, 1 Baptist, and 1 Roman Catholic. There are many fine new stores, a handsome marble bank, Masonic and town halls, a large public school with 600 to 700 scholars, 4 military high schools; Mount Pleasant Academy, established over fifty years, with 70 pupils; St. John's School, 78 pupils; Holbrook's Military School, 60; Symond's, 30 to 50; the Ossining Institute for young ladies; Mrs. Clark's, and others. Two newspapers, the *Republican* and the *Democratic Register*, are published weekly. The Croton Aqueduct crosses the Kill by a magnificent stone arch of 88 feet span and nearly 70 feet above the stream; the Kill is also crossed by two large brick and stone arch bridges, and one iron suspension road-bridge. Among the articles manufactured here are Hall's self-feeding cotton-gins, Turner's cotton-gin saws, gas and water pipes, the Monitor and the Empire lawn-mowers, Kipp's steam-engines, files, wrenches, and carriages and sleighs. The 1500 State convicts in Mount Pleasant prison, just outside the corporate limits of the village, and not included in its population, are engaged in making furniture, harness, lime, marble-dust, laundry-work, etc. P. 4696. GEORGE JACKSON FISHER.

Singular Points. A singular point of a curve is a point at which the curve possesses some analytical peculiarity not possessed by other points. The most important singular points are *cusps, multiple points, points of inflexion, isolated points*, and *points of abrupt termination*, or, as the French term them, *points d'arrêt*. A *cusp* is a point at which two branches of a curve stop, having a common tangent at that point. A *multiple point* is a point at which two branches of a curve cut each other or are tangent to each other. A *point of inflexion* is a point at which a curve changes the direction of its curvature; the curve cuts the tangent at a point of inflexion. *Isolated points* are points whose co-ordinates satisfy the equation of the curve, but which have no consecutive points. A *point d'arrêt* is a point at which a curve stops.

FIG. 1.

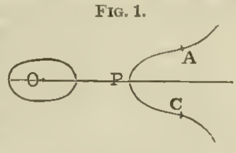
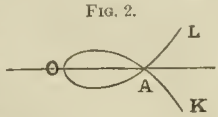
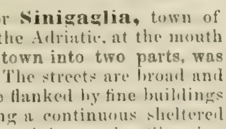


FIG. 2.



A discussion of the curve whose equation is $ay^2 = x^3 - (b - c)x^2 + bcx$ illustrates the relation between some of the more important of the singular points above defined. The general form of this curve is shown in the annexed diagram. It consists of an oval branch O and an infinite bell-shaped branch, C P A, C and A being points of inflexion. If we make $c = 0$, the oval O shrinks to a single point, which is a conjugate point. If we make $b = 0$, the curve reduces the shape K A O A L, A being a multiple point. If we make $b = 0$ and $c = 0$, the curve takes the form K A L, A being a cusp. (For further information the reader is referred to Salmon's *Treatise on the Higher Curves*.) W. G. PECK.

FIG. 3.



Sinigallia, Senigallia, or **Sinigaglia,** town of Italy, province of Ancona, near the Adriatic, at the mouth of the Misa, which divides the town into two parts, was formerly very strongly fortified. The streets are broad and well paved, and some of them are flanked by fine buildings constructed with porticoes forming a continuous sheltered promenade. Sinigallia owes its origin to the Sinonian Gauls, but lost its importance by the invasion of the Saracens. The present maritime trade is carried on by means of a short canal, for which the lower arm of the Misa has been made available. From 600 to 800 vessels enter the harbor annually. The manufacturing activity is considerable, chiefly in silk and linen. The annual fair of Sinigallia (beginning July 22) was formerly one of the most famous in Europe, and is still much frequented. P. with suburbs, 22,127.

Sinim, another name of the SERES (which see).

Sinking Fund. See FUNDS, by J. S. GIBBONS.

Sinking Springs, tp., Highland co., O. P. 200.

Sinoob' [the ancient *Sinope*], town of Asiatic Turkey, in Asia Minor, eyalet of Kastamooni, on a peninsula jutting out into the Black Sea, is surrounded with walls, has an excellent harbor, an arsenal and shipyard, extensive fortifications, just completed (1876), and a vast castle of the Byzantine period. The ancient *Sinope* was a colony from Miletus, became the capital of the kingdom of Pontus, was the residence of Mithridates, and is celebrated in modern times for the great naval battle, resulting in the destruction of the Turkish fleet by the Russian admiral Nakhimoff, Nov. 30, 1853. Half of its inhabitants are Turks, but the trade which is carried on quite extensively in corn, timber, and fish is entirely in the hands of Greeks. P. 10,000.

Sinope. See SINOOB.

Sin'ters [Ger.], a general designation for mineral substances deposited as incrustations or porous and cellular masses from the waters of mineral springs. The principal kinds are *silicious* and *calcareous* sinters, but there are also *iron* sinters. Some silicious sinters are classed by Dana with the crypto-crystalline varieties of quartz. (See SILICA.) They proceed from waters containing silica itself in solution, or sometimes, doubtless, soluble silicates of bases which are decomposed by the carbonic acid of the air. The great mass of silicious sinters are composed of hydrates of silica. *Fiorite, michaelite,* and *geyserite* are names that have been given to some of these. *Hyalite*, or glassy silicious hydrate, is also occasionally found about hot springs. *Michaelite*, of J. W. Webster, from St. Michael's in the Azores, is a snow-white capillary substance of pearly lustre, of density 1.866. Its analysis gives exactly the composition $3SiO_2.2H_2O$. Calcareous sinters are also called calcareous tufas. They are similar in nature and origin to the material of STALACTITES (which see). Of the iron sinters the most interesting is the mineral called *scorodite*, which is *tetrahydrated ferric arseniate*, $Fe_2O_3.As_2O_5.4H_2O$, found in several localities in this country. It often occurs crystalline, but sometimes as a sinter. For a complete account of it mineralogical textbooks must be referred to. H. WURTZ.

Sintus, or **Sintoos,** in Japan, the adherents of the *Sinsyu* (that is, "the worship of the gods"), the ancient religion of the country, in which the chief deity is the sun-goddess Ten-sio-dai-yin. This divinity is invoked through inferior divinities called Kami. (See JAPAN.)

Si'nus [Lat.], a cavity or depression. A term employed in anatomy and surgery. In surgery it is applied to long, narrow tracts connecting with the cavity of an abscess or with dead bone. Sinuses are usually lined with granulation tissue, which often appears as an exuberant, pouting growth at its orifice, and is popularly termed "proud flesh." In anatomy the term *sinus* is applied to two distinct classes of cavities or channels: (1) The larger venous channels of the interior of the skull and spinal column, the sinuses of the dura mater. These venous channels have an outer coat formed by the dura mater, and an inner coat which is a continuation of the serous membrane of the veins. The term is less prominently associated with other vascular pouches or local dilatations, as the sinus of the jugular vein at its base, the sinuses of Valsalva, or aortic and pulmonary sinuses, depressions behind each segment of the tripartite valves at the base of the heart, opening into the aorta and pulmonary artery. (2) Cavernous passages in the bones of the face, connecting with the cavities of the mouth and nose. These are the sinuses of the frontal bone or forehead, of the maxillæ or cheek-bones, and of the ethmoid and sphenoid bones. These remote cribriform cavities of the forehead and base of the skull are involved when the nostrils and throat are the seat of acute or chronic catarrhal inflammation. In influenza and recent colds in the head the catarrhal state of these sensitive surfaces causes a sense of fulness, tension, heat, and pain. They also contribute to the great volume of serum and mucus discharged from the nose during the early period of coryza or acute nasal and bronchial catarrh.
E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Si'on, or **Sitten,** town of Switzerland, capital of the canton of Valais, on the Rhone, is surrounded with walls, has several old and interesting churches and castles, and some manufactures of tobacco and silk. P. about 5000.

Sion, Mount. See ZION.

Sioot', city, cap. of a province of the same name and residence of the governor of Upper Egypt, near the Nile, in lat. 27° 13′ N., on the site of the ancient *Lycopolis*, in an exceedingly fertile district. It has several fine mosques, palaces, baths, bazaars, and the ruins of a Roman amphitheatre, is the residence of several foreign consuls, the seat of a flourishing American mission, and is the chief resort of the caravans from Nubia and Soodan, with which it carries on a considerable trade. The view of the Nile valley from the peaks of the neighboring Libyan hills is reputed as one of the finest in Egypt. Its inhabitants, about 25,000, enjoy a good reputation for industry and reliability.

Sioux, county of N. W. Iowa, on Big Sioux and Rock rivers, traversed by Sioux City and St. Paul R. R., has a level surface and a fertile soil. Cap. Orange City. Area, 750 sq. m. P. 576, largely increased since 1870.

Sioux, tp., Plymouth co., Ia. P. 311.

Sioux City, p.-v. and tp., cap. of Woodbury co., Ia., on Sioux City and St. Paul, Iowa division of Illinois Central, Sioux City and Pacific, and Dakota Southern R. Rs., contains several churches, excellent schools, 3 banks, 1 daily and 3 weekly newspapers, foundry and machine-shops, elevator, jobbing-houses, mills, pork-packing houses, an opera-house, water and gas works, and an efficient fire department. P. of v. 3401; of tp. 800.
PERKINS BROS., EDS. "DAILY JOURNAL."

Sioux Falls, p.-v., cap. of Minnehaha co., Dakota Ter., 100 miles N. of Sioux City, Ia., has 1 bank, 2 newspapers, U. S. land-office, a brewery, 2 flouring-mills, and 3 hotels. Sioux River falls 110 feet in half a mile, forming a fine water power. W. F. KITER, ED. "PANTAGRAPH."

Sioux Indians. See DAKOTA INDIANS.

Sioux Rapids, p.-v., cap. of Buena Vista co., Ia., on Sioux River, has 1 bank, good schools, 1 newspaper, a saw and grist mill, and 2 hotels. Business, farming and stock-raising. P. 61. D. C. & W. R. THOMAS, EDS. "ECHO."

Siphon [Gr. σιφων, a "reed"], in hydraulics, a bent tube, one leg of which is longer than the other. The shorter leg being plunged in a liquid, and the air exhausted, the liquid will flow from a higher to a *lower* level *over an obstacle*, provided the height be not more than that of the fluid column the atmosphere can support above the higher level. From its ordinary use for decanting wines, etc., a great stride is made to apply it to engineering purposes, as (*e. g.*) Sir John Hawkshaw applied it in consequence of the failure of a sluice at the "Middle Level Drainage," Lincolnshire, Eng. (See *C. E. & A.*, July, 1863.) J. G. BARNARD.

Siphonia. See EUPHORBIACEÆ, and INDIA-RUBBER, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Siphonognath'idæ [from *Siphonognathus*—Gr. σίφων, "tube," and γναθος, "jaw"—the typical genus], a family of fishes of the order Teleocephali and sub-order Acanthopteri, related to the Labridæ. The body is very elongate; the scales cycloid; the lateral line uninterrupted; the head elongate, and the facial bones produced into a tube much longer than the postocular portion; the opercula unarmed; the mouth terminal and cleft laterally, but remote from the eyes; the upper jaw non-protractile; maxillaries weak; teeth absent from the jaws and palate; branchial apertures continuous below; branchiostegal rays four on each side; dorsal fin very elongate, with its spinous portion rather larger than the soft; anal much shorter than the soft portion of the dorsal; caudal distinct; pectorals with branched rays; ventrals wanting. The vertebræ are in large number, there being about 29 or 30 abdominal or costiferous ones alone; the intestinal canal is straight and simple, without a well-defined stomach, and there are no pyloric cæca. The family has been formed for the reception of a peculiar fish (*Siphonognathus argyrophanes*), known only from King George's Sound. It was regarded by its original describer, Sir John Richardson, in 1857, as being a member of the family Aulostomidæ, but by Dr. A. Günther it was afterward referred to the Labridæ; its peculiarities, however, appear to fully entitle it to differentiation as a well-marked family. The specimens obtained measured about sixteen or seventeen inches in length. THEODORE GILL.

Sipunculoi'dea, an order of animal organisms of which *Sipunculus* is the typical genus. It is by some referred to the echinoderms, and by others to the annelides. Its species are worm-like in form, habits, and appearance, but possess decidedly radiate characters; and the whole order may be considered intermediate between the two sub-kingdoms to which it has been assigned. Some of the species are edible.

Sir Darya. See JAXARTES.

Si'redon [abridged from σειρήν, "siren," and ὀδούς, "tooth"], a name given by Wagler to the axolotl of Mexico. At one time it was supposed that this type was a very distinct genus and a true perennibranchiate amphibian. The resemblance to the larvæ of species of *Amblystoma* of the U. S. had, however, been noticed, and it was even suggested by Prof. Baird that it was nothing but a larval form. The fact, nevertheless, that it bred with gills was supposed to contradict this view. But the researches of A. Dumeril on the Mexican form amply demonstrated that the species, under favorable circumstances, develops into a true *Amblystoma*, and analogous observations by Prof. Marsh on a North American species confirmed his observations. (See also AXOLOTL.) THEODORE GILL.

Si'ren [named from the SIRENS (which see) by Linnæus, on account of the incorrect belief that it has a singing voice], a remarkable genus of perennibranchiate tailed batrachians of the Southern U. S. The best-known species is the *Sirens lacertina*, or mud-eel, of the Carolina rice-swamps. It has two weak fore legs, permanent gill-tufts, as well as lungs, is two feet long, and of a black color. It is considered venomous by the negroes. *S. intermedia* and *S. striata* are smaller sirens of the same regions.

Sirene. See ACOUSTICS, by PROF. O. N. ROOD, A. M.

Sire'nia [from the ancient name *siren*, given in this case because it is supposable that the dugong, one of the representatives of this order, may have suggested the idea of the fabulous siren], an order of mammals containing species adapted for habitual life and progression in the water, but less modified from ordinary mammals than the order of cetaceans. The form is fish-like—*i. e.* elongated—subfusiform, tapering backward, terminating in a fin (which, as in the cetaceans, is horizontal), and destitute of hind limbs; the snout is beset with bristles. The brain essentially resembles that of the hoofed and carnivorous mammals, as well as of the apes and man and the cetaceans, especially in the extension of the corpus callosum and small size of the anterior commissure; but is notable for the compression and elevation of the cerebrum, the upturned bulbous olfactory nerves, and the small size, or rather depression, of the cerebellum, which, however, is only partially covered by the cerebrum. The order contrasts with the cetaceans in the following characters: The skull has the foramen magnum posterior and directed somewhat downward; the supra-occipital is nearly vertical, and extends little forward, the parietals meeting and completely separating it from the frontals; the periotic has its posterior part irregularly rounded, and the tympanic is annuliform; the lower jaw has well-developed ascending rami, and normal transverse condyle and coronoid processes; molar teeth, adapted for the trituration of herbage, are in the sides of both jaws; the neck is moderate, and the second vertebra has a distinct odontoid process; the anterior members are moderately long and flexed at the elbows; the carpal bones are normally developed, and contiguous *inter se* and with the proximal phalanges; the digits are also distinctly developed; the mammæ are pectoral, as in man and monkeys; the heart deeply fissured between the ventricles. The species are all herbivorous, and feed upon the vegetation growing on the banks of estuaries and rivers, as well as sea-weed. In a state of captivity, according to Dr. Chapman, manatees eat "freely of cabbage, spinach, kale, baked apples, celery-tops, etc." When feeding they fan, "as it were, the food into their mouths by means of the bristles situated on their upper and lower lips; these bristles spreading out when in use so as to look very much like small fans." When at rest they remain upraised from the bottom of the water by their tail, but with the head downward, and the back consequently arched; at intervals of about one minute to one minute and a quarter they rise to breathe, and the valves of the nose open and shut as they come to the surface and go downward again. The order is now represented by two families—Trichechidæ, including the manatees, and Halicoridæ, containing the dugongs. Up to within a century a third family (Rhytinidæ) existed in the North Pacific (Behring's Sea), but its only living species was in a short time exterminated by the attacks of man. The earliest extinct representatives of the order yet known are of Eocene age, and then and since several peculiar forms flourished and died out.
THEODORE GILL.

Siren'idæ [from *siren*—the name of the ancient enchantresses applied without evident reason—the typical genus], a family of urodele or gradient amphibians confined to the U. S., and constituting the sub-order Trachystomata. (See GRADIENTIA.) The body is very elongate and eel-like; the anus in or near the posterior third of the length; the head elongate, narrowed forward from the cheeks, and truncate in front; branchial tufts three, connected with three branchial apertures; anterior feet only developed, and they very weak and with three or four toes. Such are the external characters by which the species are at once recognizable. As the osteological characters are given under the sub-ordinal head, they need not be repeated here; suffice it to add that the characters generally indicate a low or embryonic type of organization, and such as is exemplified in the young of salamanders or those of inferior grade, so far as they go. Thus, the vertebræ are biconcave, the carpus cartilaginous, etc. They are also notable for the large size of their blood-corpuscles. The species are confined to the Southern States of the Union, and, according to Cope, are reducible to two, which, however, represent as many distinct genera. The *Siren lacertina* is distinguished by the development of four digits to its feet, and

sometimes attains a length of nearly three feet; it extends from North Carolina and Southern Illinois to Florida and Northern Mexico. The *Pseudobranchus striatus* is recognizable by the presence of only three toes to the feet; it rarely attains a length of much more than half a foot, and has hitherto been only found in Georgia. Both species live habitually in the water and in muddy or sandy bottoms. They feed on worms, etc. The *Siren lacertina* is called mud-eel, and is much dreaded, as it is supposed, but without any real cause, to be very venomous. THEO. GILL.

Sirenoi'dei [from *Siren*, the generic name of a genus of amphibians, and εἶδος, "like," from the fancied resemblance of its species to that type], an order formerly supposed by some naturalists to belong to the class of amphibians, and most nearly related to the sirens, but now universally conceded to be members of the class of fishes. In this class they are by some considered to be the representatives of a distinct sub-class (Dipnoi), and by others to be aberrant members of the sub-class of ganoids. The superordinal characters are given in the article FISH. The order connects, to some extent, the amphibians and fishes —*i. e.* it has generalized characters which are elsewise peculiar either to the former or latter. It was formerly, in the Palæozoic and Secondary epochs, a predominant type of its class, but is now represented by only three genera, which represent two families. (See LEPIDOSIREN and LEPIDOSIRENIDÆ.) THEODORE GILL.

Si'rens, The [Gr. αἱ Σειρῆνες], in the Greek mythology, were three, or according to others two, females who were wont to sit upon the seashore and by their delightful song allure to destruction the passing mariners. Their myth is variously told, and their names are variously given. Several places were considered as their abode, commonly the S. W. or western coast of Italy, and at some places they received divine honors. The Sirens are the mermaids of more recent folk-lore.

Sirikul'. (1) A lake situated at an elevation of 15,600 feet in the Tameer plateau, whence issues the northern arm of the Amoo Darya. The direct but difficult road to Kashgar leads along its shore, while the crossing from the valley of the Amoo Darya to that of the Tameer takes place along the southern arm of the Amoo Darya by the Tameer or Barkoot Yassin lake, situated at an elevation of 13,300 feet. (2) A district extending along the eastern foot of the Tameer steppes, below the Lake of Sirikul, at an elevation of 11,000 feet. The principal city is Tashkoorgan, the *Lithinum pyrgum* of the ancients, whose merchants passed it on their way through Toorfan, the *Sera* of Ptolemy, to China. The district formed an independent state up to the end of 1868, when the ruler of Kashgar took possession of the country. E. SCHLAGINTWEIT.

Sir'ius [Gr. σείριος, "scorching"], the dog star, a star of *Canis major*, one of the brightest stars visible in the northern hemisphere. The ancients often speak of its ruddy color, which is no longer perceptible. It was formerly believed to exercise a powerful and, to some extent, a baleful influence upon human affairs.

Sir John's Run, p.-v., Morgan co., West Va., on Potomac River and Baltimore and Ohio R. R.

Siroc'co [Arab. *shoruk*], a hot, relaxing wind which rises in the Sahara, then blows across the Mediterranean, where it occasionally becomes filled with moisture, and finally over Sicily, Southern Italy, Malta, etc. It generally occurs in spring and autumn, lasts for one or two days, though sometimes for a whole week, and is very pernicious to both vegetable and animal life, causing general exhaustion, great prostration, and depression of all mental energy.

Sisal' Hemp, the fibre of various species of AGAVE (which see). Sisal hemp is produced in considerable quantities in Yucatan and at Key West, Fla. It makes excellent cordage, superior to that of true hemp, but it is chiefly made into hammocks of great strength and durability, known as Sisal hammocks.

Sis'co, or Cisco, a name given to several species of the genus *Argyrosomus* (sub-family Coregoninæ) in the Northern U. S. The principal species are the *A. clupeiformis* (also called "herring") of Lake Ontario, and the *A. Hoyi* of the deep waters of Lake Michigan. They are recognizable by their herring-like form, terminal mouth, with the lower jaw longest, short intermaxillary bones, and the long and narrow suborbital bones. They are small-sized fishes, rarely weighing as much as a pound. The *A. clupeiformis* is found in all the great lakes, and inhabits the shoaler waters. It is in some places excessively abundant. It is but little esteemed for the table, but when cured in a certain manner is very good; this curing is effected by a slight pickling in salt brine, and subsequent exposure to the smoke of a hot fire for a short time; it is thus ready for eating, and will keep for two or three weeks. The *A. Hoyi* is confined, so far as known, to Lake Michigan, and dwells in the deeper waters—*i. e.* depths from 30 to 70 fathoms. It is quite abundant in its favorite localities. It is caught in considerable quantities.
THEODORE GILL.

Sis'cowet, Siskowit, or **Siskawitz** [Indian], (*Salmo siscowet*, Agassiz), a species of lake trout, and an important element in the lake fisheries. It is a stout fish, the height being equal to about a fifth of the length; the head forms a fourth of the length, exclusive of the caudal; the preoperculum is long, of the form of a very opened crescent, placed almost vertically; its posterior margin is attenuate and entire; its lower branch is more extended than the upper; the operculum, of greater height than breadth, is large and notched at the summit, but without prominent processes on the rest of its circumference, which is irregularly circular; the posterior middle part, however, has a tendency to make a projection; the lower margin is denticulate; the suboperculum is one-third smaller than the operculum, irregularly elliptical, pointed at the summit, with an ascending ridge in the form of a fish-hook at its articulation; finally, the operculum has the form of a long square, curved on the posterior side; its height is contained twice in its length (*Agassiz*); B. 13, D. 12, A. 12–14, P. 14, V. 9. "The color varies according to the feeding-ground on which it is caught, and is brighter during the breeding-season, as is generally the case among all species of this family." The species is characteristic of Lake Superior, and was first made known by Prof. Agassiz in 1850. It is an inhabitant of the deep water of the lakes. It never reaches the large dimensions of the great lake-trout or salmon (*Salmo namaycush*), and averages about four and a half pounds in weight, eight pounds being near its maximum; it becomes extremely fat. The flesh is of a very light reddish tint. As a fresh fish it is quite inferior, but "as a salt fish, packed in brine, it is most excellent, and is universally admitted to surpass either whitefish or trout." (*Milner.*) It spawns comparatively early—*i. e.* in the latter part of August and September—and in the deep water, not ascending rivers. THEODORE GILL.

Sisen'na (L. CORNELIUS), b. B. C. 119; was prætor B. C. 78; defended Verres in 70, and d. B. C. 67 in Crete, being at the time legate of Pompey in the war with the pirates. Having been an actor in public affairs, he was well fitted to relate the events of his own time (including the Social war and the civil wars of Sulla) in his work entitled *Historiæ*, written in an archaic style. Cicero says of him (in his book on *Laws*) that he surpassed all previous Latin historians, and Sallust highly praises his diligence. Sisenna wrote also commentaries on several comedies of Plautus, and translated into Latin the Milesian tales (Μιλησιακά) of Aristides. Only fragments of the *Historiæ* remain, collected by Krause in *Hist. Roman. Fragmenta*, p. 303–317. (Krause, Teuffel, *Hist. Rom. Lit.*) H. DRISLER.

Sis'kin [Dan. *sisgen*], or **Aberderine** (*Chrysomitris spinus*), a bird of the family Fringillidæ, congeneric with the yellow or thistle bird of the U. S. (*Chrysomitris tristis*). The male has a black crown and nape, is olive-green on the neck and back, varied with blackish and yellowish green beneath; its throat is black; its length is about four and a half inches. It is esteemed in Europe as a cage-bird, and is susceptible of considerable training. It is often paired with the canary-bird, and the resulting hybrid is quite a fine songster. THEODORE GILL.

Sis'kiyou (sis'e-kew), county of N. California, adjoining Oregon, intersected by Klamath River, and crossed from E. to W. by a transverse range of mountains connecting the Sierra Nevada with the Coast Range. Mount Shasta, its majestic culminating peak, the highest in the State, is an extinct volcano, 14,442 feet in height, covered with perpetual snow. The cultivable lands of the county are chiefly in Scott's Valley, 40 miles long, at the base of Shasta. Staples, wheat, oats, hay, barley, butter, and wool. Cattle and sheep are numerous. Cap. Yreka. Area, about 3000 sq. m. P. 6848.

Sismon'di, de (JEAN CHARLES LÉONARD SIMONDE), b. at Geneva May 9, 1773; educated in the college of his native town, and was a clerk in a large counting-house in Lyons; accompanied in 1793 his family, which left Geneva on account of the political disturbances, to England, where he stayed for two years; returned in 1795, but fled again a short time after, and resided for several years at Pescia in Tuscany, where his father bought a farm; settled finally in his native town in 1800; devoted himself to studies and literary work, though at the same time participating very actively in politics; married in 1819 an English lady. D. at Geneva June 25, 1842. His first work was a treatise on political economy, *De la Richesse commerciale* (1803), based on the ideas of Adam Smith, which, however, he afterward

abandoned, and even opposed, in his *Nouveaux Principes d'Économie politique* (2 vols., 1819) and *Études sur les Sciences sociales* (3 vols., 1836). But his acquaintance with Madame de Staël, Benjamin Constant, Guizot, etc., turned his attention from political economy to history, and it was as an historian that he acquired his great celebrity. His *Histoire des Républiques italiennes du Moyen-âge* (16 vols.) appeared at Zurich in 1807–18; *La Littérature du Midi de l'Europe* (4 vols., 1813) was translated into English by Thomas Roscoe in 1823. Of his principal work, *Histoire des Français* (31 vols., 1821–44), he gave an abstract in 1839, *Précis de l'Histoire des Français* (2 vols.). He wrote in English, and contributed in 1832 and 1834 to the *Cabinet Cyclopædia* a *History of the Italian Republics* and *The Fall of the Roman Empire*. (See also *Sismondi, Fragments de son Journal et de sa Correspondance avec Mlle. de Sainte-Aulaire* (1863), and *Lettres inédites à Madame d'Albany* (1864.)

Sisor'idæ [from *Sisor*, the generic name of the type], a family of fishes of the order Nematognathi, approximated to the Loricariidæ, or mailed catfishes of South America. The body is elongate and depressed: the skin naked, save on the median line of the back (which has a row of bony plates) and the lateral line (which is rough); the head is depressed and spatulate; the usual opercular bones (except the suboperculum) developed; the nostrils close together; the mouth inferior and small; the intermaxillaries forming a crescent shaped upper lip; the maxillaries terminating in well-developed barbels; lower lip produced on each angle of the mouth into a long flap, reflected backward; teeth none; branchial apertures restricted to the sides, the branchiostegal membrane being confluent with the skin of the isthmus; branchiostegal rays four (or more?) on each side; dorsal fin short and anterior; anal small; caudal well developed; pectorals normal; ventrals below the dorsal. The typical form is *Sisor rhabdophorus*, an inhabitant of the fresh waters of Northern Bengal. With this have been associated certain other Indian genera—viz. *Erethistes* (= *Hora*), *Pseudecheneis*, and *Exostoma*—but the relations of these types are doubtful. THEODORE GILL.

Sis'son, tp., Howell co., Mo. P. 430.

Sisterhoods. See SISTERS OF CHARITY and SISTERS OF MERCY.

Sisters of Charity. Besides the congregations mentioned under the head CHARITY, SISTERS OF (which see), the following orders may be noticed: (1) *The Gray Nuns of Montreal*, found chiefly in Canada and the U. S.; were founded in 1745 by the widow D'Youville (1701–72); (2) *the Sisters of Charity of Nazareth*, founded in Kentucky in 1812 by Bishop David; have a few houses in the U. S.; (3) *Sisters of Charity of the Blessed Virgin*, founded in Philadelphia by T. C. Donaghoe, a priest; now found mostly in Iowa; (4) *the Sisters of Christian Charity* have a few representatives in the U. S.

Sisters of Mercy. See MERCY, SISTERS OF.

Sisters of the Holy Communion. See HOLY COMMUNION, SISTERS OF THE.

Sis'tersville, p.-v., Lincoln tp., Tyler co., West Va., on Ohio River. P. 364.

Sisto'va, town of European Turkey, eyalet of Widdin, on the Danube, has a strong citadel, some manufactures of leather and cotton, and an extensive trade, especially in wine. P. 20,000.

Sis'yphus, in Greek mythology, a son of Autolycus, the husband of Merope, reputed father of Odysseus by Anticlea, founder of Corinth and the Isthmian games, was condemned, on account of his crimes against men and gods, to roll up a steep hill a huge boulder, which, on reaching the summit, rolled down again, and thus made his task an endless one.

Sit'ka, or **New Archangel,** p.-v., cap. of Alaska Territory, on Baranov Island, near the Pacific coast, has a small but commodious harbor; was founded by the Russians in the eighteenth century, and was long the headquarters of the Russian-American Fur Company, but consisted, when transferred to the U. S. in 1867, of only about 100 log huts. Since that time several commodious edifices have been built, chiefly by San Francisco merchants, and the presence of a detachment of U. S. troops has contributed to the prosperity of the village. P. about 1000.

Siva. See HINDU RELIGION, by PROF. JOHN DOWSON.

Si'vas [anc. *Sebasteia*], town of Asiatic Turkey, eyalet of Sivas, in a barren, treeless valley on the Kizil-Irmak, the ancient *Halys*, in lat. 39° 28′ N., lon. 37° E. It consists of dirty streets, and is surrounded with ruins; its manufactures, trade, and bazaars are insignificant, and the whole place is decaying. P. about 25,000.

Sivatheri'idæ [*Sivatherium*—from *Siva*, an Indian deity, and θηριον, "wild beast"—the typical genus], an extinct family of mammals of the order Ungulata and group Ruminantia, distinguished by the singular armature of the head. The form was rather heavy—*i. e.* resembling that of an ox more than that of a deer or antelope; the neck moderate; the metacarpals and, to a less extent, the metatarsals shortened; the skull broad behind, contracted in front of the molars forward, with the facial portion produced downward and abbreviated, and with the nasal bones abbreviated and longitudinally arched; molar teeth (M. $\frac{3}{3}$, P. M. $\frac{3}{3}$) broad, with inner crescentic plates of enamel running zigzag in large sinuous flexures; horns in the males in two pairs—*i. e.* frontal and occipital: these are supposed by Murie to have been deciduous, and peculiar to the rutting season, and developed as pseudo-corneous sheaths composed of agglutinated hairs, as in the American Antilocapridæ. The family is represented by a single known species, the *Sivatherium giganteum* of Falconer and Cautley, whose remains have been found in the Miocene rocks of the Siwalik Hills, a branch of the sub-Himalayan Mountains. (See the figure in the article GEOLOGY from a restoration by Murie in the *Geological Magazine* for Oct., 1871.) THEODORE GILL.

Sivathe'rium [from *Siva*, the Hindoo god, and θηρίον, a "beast"], an extinct genus of ruminating animals from the Siwalik Hills, India, remarkable for their large size and peculiar horns. *S. giganteum* nearly equalled the elephant in size, and was armed with two pairs of horns, a small pair springing from the anterior part of the head, and a much larger pair from the top of the head. The bony cores of these horns, the only part preserved in the fossil state, show that these animals belonged to the hollow-horned type of ruminants. The front pair were divergent, apparently nearly straight, and simple. The posterior pair were branching, and had at least three points. The American antelope or prong-buck is the only living hollow-horned ruminant with branching horns. It is also the only one known to shed its horns periodically. The posterior horns of *Sivatherium* seem to have closely resembled in structure those of the prong-buck, and may have been, like them, deciduous. The bones of the skeleton of *Sivatherium* were massive, like those of oxen. The neck was strong for the support of the heavy skull. The nose was probably more or less movable, as evinced by the short projecting nasals. Falconer and Cautley supposed the animal to have possessed a true proboscis, but Dr. Murie concludes, from a study of the remains and a comparison with allied forms, that the nose was similar to that of the saiga of Tartary, and he thus figures it in his restoration of the *Sivatherium* in the *Geological Magazine*, Oct., 1871. O. C. MARSH.

Si'wah [the ancient *Ammon* or *Ammonium*], an oasis in North-western Egypt, 360 miles W. of Cairo, and 160 miles S. of the Mediterranean. The eastern part of the oasis is very fertile and rich in springs; in the northern part some limestone hills are found. In ancient times the place was celebrated as the seat of the temple of Jupiter Ammon, of which remains are still extant, and of the Fountain of the Sun, whose waters were cold at noon and hot at midnight. The temple was immensely rich and guarded by strong fortifications. Cambyses attempted in vain to capture it. Alexander visited it, and was hailed by the priests as a son of the god. The emperor Justinian built a Christian church here. At present the oasis is inhabited by about 8000 Berbers and negroes, who profess Mohammedanism, speak a peculiar dialect much mixed up with Arabic, and are governed by elders. The town of Siwah is in lat. 29° 12′ N., lon. 25° 30′ E., near the site of the ancient temple.

Six Mile, p.-v. and tp., Bibb co., Ala. P. 709.

Six Mile, tp., Franklin co., Ark. P. 880.

Six Nations. See IROQUOIS.

Six-Principle Baptists, a sect of American Christians who take as their creed the six principles laid down in Heb. vi. 1, 2, viz.: (1) repentance, (2) faith, (3) baptisms (of repentance, of fire, and of Christ's sufferings), (4) laying on of hands, (5) the resurrection, (6) the eternal judgment. They especially insist upon the laying on of hands, and refuse to commune with those who do not practise it. They are Arminians, and neither educate nor adequately support their ministry. They are found in Rhode Island, Massachusetts, New York, and Pennsylvania. They were first organized in 1639 in Rhode Island, and have never been numerous. They number some 3000 communicants.

Six Pound, tp., Warren co., N. C. P. 930.

Sixth, in music, an interval comprising five degrees of the diatonic scale. (See INTERVAL.)

Six'tus, the name of five popes—SIXTUS I. (119?–128?), SIXTUS II. (257?–258), SIXTUS III. (432–440), SIXTUS IV.

(1471–84). But most remarkable of all was SIXTUS V. (1585–90), b. at Grotto-a-Mare, near Montalto, Dec. 15, 1521; entered the order of the Franciscans in 1534; became a teacher of canon law at Rimini in 1544 and at Siena in 1546; was ordained a priest in 1548; and acquired great reputation as a preacher at Rome in 1551 and at Venice in 1566; was employed in various diplomatic missions, and became a cardinal in 1570. Arrived at this point, his ambition seemed to go no further. He was not anxious either to exercise influence on the papal government or to procure lucrative positions for his relatives. He lived quietly, and made the impression of being a man easy to lead. After the death of Gregory XIII. (1585) he was unanimously elected pope, but hardly was the result of the election pronounced before he threw aside the stick with which he had been wont to grope along, and stepped forward among the astonished cardinals, no more concealing the power and authority of his character. In all theological controversies he was cautious and tried to remain neutral, but in the discipline of the Church he introduced reforms and prepared a thorough reformation. His great idea was to raise the papal see once more to its former splendor, and although his negotiations with the emperor Rudolph II. of Germany and Stephen Báthori, king of Hungary, led to no permanent result, they show his ambition and his talent. The celebrated aqueduct, *Acqua Felice*, the great dome of St. Peter's church, the obelisk in front of this church, the foundation of the Vatican library, etc., are monuments of his internal government. He d. suddenly at Rome Aug. 24, 1590.

Sizemore's, tp., Sanford co., Ala. P. 242.

Sizes of Books. See PRINTING, by W. S. PATERSON.

Skagerrak′, or **Skager-Rack,** an arm of the North Sea, 80 miles broad, extending between Norway and the Danish peninsula of Jutland, and connecting the German Ocean with the Cattegat or Kattegat. The current generally sets E. along the coast of Jutland, where the depth varies between 30 and 40 fathoms, and W. along the Norwegian coast, where the depth generally is 200 fathoms. There is neither haven nor good anchorage on the Jutland, but good harbors abound on the opposite coast.

Ska′litz, or **Szakoleza,** town of North-western Hungary, near the Moravian frontier, on the March, has some wool-spinning and weaving factories and a trade in wine and hemp. P. 5882.

Skama′nia, county of Washington Territory, N. of Columbia River, bounded E. by the Cascade Mountains, and traversed by spurs of the same range, in one of which is Mount St. Helens, 9750 feet high. Cap. Cascades. Area, 1800 sq. m. P. 133.

Skaneat′eles, p.-v. and tp., Onondaga co., N. Y., on New York Central and Hudson River R. Rs., 18 miles S. W. of Syracuse, at the N. end of Skaneateles Lake, has 6 churches, good schools, 2 banks, 2 newspapers, a commodious hotel, 1 flour-mill, and manufactories of carriages, printing paper, woollen goods, hydraulic lime, and merchant iron. Large quantities of the teasel-plant are grown here. It is a favorite summer resort. Pop. of v. 1409; of tp. 4524. H. B. DODGE, ED. "DEMOCRAT."

Skate, a name given to species of the family RAIIDÆ (which see).

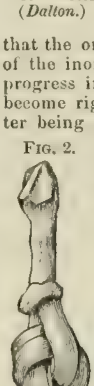
Skeat (WALTER WILLIAM), b. in London, England, Nov. 21, 1835; educated at King's College School and at Sir R. Cholmeley's school, Highgate; graduated at Christ's College, Cambridge, as fourteenth wrangler 1858; became a fellow of that college July, 1860; took orders in the Church of England; obtained the curacy of East Dereham, Norfolk, Dec., 1860, and that of Godalming, Surrey, Dec., 1862; became lecturer on mathematics at Christ's College Oct., 1864, and subsequently English lecturer; is a diligent student of early English literature and philology; a prominent member of the Philological and the Early English Text societies, for which he edited several publications; was in 1873 one of the founders of the English Dialect Society, of which he is director and responsible editor. He has published *The Songs and Ballads of Uhland* (1864), *A Tale of Ludlow Castle*, a poem (1866), *Lancelot of the Laik, a Scotch Metrical Romance* (1865), *Parallel Extracts from 29 MSS. of Piers the Plowman* (1866), *The Romans of Partenay or Lusignan, otherwise known as the Tale of Melusine* (1866), *Pierce the Ploughman's Crede* (1867), *The Vision of William concerning Piers the Plowman* (3 parts, 1867–73), *The Romance of William of Palerne, or William and the Werwolf* (1867), *The Lay of Havelok the Dane* (1868), *The Bruce, by Master John Barbour* (part i. 1870), *Joseph of Aramathie, or the Romance of the Seint Graal* (1871), and Chaucer's *Treatise on the Astrolabe*, the ten latter being publications of the Early English Text Society, for several of which he prepared introductions, notes, and glossarial indexes. For the Philological Society he edited a *Mœso-Gothic Glossary* (1868), for the Oxford University Press 2 vols. of *Specimens of English Literature* and several of Chaucer's *Canterbury Tales*, and is now completing for the Cambridge University Press the *variorum* edition of the *Anglo-Saxon Gospels*, left unfinished by the late John Mitchell Kemble (Mark and Luke, 2 vols., 1875). In a new edition of Chatterton's *Poems* he settled the question of authenticity by showing the precise sources of Chatterton's diction; is author of a *Hand-List of some Cognate Words in English, Latin, and Greek* (1871), *Questions for Examination in English Literature* (1873), and is editing *Shakspeare's Plutarch* (vol., i. 1875).

Skel′eton [Gr. σκέλλειν, to "dry"], the osseous framework of the body of animals, the articulated bones. The human skeleton commences to develop in early embryonic life by the appearance of points of ossific matter, which soon assume definite forms, the bones of the spinal column, head, extremities, thoracic walls, and pelvis (Fig. 1). At birth all the bones are fully shaped, but many imperfectly ossified, many osseous nuclei appearing between birth and the fourth year, some few later, and the bony union of the shafts of the long bones with their epiphyses or heads occurring as late as the fifteenth, eighteenth, and twentieth years. The skeleton in infancy and childhood is elastic, due in part to cartilaginous structure near the articulations, but chiefly that the organic constituents of bone are largely in excess of the inorganic or mineral constituents. Reversely, with progress in age, the bones and the skeleton as a whole become rigid, unyielding, non-elastic, mineral ossific matter being greatly in excess, so that in old age the bones are brittle and liable to fracture from slight injuries. The organic matter in bones of adults forms about one-third, the inorganic two-thirds. The former is chiefly gelatine (Fig. 2); the latter includes 51 per cent. of phosphate of lime, 11½ per cent. of carbonate of lime, and from 1 to 2 per cent. each of chloride of sodium, phosphate of magnesia, and fluoride of calcium. In minute structure bone is not solid, but constructed to secure the greatest strength with the least possible weight. A microscopic section of bone reveals a methodical arrangement of bone-tissue around minute internal canals and cavities, the Haversian canals, canaliculi, and lacunæ. (See diagrams of bone in article on HISTOLOGY.) The bones are classified according to their shape, into the (1) long bones, (2) short bones, (3) flat bones; the office of each being quite distinct. The long bones, as of the leg and arm, are intended to sustain weight or force as in traction, and to serve as powerful levers, acted upon by the muscles in the performance of locomotion and manual labor. The short bones, as of the wrist and ankle, serve to facilitate motion, unite compactness with strength, and add grace in form and motion. The flat bones, as of the flat bones of the head, the ribs, and pelvic bones, serve primarily to protect the important organs which they enclose—the brain, heart, lungs, bladder, and uterus—and also as fixed points of muscular origin and attachment. Other bones, as the vertebræ and bones at the base of the skull, are to be classed as mixed or irregular bones, and serve chiefly a passive object—to sustain weight and pressure and give form. The entire skeleton of the adult consists of 204 distinct bones; if the teeth and certain accessory bones, termed sesamoid, are included, the number is 246. The bones are covered by a thin, adherent, fibrous sheath, the periosteum, which contains the nutrient vessels; other vessels pass through foramina, or minute apertures, to the interior of the bone, nourishing the interior structure, which varies with the

FIG. 1.

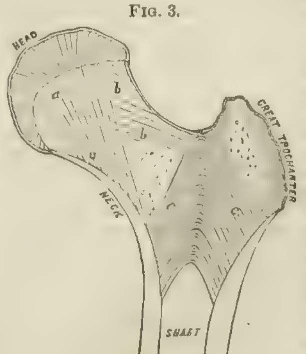
Human embryo at 1 month: points of ossification. (*Dalton.*)

FIG. 2.



A bone deprived of its mineral matter by maceration in dilute acid, and tied in a knot, showing the pliability of the organic matter. (*Dalton.*)

FIG. 3.



Section of head, neck, and part of shaft of thigh-bone (femur).

shape and office of the bone. Thus, the long bones are essentially hollow cylinders, a structure giving greatest strength and elasticity with least material and weight. The bones of the cranium also consist of an outer and inner tablet, with interposed cancellated or spongy bone-structure. The short and flat bones are composed of spongy structure throughout, with a very thin capsule or shell of compact bone. The head of the femur (thigh-bone, Fig. 3) illustrates the distribution and direction of the strata of bone-structure with reference to the forces and offices which are to be sustained. The growth of the bones in childhood, and their healthy condition in the adult, demand a nutritious mixed animal and vegetable diet, rich in phosphates and carbonates, as well as albuminoid matter. The diseases of the bones are many; many due to defective nutrition, as rickets, mollities ossium, fragilitas ossium; others the result of general constitutional disease or local pathological changes in bones—syphilitic, tubercular, and cancerous growths in bone, periostitis, abscess, necrosis, caries, atrophy, mercurial and phosphorous poisoning of bone. (See OSTEOLOGY.)

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Skel'ton, tp., Warrick co., Ind. P. 1330.

Skel'ton (JOHN), b. probably in Norfolk, England, about 1455; graduated at Cambridge about 1482; was laureated at Oxford University about 1490; was ordained deacon 1498 and priest 1499; was tutor to Prince Henry (afterward Henry VIII.); held a nondescript position at court, by some considered equivalent to king's jester, by others to poet-laureate (which latter had not yet become a distinctly-recognized office); became rector of Diss, Norfolk, and curate of Trompington, Cambridge, 1504; subsequently became "royal orator;" was suspended from his benefice by the bishop of Norwich, having concealed the fact of his marriage; incurred the resentment of his former patron, Cardinal Wolsey, by his satirical verses; was obliged to take sanctuary at Westminster, and d. there June 21, 1529. Skelton was one of the earliest English poets whose writings are easily intelligible to modern readers. Most of his verses are coarse, but were highly esteemed by Erasmus and the wits of the day. His best-known poems are *Philip Sparrow* and *Colin Clout*; he also enjoyed fame as a writer of Latin epigrams. The only good edition of his complete *Works* is that of Rev. Alexander Dyce (2 vols., 1843).

Skene (PHILIP), b. in Scotland about 1720; entered the British army 1739; served in the taking of Portobello and Cartagena in South America, at the battles of Fontenoy and Culloden, and in the American campaigns against Ticonderoga and Havana; made in 1765 a settlement at Wood Creek and South Bay, at the head of Lake Champlain, N. Y., which was afterward called Skenesborough; was arrested as a loyalist at Philadelphia June, 1775, exchanged Oct., 1776; accompanied Burgoyne in his invasion of Northern New York; was taken prisoner at Saratoga; was attainted by the legislature of New York 1779, his estate being confiscated; resided for the remainder of his life in England. D. near Stoke Goldington, Bucks, Oct. 9, 1810.

Skene (WILLIAM FORBES), LL.D., b. at Peverie, Kincardineshire, Scotland, June 7, 1809; educated at the High School and University of Edinburgh, also at that of St. Andrew's, and in Germany; became a lawyer, a distinguished archæologist, and officer of several learned societies. Author of *The Highlanders of Scotland, their Origin, History, and Antiquities* (2 vols., 1837), and editor of *The Dean of Lismore's Book, a Selection of Ancient Gaelic Poetry* (1861), *Chronicles of the Picts and Scots and other Early Memorials of Scottish History* (1868), *The Four Ancient Books of Wales* (2 vols., 1869), *The Coronation Stone* (1869), and *John of Fordun's Chronicles of the Scottish Nation* (2 vols., 1871).

Skepticism. See SCEPTICISM, by W. T. HARRIS, LL.D.

Sker'ryvore, a rock, or rather reef, in the sea about 30 miles W. of the isles of Iona and Mull and 11 miles S. W. of Tyree Island (W. coast of Scotland); lat. 56° 19', lon. 7° 7'. Its name is known in connection with its lighthouse. (See LIGHTHOUSE CONSTRUCTION.) The word *skerries* is applied generally in Scotland to isolated seagirt rocks.

Skim'mer, an English appellation of the birds of the family Laridæ, sub-family Rhynchopsinæ, and genus *Rhynchops*. (See RHYNCHOPSINÆ.)

Skin. See HISTOLOGY, by COL. J. J. WOODWARD, M. D.

Skin, Chemistry of. Animal skins consist mainly of elastine or KERATINE (which see), and a tissue which with hot water yields a solution of GELATINE (which see). It is the latter which combines with tannic acid in the conversion of the skin into leather. Skins are not always tanned, but for some uses are dressed in other ways. The aborigines of America are said to use for dressing dried buffalo skins the brains and marrow of the animal. Skins for gloves are treated with alum, and afterward with yelk of egg. Such so-called glove-leather is therefore still readily altered by water, acting upon the gelatine. (See also LEATHER.) H. WURTZ.

Skin Diseases. See APPENDIX.

Skink, the English name applied to lizards of the family SCINCIDÆ (which see.)

Skin-Moths, a name sometimes given to beetles of the family Dermestidæ, which attack skins. They are small insects (about a quarter of an inch or less in length) of dark color, and sometimes commit great ravages in collections of skins and museums. The most notable species are (1) *Dermestes lardarius*, (2) *Dermestes vulpinus*, and (3) *Anthrenus museorum*. (1) The first is for the most part blackish, but the bases of the elytra are ashy or gray buff, relieved by two or three black spots. Both in the imago and larva stages it is very destructive. (2) The second is totally black above, but the sides of the thorax and the under part of the body are covered with white scales. It is less common and generally distributed than the preceding, but almost equally to be dreaded. Some twenty-five or thirty years ago the larvæ committed great ravages in furriers' stores in London, and a large reward was offered for an antidote to their attacks. Both the preceding attain about a quarter of an inch in length. (3) The third species has transverse waved lines. It is often very destructive to museum specimens, and especially to collections of pinned insects. It is only about a tenth of an inch in length. All these species may be killed by applications of benzene; and this remedy is perhaps the most efficacious, although camphor and turpentine are also used. Specimens for museums should be prepared for resistance to the attacks of these pests by applications of arsenic, carbolic acid, corrosive sublimate, and benzene. THEODORE GILL.

Skin'ner (CORTLANDT), b. in New Jersey in 1728; received a good education; became a prominent lawyer; was royal attorney-general of New Jersey 1775; was an active loyalist ("Tory"); raised three battalions of New Jersey volunteers for service against his countrymen; went to England at the peace and received compensation from the British government for his losses through his adherence to the royal cause. D. at Bristol, England, in 1799.—His son, PHILIP KEARNEY, b. at Amboy, N. J., served in a loyalist battalion, and was afterward distinguished in the East and West Indies and in Spain, becoming a lieutenant-general. D. at London Apr. 9, 1826.

Skinner (EZEKIEL), M. D., b. at Glastenbury, Conn., June 27, 1777; was in youth a blacksmith's apprentice, but became a physician at Granville, Mass., 1801; removed to Lebanon, Conn., 1807; served both as a soldier and as a surgeon in the war of 1812–15; was licensed as a Baptist preacher at Stafford, Conn., 1819, and became pastor of a church at Ashford 1822. His son, Rev. Benjamin Rush Skinner, having gone to Liberia as a missionary in 1830, and died there in 1831, he proceeded to Africa to supply his place in 1834; became medical director of the colony; preached frequently, and acted for a time as governor. Returning to the U. S. 1838, he resumed his pastoral duties and his medical practice. D. at Greenport, L. I., Dec. 25, 1855.

Skinner (JOHN), b. at Balfour, Aberdeenshire, Scotland, Oct. 3, 1721; educated at Marischal College, Aberdeen; was minister to an Episcopal church at Longside for sixty-five years; was subjected to many trials from poverty and from his Jacobite sympathies; was an accomplished Hebrew, Greek, and Latin scholar, and author of several learned works on biblical antiquities and interpretation, but is best known as the author of many popular songs, one of which, *Tullochgorum*, is still widely known. D. at Aberdeen June 16, 1807.

Skinner (JOHN), b. in New Jersey about 1750; served as a loyalist in the Southern campaigns, attaining the command of a troop in Tarleton's Legion; subdued the revolt of the Maroons in Jamaica 1795; was engaged in the expedition against Surinam 1804; became major-general, and was successively governor of several British islands of the West Indies, having commanded a brigade at the capture of Guadaloupe, 1810. D. in England Oct. 10, 1827.

Skinner (JOHN STUART), b. in Maryland Feb. 12, 1788; was admitted to the bar 1809; settled at Baltimore 1813; was postmaster of that city 1822–37; began in 1819 the publication of the *American Farmer*, the first American periodical exclusively devoted to agriculture; afterward edited several other papers of similar character, including the *Turf Register* and *The Plough, Loom, and Anvil*; was the first organizer of agricultural shows and fairs in the Middle and Southern States; wrote several works on farm-

ing and sporting topics, and was third assistant postmaster-general 1841–45. D. at Baltimore Mar. 21, 1851.

Skinner (OTIS AINSWORTH), D. D., b. at Royalton, Vt., July 3, 1807; was for some time a school-teacher; became a Universalist preacher 1826; was settled as a pastor at Baltimore, Md., 1831, at Haverhill 1836, at Boston 1837, at New York 1846, again at Boston 1849, and became in 1857 president of Lombard University at Galesburg, Ill., preaching also at Elgin, and subsequently at Joliet 1858. He edited religious periodicals at Baltimore, Haverhill, and Boston; wrote several religious treatises, and was an active worker in behalf of education, temperance, and reform generally. D. at Napierville, Ill., Sept. 18, 1861. His *Life* was written by T. B. Thayer (1861).

Skinner (RICHARD), LL.D., b. at Litchfield, Conn., May 30, 1778; studied at the Litchfield Law School under Judge Reeve; was admitted to the bar 1801; settled at Manchester, Vt.; became known as the ablest lawyer in that State; was judge of probate for Bennington co. 1806–12; member of Congress 1813–15; associate judge 1815; chief justice of the supreme court 1816; Speaker of the assembly 1818; governor 1820–23; again chief-justice 1824–29; and was distinguished for benevolence and public spirit. D. at Manchester May 23, 1833.

Skinner (STEPHEN), M. D., b. in London, England, in 1623; graduated at Christ Church, Oxford, 1646; studied philology and medicine on the Continent, especially at Heidelberg; became a physician at Lincoln; was an earnest student of many languages, and devoted his life to the preparation of a vast work on English etymology, which he left incomplete at his death, which occurred at Lincoln Sept. 5, 1667. Fortunately, his MSS. fell into the hands of Thomas Henshaw, who edited them under the title *Etymologicon Linguæ Anglicanæ* (London, folio, 1671), a work of great value to the critical student of the English language.

Skinner (THOMAS HARVEY), D. D., LL.D., b. at Harvey's Neck, N. C., Mar. 7, 1791; graduated at Princeton 1809; studied law, and afterward theology; was co-pastor with Dr. Janeway of the Second Presbyterian (Arch street) church in Philadelphia 1813–16, and pastor of the Fifth Presbyterian church (first in Locust, and after 1823 in Arch street) 1816–32, with the exception of a few months in 1828, when he was over Pine street church in Boston, Mass.; professor of sacred rhetoric at Andover Theological Seminary 1832–35; pastor of Mercer street Presbyterian church, New York, 1835–48, and professor of sacred rhetoric and pastoral theology in Union Theological Seminary, N. Y., from 1848 to his death, Feb. 1, 1871. He published, besides many sermons and essays, *Religion of the Bible* (1839; republished in England 1848–51), *Aids to Preaching and Hearing* (1839; republished in England 1839–40), Vinet's *Pastoral Theology*, trans. (1854), Vinet's *Homiletics*, trans. (1854), *Discussions in Theology* (1868). (See *A Discourse in Memory of Dr. Skinner*, by George L. Prentiss, D. D. (1871).)

Skin'nersville, tp., Washington co., N. C. P. 868.

Skins, for furs. See FURS AND THE FUR-TRADE, by L. P. BROCKETT, A. M.

Skins, for leather. See LEATHER, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Skip'jack, a name given in the U. S. to several species of fishes very distinct from each other. (1) It is sometimes used, as in the Boston market, for the *Sarda pelamys*, a fish more generally known under the name BONITO (which see). (2) It is, along the coast of the Carolinas, given to the *Pomatomus saltatrix*, the bluefish of New York and tailor of Maryland and Virginia. (3) It is also sometimes applied to the *Scomberesox scutellatus*. These three fishes have no common characters, and it is impossible to realize how the same name has become perverted to such diverse forms. THEODORE GILL.

Skip'pack, p.-v., Montgomery co., Pa., 25 miles N. W. of Philadelphia, contains 1 church, a good school system, a public hall and lyceum, 1 newspaper (German), 2 carriage-factories, tin-ware establishment, a washing-machine factory, grist and flouring mills, 2 hotels, rod-iron fence manufactory, and 2 cigar-factories. Principal business, farming, dairying, and live-stock raising. P. about 400.
A. E. DAMBLY, ED. "DER NEUTRALIST."

Skip'per, a name applied in England to certain animals—viz. (1) to the *Scomberesox saurus*, a long, compressed, mackerel-like fish; and (2) to butterflies of the family Hesperiidæ, small dark-colored butterflies.

Skip'perville, p.-v., Dale co., Ala. P. 1720.

Skip'with's Land'ing, p.-v., Issaquena co., Miss., on Mississippi River, has 1 weekly newspaper.

Skir'ret, the *Sium sisarum*, an umbelliferous parsnip-like plant, a native of Asia, long cultivated in Europe, and rarely in the U. S., for its root, which is very nutritious and palatable. Skirret affords a good percentage of alcohol when distilled, owing to the large amount of sugar present.

Skittles. See NINE-PINS.

Skopin', town of Russia, government of Riazan, on the Verda, has 9 churches, many educational institutions, and large manufactures of Russian leather. P. 10,578.

Skowhe'gan, p.-v., cap. of Somerset co., Me., on Skowhegan branch of Maine Central R. R. and on Kennebec River, 100 miles N. E. of Portland, has 5 churches, good schools, 3 banks, 1 newspaper, a handsome courthouse, a woollen-mill, 3 axe-factories, oilcloth-factories, and 2 hotels. P. 3893. W. K. MOODY, ED. "REPORTER."

Skrzynec'ki (JAN BONCZA), b. Feb. 18, 1786, in Galicia; studied at Lemberg; entered the Polish army and fought under Napoleon. When the revolution broke out (Nov. 29, 1830) Skrzynecki was made a brigadier-general; distinguished himself in the battle of Grochow, and was appointed commander-in-chief Feb. 26, 1831. He repeatedly defeated the Russians, at Wawre, Dembe, Iganie, and the Narew, but owing to peculiar political or diplomatic circumstances he failed to pursue his victories. May 26, 1831, he was defeated at Ostrolenka, and compelled to retreat to Warsaw; Aug. 10 he was superseded by Dembinski, and after the capture of Warsaw he fled to Bohemia, where he lived for several years in Prague; in 1839 was appointed commander-in-chief of the Belgian army, but was compelled by the reclamations of Russia, Austria, and Prussia to resign. He afterward lived for twenty years in Brussels, but moved in 1859 to Cracow, where he d. Jan. 12, 1860.

Skua, an English name for the species of birds of the family Laridæ and sub-family LESTRIDINÆ (which see).

Skull [Ang.-Sax. *scylan*, to "divide"], the collection of bones enclosing the brain and organs of special sense, and forming the osseous frame of the face. The skull includes 22 bones. In the cranium (Gr. κράνος, a "helmet"), the vaulted case which protects the brain, there are 8 bones—the occipital, 2 parietal, frontal, 2 temporal, sphenoid, and ethmoid. The face includes 14 bones—2 nasal, 2 superior maxillary, 2 lachrymal, 2 malar, 2 palate, 2 inferior turbinated, vomer, and the inferior maxillary. In addition to these bones proper of the skull, there are the appended teeth, 32 in number in the adult (see TEETH); the Wormian bones, small bony wedges which develop in variable number and size in the sutures or lines of union of the cranial bones, and the delicate bones of the auditory apparatus, the ossicula auditus, which are lodged within the temporal bone. (See EAR and ACOUSTICS.) The size and shape of the skull and the facial angle vary in the different races of man (see ANTHROPOLOGY), and at different ages from infancy to old age. In the new-born infant the sutures between the cranial bones are open, a condition permitting the bones to overlap during parturition. During the early months of infant life, after union of these sutures, upon the top of the head two noticeable interspaces exist, termed the anterior and posterior fontanelles. As the child grows, the bones firmly unite, their irrregular borders interdigitating and exhibiting a tortuous line of union—the sutures. The fontanelles are covered by the growing cranial bones and the development of the interposed Wormian bones. The lower cranial bones and the facial bones are very irregular and complicated in structure, having numerous bony processes, canals, and foramina for the transmission of nerves of special sense and sensation and nutrient blood-vessels. The great opening at the base of the skull is the foramen magnum, and transmits the aggregated tubules, both motor and sensory, of the spinal cord from the origin and seat of volition and sensation, the brain, to the various parts of the body over which it presides. The two lesser foramina, one in either orbit, transmit the optic nerves. The interior of the cranium is divided into compartments by partial membranous partitions or folds of dense fibrous structure, reflections of the meninges, or membranes lining the interior of the cranial vault; this structure partially separates, supports, and maintains *in situ* the different ganglia and lobes of intercranial nerve-matter, and is a protection from injury by concussion. The bones of the skull are liable to fracture, necrosis, non-development, and periostitis. The maxillary bones are the frequent seat of abscesses consequent upon irritation of the teeth. Death of the maxillary bones is a chief result of phosphorus poisoning, the phosphorus gaining access through necrosed teeth or vacant alveolar cavities.
E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Skull'cap [Lat. *Scutellaria*, from *scutella*, a "little dish"], the common name of a genus of perennial herbs found over a wide range of climates in America, especially in Mexico and the sub-tropical regions, though several

species grow in the Northern U. S. and in Europe. They derive their name from an envelope around the fruiting calyx, have little aroma, and enjoy a popular but delusive reputation, especially for the cure of hydrophobia.

Skull Creek, p.-v. and tp., Butler co., Neb. P. 238.

Skunk [from the Abenaki *seganku*], the common name applied in the U. S. to the species of the family Mustelidæ and sub-family Mephitinæ. The body is moderately elongated and arched backward; the legs comparatively short; the feet sub-plantigrade; the tail rather long and very bushy; the color is particolored, black and white being contrasted. Their distinctive characters, as contrasted with the other members of the family, are chiefly exhibited in the skull and teeth. The skull is compressed backward, produced forward and transversely convex, with the ante-orbital foramen small and opening forward, and the auditory bullæ much inflated and bulging forward; the teeth are M. $\frac{1}{2}$, P. M. $\frac{3}{3}$ or $\frac{2}{3}$, C. $\frac{1}{1}$, I. $\frac{3}{3} \times 2$; the last molar of the upper jaw enlarged, and more or less extended longitudinally. Their anal glands, according to Chatin,* are essentially like those of the badgers and ratels, and are in a single pair and of large dimensions; their outer walls are formed by a thick fleshy tunic formed of two layers of interlaced fibres, capable of sudden strong compression of the receptacles; these are enormous reservoirs, with a dense resisting fibrous coat, always containing a considerable quantity of the follicular product. The glandular substance is not spread all over the central pouch, but is restricted to a particular portion, and contrasts by its dark color with the white ground of the envelope of the pouch. The contents of the receptacles are sufficiently offensive to justify the profound and universal disgust which these animals excite in consequence of their curious and very efficacious means of defence. The voiding of the liquid must be sudden; and it does not suffice that the receptacle is large and powerfully muscular; the offensive liquid must be directed far backward, so as to flow as little as possible upon the rectal muscular membrane; so the opening is large and upon the summit of an umbilicated papilla, around which rests a cutaneous fold which in a measure directs the discharge. It is said that the mephitic fluid is also to some extent diffused by a whisk of the tail, but this is doubtful. The skunks are distributed throughout America, N. as well as S., except the coldest parts, and are found in no other portion of the world. The number of species is not yet entirely certain, but they are much fewer than was formerly supposed. According to Gray, there are three species of *Mephitis* (*M. mephitica* or *varians*, *M. bittata*, and *M. mexicana*), one of *Spilogale* (*S. putorius*), and one of *Conepatus* (*C. mapurito*). Three of these occur in the U. S. The *Mephitis mephitica* is the common large skunk generally distributed over the country; the *Spilogale putorius* is a small species, confined to the Western and South-western States W. of the Mississippi River, and from Iowa southward; the *Conepatus mapurito* is about the size of *Mephitis mephitica*, and confined to the south-western parts of the U. S. (Texas, etc.), into which it extends from Mexico. Although they vary much in color, they can generally be distinguished as follows: the *Mephitis* is black, with the crown white and with two white streaks diverging thence; the *Spilogale* is black, with a spot on the forehead and one on each temple, and a number of white but interrupted longitudinal streaks on the back; the *Conepatus* is black, but with a broad white dorsal median band. The species are all active carnivorous animals, feeding on small quadrupeds and birds as well as reptiles. They burrow in the ground, and in the Northern States remain torpid during the winter. They bring forth from six to nine young at a birth. The mephitic fluid has been employed medicinally to some extent as an antispasmodic in hysteria, asthma, etc. The bite of the animal is in some quarters much dreaded, and is said to induce hydrophobia. THEODORE GILL.

Skunk'-cabbage [*Symplocarpus fœtidus*], the popular name of a large marsh-plant of the arum family, common in the U. S. from Maine to South Carolina, distinguished by the unpleasant smell and by the clusters of leaves from which it derives its name, is an endogen, producing early in the spring its four-petaled flowers in a globular cluster upon a short stem within a shell-shaped spathe or hood, of a dark purplish color, or with yellow and purple stripes and spots, variegated with patches of red or green. The fruit is oval and fleshy, enclosing large purple seeds. The roots and leaves have been used as stimulants.

Skye, an island of Scotland, the largest of the Inner Hebrides, belongs to the county of Inverness, from the mainland of which it is separated by the channel of Kyle Rhea, half a mile broad. Area, 547 sq. m. Pop. 21,521 in 1851; 18,751 in 1861. The surface is mountainous and rugged; the coast-line especially is steep, abrupt, and wild, but often strikingly picturesque on account of its peculiar basaltic formations, its caves and waterfalls. The soil is not unproductive, but, on account of the extreme dampness of the climate, it is utterly unfit for agriculture. The name of the island, *Skye*, means in the old Scandinavian tongue "cloud," and is very appropriate, for it always rains here; the days during the year on which no rain falls are very few. Turnips and potatoes grow well, however, and sheep-breeding is carried on with some success. Fishing is the principal occupation, and large quantities of salt and dried cod, herring, ling, and saithe are exported. The inhabitants, who are of Gaelic descent, interspersed with Norse settlers, and who still use the Gaelic language, are poor, and their number decreases, as many of them emigrate to the colonies in search of a better home.

* The writer is indebted to Dr. Coues for the abstract of Chatin's conclusions.

Sky'lark (*Alauda arvensis*), a European bird, type of the family Alaudidæ, celebrated for its song. It is characterized in its genus by the slight prolongation of the feathers of the occiput, but not enough so to form a crest; the very small size of the first primary, the equality of the second and third (which exceed the fourth), and the margination outside with white of the external tail-feathers; the upper parts are variegated with blackish and reddish gray; the lower parts white on the abdomen, but with the neck, breast, and sides tinged with reddish and spotted with brown. The length is about seven inches, the tail being three. It is found all over Europe as well as Northern Africa and the corresponding zones of Asia. It frequents meadows, and does not perch. It feeds chiefly on the seeds of various plants and larvæ. Its nest is formed on the ground. It lays four or five eggs of a whitish gray color. It is almost equally esteemed for the delicacy of its flesh and the melody of its song. THEODORE GILL.

Sky'ros [anc. *Scyros*], an island of Greece, in the Ægean Sea, 24 miles N. E. of Eubœa, comprises an area of 60 sq. m., with 2630 inhabitants. The southern part is very mountainous and rugged, and partly barren, but the northern, more level, is fertile, and produces wine, wheat, oak and pine timber, and goats of a superior breed.

Slab Fork, tp., Wyoming co., West Va. P. 480.

Slade (WILLIAM), b. at Cornwall, Vt., May 9, 1786; graduated at Middlebury College 1807; began the practice of law 1810; was editor and publisher of the *Columbian Patriot* 1814–15; secretary of state 1815–23; judge of Addison co. 1816–22; clerk in the state department at Washington 1823–29; State attorney for Addison co. 1830–31; member of Congress 1831–43; reporter of the supreme court of Vermont 1844; governor of that State 1844–46, and from 1846 to 1858 secretary of the national board of popular education, in which capacity he rendered eminent service in annually sending to the Western States a considerable number of competent teachers. D. at Middlebury Jan. 18, 1859. Compiler of *Vermont State Papers* (1823), *Statutes of Vermont* (1825), and *Vermont Reports*, vol. xv. (1844), and author of many pamphlets on law, politics, and education.

Slags [Dan. *slagg*], the imperfect glassy or vitrifiable compounds which are produced during the reduction of metallic ores by various fluxes. The slags produced in metallurgical operations should have the following properties: They should fuse at the right temperature; be of such fluidity and specific gravity as to allow the metal or matte (*regulus*) produced to sink readily through them; have such a composition that they will not attack the desired product or the furnace-walls, and will not allow undesirable bodies to separate from themselves; must be able to take up foreign substances, and must be in sufficient quantity to protect the desirable products from the hurtful influence of the blast or other agencies. It is seldom the case that all of these conditions can be fulfilled, and therefore the efforts of the smelter must be directed to securing as advantageous a combination as possible. The slags of ordinary occurrence are silicates, combinations of silicic acid with bases already present in the charges or formed during the operation; but they will frequently contain earthy sulphides and fluorides, as well as particles of metal and matte. Sometimes they may be looked upon as single chemical compounds, at other times they appear to consist of mixtures, but in normal slags the amount of silicic acid is always within certain limits.

The following classes of slags have been recognized: *Sub-silicates*, in which the oxygen of the base is to that of the silica as 1 to less than 1; they have sometimes the formula $3RO.SiO_2$, but must frequently be regarded as mixtures of still more basic silicates, while sometimes they approach very near to the uni-silicates. RO is generally represented by FeO (protoxide of iron) and MnO (protoxide of manganese) in these slags, which are produced in pud-

dling and reheating iron. They fuse easily, flow very freely, and solidify quickly to a dark brittle mass of high specific gravity, frequently possessing a metallic lustre; and they are gelatinized by acids. *Uni-silicates* have the oxygen of the bases to that of the silica as 1 to 1: they may therefore have the formula $2RO,SiO_2$, or $2R_2O_3,3SiO_2$, or a combination of protoxide bases with sesquioxide, as $2RO,SiO_2 + 2R_2O_3,3SiO_2$. In these, RO may consist mainly of protoxide of iron, or mainly of lime (CaO) and magnesia (MgO), with R_2O_3 represented by alumina (Al_2O_3). Uni-silicates of the first class are produced in certain lead-smelting operations and in the early stages of iron-puddling. They closely resemble the foregoing sub-silicates in appearance and properties, and are very prone to form obstructions in the furnace on account of the easy reduction of the oxide of iron contained in them. When the bases are mainly earthy, the uni-silicates are somewhat difficult to fuse, flow quite easily, solidify quickly, and have a light-colored, stony appearance. They are frequently crystalline, and more or less porous, and are sometimes produced intentionally by adding much lime to remove sulphur, as sulphide of calcium, in iron-blast furnaces. *Bi-silicates*, with twice as much oxygen in the silica as in the bases, may have the formulas RO,SiO_2; $R_2O_3,3SiO_2$, or $RO,SiO_2 + R_2O_3,3SiO_2$. In general, these are the most desirable slags, as they can be so compounded as to possess most of the qualities of a desirable slag. They do not solidify so quickly as the preceding, can be drawn into threads, are generally vitreous, translucent, and often yield crystals in cooling. They are not completely decomposed by acids until after fusion with alkalies. *Tri-silicates* have three times as much oxygen in the silica as in the bases; $2RO,3SiO_2$; $2R_2O_3,9SiO_2$; or $2RO,3SiO_2 + 2R_2O_3,9SiO_2$. By reason of the large proportion of silicic acid in them, these slags are very apt to take up metallic oxides, and they also fuse at so high a temperature that, in the case of blast furnaces, there is danger of reducing silicon, which would combine with the iron. They are therefore very seldom produced in regular smelting operations.

Although in the preceding formulas combinations of one base with silica have been indicated, this is very seldom the case in practice, partly from the nature of the ores and fluxes, partly from the intentional production of mixed silicates, it being well known that compound silicates are in general much more fusible than those with but a single base. Thus, according to Plattner, silicate of alumina is formed from its constituents at a temperature of 2400° C.; silicate of magnesia, at 2200 to 2250°; silicate of lime, at 2100 to 2150°; while the compound silicate of lime and magnesia forms at 2000°, of lime and alumina at 1950°. Bodeman's bi-silicate slag, regarded as the most fusible combination of ordinarily-occurring slag-forming materials, contains 56 per cent. of silica, 30 per cent. of lime, and 14 per cent. of alumina; any variation from these proportions lessens its fusibility. Most slags obtained in copper and lead smelting will contain metallic oxides, particularly protoxide of iron, in addition to, or in place of, the lime and other earthy bases, thus becoming still more fusible, while the earthy bases alone, even in the case of compound silicates, give slags too infusible for these operations, but well adapted to iron-blast furnaces. Magnesia is not added when any other base can be obtained, even to make a compound silicate, because it gives such an infusible silicate, but sometimes magnesia is purposely added to increase the infusibility of the slag; and it may amount to 25 per cent. Lime is rarely wanting in slags; the alumina should not exceed 15 or 16 per cent.; protoxide of manganese sometimes replaces the lime. A slag once formed will remelt at 300 to 400° C. less than the temperature required to form it, and hence it is better to use native silicates, like hornblende and clay-slates, or old slags, than to add the separate ingredients, whenever it is possible thus to control the acid or basic property of the resulting slag. Frequently, by judicious mixture of ores, the proper slag can be obtained without adding any flux: at other times a basic flux, like limestone, will be absolutely necessary. Occasionally, there will be an excess of alumina, and it is then to be regarded as playing the part of an acid, but aluminates without silicates do not occur as slags. The most infusible silicates, like silicate of zinc or tin, can be made to fuse when combined with other silicates. A slag should not fuse before the desired effect has been produced in the furnace, whether it be the reduction of an oxide, absorption of carbon by iron, sulphurization of metals, etc. Slags are often affected by the manner in which they solidify: rapid cooling producing a glassy, brittle slag, while slow cooling tends to produce a stony, tough slag, provided the chemical constitution is right. For this reason the slags when used for paving or building materials are slowly cooled. Slags have also been used to manufacture cement, alum, for fertilizers, and for ornamental purposes.

The color of slags is very various. Generally, a dark slag will owe its color to metallic oxides, dark green or black indicating iron oxides, and dark brown manganese; light green indicates protoxide of iron; red or reddish-brown, suboxide of copper. Some very dark slags from iron furnaces, however, owe their color probably to sulphur, and contain little iron oxide. The peculiar blue color of some blast-furnace slags has been referred to the presence of ultramarine, vanadium, molybdenum, cobalt, and titanium. While each or all of these, excepting perhaps ultramarine, may be present in blue slags, and may possibly cause the blue color, especially the cobalt oxide, Bontemps has shown that oxide of iron alone can impart all colors to glass; while Fournet refers the blue shades of most of these slags to their physical constitution. The blue color of old zinc retorts has been also referred to the presence of titanium; and Wöhler considered that certain blue slags from blast furnaces owed their color to a compound like ultramarine, but containing sulphide of calcium in place of sulphide of sodium. Among the minerals closely imitated by certain slags in composition and crystalline form may be mentioned amphibole, pyroxene, wollastonite, diopside, gehlenite, and labradorite, all of which have been found in various blast-furnace slags. H. B. Cornwall.

Slan'der [Gr. σκάνδαλον], in law, is the speaking by one person, in the presence of one or more hearers, of defamatory words concerning another injurious to his reputation and character, by which pecuniary damage is done to him, and for which he is entitled to recover compensation in an action at law. The defamatory words which constitute slander are of two classes: (1) those which are actionable in themselves, because the law conclusively presumes that pecuniary damage results from their utterance; (2) those which become actionable only by alleging and proving that such pecuniary damage was in fact sustained by the person defamed. The first class includes (*a*) words which impute the commission of a crime involving moral turpitude and punishable by the law, or, as it is sometimes expressed, a crime involving an infamous punishment; (*b*) words which charge that a person has an infectious disease, or one which renders him unfit to be associated with, such as small-pox or syphilis; (*c*) words spoken of a person in connection with his office, profession, trade, or business, and which naturally or necessarily tend to injure him therein. All other defamatory words, spoken merely, become actionable only when they actually and directly cause pecuniary loss or injury; and that fact must be averred and proved by the plaintiff. At the common law, words charging incontinence or want of chastity upon a female are not actionable of themselves, and require the additional fact of an injury which the law calls pecuniary; but this serious and barbarous defect has been remedied by statute in many of the States. The gist of the wrong and the foundation of the defendant's liability is his *malice* in uttering the words, and this malice is (except in the single instance of privileged communications) conclusively presumed to exist if the defamatory statement is false. On the other hand, if the charge is true, no matter how injurious it may be, nor how hostile may have been the defendant's motives, the *legal* malice is not present. In an action for slander the defences may be (1) a denial that the words were spoken; (2) a justification, or the assertion that the charge is true; (3) a claim that the words constituted a "privileged communication," and were not malicious; or (4) matters in mitigation of damages, which do not form a complete defence, but tend to reduce the amount of the recovery. At the common law, the rules concerning the defences of justification and of mitigation were exceedingly technical and severe upon the defendant, but they have been much relaxed by modern legislation both in the U. S. and in England. (For several other matters which are common to the actions for slander and for libel, and especially for the rules concerning the defence of "privileged communications," see the article Libel.) John Norton Pomeroy.

Slang [a word of doubtful derivation], the use of words which are unauthorized and vulgar, and which usually have a burlesque character. (See Argot.)

Slate [O. Eng. *sclate*], indurated metamorphosed shale; a hard tough rock which splits into thin plates, the type being roofing-slate. The lamination of slate is not that of the bedding, but is often at right angles to it. It is produced by lateral pressure, is confined to disturbed and metamorphosed rock (argillite), and from its peculiar character is called slaty cleavage. Slate is now the most highly-esteemed material in use for roofing, and is very largely employed for that purpose. Its excellencies are—its neatness of appearance, its cleanliness, its indestructibility, and its resistance to fire. Slate is found in all countries where there are metamorphic rocks: the great source of supply has, however, been North Wales, where

there are immense quarries located on or near the coast, and from which slate is sent to nearly all parts of the world. The quarries of Penrhyn alone employ nearly 3000 workmen. Excellent roofing-slate is also obtained in many localities in the U. S., as at Brownville, Me.; Poultney, Castleton, etc., Vt.; Granville, Jamesville, and Hampton, N. Y.; Newton, Delaware, Slatington, Pa.; Peachbottom, on the N. line of Maryland, etc. In these different localities there are some hundreds of quarries in active operation, from which the demand for slate in the U. S. is principally supplied. Slate of good quality is also known to exist in North and South Carolina and in the Huron Mountains N. of Marquette, Mich. Although the great consumption of slate is for roofing, it is employed for many other purposes, such as billiard-tables, counters, tiles, blackboards, and writing-slates, and, when enamelled, for mantels, table-tops, etc. In using slate for roofing the larger sizes are attached to battens nailed across the rafters; smaller slates are laid upon a rough board roofing. The slate is attached to its support by nails driven through holes which are made with a sharp-pointed instrument with great facility when skilfully used. The unit of measure usually employed for roofing-slate is a square of 10 feet, or 100 square feet. J. S. NEWBERRY.

Slate, tp., Wood co., West Va. P. 878.

Sla'ter (SAMUEL), b. at Belper, Derbyshire, England, June 9, 1768; was apprenticed at the age of fourteen to Jedidiah Strutt, partner of Arkwright in the business of cotton-spinning; assisted his master in making some improvements in his machinery, of which he acquired a thorough knowledge; saw in a newspaper in 1789 the law passed by the U. S. Congress in that year for the encouragement of manufactures, and a notice of the bounty offered by the Pennsylvania legislature for the introduction of the Arkwright patents into the U. S., the communication of the models of the new machinery to foreign countries being then forbidden by English law under severe penalties. Believing himself able to construct new machinery from memory, he sailed for New York; arrived there Nov., 1789, and learning that Moses Brown of Rhode Island had attempted the spinning of cotton by machinery, wrote him stating the facts of his knowledge of the Arkwright machinery. By invitation of the latter he proceeded to Providence, entered into a contract with William Almy and Smith Brown to construct and work the new cotton-spinning machinery, and started at Pawtucket Dec. 21, 1790, a mill with three carding-machines and seventy-two spindles, which was the virtual beginning of the cotton manufacture in America. Acquiring a competent fortune by the results of his industry, he erected cotton-mills of his own at Oxford (now Webster), Mass., in 1812, to which he added woollen-mills 1815–16, the nucleus of the prosperous village of Slatersville. He gave due attention to the mental wants of his employés, having established a Sunday-school as early as 1796, and having subsequently maintained schools for the children of his artisans. While engaged in the task of reproducing from memory the models of the Arkwright machinery, he was for a considerable time unable to remember a small but very essential piece of the mechanism, until, having in a dream revisited the English establishment, he examined the piece in question, and was able on waking to make use of the information thus derived. D. at Webster, Mass., Apr. 21, 1835. (See Rev. George S. White's *Memoir of Samuel Slater, the Father of American Manufactures, connected with a History of the Rise and Progress of the Cotton Manufacture in England and America* (Philadelphia, 1836; 2d ed. 1846).) PORTER C. BLISS.

Slate Range, tp., Yuba co., Cal. P. 880.

Slate River, tp., Buckingham co., Va. P. 2101.

Sla'tersville, p.-v., North Smithfield tp., Providence co., R. I., founded by SAMUEL SLATER (which see).

Sla'tington, p.-b., Washington tp., Lehigh co., Pa., on Lehigh River and Lehigh Valley R. R., has extensive slate-quarries. P. 1508.

Slaugh'terville, p.-v., Webster co., Ky., on St. Louis and South-eastern R. R. P. of v. 130.

Slave Coast. See GUINEA.

Slave Lake and **River.** See GREAT SLAVE LAKE.

Slavery. See APPENDIX.

Slavery Compromise of 1850. See SLAVERY.

Slaves and the Slave-Trade. See SLAVERY.

Slavic Races. See SLAVS.

Slavo'nia, formerly a province of Hungary, but forming now, together with Croatia and the Military Frontier, the kingdom of Croatia and Slavonia, a political division of the Austrian empire, comprising an area of 8873 sq. m., with 1,864,034 inhabitants. Slavonia proper is bounded N. by the Drave and S. by the Save, E. by the Danube and W. by Illyria and Styria. A branch of the Carnian Alps enters Slavonia from the W., and traverses it in its whole length, forming the watershed between the Drave and the Save, and terminating somewhat abruptly on the banks of the Danube. These mountains, which nowhere rise above 2700 feet, are rich in copper, iron, lead, and beautiful marble, and their slopes are clothed with fine timber-yielding forests, vineyards which produce a sweet, strong, richly-flavored wine, and orchards in which apples, pears, cherries, and peaches, figs, oranges, and walnuts, ripen to perfection. Along the rivers extend low, rather marshy, but very fertile plains, where large crops of wheat and maize are raised and immense herds of cattle and swine reared. Of manufactures there are almost none; some linen fabrics are made from the excellent flax and hemp which are raised, but only for home use. The inhabitants, who call themselves *Slavonatz* and their country *Slavonska*, are at once warlike and dreamy, fond of music, poetry, and dancing, excelling in all kinds of horsemanship, and preferring the life of the shepherd to that of the tiller of the soil. They are deeply attached to their fatherland and proud of their nationality, and of late political ideas and political passions have begun to play a conspicuous part in their lives. They are mostly Roman Catholics, and speak the Illyrian dialect, which is closely allied to the Servian. Cap. Eszek.

Slavs. The present Slavs or Slavonians may be divided into three main branches—Eastern, Western, and Southern. To the first belong the Russians; to the second, the Poles, the Czechs, the Slovaks, and the Lusatian Wends; to the third, the Bulgarians, the Servians and Croatians, and the Slovenes. Among Russians are comprised about 35,000,000 Great Russians, 13,000,000 Little Russians, and 3,000,000 White Russians. The Poles number about 9,000,000, divided between the empires of Russia, Germany, and Austria. Of Czechs there are about 5,000,000 in Bohemia and Moravia. There are about 140,000 Wends in Saxony and Prussia, and about 2,000,000 Slovaks in Hungary. Of South Slavonians there are from 10,000,000 to 12,000,000 in Turkey, Austria, the principality of Servia, etc. The whole population of the Slavonic world is variously estimated, but is supposed to number nearly 80,000,000. No information is given, even by legends, as to the first appearance of the Slavs in Europe. In the fourth century they were found in great numbers in the neighborhood of the Carpathians, and that is supposed to have been one of their earliest haunts. Thither point the legends of many Slavonic peoples, especially the Poles and Czechs, and thence the Slavonic settlers appear to have spread northward to the Baltic and southward to the Adriatic. But the earliest authentic records of the Slavs are given by Procopius, Jornandes, Agathias, the emperor Maurice, and other writers during the second half of the sixth century. These authors all lived in Byzantium or in Italy, and were personally acquainted only with the Southern Slavs, who haunted the Lower Danube and spread through ancient Mœsia and Pannonia. The Northern Slavs they knew by report only. No political unity seems ever to have existed among these early Slavs, but their different bodies consolidated at various periods between the seventh and eleventh centuries into monarchies, of which all but one have virtually disappeared. The Polish, Bohemian, Servian, Moravian, and Bulgarian kingdoms have all lost their independence. Only the Russian has maintained its ground. To the early Slavs, Jornandes and some other writers give the name of Wends, by which name the Slavonic inhabitants of Lusatia are still known to their German neighbors. This designation, under various kindred forms, appears to have been applied to Slavs by foreigners, just as that of Welsh (*Wälsche*) was given by the Teutonic to the Latin-speaking peoples. Of the word *Slav* or *Slavonian* (*Slovenin*) various explanations have been given, some authorities deriving it from *slovo*, "a word," others from *slava*, "glory," but the question is still in abeyance. From it, owing to the state of degradation to which so many Slavs were reduced by their German masters, have sprung the words *slave, esclave, schiavo, sclave*, etc.

Of the ancient Slavs little information can be obtained except from extraneous sources—from the writings of Greeks, Germans, Arabs, and other foreigners. But they appear to have differed but little in the various lands which they occupied, everywhere bearing the character of being a brave and hardy race, but given to agriculture, and therefore of a peaceable nature, except where they were influenced by more martial neighbors. Some modern writers suppose that the Slavs formed into clans, others that the foundation of Slavonic society was the family community. Among the Western Slavs, at least, a cluster of such communities formed a *jupa*, or district, at the head of which was a *jupan*, or chief, and in its centre a *grad*, or town. The mode of life among all the Slavonic tribes was patri-

archal, the father ruling his family with despotic power. Polygamy prevailed among them in heathen times, and also a kind of sutteeism, but women do not seem to have occupied an altogether degraded position. Of Slavonic heathenism not much is known, but its deities appear to have been for the most part personifications of nature-forces. Vague recollections survive of Svarog, the heaven-god, answering to the Greek Ouranos, the Vedic Varuna. He appears to have given place, in some parts, to a solar deity, Dazhbog, together with whom, as the representative of the sun, a Khors is mentioned. Another solar deity was Volos or Veles, the special protector of cattle, surviving in Christian times as St. Blasius or Vlasy. Kupalo and Garilo are supposed to have been representatives of the summer sun, the fertilizer of the earth. Fire is said to have been worshipped under the name of Ogon, answering to the Vedic Agni, and there was a wind-god, Stribog. But the chief deity of the North-eastern Slavs was Perun, the thunder-god, answering to the Teutonic Thor, and supposed to be the European representative of the Vedic Parjayna. Among the Western Slavs other deities were worshipped, such as Radigost and Sviatovit, and the three-headed Triglaf, of whose images detailed accounts are given by old writers. These Western Slavs appear to have had temples and priests, but it is doubtful whether this was the case among their Eastern brethren. Of inferior deities the memory is still preserved in the belief of the common people of all Slavonic lands in Rusalkas, Vilas, and many other supernatural beings supposed to haunt woods, waters, and pastures. The Western Slavs appear to have been the first to accept Christianity, many of the Moravians, for instance, having been converted as early as the seventh century, their religious teachers coming from the West. But the submission of the great body of the Slavs dates from the mission of the Greek monks Cyril and Methodius in the ninth century. After many changes and struggles the Western Slavs mostly submitted to the Latin Church and employed the Latin alphabet, while the Eastern, forming part of the Oriental Church, retained, with some modifications, the alphabet said to have been invented by Cyril, their liturgies keeping to some extent alive at the present day the ancient tongue which seems to have been common to all the Slavonic peoples 1000 years ago.

W. R. S. RALSTON.

Sleeman (Sir WILLIAM HENRY), K. C. B., b. at Stratton, Cornwall, England, in 1788; became a cadet in the Bengal service of the East India Company 1808; filled many civil and military trusts with great credit, rising to the post of president at Lucknow 1849; became major-general Nov., 1855, and was knighted Jan., 1856. D. at sea, on his return to England, Feb. 10, 1856. While acting as agent in the Saugor and Nerbudda district, Col. Sleeman discovered the existence of the secret order of murderers since widely renowned as "Thugs," and devoted several years to their suppression, which he effected about 1838. Author of *The Thugs or Phansigurs of India* (2 vols., 1839), *Military Discipline in our Indian Army*, *Rambles and Recollections of an Indian Officer* (2 vols., 1844), *Journey through the Kingdom of Oude* (2 vols., 1858), and other writings on India and on political economy.

Sleep [Ang.-Sax. *slâpan*] is that condition of the organism, normal, and occurring generally periodically, in which there is a more or less complete suspension of consciousness and the power of voluntary motion, due to diminished or interrupted cerebral action. The approach of sleep is characterized by a languor which is agreeable when it can be yielded to, but which when circumstances prevent this is far from being pleasant. Many persons are rendered irritable as soon as they become sleepy, and children are especially liable to manifest ill-temper under the uncomfortable feelings they experience when unable to indulge the inclination to sleep. It is somewhat difficult to analyze the various phenomena which go to make up the condition called sleepiness. The most prominent sensations are an impression of weight in the upper eyelids, and of a general relaxation of the muscles of the body; but there is besides an internal feeling of supineness, enervation, and torpor, to describe which is by no means easy. This sluggishness is closely allied in character to, if not altogether identical with, that experienced immediately before an attack of fainting, and is doubtless due to a like cause—a diminution of the quantity of blood in the brain. Along with this languor there is a general obtuseness of all the senses, which increases the separation of the mind from the external world already initiated by the physical condition of the brain. The liveliest scenes cease to engage the attention, and the most exciting conversation no longer interests. For a time, indeed, such circumstances may dissipate the inclination for sleep, but eventually nature obtains the ascendency and consciousness is lost. Before this event there is usually yawning—a phenomenon strongly indicative of a wearied attention—the head nods and droops upon the breast, and the body assumes that position which is most conducive to ease, comfort, and entire muscular inactivity. The order in which the muscles lose their power is in general well marked, and bears a distinct relation, as Cabanis has pointed out, to the importance of their functions. Thus, the muscles which move the arms and legs become relaxed before those which support the head, and the latter before those which maintain the erectness of the back. This, however, is not always the case, for, as we shall presently see, individuals will occasionally walk and keep their position on horseback while in a sound sleep, and persons may be seen slumbering in church, their heads drooping, but yet firmly holding their prayer-books in their hands under pretence of going through the services.

As regards the senses, the sight is of course the first to be lost in ordinary cases, the closure of the eyelids interposing a physical obstruction to the entrance of light. But even where the eyelids have been removed, or from disease cannot be closed, the sight, nevertheless, is the first of the special senses to be abolished. Some animals—as the hare, for example—do not shut the eyes when asleep, but even in them the ability to see disappears before the action of the other senses is suspended. These latter are not entirely abolished during sleep; their acuteness is simply lessened. Taste is the first to fade, and then the smell; hearing follows, and touch yields last of all. To awaken a sleeping person impressions made upon the sense of touch are more effectual than attempts to arouse through any of the other senses; the hearing comes next in order, smell next, then taste, and the sight is last of all in capacity for excitation.

During sleep the respiration is slower, deeper, and usually more regular than during wakefulness. The vigor of the process is lessened, and therefore there is a diminution of the pulmonary exhalations. In all probability also, the ciliated epithelium which lines the air-passages functionates with reduced activity. Owing to this circumstance, and to the general muscular torpor which prevails, mucus accumulates in the bronchial tubes, and requires to be expectorated on awaking. The circulation of the blood is rendered slower. The heart beats with more regularity, but with diminished force and frequency. As a consequence, the blood is not distributed to distant parts of the body so thoroughly and rapidly as during wakefulness, and accordingly the extremities readily lose their heat. Owing to the reduction in the activity of the respiratory and circulatory functions, the temperature of the whole body falls, and coldness of the atmosphere is less easily resisted. The functions of the several organs concerned in digestion indirectly have their activity increased during sleep. The blood which leaves the brain goes, as Durham has shown, to the stomach and other abdominal viscera, and hence the quantities of the digestive juices are augmented, and the absorption of the nutritious elements of the food promoted. The urine is excreted in less quantity during sleep than when the individual is awake and engaged in mental or physical occupation, because the wear and tear of the system is at its minimum. The perspiration is likewise reduced in amount in sleep. In warm weather, however, the effort to go to sleep often causes an increase in the quantity of this excretion, just as would any other mental or bodily exertion. This circumstance has led some writers to a conclusion the reverse of that just expressed. Others, again, have accepted the doctrine of Sanctorius without stopping to inquire into its correctness. This author, with his weighing-chair, established a good many important results, but his observations in regard to sleep were inexact, inasmuch as he determined the loss from the skin and lungs collectively, and as his apparatus was too imperfect to determine a question of such delicacy.

The ganglionic nervous system and the spinal cord continue in action during sleep, though generally with somewhat diminished power and sensibility. The so-called reflex faculty of the latter organ is still maintained, and thus various movements are executed without the consciousness of the brain being awakened. Somnambulism is clearly a condition of exaltation in the functions of the spinal cord, without the controlling influence of the cerebrum being brought into action. But aside from this rather abnormal phenomenon, there are others which are entirely within the range of health, and which show that the spinal cord is awake even though the sleep be most profound. Thus, for instance, if the position of the sleeper becomes irksome, it is changed; if the feet become cold, they are drawn up to a warmer part of the bed; and cases are recorded in which individuals have risen from bed and emptied a distended bladder without awaking, as well as performing many other complicated and apparently volitional acts.

We see, therefore, that though during sleep the operations of the senses are entirely suspended as regards the effects of ordinary impressions, the purely animal functions of the body continue in action. The heart beats, the lungs respire, the stomach, the intestines, and their accessory organs digest, the skin exhales vapor, and the kidneys excrete urine. With the central nervous system, however, the case is very different, for while some parts retain the power of receiving impressions or developing ideas, others have their actions diminished, exalted, perverted, or altogether arrested.

In the first place, there is undoubtedly during sleep a general torpor of the sensorium, which prevents the appreciation of the ordinary excitations made upon the organs of the special senses. So far as the nerves themselves are concerned, there is no loss of their irritability or conducting power, and the impressions made upon them are accordingly perfectly well conveyed to the brain. The suspension of the operation of the senses is not therefore due to any loss of function in the optic nerves, the auditory nerves, the olfactory nerves, the gustatory nerves, or the cranial or spinal nerves concerned in the sense of touch, but solely in the inability of the brain to take cognizance of the impressions conveyed to it. The immediate cause of this torpor will presently engage our attention.

Now, it must not be supposed that, because mild excitations transmitted by the nerves of the special senses are incapable of making themselves felt, therefore the brain is in a state of complete repose throughout all its parts. So far from such a condition existing, there are very decided proofs that several faculties are exercised to an extent almost equalling that reached during wakefulness; and we know that if the irritations made upon the senses be sufficiently strong, the brain does appreciate them, and the sleep is broken. This ability to be readily roused through the senses constitutes one of the main differences between sleep and stupor, to which full attention will be given directly. Relative to the different faculties of the mind as affected by sleep great variations are observed. It has been thought by some authors that several of them are really exalted above the standard attained during wakefulness, but this is probably a wrong view. The predominance which one or two mental qualities apparently assume is not due to any absolute exaggeration of power, but to the suspension of the action of other faculties which, when we are not asleep, exercise a governing or modifying influence. Thus, for instance, as regards the imagination, the faculty of all others which appears to be most increased, we find that, when we carefully study its manifestations in our own persons, although there is often greater brilliancy in its vagaries, uncontrolled as it is by the judgment, the pictures which it paints upon our minds are usually incongruous and silly in the extreme. Even though the train of ideas excited by this faculty when we are asleep be rational and coherent, we are fully conscious on awakening that we are capable of doing much better by intentionally setting the brain in action and governing it by our will and judgment. Owing to the fact that these two faculties of the mind are incapable of acting normally during sleep, the imagination is left absolutely without controlling influence. Indeed, we are often cognizant in those dreams which take place when we are half awake of an inability to direct it. The impressions which it makes upon the mind are therefore intense, but of very little durability. Many stories are told of its power—how problems have been worked out, poetry and music composed, and great undertakings planned; but if we could get at the truth, we should probably find that the imagination of sleep had very little to do with the operations mentioned. Indeed, it is doubtful if the mind of a sleeping person can originate ideas. Those which are formed are, as Locke remarks, almost invariably made up of the waking man's ideas, and are for the most part very oddly put together; and we are all aware how commonly our dreams are composed of ideas or based upon events which have recently occurred to us.

In the previous section to the one just quoted Locke alludes to the exaggeration of ideas which forms so common a feature of our mental actions during sleep. "It is true," he says, "that we have sometimes instances of perception while we are asleep, and retain the memory of those thoughts: but how extravagant and incoherent for the most part they are, how little conformable to the perfection and order of a rational being, those acquainted with dreams need not be told." And yet many remarkable stories are related which tend to show the high degree of activity possessed by the mind during sleep. Thus, it is said of Tartini, a celebrated musician of the eighteenth century, that one night he dreamed he had made a compact with the devil and bound him to his service. In order to ascertain the musical abilities of his servitor, he gave him his violin and commanded him to play a solo. The devil did so, and performed so admirably that Tartini awoke with the excitement produced, and seizing his violin endeavored to repeat the enchanting air. Although he was unable to do this with entire success, his efforts were so far effectual that he composed one of the most admired of his pieces, which in recognition of its source he called "The Devil's Sonata." Coleridge gives the following account of the composition of the fragment *Kubla Khan*: "In the summer of 1797 the author, then in ill-health, had retired to a lonely farmhouse, between Perbeck and Linton on the extreme confines of Somerset and Devonshire. In consequence of a slight indisposition an anodyne had been prescribed, from the effects of which he fell asleep in his chair at the moment that he was reading the following sentence, or words of the same substance, in Purchas's *Pilgrimage*: 'Here the Khan Kubla commanded a palace to be built, and a stately garden thereunto. And thus ten miles of fertile ground were enclosed within a wall.' The author continued for about three hours in a profound sleep, at least of the external senses, during which time he had the most vivid confidence that he could have composed not less than from 200 to 300 lines, if that indeed can be called a composition in which all the images rose up before him as *things*, with a parallel production of the corresponding expression, without any sensation or consciousness of effort. On awakening he appeared to himself to have a distinct recollection of the whole, and taking his pen, ink, and paper, instantly and eagerly wrote down the lines that are here preserved. At this moment he was unfortunately called out by a person on business from Perbeck, and detained by him above an hour, and on his return to his room found, to his no small surprise and mortification, that although he still retained some vague and dim recollection of the general purport of the vision, yet with the exception of some eight or ten scattered lines and images all the rest had passed away like the images on the surface of a stream into which a stone has been cast, but, alas! without the future restoration of the latter." Dr. Cromwell, citing the above instance of poetic inspiration during sleep, states that having, like Coleridge, taken an anodyne during a painful illness, he composed the following lines of poetry, which he wrote down within half an hour after awakening. These lines, though displaying considerable imagination, are not remarkable for any other quality:

"*Lines composed in Sleep on the Night of January 9, 1857.*

"*Scene—Windsor Forest.*

"At a vista's end stood the queen one day,
Relieved by a sky of the softest hue;
It happened that a wood-mist risen new
Had made that white which should have been blue.
A sunbeam sought on her form to play;
It found a nook in the bowery nave,
Through which with its golden stem to lave
And kiss the leaves of the stately trees
That fluttered and rustled beneath the breeze;
But it touched not her, to whom 'twas given
To walk in a white light pure as heaven."

In the last two of these instances it is impossible to say whether the individuals were really asleep or not, as the opium or other narcotic taken is a very disturbing factor in both conditions, and doubtless was the exciting cause of the activity in the imagination. No more graphic account of the effects of opium in arousing the imagination to its highest pitch has been written than that given by De Quincey. He says: "At night, when I lay awake in bed, vast processions passed along in mournful pomp—friezes of never-ending stories, that to my feelings were as sad and solemn as if they were stories drawn from times before Œdipus or Priam, before Tyre, before Memphis. And at the same time a corresponding change took place in my dreams: a theatre seemed suddenly opened and lighted up within my brain which presented nightly spectacles of more than earthly splendor." And then, after referring to the various scenes of architectural magnificence and of beautiful women which his imagination conceived, and which forcibly recalls to our minds the poetical effusions of Coleridge and Cromwell, he gives the details of another dream in which he heard music: "A music of preparation, of awakening suspense—a music like the opening of the Coronation Anthem, and which, like *that*, gave the feeling of a vast march, of infinite cavalcades filing off, and the tread of innumerable armies."

In reference to this subject Dr. Forbes Winslow relates the following interesting case: "A feeble, sensitive lady, suffering from a uterine affection, writes to us as follows concerning the influence of three or four sixteenths-of-a-grain doses of hydrochlorate of morphia: 'After taking a few doses of morphia, I felt a sensation of extreme quiet and wish for repose, and in closing my eyes visions, if I may so call them, were constantly before me, and as constantly changing in their aspect—scenes from foreign lands, lovely landscapes, with tall, magnificent trees covered with droop-

ing foliage, which was blown gently against me as I walked along. Then in an instant I was in a besieged city filled with armed men. I was carrying an infant, which was snatched from me by a soldier and killed upon the spot. A Turk was standing by with a scimitar in his hand, which I seized, and attacking the man who had killed the child, I fought most furiously with him and killed him. Then I was surrounded, made prisoner, carried before a judge and accused of the deed; but I pleaded my own cause with such a burst of eloquence (which, by the by, I am quite incapable of when in my right mind) that judge, jury, and hearers acquitted me at once. Again, I was in an Eastern city visiting an Oriental lady, who entertained me most charmingly. We sat together on rich ottomans, and were regaled with supper and confectionery. Then came soft sounds of music at a distance, while fountains were playing and birds singing, and dancing-girls danced before us, every movement being accompanied by the tinkling of silver bells attached to their feet. But all this suddenly changed, and I was entertaining the Oriental lady in my own house, and in order to please her delicate taste I had everything prepared as nearly as possible after the fashion with which she had so enchanted me. She, however, to my no small surprise, asked for wine, and took not one, two, or three glasses, but drank freely, until at last I became terrified that she would have to be carried away intoxicated. While considering what course I had better adopt, several English officers came in, and she at once asked them to drink with her, which so shocked my sense of propriety that the scene changed and I was in darkness. Then I felt that I was formed of granite, and immovable. Suddenly, a change came again over me, and I found that I consisted of delicate and fragile basketwork. Then I became a danseuse, delighting an audience and myself by movements which seemed barely to touch the earth. Presently beautiful sights came before me—treasures from the depth of the sea, gems of the brightest hues, gorgeous shells, coral of the richest colors, sparkling with drops of water and hung with lovely seaweed. My eager glances could not take in half the beautiful objects that passed before me during the incessant changes the visions underwent. Now I was gazing upon antique brooches and rings from buried cities; now upon a series of Egyptian vases; now upon sculptured woodwork blackened by time; and lastly I was buried amid forests of tall trees, such as I had read of, but never seen. The sights that pleased me most I had power to a certain extent to prolong, and those that displeased me I could occasionally set aside; and I awoke myself to full consciousness once or twice while under the influence of the morphia by an angry exclamation that I would not leave it. I did not once lose my personal identity.' The lady almost invariably suffers more or less from hallucinations of the foregoing character if it becomes necessary to administer to her an opiate; and on analyzing her visions she can generally refer the principal portions of them, notwithstanding their confusion and distortion, to works that she has recently read."

Opium in certain doses increases the amount of blood in the brain, and thus induces a condition very different from that of sleep. In this fact we have an explanation of the activity of the imagination as one of its prominent effects. That Coleridge should have composed the *Kubla Khan* under its influence is in nowise remarkable. It is probable, however, that the full influence of his mind was exerted upon it after he awoke to consciousness, and that the wild fancies excited by the opiate, and based upon what he had been previously reading, formed the substructure of his conceptions. In any event, the ideas contained in this fragment are no more fanciful than those which occurred to De Quincey and the lady whose case has been recorded, nor are they more impressively related.

The imagination may therefore be active during sleep, but we have no authentic instance on record that it has, unaided by causes which exercise a powerful influence over the intracranial circulation, led to the production of any ideas which could not be excelled by the individual when awake.

That the imagination may in its flights during sleep strike upon fancies which are subsequently developed by the reason into lucid and valuable ideas, is very probable. It would be strange if, from among the innumerable absurdities and extravagancies to which it attains, something fit to be appropriated by the mind should not occasionally be evolved, and thus there are many instances mentioned of the starting-point of important mental operations having been taken during sleep. Some of these may be based upon fact, but the majority are probably of the class of those just specified, or occurred at an age of the world when a belief in the supernatural exercised a greater power over men's minds than it does at the present day.

As regards the memory in sleep, it is undoubtedly exercised to a considerable extent. In fact, whatever sign of activity the mind may then exhibit is based upon events the recollection of which has been retained. But there is more or less error mingled with a small amount of truth. The unbridled imagination of the sleeper so distorts the simplest circumstances as to render their recognition a matter of no small difficulty, and thus it scarcely if ever happens that events are reproduced during sleep exactly as they would be recalled by the mind of the individual when awake. Frequently, also, recent events which have made a strong impression on our minds are forgotten, as when, for instance, we dream of seeing and conversing with persons not long dead. And yet there are many instances on record of knowledge which had passed out of the mind being reacquired during sleep. Thus, Lord Monboddo states that the countess de Laval, while asleep in the course of a severe illness, spoke in a language which no one around her but an old Breton nurse understood. The countess had in her childhood passed several years in Brittany, but had entirely forgotten the language.

The judgment is frequently exercised when we are asleep, but almost invariably in a perverted manner. In fact, we scarcely ever estimate the events or circumstances which appear to occur in our dreams at their real value, and very rarely form correct conceptions of right and wrong. High-minded and honorable men do not scruple during sleep to sanction the most atrocious acts, or to regard with complaisance ideas which in their waking moments would fill them with horror. Delicate and refined women will coolly enter upon a career of crime, and the minds of hardened villains are filled with the most elevated and noble sentiments. The deeds which we imagine we perform in our sleep are generally inadequate to or in excess of what the apparent occasion requires, and we lose so entirely the ideas of probability and possibility that no preposterous vision appears otherwise than as perfectly natural and correct. Thus, a physician dreamed that he had been transformed into a monolith which stood grandly and alone in the vast desert of Sahara, and had so stood for ages while generation after generation wasted and melted away around him. Although unconscious of having organs of sense, this column of granite saw the mountains growing bald with age, the forests drooping with decay, and the moss and ivy creeping around its crumbling base. But although in this instance there was some conception of time, as shown in the associations of the evidence of decay with the lapse of years, there is in general no correct idea on this subject. The following example, detailed by Lavalette as occurring to him while in prison, is an illustration of this statement: "One night, while I was asleep, the clock of the Palais de Justice struck twelve and awoke me. I heard the gate open to relieve the sentry, but I fell asleep again immediately. In this sleep I dreamed that I was standing in the Rue St. Honoré, a melancholy darkness spread around me; all was still; nevertheless, a slow and uncertain sound soon arose. All of a sudden I perceived at the bottom of the street, and advancing toward me, a troop of cavalry—the men and horses, however, all flayed. The men held torches in their hands, the red of which illuminated faces without skin, and bloody muscles. Their hollow eyes rolled fearfully in their sockets, their mouths opened from ear to ear, and helmets of hanging flesh covered their hideous faces. The horses dragged along their own skins in the kennels, which ran with blood. Pale and dishevelled women appeared and disappeared at the windows in dismal silence; low, inarticulate groans filled the air, and I remained in the street alone, petrified with horror and deprived of strength sufficient to seek my safety in flight. This horrible troop continued passing along rapidly in a gallop, and casting frightful looks upon me. Their march continued, I thought, for five hours, and they were followed by an immense number of artillery wagons full of bleeding corpses, whose limbs still quivered; a disgusting smell of blood and bitumen almost choked me. At length the iron gates of the prison shutting with great force awoke me again. I made my repeater strike; it was no more than midnight; so that the horrible phantasmagoria had lasted no more than two or three minutes—that is to say, the time necessary for relieving the sentry and shutting the gate. The cold was severe and the watchword short. The next day the turnkey confirmed my calculations. I nevertheless do not remember a single event in my life the duration of which I have been able more exactly to calculate, of which the details are more deeply engraven on my memory, and of which I preserve a more perfect consciousness." No instance can more strikingly exemplify aberrations of the faculty of judgment than the above. There was no astonishment felt at the horror experienced, but all the impossible events which appeared to be taking place were ac

cepted as facts which might have occurred in the regular order of nature.

My opinion, therefore, is, that during sleep the power of bringing the judgment into action is suspended. We do not actually lose the power of arriving at a decision, but we cannot exert the faculty of judgment in accordance with the principles of truth and correct reasoning. An opinion may therefore be formed during sleep, but it is more likely to be wrong than right; and no effort that we can make will enable us to distinguish the false from the true, or to discriminate between the possible and the impossible. That faculty of the mind, the judgment, which when we are awake is pre-eminently our guide, can no longer direct us aright. The stores of experience go for naught, and the mind accepts as truth whatever preposterous idea the imagination presents to it. We are not entirely rendered incapable of judging, as some authors assert, but the power to perceive the logical force of circumstances, to take them at their true value, and to eliminate error from our mental processes, is altogether arrested, and we arrive at absurd conclusions from impossible premises.

But there is no doubt that at times the faculty of judgment is suspended as regards some parts of our mental operations during sleep, and this to such an extent that we are not capable of recognizing our own individuality. Thus, it is related of Dr. Johnson that he had once in a dream a contest of wit with some other person, and that he was very much mortified by imagining that his opponent had the better of him. "Now," said he, "we may mark here the effect of sleep in weakening the power of reflection; for had not my judgment failed me, I should have seen that the wit of this supposed antagonist, by whose superiority I felt myself depressed, was as much furnished by me as that which I thought I had been uttering in my own character." Van Greuz dreamt that he could not answer questions to which his neighbor gave correct responses. An interesting case in which the judgment was still more at fault has recently come to my knowledge. Mrs. C. dreamed that she was Savonarola, and that she was preaching to a vast assembly in Florence. Among the audience was a lady whom she at once recognized to be her own self. As Savonarola she was delighted at this discovery, for she reflected that she was well acquainted with all Mrs. C.'s peculiarities and faults of character, and would therefore be enabled to give special emphasis to them in the sermon. She did this so very effectively that Mrs. C. burst into a torrent of tears, and with the emotion thus excited the lady awoke. It was some time before she was able to disentangle her mixed-up individualities. When she became fully awake, she perceived that the arguments she had employed to bring about the conversion of herself were puerile in the extreme, and were directed against characteristics which formed no part of her mental organization, and against offences which she had not committed.

Why the judgment is not properly exercised during sleep we do not know. Dr. Philip believes that in this condition ideas flow so rapidly that they are not submitted to the full power of the judgment, and that hence the absurdity which characterizes them is not perceived. But this explanation is by no means satisfactory; for a merely swift succession of ideas is no very serious bar to correct judgment, and when the thoughts are as preposterous as those which so often occur in dreams, they present no obstacle at all to a proper estimation of them by the healthy mind. The cause probably resides in some alteration in the circulation of the blood in that part of the brain which presides over the judgment, whereby its power is suspended and the imagination left free to fill the mind with its incongruous and fantastic images.

As regards the will, we find very opposite opinions entertained relative to its activity; but no one, so far as I am aware, appears to have had correct views upon the subject. Without going into a full discussion of the views enunciated, it will be sufficient to refer to the ideas on the point in question which have been expressed by some of the most eminent philosophers and physiologists. In the course of his remarks on sleep, Darwin repeatedly alleges that during this condition the action of the will is entirely suspended, but he falls into the singular error of confounding volition with the power of motion. Thus, he says: "When by one continued posture in sleep some uneasy sensations are produced, we either gradually awake by the exertion of the volition, or the muscles connected by habit with such sensations alter the position of the body; but when the sleep is uncommonly profound and these uneasy sensations great, the disease called incubus or nightmare is produced. Here the desire of moving the body is painfully exerted, but the power of moving it, or volition, is incapable of action until we are awake." In consequence of this misapprehension of the nature of the will it is not easy to arrive at Darwin's ideas on the subject; and the attempt is rendered still more difficult from the fact that though he repeatedly states that volition is entirely suspended during sleep, he yet in the first part of the foregoing quotation makes an individual awake by the gradual exercise of the power of the will, and then in the last part of the same paragraph asserts that volition is incapable of action till sleep is over.

Mr. Dugald Stewart contends that during sleep the power of volition is not suspended, but that those operations of the mind and body which depend on volition cease to be exercised. In his opinion, the will loses its influence over all our powers both of mind and body in consequence of some physical alteration in the system which we shall never probably be able to explain. A very little reflection will suffice to convince the reader that Mr. Stewart has altogether mistaken the nature of sleep. There is no evidence to support his view that the body is not subject to the action of the will during sleep. No change whatever is induced by this condition in the nerves or muscles of the organism. The first are just as capable as ever of conducting the nervous fluid, and the muscles do not lose any of their contractile power. The reason why voluntary movements are not performed during sleep is simply because the will does not act. And Mr. Stewart is again wrong in asserting that volition is not then suspended. We do not will any actions when we are asleep: we *imagine* we do, and that is all. The difficulties which encompass us when we sleep are, it must be recollected, purely imaginary, and the efforts we make to escape from them are likewise the products of the fancy. Herein lies the main error which Mr. Stewart has committed. He appears to accept the dream for a reality, and to regard the seeming volitions which occur in it as actual facts, whereas they are all entirely fictitious. An example will serve to make this point still clearer. Not long since I dreamed that I stood upon a very high perpendicular table-land, at the foot of which flowed a river. I thought I experienced an irresistible desire to approach the brink and to look down. Had I been awake, such a wish would have been the very last to enter my mind, for I have an instinctive dread of standing on a height. I dreamed that I threw myself on my face and crawled to the edge of the cliff. I looked down at the stream, which scarcely appeared to be as wide as my hand, so great was the altitude upon which I was placed. As I looked I felt an overpowering impulse to crawl still farther and to throw myself into the water below. I imagined that I endeavored with all my will to resist this force, which appeared to be acting by means altogether external to my organism. My efforts, however, were all in vain. I could not control my movements, and gradually I was urged farther and farther over the brink, till at last I went down into the abyss below. As I struck the water I awoke with a start. During my imaginary struggles I thought I experienced all the emotions which such an event, if real, would have excited, and I was painfully conscious of my utter inability to escape from the peril of my situation. Here were circumstances such as, according to Mr. Stewart, demonstrate the activity of the volition, but at the same time show its inability to act upon the body. But clearly they show no such thing, for the imaginary volition was to refrain from crawling over a precipice which did not exist, and over which therefore I was not hanging. Such an act of the will, if real, could not, in the very nature of the real conditions of the situation, have been carried out; the volition was just as imaginary as all the other circumstances of the dream.

Again, it is not always the case that the imaginary acts of the will are not executed during sleep; and hence it would follow from Mr. Stewart's argument that the power of the will over the body is not then suspended. Assuming for a moment that the volitions of sleep are real, as Mr. Stewart supposes, if it can be shown that they are satisfactorily performed, it results from his line of reasoning that the will has power over the body during sleep. Every one who has dreamed has at times had his will carried out to his entire satisfaction. He has ridden horses when pursued, and has urged them forward with whip and spur so as to escape from his enemies; or he has executed the most surprising feats both with his mind and body, and has performed voluntary deeds which have excited the admiration of all beholders. Such acts are of course entirely the product of the imagination, and all the volitions which accompany them have no firmer basis than the unbridled fancy; but, according to Mr. Stewart, they would be evidence of the power of the will over the body—a power which in reality does not exist; not, however, as Mr. Stewart supposes, from any impediments in the nerves or muscles, but because it is never exerted.

So far as relates to movements performed during sleep, such as turning in bed and assuming more comfortable positions, they have nothing whatever to do with the will.

They are dependent upon the action of the spinal cord, an organ that is never at rest, and the functions of which were not known as well when Dr. Darwin and Mr. Stewart wrote as they are now. The same is true of more complex and longer-continued actions, such as those already mentioned of individuals riding on horseback, or even walking, during sleep. The theory that the will is in action during sleep is therefore, to my mind, untenable. It has probably had its origin in the idea that confounds it with desire, from which it differs so markedly that it seems strange the distinction should ever fail to be made. Locke points out very clearly the differences between the two faculties. In fact, they may be exerted in directly opposite ways. Desire often precedes volition; but we all at times will acts which are contrary to our desire, and desire to perform others which we are unable to will. That desire is manifested during sleep there can be no doubt; and Mr. Stewart, although insisting as he does on the distinction between this faculty and volition, confounds them in his remarks already referred to. A person suffering from nightmare has a most intense desire to escape from his imaginary troubles. In my own dream, to which reference has been made, my desire to restrain myself from crawling over the precipice was exerted to the utmost, but the will could not be brought into action. Darwin, when he says that in nightmare "the *desire* of moving the body is painfully exerted, but the *power of moving it in volition* is incapable of action till we awake," makes the proper distinction between desire and will, but, as I have already shown, confounds the latter with another very different faculty.

From the foregoing observations it will be seen that during sleep the three great divisions of the mind are differently affected. (1) Feeling, embracing sensation and emotion, is suspended so far as the first is concerned, but is in full action as regards the second. We do not see, hear, smell, taste, or enjoy the sense of touch in sleep, although the brain may be aroused into activity, and we may awake through the excitations conveyed to it by the special senses. The emotions have full play, unrestrained by the will, and governed only by the imagination. (2) The will or volition is entirely suspended. (3) The thought or intellect is variously affected in its different powers. The imagination is active, and the memory may be exercised to a great extent, but the judgment, perception, conception, abstraction, and reason are weakened, and sometimes altogether lost.

In the next place, we have to inquire into the circumstances which make sleep necessary to the system, and which are in force in all organic things, whether plants or vegetables. The state of general repose which accompanies sleep is of especial value to the organism in allowing the nutrition of the nervous tissue to go on at a greater rate than its destructive metamorphosis. The same effect is of course produced upon the other structures of the body, but this is not of so much importance as regards them, for while we are awake they all obtain a not inconsiderable amount of rest. Even those actions which are most continuous, such as respiration and the pulsation of the heart, have distinct periods of suspension. Thus, after the contraction and dilatation of the auricles and ventricles of the heart there is an interval during which the organ is at rest. This amounts to one-fourth of the time requisite to make one pulsation and begin another. During six hours of the twenty-four the heart is therefore in a state of complete repose. If we divide the respiratory act into three equal parts, one will be occupied in inspiration, one in expiration, and the other by a period of quiescence. During eight hours of the day, therefore, the muscles of respiration and the lungs are inactive. And so with several glands, each has its time for rest; and of the voluntary muscles, none, even during our most untiring waking moments, are kept in continued action. But for the brain there is no rest except during sleep, and even this condition is, as we have seen, only one of comparative repose. So long as an individual is awake there is not a single second of his life during which the brain is altogether inactive, and even while he is deprived by sleep of the power of volition nearly every other faculty of the mind is capable of being exercised, and several of them—as the imagination and memory, for instance—are sometimes carried to a state of exaltation not ordinarily reached by direct and voluntary effort. If it were not for the fact that all parts of the brain are not in action at the same time, and that thus some slight measure of repose is afforded, it would probably be impossible for the organ to maintain itself in a state of integrity. During wakefulness, therefore, the brain is continually in action, though this action is not always of such a character as to make us conscious of its performance. A great deal of the power of the brain is expended in the continuance of functional operations necessary to our well-being. During sleep these are altogether arrested as regards some, or else materially retarded in force and frequency so far as others are concerned.

Many instances of what Dr. Carpenter very happily calls "unconscious cerebration" will suggest themselves to the reader. We frequently find suggestions occurring to us suddenly—suggestions which could only have arisen as the result of a train of ideas passing through our minds, but of which we have been unconscious. This function of the brain continues in sleep, but not with so much force as during wakefulness. The movements of the heart, of the respiratory muscles, and of other organs which perform either dynamic or secretory functions are all rendered less active by sleep, and during this condition the nervous system generally obtains the repose which its ceaseless activity during our periods of wakefulness so imperatively demands. Sleep is thus necessary in order that the body, and especially the brain and nervous system, may be renovated by the formation of new tissue to take the place of that which by use has lost its normal characteristics. For the substance of this organ is consumed by every thought, by every action of the will, by every sound that is heard, by every object that is seen, by every odor that is smelled, by every pleasurable or painful sensation; and so each instant of our lives witnesses the decay of some portion of its mass, and the formation of new material to take its place. When we are awake, the expenditure exceeds the income, but when we sleep, the balance is restored. If we do not sleep, we are burning our candle at both ends, and we are in the position of the spendthrift, whose receipts not being sufficient for his extravagances, makes inroads upon his capital. For him financial, for us intellectual bankruptcy, is not far distant.

As to the immediate causes of sleep, it was formerly almost uniformly attributed to an increase in the amount of blood in the brain, but recent investigations instituted by Mr. Durham and myself, independently of each other, have established the fact to the satisfaction of physiologists that sleep is the direct consequence of a diminished amount of blood in the cerebral blood-vessels, and that unless this diminution takes place sleep is impossible. The consideration of these experiments in their entirety, though interesting, would lead us too far into technical grounds.

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W. A. HAMMOND.

Sleep'er, a name given to several fishes: (1) At some points in New England (*e. g.* Marblehead, according to Lesueur) it is applied to the *Somniosus microcephalus*, a shark belonging to the family Scymnidæ: this is distinguishable by the absence of an anal fin, the nearly equal length of the dorsals (which have no spines), and the oblique truncate lower teeth: it attains a length sometimes of twenty-five feet or more, and is an inhabitant of the Northern Atlantic, descending on the American side as far southward as Cape Cod. (2) On the coasts of Florida and Jamaica it is bestowed on the *Ginglymostoma cirratum*, also a shark, but belonging to a peculiar family, the Ginglymostomidæ, and distinguished by the position of the first dorsal behind the ventrals, and the teeth, which are in many rows, each tooth having a strong median cusp, and one or two much smaller ones on each side. The species sometimes attains a length of nearly ten feet. (3) In some of the West Indian islands the same name is given to species of the gobivid sub-family Eleatridinæ; these are rather small fishes (rarely much if at all exceeding a foot in length), of an elongated form, and recognizable by the development of two quite widely-separated dorsals, the first of which has six slender spines, and the thoracic ventrals, which have each a spine and five rays, the inner half of which are longest. THEODORE GILL.

Sleep'ing Bear, tp., Leelenaw co., Mich. P. 310.

Sleep of Plants, the diurnal or nocturnal suspension of some of the vegetative functions. It is not to be confounded with the annual rest from functional activity which characterizes most perennial plants. The latter is analogous to hibernation, the former to the true sleep of animals. The sleep of plants is sometimes evinced by the

closure of petals and the drooping or other change of position in the leaves. (The differences in some of the functional activities of plants by day and those occurring by night are noticed in the RESPIRATION IN PLANTS.)

Sleepy Creek, tp., Morgan co., West Va. P. 374.

Sleepy Eye, p. v., Brown co., Minn., on Winona and St. Peter R. R., between Minnesota and Cottonwood rivers, has 4 churches, 1 high school, 1 newspaper, wheat elevator and storehouse with a capacity of 200,000 bushels, and 5 hotels. P. about 500. J. W. TAYLOR, ED. "ARGUS."

Sleepy Hole, tp., Nansemond co., Va. P. 2112.

Sleepy Hollow, tp., Barnwell co., S. C. P. 1219.

Slei′dan (JOHANN), whose true name was PHILIPPSOHN, b. at Schleiden, near Cologne, in 1506; studied jurisprudence at Liege, Cologne, Louvain, Paris, and Orleans; was employed by Francis I. as his representative at the Diet of Regenburg; settled afterward, having embraced the Reformation, as a professor of law at Strasbourg; was appointed historiographer by the princes of the Smalkaldian League; represented the city of Strasbourg at the Council of Trent. D. in Strasbourg Oct. 31, 1556. His *De Statu Religionis et Reipublicæ, Carolo Quinto Cæsare, Commentarii* (Strasbourg, 1555), best ed. by Am. Eude (3 vols., Frankfort, 1785), gives a history of the Reformation from 1517 to 1556, and is distinguished both for the impartiality of its view and for the elegance of its style. It was translated into English by Edmund Bohun in 1689, under the title *General History of the Reformation begun in Germany by Martin Luther*. He also wrote *De quatuor Summis Imperiis* (1556; often reprinted) and *Summa Doctrinæ Platonis de Republica et de Legibus* (1548).

Slem′mer (ADAM J.), b. in Montgomery co., Pa., in 1828; was graduated from the U. S. Military Academy July 1, 1850, when appointed brevet second lieutenant in the artillery; first lieutenant 1854. Served a short campaign in Florida against the Seminoles 1850–51; on frontier duty in California 1851–54. Detailed for duty at West Point in 1855, he served as assistant professor of geography and history a year, and of mathematics 1856–59. In the latter year he returned to his company, at Fort Moultrie, S. C., and in 1860 was transferred to Florida, where, in 1861, he commanded the small body of U. S. troops in Pensacola harbor, occupying with them Fort Barrancas and the neighboring feeble Barracks, which, upon intelligence of the surrender of the Pensacola navy-yard reaching him, he transferred (Jan. 10) to Fort Pickens, opposite: which prompt action prevented the seizure of that important work by the seceding States (see FORT BARRANCAS and FORT PICKENS), and which he held until reinforced in April, when superseded in command by Col. Harvey Brown. On May 4 he was appointed major of the 16th Infantry, and ordered to New York harbor; was engaged in recruiting his regiment July–August, then acting inspector-general of the department of the Ohio until November, when compelled by ill-health to take leave of absence. Returning to duty in May, 1862, he was attached to Gen. Buell's army, and participated in the siege of Corinth and in the subsequent movement to Louisville, Ky., and to the relief of Nashville, Tenn. He was commissioned a brigadier-general of volunteers Nov. 29, 1862, and engaged in the battle of Murfreesboro', Dec. 31, where severely wounded and incapacitated from further active service in the field. From July, 1863, to the close of the war he served as president of an examining board. In Aug., 1865, he was mustered out of the volunteer service, and resumed his regular army commission, at that date lieutenant-colonel 4th Infantry. For gallantry at Murfreesboro' he was brevetted lieutenant-colonel, and for gallant and meritorious conduct during the war colonel and brigadier-general. In enfeebled health he served on garrison duty until Oct., 1866, when placed on board duty. D. at Fort Laramie Oct. 7, 1868.

Sleswick. See SCHLESWIG.

Sley′dinge, town of Belgium, province of East Flanders, manufactures linen, leather, candles, mustard, and vinegar. P. 5797.

Slick′ensides, a peculiar polished and striated surface found commonly on the wall-rocks of mineral veins or faults, and where slate, shale, coal, and other fine materials have been crumpled and folded by pressure. Not unfrequently a foreign body, such as a concretion, shell, or nut lying in an argillaceous rock of which the particles have been moved on each other with great force, shows the polished striated surface to which this name has been given. J. S. NEWBERRY.

Slidell′ (JOHN), b. in New York City about 1793; graduated at Columbia College 1810; settled at New Orleans, where he became a distinguished lawyer; U. S. district attorney 1829–33; member of Congress 1843–45; appointed minister to Mexico 1845, but not received by the Mexican government; was U. S. Senator 1853–61; withdrew in consequence of the secession of his State, which he had done much to promote; sailed for Europe as commissioner of the Confederate government to France; was taken from the Trent with Mason, Nov. 8, 1861, but given up Jan. 1, 1862, and resided in England until his death, at London July 29, 1871.

Sliding Rule, an instrument for solving arithmetical, trigonometrical, and other problems with approximate accuracy. Several forms are made, but that invented by the Rev. William Oughtred (1573–1660) is the best known. The rule is chiefly used in gauging, in measuring timber, etc. It consists of two pieces, one of which slides on the other. Each is marked with certain figures; and when a given number on one piece corresponds in position to a given number on the other, their product or other function is seen at once by inspection. The sliding rule may be constructed with various scales, each adapted to some particular use.

Sli′go, county of Ireland, province of Connaught, borders N. on the Atlantic, comprises an area of 721 sq. m. The surface is mountainous E. and N. E.; Trushmore rises to the height of 2072 feet. The western part is level, the soil mostly consisting of a light sandy or gravelly loam, interspersed with patches of bog. There are, however, districts with a deep and rich soil well adapted for tillage. Agriculture is the principal occupation, especially cattle-breeding and dairy-farming. Some coarse woollen stuffs are manufactured, and fishing is occasionally carried on. P. 180,809 in 1841, 128,510 in 1851, 124,845 in 1861, 115,493 in 1871. Between 1851 and 1872, 27,608 persons emigrated. Of the present pop., 43,219 are unable to read or write. Principal town, Sligo.

Sligo, town of Ireland, capital of the county of Sligo, in the neighborhood of charming scenery, at the head of the Bay of Sligo, has a good harbor. Its manufactures are not important, but it carries on an extensive trade in grain, flour, meal, butter, provisions, and yarn. P. 9340.

Sling, a simple contrivance for hurling missiles, consists of a small disk of leather pierced by a hole and suspended by one, two, or three strings, say a yard long. A stone or other missile is placed upon the leathern disk, and then whirled rapidly about for a time, when one of the strings is dropped from the hand at the proper instant, and the missile is sent with great force through the air. The ancient Greek light-armed troops used the sling (σφενδόνη; Lat. *funda*), often with a plummet of lead instead of a stone. These bullets are well known to antiquarians. They frequently bear the word ΔΕΞΑΙ, "Take this," or some similar word. The Persians, Achæans, Acarnanians, and especially the Balearians, were famous slingers. The latter used either hand; and we are told that parents obliged their sons to strike their food down with the sling from a pole where it was hung before they were allowed to eat it. Hence their great skill. As late as 1686 British grenadiers were armed with slings.

Slippery Rock, p.-v. and tp., Butler co., Pa. P. 879.

Slippery Rock, tp., Lawrence co., Pa. P. 1778.

Sloan (SAMUEL), b. at Lisburn, near Belfast, Ireland, Dec. 25, 1817; was taken to America in infancy, arriving in New York in 1819; received a common-school education; held several local offices in Kings co., N. Y., and in 1855 was elected president of Hudson River R. R. Co., holding that office for about ten years. Subsequently for two years he acted as commissioner of the "trunk lines" of railroad to the West, as general arbitrator of competitive disputes; in 1863 was elected president of Delaware Lackawanna and Western R. R. Co., which position he now holds. He is also president of Marquette Houghton and Ontonagon R. R. of Michigan and International and Great Northern R. R. of Texas. J. B. BISHOP.

Sloane (Sir HANS), BART., F. R. S., b. at Killyleagh, county Down, Ireland, Apr. 16, 1660; became a distinguished physician at London; went to Jamaica in 1687 as physician to the governor, the duke of Albemarle; made there a large collection of plants and other objects of scientific interest; became physician to Christ's Hospital, London, 1694, and retained that post thirty-six years; was influential, as secretary of the Royal Society, in reviving the *Philosophical Transactions* as the organ of that body, and edited it for many years; was made physician-general to the army and a baronet 1716; became president of the College of Physicians 1719, of the Royal Society 1727, and physician to the king in the latter year. D. in Chelsea Jan. 11, 1753. Author of *The Natural History of Jamaica* (2 vols. folio, 1707–25) and various other publications. His magnificent library and collections of botany and natural history were, in accordance with his will, sold to the nation for £20,000, a sum considered to represent not more than a

fourth of their value. The Sloane collections became the nucleus of the British Museum.

Sloan's, tp., Moore co., N. C. P. 2206.

Sloan's Station, p.-v. and tp., Jefferson co., O., on Ohio River and on River division of Cleveland and Pittsburg R. R. P. 476.

Sloat (JOHN DRAKE), b. in New York City in 1780; entered the U. S. navy as a sailing-master 1800; was engaged in the action between the United States and the Macedonian Oct. 25, 1812; served in the expedition against West Indian pirates 1824–25; was commander of the Pacific squadron 1846–52; was next placed in charge of the Norfolk navy-yard; superintended the construction of the Stevens battery at Hoboken: became commodore (retired list) July 16, 1862, and rear-admiral July, 1866. D. at New Brighton, Staten Island, N. Y., Nov. 28, 1867.

Slobodskoi', town of Russia, government of Viatka, on the Viatka, has a large trade in corn. P. 6032.

Slo'cum, p.-v. and tp., Luzerne co., Pa. P. 317.

Slocum (HENRY WARNER), b. at Pompey, Onondaga co., N. Y., Sept. 24, 1827; was graduated from the U. S. Military Academy July 1, 1852, when appointed second lieutenant of artillery; first lieutenant 1855. After a brief campaign in Florida against the hostile Seminoles, he served in garrison at Fort Moultrie, S. C., until Oct. 31, 1856, when he resigned from the army to enter upon the practice of law at Syracuse, N. Y.; was a member of the New York State legislature in 1859. On the outbreak of civil war he tendered his services, and May 21, 1861, was appointed colonel of the 27th New York Vols., which regiment he led in the battle of Bull Run, July 21, where severely wounded. Early in August he was commissioned brigadier-general of volunteers. Returning to duty in September, he was assigned to command of a brigade in Franklin's division of the Army of the Potomac, and in the Virginia Peninsular campaign of 1862 was engaged in the siege of Yorktown and action of West Point, succeeding to command of the division May 15, on Franklin's assignment to the 6th corps. At the battle of GAINES'S MILL, June 27 (which see), his command was sent to Porter's relief at a critical period, and rendered important service; at the battle of GLENDALE, June 30 (which see), it held the right of the main line, as at Malvern Hill, July 1. He was made a major-general of volunteers July 4, and engaged in the second battle of Bull Run, of South Mountain, and of Antietam. In October he was assigned to the command of the 12th corps, which he led at the battle of Chancellorsville and at Gettysburg, where in command of the right wing of the army. Transferred, with his corps, to the West, he served in the department of the Cumberland until Apr., 1864, when, his corps being consolidated with the 11th, he was assigned to a division, and command of the district of Vicksburg. In Aug., 1864, he succeeded Gen. Hooker in command of the 20th corps, which was the first to occupy Atlanta, Ga., Sept. 2. In Sherman's "march to the sea" and invasion of the Carolinas he commanded the left grand division or wing of that army, participating in all its engagements, from the departure from Atlanta to the surrender of Johnston at Durham Station, N. C., and in its subsequent march to Washington, where disbanded. In Sept., 1865, he resigned, and resumed the practice of his profession at Brooklyn, N. Y., declining in 1866 the appointment of colonel of infantry in the regular army. Was Democratic candidate for secretary of state of New York in 1865, but defeated; was elected to the 41st and to the 42d Congress, and in 1876 was appointed president of board of public works of Brooklyn.

Sloe, the fruit of *Prunus spinosa*, a small thorny plum tree of Europe, sparingly naturalized in the Eastern U. S. This black austere fruit is used for preserves, for making a factitious port wine, and for dyeing black. The unripe fruit yields German acacia, a substitute for gum-arabic, and the wood is made into walking-sticks.

Slo'nim, town of Russian Poland, government of Grodno, has some manufactures, and 8708 inhabitants.

Slootsk, town of Russian Poland, government of Minsk, on the Slootch; is built of wood. P. 5174.

Sloth [Ang.-Sax. *slǽwdh*], the English name for the species of the family Bradypodidæ, notable for sluggishness. The form is quite characteristic, and somewhat recalls that of the Primates (man and monkeys) in the exclusion of the members from the common abdominal integument, the length of the limbs, and especially of the fore ones, and the atrophy of the tail. The skull is oblong and compressed, with the rostral portion much abbreviated; the intermaxillary bones much reduced; the supramaxillaries widest in front and converging backward; malar bones disconnected from the zygomatic processes of the squamosal bones, and each with a "supratemporal" process; "the mastoid bone with a wide digastric fossa, and a strong, thick styloid process, terminating in a circular concavity for the reception of the stylohyal bone:" the lower jaw has a gutter-like symphysis; molar teeth $\frac{5}{4} \times 2$, simple and rounded; the members are slender and elongated, the anterior especially so; pelvis moderate; posterior limbs shorter than the anterior; toes in reduced numbers, two or three (fully developed) in front and three behind. The species thus agreeing differ considerably in other characters. (1) Some have three fully-developed toes to the front as well as hind feet, and rudimentary lateral (first and fifth) ones; these have also the thorax comparatively short, and expanded toward the middle, and with about fifteen ribs: the neck is rather elongate, and provided with nine vertebræ, and the tail is moderately developed (with about ten vertebræ). Such are the Bradypodinæ. (2) Others have two toes to the front feet, but three to the hind (besides which, however, are lateral ones represented by metacarpals); the thorax is elongated and subcylindrical, and with about twenty one ribs: the neck is comparatively short, and with six or seven vertebræ; the tail is almost wanting. To this group has been given the name Cholœpodinæ. All the species are confined to South and Central America. Numerous peculiar characters in addition to those mentioned are exhibited by the skeleton, as well as by the nervous, vascular, muscular, and digestive systems. One of the most remarkable features is the number of cervical vertebræ. Almost without other exceptions (the manatees form one) mammals have seven cervical vertebræ, and no more or less; but in the sloths some (the Bradypodinæ) have as many as nine, while one (*Cholœpus Hoffmannii*) has only six, although its near relations (*e. g. Cholœpus didactylus*) have seven. The species are ill-adapted for progression on the ground, the feet being bent inward or "club-footed," but are admirably fitted for life in the trees. Unlike all other mammals, they cling to the branches by their feet with the back downward, and thus they progress, feed, and sleep. They rarely or never voluntarily descend to the ground, but when one tree is denuded of its leaves proceed from it to a contiguous one by means of interlocking or neighboring boughs. The species have not yet been definitely distinguished. By the latest writer on the group (Dr. J. E. Gray) twelve species are admitted—viz. two of *Bradypus* and eight of *Arctopithecus* (both of which genera belong to the sub-family Bradypodinæ), and two of *Cholœpus*, the type of the sub-family Cholœpodinæ. THEODORE GILL.

Slough, tp., Limestone co., Ala. P. 1468.

Slough (JOHN P.), b. at Cincinnati, O., in 1829; became a lawyer in his native city, and a member of the Ohio legislature, from which he was expelled for striking a fellow-member (1850); settled soon afterward in Kansas, and subsequently (1860) at Denver, Col.; raised a company of volunteers at the outbreak of the war, and became colonel of the 1st Colorado regiment, which formed a part of Gen. Canby's expedition to New Mexico; fought there, against orders, the battle of Pigeon's Ranche, gaining a victory over Gen. Sibley, who was forced to withdraw to Texas; went thereafter to Washington, where he was made brigadier-general and military governor of Alexandria; was appointed chief-justice of New Mexico by Pres. Johnson, and killed in an affray with a senator of the Territorial legislature Dec. 16, 1867.

Slo'vaks, a nation belonging to the Slavic family, inhabit the north-western part of Hungary, between the Carpathian Mountains and the Danube, and the adjacent regions of Moravia and Austria. Here they formed an independent empire, the kingdom of Moravia, in the ninth century, and fought with success against the Avars, but in 907, in the battle of Presburg, they were defeated by the Magyars, their kingdom dissolved, and the larger part of the nation incorporated with the Magyars, to whom, however, they never became reconciled. Their number is estimated at about 3,000,000, of which two-thirds are Roman Catholics and the rest Protestants. Their language is closely related to the Bohemian, and as the Reformation was introduced among them from Bohemia, the original Slovak language became so mixed up with Bohemian elements, and was so entirely superseded by the Bohemian as a means of literary communication, that it was on the point of disappearing. Of late, however, much pains has been taken to reinstate it in its natural rights, and books, periodicals, and newspapers are now published in it. Two collections of popular ballads (Pesth, 1823, and Ofen, 1834) have attracted great attention by the peculiar beauty of the songs. The Slovaks are chiefly agriculturists; many of them, however, stroll over all European countries as peddlers. The manufacture of mousetraps and other kinds of wire-work is a branch of industry much cultivated among them.

Sloventzi, Slovenes, Vinds, or **Corutans,** a South Slavic race of Carinthia, Carniola, Styria, and Hungary, number 1,260,000, and are mostly Roman Catholics of the Latin rite. The name *Vinds*, long applied to this people, has led to the confounding of them with the WENDS (which see), a distinct but remotely kindred race. The Vindish language is allied to the Servian. It is written in the Roman alphabet, and was, we are told, the first Slavic language to receive literary culture. But the suppression of the Reformation crushed its rising literature. There is, however, considerable recent literature, mostly religious.

Slow′-Worm, a name given occasionally to several species of reptiles of the order Sauria—*e. g. Anguis fragilis.*

Slug, a name applied to naked terrestrial mollusks, especially those of the families Arionidæ and Limacidæ. Both of these agree in having the body elongated, depressed, and attenuated backward; the mantle moderately developed; four tentacles, of which the posterior are large and support the eyes at their extremities, and the anterior are small; they differ, however, decidedly in several respects. The Arionidæ have the body subtruncated behind, and furnished with a muciferous pore; the lateral teeth of the lingual ribbon are modified on the plane of the median, and mostly more or less bicuspid; and the jaw is ribbed. The Limacidæ have the body pointed behind, and destitute of a pore, the lateral teeth of the tongue are uncine or aculeate, and the jaw is ribless. The name is also loosely applied to other naked mollusks, both of the land and the water. (See LIMACIDÆ, etc.) THEODORE GILL.

Slug′-Worms, popularly but incorrectly called **Slugs,** are the larvæ of certain of the saw-flies (Tenthredinidæ), insects usually assigned to the Hymenoptera, but in many respects resembling the Lepidoptera. The larvæ in question are slug-like in form. In the U. S. the pear, rose, vine, raspberry, walnut, linden, and other trees are infested with the larvæ of a peculiar species of *Selandria*, which are often very destructive. Decoctions of tobacco or quassia, whale-oil soap, a weak solution of carbolic acid, and petroleum are among the substances recommended for showering shrubs and trees infested with slug-worms. For small trees and shrubs hand-picking should be resorted to.

Smack′over, tp., Ouachita co., Ark. P. 660.

Smalcald. See SCHMALKALDEN and THIRTY YEARS' WAR.

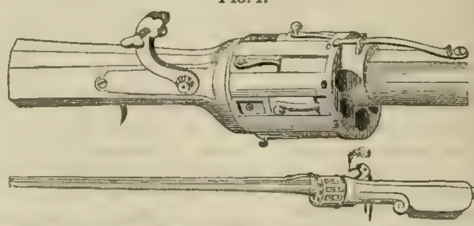
Small (JOHN), b. at Strathardle, Scotland, in 1726; served in the Scotch brigade in the Dutch service, in the pursuit of the Jacobites of Scotland 1747, at Ticonderoga 1758, at Montreal 1760, and in the West Indies 1762; was in the battle of Bunker Hill; raised a corps of Highlanders in Nova Scotia, the 84th battalion, known as the "Royal Emigrants," which he commanded as major in the campaigns of New Jersey and Pennsylvania; became lieutenant-colonel 1780, lieutenant-governor of Guernsey 1793, and major-general 1794. D. at Guernsey Mar. 17, 1796.

Small′-Arms, portable firearms: known as muskets, musketoons, rifles, carbines, pistols, and sporting arms or fowling-pieces. The chief components of small-arms are known as follows: The *barrel*, as smooth-bores or rifles, muzzle-loaders or breech-loaders; the *lock*, as match-lock, wheel-lock, or flint-lock, prior to the discovery of percussion powder; and as cap-lock, primer-lock, firing-pin lock, or needle-lock, since the introduction of percussion powder; the *stock*, as half-stock or full-stock.

The earliest firearms in use were not portable arms. Cannon, called bombards, were used "*in the attack*" upon towns and ships as early as 1350, but the Burgundians, in the *defence* of Arras in 1414, first successfully employed smaller tubes throwing lead balls. These were movable from place to place on the walls, and in order to check recoil the barrels were made with a hook near the muzzle to catch against the face of the wall; hence they were called *arquebuse*, or "hook-guns." For field use they were placed upon tripods, and in 1471, 300 Flemings, thus armed, accompanied Edward IV. when he landed at Ravenspur. The service of these arms was so difficult, and they were so little efficient compared with the English bow and arrows, that for fifty years thereafter all attempts to introduce firearms into the English army failed, although they were used in other armies. It is stated in the *United Service Journal* for Sept., 1832 (Moritz Meyer, *Technologie des Armes à Feu*, note, anno 1471), as sufficient explanation for this, that "the English archer of that period who did not discharge twelve arrows per minute, of which one only should fail its aim, was dishonored," and "at the distance of 240 yards the arrow could penetrate two or three inches of oak." Smooth-bore small-arms, even in our day, can do no better, either in rapidity of fire, accuracy of aim, or percussive force.

1471. This arquebuse weighed about 30 pounds, threw a ball of 3 ounces, was fired by a match held by the left hand to the vent on the *left* side of the barrel. Three men were assigned to serve each arm.—1494. An arquebuse, firing a ball of $1\frac{1}{2}$ ounces, and having a match-lock, called a *serpentine*, attached on the right side of the barrel, is adopted in France and Spain for part of the infantry.—1480 to 1500. Fig. 1 shows lock of this description upon a revolving

FIG. 1.



Revolver with matchlock (1500), owned by Court-Antiquary Pickert in Nuremberg.

chambered gun, said to be now in a museum at Nuremberg.—1517. The wheel-lock is invented at Nuremberg, and applied to short arms for cavalry use.—1525. The *mousquet* (said to be so called from Mochetto de Villetri, who first attached barrel and ramrod to the present form of stock) was in use in Italy. It weighed 15 pounds, and was fired from a forked rest, which the soldier carried as a cane. (See Fig. 2.) Each mousqueteer wore a broad belt across the breast, to which wood cases containing the proper charge of powder were attached by leather thongs; also a ball-pouch and a priming-flask. Six yards of slow-match for firing was wound about the stock. At the battle of Pavia these mousquets were used with such effect by the Spaniards under Charles V. that the army of Francis I. of France was utterly routed—"*all lost save honor.*" The balls readily penetrated the best armor of the knights, which, it is said, the old arquebuse balls could not do.

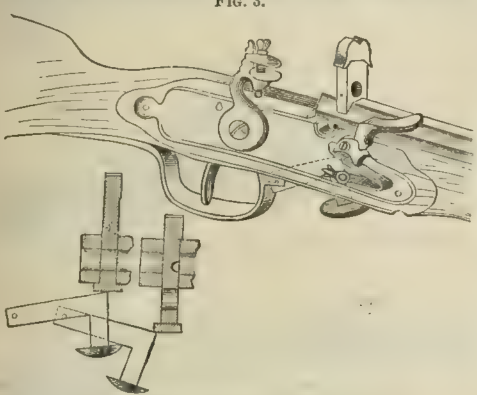
FIG. 2.

Mousqueteer of 1525.

Improvements in the models of small-arms, and in their ammunition, soon became of the first importance to nations; and notwithstanding the great advances made in field artillery, the possession of the best small-arm is even now justly regarded as the first requisite for success in battle. In view of the general interest of this subject, the dates of introduction of some of the important changes in the models and methods of manufacture of small-arms are here given. (For the greater portion of the earlier dates reference has been made to *La Technologie des Armes à Feu*, par Moritz Meyer.)—1530. The French cavalry have a short arquebuse and pistols, both with wheel-locks. A model of an infantry arm of this date shows a *sight*, a *pan-cover*, and the barrel let into the stock.—1540. An arm of this date (in England) loads at the breech, the charge is placed in a tin case, the barrel opens by a hinge at the breech; the lock is a wheel-lock.—1570. The French, German, and Spanish infantry have mousquets, part with wheel-locks and part with match-locks.—1592. A decree of this date abolishes the use of the bow and arrow by the French army.—1610. Gustavus Adolphus introduces cartridges having the ball and powder in the same paper cylinder; also the cartridge-box to receive the number allowed to each soldier. The Swedish musket calibre is fixed this year at 0.72 inch, and so remains until 1810.—1630. A flint-lock is proposed for small-arms in France, and the rifled carbine adopted. Four carbines are to be issued to each cavalry company.—1640. The bayonet is first proposed in France. It is made with a wooden handle, which enters the muzzle of the gun, and must be removed in order to fire.—1647. The mousqueteers are so harassed by the cavalry charging while they are loading their arms that orders are given to arm one-third of each regiment with pikes.—1671. The French adopt a flint-lock arm,

which they call the "*fusile*" (from the Italian name given to the flint-and-steel box, or to the steel used to strike the flint). It has a hammer (with a notch to catch the trigger) placed on the inside of the lock-plate, and a bayonet, with wooden handle to enter the muzzle. The gun weighs only 9½ pounds, and can be fired from the shoulder without a rest. This arm is soon adopted by the Spaniards, Austrians, and Germans.—1686. The English arm three regiments with the French fusil, the 7th, 21st, and 23d; these are called the *Royal Fusileers*, and retain the name to this day on the army list.—1689. The bayonet is fitted with a socket-handle, fitting around the muzzle; said to have been invented by the English general Mackay. This improvement is soon universally adopted.—1700. Figs. 3 and 4

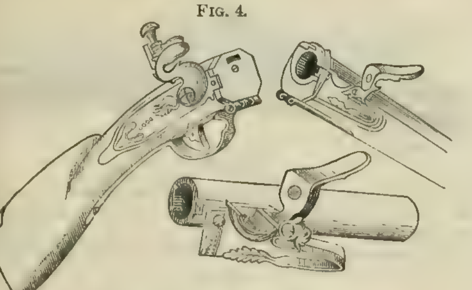
FIG. 3.



Breech-loader of about 1700 (Nuremberg).

show breech-loading arms proposed about this date; models now exist in Nuremberg.—1722. Verifying gauges are

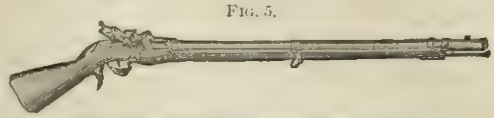
FIG. 4.



Breech-loader of about 1700 (Nuremberg).

adopted for making the new French fusil, called model 1717. It is proposed to make parts of the fusil lock *identical* and *interchangeable*. Trials are commenced at St.-Étienne.—1730. Iron ramrods first introduced. In Russia it is proposed to use the "elliptical ball," having a cavity in the rear, "found to have great percussive force, especially when fired from rifled guns." This is the first suggestion of the present cylindro-ogival ball, with cup in the base. The "*bridle*" of the lock is introduced, also the "*tumbler*," separated from the hammer.—1732. The plan of making lock work "identical" does not succeed, and is abandoned in France.—1738. The buck-and-ball cartridge is introduced in Sweden. The English call their infantry arm "*musket*." The French apply the word *mousquet* to arms made prior to the flint-lock. The flint-lock arms for infantry are called "fusil."—1740. In France it is proposed to rifle the carbine barrel for a length of only 8 inches nearest the muzzle, leaving the calibre of the rest of the barrel the same as the bottom of the grooves. (This plan has recently been again proposed in England and the U. S. In 1874 it was ordered to be fully tried at the U. S. armory, and proved of no advantage.)—1777. A new system of models for all small arms ordered in France.—1785. Gribeauval, in France, proposes to try again to make the metal parts of the fusil "identical and interchangeable." After ten years' work the plan is again abandoned. In the opinion of the commission, "swedging in dies injures the strength of the metal;" "is more expensive, because of more numerous rejections," and "from the rapid destruction of the dies the work is less accurate." Gassendi, in 1819 (*Aide Mémoire d'Artillerie*), warmly condemns the plan as impracticable.—1791. In France the fusil lock is simplified—parts reduced from 20 to 12.—1792. A turning-lathe, to finish the conical exterior of the barrel, is introduced at St.-Étienne in France. The *flats* have to be filed after the turning is finished.—1807. Rev. Mr. Forsyth of England first proposes to use a priming of percussion-powder for small-arms, the powder to be chiefly of chlorate of potassa. At the trial one priming sufficed for forty discharges of the gun.—1813. Hall, in the U. S., proposes a breech-loading arm, to be made on the system of "interchangeable" parts, which had been condemned by the French. (Fig. 5.) He

FIG. 5.



Hall's Breech-loading Musket, patented 1811.

receives an order for trial.—1816. Blanchard, at Springfield Armory, introduces his turning-lathes for the *exterior* of the barrel, finishing the flats in the lathe, as well as the conical parts.—1817. Shaw of Bordentown, U. S., first proposes to use percussion-caps to prime small-arms. Hall having finished 100 of his arms, they are tried by a commission, and found, both in the interchange and quality of work, so satisfactory that he is employed to superintend the introduction of this method of manufacture at the U. S. armory, Harper's Ferry.—1818. In Birmingham, England, musket-barrels are successfully welded and drawn to shape and size under rollers; after the first welding the iron need be at a *red* heat only. A hand machine for rifling barrels is invented in France; the barrel is made to turn regularly as the cutting-rod advances from end to end.—1818. At St.-Étienne the principle of proving the straightness of gun-barrels by the reflection within of a straight edge is said to be understood, although the method of straightening by a string continues in use there and elsewhere for many years after this date.—1819. Fulminate of mercury is first proposed in England for percussion-caps, in place of chlorate of potassa.—1820. This year a copper percussion-cap was brought to France by a workman from England (*Catalogue Musée d'Artillerie*, 1862, p. 637); also, this year the discovery is ascribed to Déboubert (Deane's *Manufacture of Firearms*, 1858, p. 90). Hence Shaw's claim (see 1817) is considered prior to both, and has been so recognized by an honorary award from the U. S. Congress.—1820. Blanchard completes his gun-stock machine at Springfield.—1822. A new model musket is adopted. Many parts made upon the interchangeable system.—1825. Breech-loading muskets and rifles of Hall's pattern are made complete this year at Harper's Ferry, the parts interchangeable and accurate.—1827. 100 of Hall's arms, sent to Springfield in 1824, are brought to Harper's Ferry and there compared with 100 arms of current manufacture. All being dismounted, and the parts of each 100 thoroughly intermingled, are remounted, using for each lot of metal parts the stocks previously belonging to the other lot. All the 200 are found to be well fitted. The cost of manufacture of Hall's arms has been reduced nearly one-half by use of identical machines.—1828. Trials by companies at Fort Monroe of Hall's arms prove them to be very satisfactory as compared with muzzle-loading arms.—1832. Changes of form in many parts of the U. S. flint-lock musket are introduced in 1832 and 1840, with a view to facilitate the machine-work without change of calibre or of ammunition; also, a new model percussion musket is in hand at Springfield in 1840.—1841. The Harper's Ferry rifle, cal. 0.54 inch, made this year, has the percussion lock and cone for cap.—1842. The new model rifle musket, cal. 0.69 inch, is made with percussion lock and cone, and trials in progress to determine the best form of ball.—1844. All flint-lock muskets in store inspected and classified for conversion to percussion, and trials in progress of different plans of alteration. —1847–48. During the war with Mexico the U. S. troops used the following varieties of small-arms: *infantry*, flint-lock and percussion smooth-bore muskets; *cavalry*, percussion B.-L. Hall's carbine, cal. 0.52 inch, North's pattern; *mounted rifles*, Harper's Ferry rifle, cal. 0.54 inch, percussion; *artillery*, musquetoons, smooth-bore, percussion, cal. 0.69 inch; pistols, flint and percussion, both smooth bore, cal. 0.54 inch. The advantage of the interchangeable system of construction—fully tried in this war—proves to be very great in facilitating repairs in the field. All U. S. arms in Mexico are readily kept serviceable by the ordnance company, using extra parts kept ready for exchange. —1853. The English obtain machinery in the U. S. for introducing the U. S. system of manufacture at Enfield. The Maynard tape-primer is ordered to be adopted as a substitute for the percussion-cap, and experiments made this year to perfect the lock and primer. New models are prepared for musket, rifle, and pistol carbine; also a plan of converting smooth-bores to rifled percussion cal. 0.69 inch, by attaching a new lock and breech piece. In doing this work at Frankford arsenal, Philadelphia, rifling-machines are for the first time used which cut three

grooves simultaneously by means of expanding cutters, operated by a central cone in a tubular rod; also, a method of threading breech-screws and tapping barrels by machinery, which for the first time produces identical screws, thus completing the system of interchangeable parts in gun-making. Previously, breech-screws were fitted by hand to each barrel.—1855 and 1856. New models on trial are adopted for all muzzle-loading small-arms to be 0.58 inch cal., and with the primer-lock. Experiments are made testing the best form of elongated ball and weight of cartridge for the different arms.—1860. It is decided to abandon the Maynard primer and use the percussion-cap, without changing lock at present.—1861. War begins in April; Harper's Ferry armory broken up; that at Springfield ordered to be immediately extended.—Mar. 4, 1861. Small-arms in store, as per report of the chief of ordnance:

Muskets, smooth-bore	336,788
Rifles and rifled muskets	106,397
Smooth-bore pistols	24,303
Revolvers	3,928
Breech-loading carbines	4,076
Total	475,492

To increase the supply of arms promptly—in June, 1861—contracts are made (in the U. S.) to manufacture 0.58-inch cal. rifled muskets, to be interchangeable with each other and the Springfield arm, and to manufacture breech-loading rifles, revolvers, and carbines of various patterns; all small-arms, home-made and imported, are purchased as offered. The following table shows the total number of small-arms provided by the government for the use of its armies from Jan. 1, 1861, to June 30, 1866:

1861.	Muskets.			Rifles.		Carbines.		Revolvers.		Pistols.	Remarks.
	S.-bore, flint and perc'n.	Rifled, U. S pattern.	Rifled, foreign.	U. S. muzzle loading.	Repeating and breech-loading.	M.-L. and musquetoon.	B.-L., U. S. makes.	U. S. pattern.	Foreign patt'n	S.-bore muzzle-loaders.	
On hand Mar. 4, 1861	336,788	73,544	....	32,855	....	2,721	1,355	3,928	....	24,303	19 varieties of B.-L. carbines, U. S. pattern.
Purchased in open market and from contractors	113,034	670,617	1,055,862	22,793	32,048	10,838	396,896	360,034	12,789	648	8 varieties of repeating B.-L. rifles, U. S. pattern.
Fabricated U. S. armory	....	805,537	....	....	....	....	....	....	....	....	13 varieties of revolvers, U. S pattern; 3 varieties of foreign revolvers.
Total	449,822	1,559,698	1,055,862	55,648	32,048	13,559	398,251	363,962	12,789	24,951	

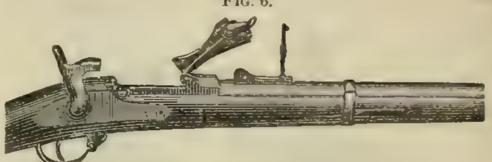
Total small-arms provided	3,966,590
Total on hand, serviceable and unserviceable, June 30, 1866	2,649,439
	1,317,151
Number retained by soldiers and paid for by them, besides sabres	158,244
Difference, lost and consumed	1,158,907

1866. Report of chief of ordnance, dated Oct., 1866, states that the returns made by regiments of losses, by wear and tear, during the *three consecutive years of active warfare*, show as follows:

Cavalry, carbines, 20 per cent. per annum.
" pistols, 26 " " "
Infantry, muskets, 13 " " " "

Jan., 1866. A board of officers (Gen. Hancock, president) called by the secretary of war to examine and report what form and calibre should be adopted for breech-loading muskets and carbines, and what form of conversion for muskets from muzzle-loading to breech-loading should be adopted. After testing 22 varieties of breech-loading muskets and 17 varieties of breech-loading carbines, the board reported that their experiments had shown the best calibre for muskets to be 0.45 of an inch, the best charge of powder from 65 to 70 grains, and best weight of ball from 480 to 500 grains; that they could not recommend any of the patterns presented for a new breech-loading musket or carbine, considering all to be capable of further improvement. For altering arms they recommend the reduction of calibre by inserting a tube (as then under trial at Springfield) and using a hinged breech-block.—1869. A board of officers (Gen. Schofield, president) called by orders of the general of the army to meet at St. Louis, Mo., to select the six best patterns of muskets for infantry, and carbines and pistols for cavalry. After examining 34 varieties of breech-loading muskets, 8 varieties of carbines and 8 of pistols, the board recommended the Remington, Springfield, and Sharps's systems of breech-loading as superior to others (in the order named), and alone suitable for adoption by the government without further trial in the hands of troops.—1870. Upon the recommendation of the chief of ordnance, muskets and carbines of each system, and also of the Ward-Burton system of magazine breech-loader, were prepared and placed in the hands of companies of infantry and cavalry for comparative trial in service during a period of not less than twelve months, monthly reports to be made regularly by company commanders, and at the end of the time appointed to be laid before a board of officers appointed to select a suitable breech-loading arm for adoption for the military service.—1872. In compliance with an act of Congress approved June 6, 1872, a board of officers (Gen. A. H. Terry, president) was appointed to meet in New York and Springfield in Sept., 1872, "to recommend a breech-loading system for muskets and carbines to be adopted for the military service: which system, when so adopted, shall be the only one to be used by the ordnance department in the manufacture of muskets and carbines for the military service." After the trial and examination of 99 varieties, besides 9 varieties of breech-loaders in use by foreign nations, the board (May, 1873) recommended that the "*Springfield breech-loading system* be adopted for the military service"

FIG. 6.

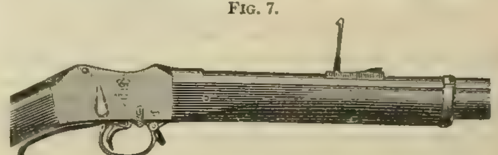


Springfield.

(see Fig. 6): which recommendation having been approved, all breech-loaders for the U. S. army are now made upon that system.

Fig. 7 shows the Martini-Henry, adopted by England;

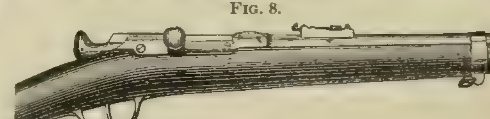
FIG. 7.



Martini-Henry (English).

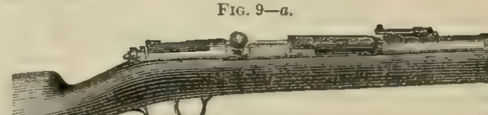
Fig. 8, Chassepot, adopted by France; Fig. 9, needle-gun,

FIG. 8.



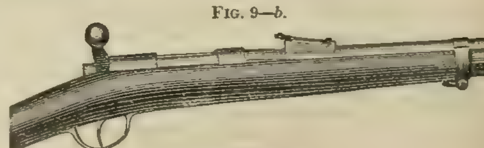
Chassepot (French).

FIG. 9—*a*.



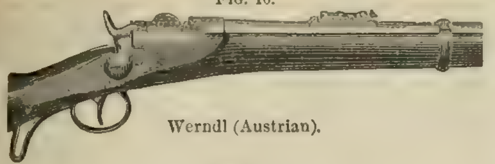
Dreyse improved Needle-gun (German).

FIG. 9—*b*.



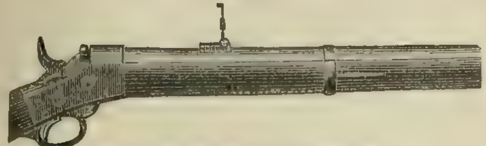
Mauser (German).

FIG. 10.



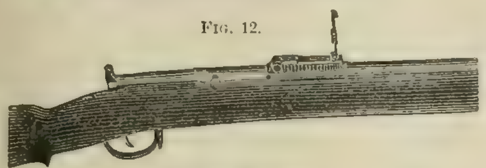
Werndl (Austrian).

FIG. 11.



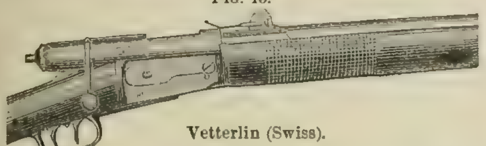
Remington Locking Rifle, model 1871.

FIG. 12.



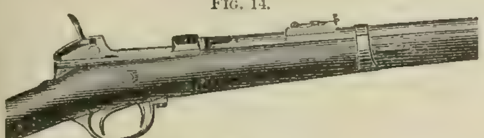
Russian Berdan.

FIG. 13.



Vetterlin (Swiss).

FIG. 14.

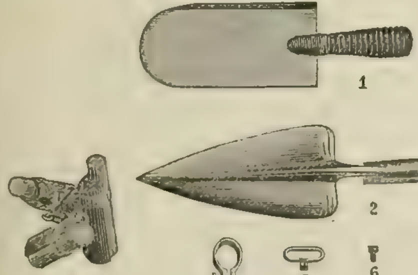


Werder (Bavarian).

adopted by Prussia; Fig. 10, Werndl system, adopted by Austria; Fig. 11, Remington system, adopted by Spain; Fig. 12, Berdan system, adopted by Russia; Fig. 13, Swiss model: Fig. 14, Bavarian model; Turkey uses Martini-Henry's (English), and Denmark and Sweden the Remington's model. France has recently altered the Chassepot to use the metallic cartridge.

Description of the Springfield Model.—The *barrel* is of "low steel," cal. 45 inches; rifled with three concentric grooves of equal widths with the lands, and of the uniform depth of .005 of an inch, and uniform twist of one complete turn in 22 inches. The *lock-plate* is 0.175 inch thick, and let in flush. The exterior metal-work (except the bayonet) is browned. An open swivel is attached to the upper band, for stacking arms, instead of locking bayonets, as heretofore; also, a "trowel-bayonet" and "intrenching-tool" proposed. (See Fig. 15.) Length of rifle-barrel, including receiver, 36 inches; of carbine, 25.4 inches. Length of rifle bayonet, 18 inches; crook of stock, 2¼ inches, and distance from butt to trigger, 13½ inches. Total length of rifle, without bayonet, 51.9 inches; of carbine, 41.3 inches; weight of rifle, without bayonet, 8.38 pounds; of carbine, 6.87 pounds. Triggers adjusted to pull at 6 to 8 pounds.

FIG. 15.



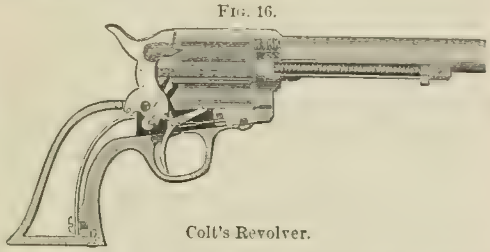
1, 2, proposed intrenching-tool and trowel-bayonet; 3, 4, 5, 6, Merrill Upper Band.

Details of Practice.—*Rapidity of fire*, using service cartridge box, 12 to 13 times per minute: a very skilful expert has fired 23 times per minute. *Drift*, or deviation, of the projectile to the right, for the rifle at 500 yards, is 25 inches. Initial velocity of rifle-ball, with 70 grains of powder, 1350 feet; of carbine ball, with 55 grains of powder, 1100 feet. Pressure per square inch, 19,000 pounds. Force of recoil with rifle, with service charge, 174 pounds; of carbine, with service charge, 155 pounds; of carbine, with rifle charge, 182 pounds. Penetration into white pine (1 inch corresponds in force with that producing dangerous wounds upon the body), with the rifle at 100 yards, 17.2 inches; with the carbine, 14.5 inches; with the rifle at 1200 yards, 3.7 inches. The range corresponding with the *maximum continuous dangerous space*, holding the gun 56 inches from the ground, is 262 yards for the rifle, and for the carbine 204 yards (the foot-soldier (height, 68 inches) is covered at all distances between these points and the firer); the like *maximum dangerous space* for cavalry (height, 8 feet) is 291 yards for rifle and 230 yards for the carbine. Hence the best range for military practice-firing is 300 yards, about. (See *Description and Rules*, published at National Armory, 1874.)

Cadet Rifle, a special arm made at Springfield for the corps of cadets and for students of colleges and universities receiving military instruction. It has the same calibre, but is shorter and lighter than the infantry rifle musket, and is sighted to use the carbine cartridge. Dimensions: length of barrel, 29.6 inches; length of arm complete, without bayonet, 48.92 inches, and with bayonet, 65.15 inches. Weight of arm, without bayonet, 8 pounds 3 ounces; weight of bayonet, 10 ounces.

Revolvers for Cavalry, using the Metallic Cartridge.—Three systems of construction are now under trial in the U. S. service—the Colt's (Fig. 16), the Schofield, Smith & Wesson's, and the Remington. The principal differences are as follows:

FIG. 16.



Colt's Revolver.

	Colt's.	S., S. & W.	Remington.
Total length	12.5 inches.	12.5 inches.	13.03 inches.
Length of barrel	7.5 "	7.5 "	7.46 "
Diameter of bore	0.45 "	0.435 "	0.44 "
Number of grooves	6	5	5
Twist, 1 turn in	16 inches.	20 inches.	26 inches.
Depth of grooves	.005 "	.0075 "	.004 "
Total weight	2.31 pounds.	2.50 pounds.	2.60 pounds.

Weight of charge, the same for all—28 grains of powder and 230 grains of ball. A special holster is made to receive each revolver.

Private Factories for Small-Arms.—The system of forging the metal parts of small-arms in swedges and dies, and finishing them by milling-machines, producing identical and interchangeable parts, brought into successful use for the first time in the national armories of the U. S., is now universally followed in the large private factories, and with great advantage both in the cost of production and in quality of work. Iron and steel swedged to shape under the drop must needs be of uniform good quality or the material fails in the working, and the part is lost after labor has been expended upon it. Hence, the manufacturer finds himself enforced, on the score of economy, to use the better kinds of material, as less costly than to return to hand-work. The larger arms factories of this country, thoroughly equipped with appropriate machinery, are thus enabled to produce so rapidly and of such uniform good quality that they supply a large proportion of the world's demand, at prices not exceeding hand-work of inferior finish.

The following-named private factories are now making small-arms of special patterns for military use in different countries: Colt's Co., Hartford, Conn., making rifles and pistols, revolvers; Sharp's Co., Hartford, Conn., making Sharp's breech-loading rifles and carbines; Winchester Co., New Haven, Conn., making Winchester repeating rifles and carbines; Providence Tool Co., Providence, R. I., making Peabody rifles; Remington Arms Co., Ilion, N. Y., Remington's rifles and revolvers.

The zeal aroused of late years in rifle-shooting has also done much to give notoriety to U. S. arms, as well as to U. S. marksmen. At the International rifle match at Creed-

moor in 1874, [illegible] the American team, firing 15 shots at each of [illegible] 800, 900, and 1000 yards distance, [illegible] 171 [illegible] higher by 5 points, it is said, than any [illegible] maximum, 180 points. He used [illegible] rifle, loading it at the muzzle. [illegible] *Committee Amateur Rifle Club,* 187[illegible]. P. V. HAGNER.

Small-Arms, Cartridges for. See CARTRIDGE.

Small Pi'ca, in typography, type one size smaller th[illegible] (See PRINTING.)

Small'-pox, or **Vari'ola,** is the most important of the [illegible] acute general contagious diseases known as the [illegible] *fevers*, since, when not controlled by vaccination, it is the most fatal of them all. It is said to have prevailed in Eastern countries from the most remote antiquity, but its early history is shrouded in obscurity. Aaron or Aharon, an Alexandrian priest, who lived in the early part of the seventh century, is said to have first described the disease in an extinct work entitled *Pandects of Medicine*. Some have traced an allusion to it in certain passages of the Old Testament, as, for instance, Moses's record of "the plague of boils and blains." The Greek writers included small pox and measles under the term λοιμική. The Latin word *variola*, now generally employed by medical writers, is said to have been first used by Constantinus Africanus in the eleventh century. The first appearance of small pox in Europe is supposed by some to have been the epidemic *cum pusulis et vesicis, quæ multum populum affecerunt morte*, described by Gregory de Tours as having prevailed in France in the reign of King Childebert about the year 520; it is more generally considered, however, that the disease was first brought to Europe by the Saracens about the year 710. Spreading from Spain, it soon overran Europe, but spared for a time certain isolated countries, such as Denmark, where it first appeared in 1527. It was carried to the West Indies in 1517 by the adventurers who hastened to profit by Columbus's discovery of the New World. It reached Mexico in 1520, and Brazil in 1563. Farther north it first appeared in Maryland, having been brought there by an English ship in the early part of the seventeenth century. Thence it rapidly spread through Virginia, the Carolinas, New England, and other portions of the colonies.

Up to the beginning of the present century, when its ravages were decidedly checked by VACCINATION (which see), it continued its course as a deadly pestilence almost always and everywhere present, sparing no age, sex, condition, or nationality, no one being safe from it except by virtue of having already passed through its perils. Its history, like that of the other acute contagious diseases, is that, while always prevailing to a certain extent, especially in large cities, it raged as an epidemic every few years. This periodical recurrence of epidemics is doubtless chiefly due to the fact that each epidemic exhausts nearly all the subjects susceptible to the disease, so that a certain time has to elapse for a sufficient number of others to be born into the world to afford the material for a fresh outbreak. The last great epidemic of small-pox began in 1870, overrunning all Europe and North America, and abated in 1873.

Of the original cause of small pox we know nothing, but we do know that it now never occurs save as the consequence of infection conveyed from one person to another. The contagion exceeds in virulence that of any other disease. The infectious principle is known to reside in the fluid contents of the pocks and in the crusts resulting from their desiccation, and it is probable that it is also contained in many if not all of the fluids of the body. Moreover, it pervades the emanations from the person, so that actual contact with the sick is not necessary to the conveyance of the disease. To what distance the volatile contagium may extend is uncertain, but it is known to have crossed a river 1500 feet wide. In its fixed condition, attached to articles of clothing, bedding, merchandise, mail-matter, paper money, etc., it is very energetic and persistent. The disease is communicable at all periods of its course, even in the period of incubation, before any symptoms have occurred, and as late as the close of the stage of decrustation; but probably it is most intensely contagious during the vesicular stage of the eruption. Even the dead body is capable of conveying the infection. It may also be carried from one person to another without the person who carries it himself suffering an attack. This is termed "mediate contagion." It is reasonably certain that the prevalence of the disease is more or less influenced by the season of the year, and perhaps by the state of the weather, but the effects of these differ in different countries and in different years, so that the precise part which they play in the production of epidemics can scarcely be stated.

Very few persons (certainly not more than five in every hundred) are naturally and permanently insusceptible to small-pox, and very few are even temporarily insusceptible, except from having already had the disease or from having been vaccinated. Very young infants have been supposed to be rather insusceptible to the infectious diseases, yet it is among children, including very young ones, that small-pox makes its greatest havoc, and it is by no means rare for it to attack the unborn child. One attack of the disease generally exempts the affected person from subsequent attacks, but in exceptional cases second attacks do occur, and even fifth and sixth attacks have been recorded. The immunity conferred by vaccination is almost as complete as that which results from having had the disease.

On contracting the small-pox contagion the individual shows no signs of the disease until after the lapse of a *period of incubation*, which generally lasts thirteen days. It is occasionally a few days shorter, especially in persons who have been vaccinated, and in the case of inoculated small-pox it is remarkably abridged, the local phenomena resulting from the inoculation being observed to begin in two or three days. The *initial stage* is usually ushered in by a violent chill or by repeated slighter chills, followed by high fever, weakness, vomiting, severe headache, and pain in the back. Delirium is frequently observed, and in children convulsions or coma. This stage lasts from two to four (usually three) days, and death may occur before its termination. A preliminary rash—commonly of a roseolous character—is sometimes observed during the initial stage. This is of some value from a prognostic point of view, but must not be confounded with the essential rash which marks the *eruptive stage*. Little red elevations of the skin (somewhat pale at first) appear upon the face and head, and a few hours afterward upon the back, breast, arms, abdomen, legs, and feet. These elevations vary in size from that of a millet-seed to that of a pin-head. They are often more plainly to be felt than seen. They are usually the most numerous on the face. On the second day after their appearance (fifth day of the disease) they have increased in size, constituting distinct papules, and are of a darker hue. On the third day (sixth of the disease) they are more conical, and each papule shows at its summit a minute vesicle containing a clear, lymphy fluid. These vesicles encroach more and more upon the area of the papule from day to day, the remains of the latter being visible as a delicate red line surrounding the vesicle. The vesicle itself is flattened, circular, of a pearly-white color, and very frequently depressed at the centre ("umbilicated"). By the seventh or eighth day (tenth or eleventh of the disease) it has reached the size of a split pea, and, the central depression being effaced, is nearly hemispherical in shape. On the outbreak of the eruption, or soon afterward, the fever disappears or moderates for the time being, according to the severity of the case; but about the sixth day of the eruption (ninth of the disease) the contents of the vesicle, which have gradually been growing opaque, become completely changed into pus. In other words, the vesicle becomes a pustule, the red line or halo surrounding it becomes increased in breadth, and the *stage of suppuration* or *maturation* begins. In mild cases this stage is accompanied by little or no fever, but in severe cases of confluent small-pox the *secondary fever* is generally well marked, being sometimes announced by a chill or chills, and lasting from three to six or eight days, according to the severity of the case. With the renewal of fever there is a return of headache, nervous disturbances, such as delirium, etc., the skin becomes enormously swollen, so that the countenance is frightfully disfigured, and the pustules are exquisitely painful, especially upon the face, the hands, and the feet. At this time the formation of boils is quite common, and numerous complications are apt to occur, such as erysipelas, diffuse inflammation of the cellular tissue, pyæmia, gangrene, affections of the organs of special sense, pleurisy and other inflammatory diseases of the respiratory apparatus, affections of the heart and great vessels, and occasionally abdominal inflammations. About the eleventh or twelfth day of the eruption (fourteenth or fifteenth of the disease) the pustules begin to dry up, which process characterizes the *stage of desiccation*. The general and local symptoms now gradually abate, and the pustules, beginning generally with those on the face, dry into hard, dark-brown crusts. Preceding this occurrence, a yellowish, gum-like exudation frequently takes place upon the surface of the pustules, especially if they have been ruptured, and concretes into a rough, brittle coating overlying the darker and firmer crusts. During the stage of maturation and the earlier portion of that of desiccation the patient's body exhales a peculiar and repulsive odor, which, together with his frightful appearance, makes him an object of horror as well as of pity. The process of incrustation is often accompanied by intolerable itching, and by scratching the course is so interfered with that secondary and tertiary crusts often form;

and this fact, as well as the varying severity of the cutaneous lesions, makes the period of decrustation somewhat variable. After the crusts have fallen off, the sites of their former attachment remain visible for a considerable time in the form of red and somewhat elevated spots, giving the patient a peculiar mottled appearance. In course of time the redness and swelling disappear without leaving any permanent marks, or else (in case the pocks have involved the papillary layer of the skin) the spots become whiter than the surrounding skin, radiated and depressed scars remaining for life. The individual is then said to be pock-marked.

As to the *structure of the pock* (vesicle or pustule), it is not a mere tent-like elevation of the cuticle from distension by a subjacent fluid, but the inflammation begins in the lower layers of the epidermis (the *rete Malpighii*), and soon results in the exudation of fluid *into the substance* of that portion of the skin, separating its cells and forming a multilocular swelling. Hence it is that, on puncturing the vesicle, only a small portion of its contents escapes, the fluid being contained in a number of separate compartments. Along with these changes in the epidermis (and perhaps preceding them, and therefore more essential) the subjacent papillæ of the derma, and even the fibrous corium, become hyperæmic and subsequently infiltrated. In so-called "diphtheritic" pocks the bases of the papillæ are so swollen and gorged with blood that their summits become strangulated, as it were, and die. These dead and bloodless heads of the affected papillæ form a white, pultaceous mass upon the floor of the pock—the "false membrane" of the older writers. Its formation is always followed by pitting. The umbilication of the pock is, as regards the mode of its production, still a matter of dispute. Many have supposed it to be due to a bridle-like action of that portion of the epidermis which dips down to form the lining of a sebaceous or sudoriparous follicle, and they assume that such a follicle constitutes the usual centre of a pock. Others attribute it to the early commencement of desiccation at the centre of the pock while yet the exudation is increasing at the border. In the vesicular stage of the pock the contents consist of a clear, viscid, albuminous fluid (lymph), containing epithelial débris, leucocytes, and very minute globular bodies, about $\frac{1}{30000}$th of an inch in diameter, termed microspheres, microzymes, etc. (also falsely called bacteria). It is probable that these latter bodies are, *par excellence*, the bearers of the contagium. They are supposed to be of a fungous nature, but attempts at their cultivation have resulted in nothing satisfactory. The crust includes the "false membrane" already mentioned, and occasionally a portion of sloughy tissue from the corium, or the subcutaneous layer of cellular tissue, is found attached to it.

Numerous *varieties* of small-pox are spoken of by writers. In the first place, we have the *discrete* and the *confluent* forms. In the former the pocks are separate and distinct from each other, the secondary fever is mild or altogether wanting, and, except for complications, the disease is not specially dangerous. The latter, as its name implies, is characterized by a running together of the pocks, and is always severe and frequently fatal. Semi-confluent eruptions show appearances midway between those of the discrete and the confluent, and betoken a corresponding severity of the disease. In *corymbose* small-pox the pocks are aggregated in clusters or in a single cluster, the eruption being elsewhere discrete. This form is rare and very dangerous. *Malignant* small-pox (black or hæmorrhagic small-pox) is characterized by the early occurrence of blood-poisoning, resulting in effusions of blood into the pocks and into the substance of the organs and tissues of the body, and in hæmorrhages from the mucous surfaces. It may prove fatal before the eruption has had time to appear. Such cases have been called *purpura variolosa*. *Benign* small-pox (*variola verrucosa*, or *cornea*, stone-pock, horn-pock, or wart-pock) is of occasional occurrence. It is exceptionally mild, although the primary fever may be severe. The pocks are abortive, and there is no secondary fever and no pitting. Small-pox *without eruption* (*variola sine exanthemate*, the *febris variolosa* of Sydenham) is of rare occurrence. The whole process consists of the primary fever. *Varioloid* is small-pox mitigated by previous vaccination. The initial fever may be severe, but the eruption is moderate, many of the pocks shrivel early, and there is no secondary fever.

In regard to the *sequelæ* or after-effects of small-pox, it may first be stated that it is capable of rousing into activity any dormant diathesis or morbid tendency, such as the scrofulous, tubercular, syphilitic, etc. Some have supposed that an attack of small-pox had a tendency to improve the general health; but not only is there no foundation for this opinion, the very reverse is the case. Ophthalmia, blindness, chronic ulcers, enlargements of the lymphatic glands, inflammation of the ear, boils or abscesses, cancrum oris, pestilential bubo and carbuncle, laryngitis, salivation, dropsy, necrosis, and many other affections have been known to follow the disease, apparently owing their origin to its occurrence.

The *post-mortem appearances* in small-pox, besides the results of inflammatory complications, consist mainly in degenerative changes in the organs, especially the liver, the kidneys, and the spleen, and hæmorrhagic effusions. On the mucous membranes, particularly near the natural openings of the body, pocks are found essentially like those on the skin. In the trachea they extend down to its bifurcation, and sometimes into the bronchi of the second and third orders. The brain and spinal cord are sometimes congested and œdematous, but generally healthy.

The *diagnosis* of small-pox is easy in cases where the eruption is well advanced, but in the earlier stages, as well as in sporadic cases and modified forms, it is often difficult, and sometimes impossible. It is most apt to be confounded with measles, chicken-pox, pustular syphilides, acne, and lichen among skin affections, and with typhus, relapsing fever, pneumonia, meningitis, and several other acute inflammatory diseases. Too much reliance should not be placed upon the appearance of the eruption, particularly in its earlier stages. The initial fever of small-pox is usually productive of a higher temperature than is that of measles (105° F. or over in the former, and from 102° to 104° F. in the latter); and in measles the catarrhal symptoms occur earlier than in small-pox. In chicken-pox there is little or no premonitory fever, and, if there be any, it lasts only twenty-four hours before the eruption appears, and the latter is more superficially situated and more rapidly developed than that of small-pox. Syphilitic eruptions and acne cause little or no fever, and can only be mistaken for small-pox by a too exclusive attention to the cutaneous appearances. Febrile lichen may for a short time be confounded with small-pox, but the eruption occurs after only one day's illness, appears on various parts of the body indifferently, and does not advance beyond the formation of papules. The preliminary roseola of small-pox often resembles the rash of scarlet fever, but its localization, together with the absence of the marked throat symptoms of the latter disease, will serve to distinguish it. The early diagnosis of small-pox from exanthematic typhus is often very difficult. In the former disease, however, the temperature falls on the appearance of the rash, but does not in the latter. The appearance of the eruption will distinguish variola from the first attack of relapsing fever. The acute inflammations are to be distinguished by a close attention to the local symptoms proper to them, and by the non-occurrence of eruption.

The *mortality* of small-pox varies in different epidemics, ranging in unmodified cases from 15 to 50 per cent. Of 46 hæmorrhagic cases observed by Curschmann, all proved fatal, while 235 cases of unmodified variola (including the 46 hæmorrhagic cases) resulted in 99 deaths—a mortality of over 42 per cent. Marson, of the London Small-pox Hospital, records 1838 cases of confluent small-pox, with 937 deaths (50 per cent.), 614 semi-confluent cases, with 51 deaths (8 per cent.), and 202 discrete cases, with 8 deaths (4 per cent.). Of 4896 cases of small-pox after vaccination (including good, bad, and indifferent vaccination), Marson saw death result from small-pox alone in 316 cases (6.56 per cent.). Confluent small-pox, even if the eruption be confluent only on the face and discrete elsewhere, often proves fatal. Certain abnormal conditions of the pocks—a flat, white, and pasty appearance, with claret-colored areolæ on the limbs—are of ill omen. Young children and aged persons are particularly apt to die if attacked by the disease. Symptoms of blood-poisoning or of a severe implication of the nervous system, as well as affections of the air-passages, are of bad import. Pregnant and lying-in women are in very great peril from small-pox. In the former abortion usually precedes death. Drunkards also are very apt to die. Robust and healthy persons, in good hygienic circumstances, are much more apt to recover than are those of the opposite description. Death may take place at any period of the disease, but is most common during the secondary fever.

The *treatment* of small-pox consists in husbanding the resources of the patient, and in early detecting and combating complications. No sort of medication or regimen exerts any curative effect in the proper sense of the word. Many so-called specifics have been vaunted, but there is no satisfactory proof that they have ever accomplished anything. Vaccination, although of such signal efficacy in *preventing* small-pox, is utterly powerless to cure it; and it has not been shown that vaccination of a person already suffering from small-pox can even ameliorate the disease, whether done in the ordinary way or by the subcutaneous injection of vaccine lymph. No treatment will prevent pitting.

The *prevention* of small-pox may be almost certainly accomplished by thorough VACCINATION (which see). Avoidance of exposure to the contagion will also, of course, prevent the disease, but this is difficult, and often impossible, to manage. Small pox patients should always be isolated, and the funerals of those who die should be strictly private. All clothing, bedding, etc. which may have become infected should be destroyed by fire, or, if too valuable to be sacrificed, it should be disinfected by heat (as high as 212° F.) or by the fumes of burning brimstone. Every one exposed to the disease should be at once revaccinated. Patients are capable of conveying the infection until all the crusts have fallen off. FRANK P. FOSTER.

Small'wood, tp., Jasper co., Ill. P. 993.

Smallwood (WILLIAM), b. in Maryland about 1732; raised a battalion of Marylanders 1776, which he commanded as colonel, and half of which perished in the battle of Long Island, at which, however, he was not present; was engaged in the battle of White Plains; was appointed brigadier-general Oct. 23, 1776; accompanied Gen. Sullivan in the Staten Island expedition 1777; raised a new battalion of militiamen from the Western Shore of Maryland, whom he led at the battle of Germantown; was made major-general Sept. 15, 1780; was with Gates in his Southern campaign, but left after the defeat at Camden, refusing to serve under Steuben; was member of Congress 1785, and governor of Maryland 1785–88. D. in Maryland Feb. 14, 1792.

Smalt. See COBALT, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Smart (BENJAMIN HUMPHREY), b. in England about 1785; was for more than fifty years from 1815 a successful teacher of elocution in London; was considered high authority upon English pronunciation, and was a voluminous writer upon grammar, logic, rhetoric, and metaphysics, in which last department he claimed to "assert, correct, and carry onward the philosophy of Locke." Among his works were *A Grammar of English Pronunciation* (1810), *Rudiments of English Grammar elucidated* (1811), *A Grammar of English Sounds* (1813), *Practical Logic* (1829), *An Introduction to Grammar on its True Basis* (1858), *Accidence of Grammar*, *Principles of Grammar*, *Manual of Rhetoric and Logic*, *The Practice of Elocution*, and *Historico-Shaksperian Readings*, the five latter being issued as a complete series in 1858; *Outlines of Sematology* (1831), with a *Sequel* (1837) and an *Appendix* (1839), the three works being issued together as *The Beginnings of a New School of Metaphysics* (1839); *The Way out of Metaphysics* (1844), *The Metaphysicians, a Memoir of Franz Carvel, Brushmaker, and of Harold Fremdling, Esq.* (1857), and *Thought and Language* (1855). Mr. Smart also published in 1836 a *Pronouncing Dictionary*, based upon that of John Walker, issued an epitomized edition of the same in 1840, and an *Appendix* in 1846 (revised editions 1860), which figure among the authorities upon pronunciation most frequently cited in the later editions of Webster's and Worcester's dictionaries.

Smart (CHRISTOPHER), b. at Shipbourne, Kent, England, in 1722; educated at Pembroke College, Cambridge, where he became a fellow 1745; settled in London as a writer, becoming intimate with Pope, Johnson, and Garrick; was noted for improvidence and a convivial disposition, which made him successively the inmate of an insane asylum and of the king's bench prison for debtors, within the rules of which he d. in 1771. He translated into Latin verse Pope's *Ode on St. Cecilia's Day* and *Essay on Criticism*, the *Works of Horace* into English prose (2 vols., 1756), and into verse (1767); the *Poems of Phædrus* (1765) and the *Psalms of David* (1765) into English verse; published *The Hilliad, an Epic Poem* (1753), being a satire on Sir John Hill, noted for his quarrels with Fielding and with the Royal Society, and *The Parables of Christ done into Verse* (1765); but his most remarkable production was the *Song to David* (1763), reprinted in full in Chambers's *Cyclopædia of English Literature* (ii. 109), as "possessing passages of considerable power and sublimity," which make it "one of the greatest curiosities in our literature," it having been written on the walls of a mad-house.

Smart (Sir GEORGE THOMAS), K. C. B., b. in London, England, in May, 1776; became a chorister in the chapel royal when a boy of eight years; took part in executing the Handel commemorations in Westminster Abbey 1784–91; became an accomplished conductor of musical festivals and of the famous Lent oratorios at Covent Garden and Drury Lane theatres; was one of the founders of the Philharmonic Society 1813; was the instructor of nearly all the great English musicians of the last generation, and the personal friend of Beethoven, Mendelssohn, Rossini, and Weber, the latter of whom died at his house. He was knighted at Dublin 1818, and was in his later years organist to the chapel royal. D. in London Feb. 23, 1867.

Smart-Weed. See POLYGONACEÆ.

Smeaton (JOHN), b. at Austhorpe, near Leeds, England, May 28, 1724; was noted in childhood for mathematical and mechanical talent; abandoned the study of the law for the business of a mathematical instrument-maker 1750; invented the following year an instrument for measuring a ship's progress; made several valuable inventions in hydraulic machinery, for which he received the Copley medal 1759; was noted as the builder of Eddystone lighthouse (Aug. 5, 1756–Oct. 9, 1759), of Ramsgate harbor (1749–74), of the Forth and Clyde Canal, the Greenwich and Deptford waterworks, and many other important public improvements. D. at Austhorpe Oct. 28, 1792.

Smectym'nuus, the title of a celebrated tract written in reply to Bishop Hall's *Divine Right of Episcopacy*. The name is formed from the initials of the names of its five writers—to wit, Stephen Marshall, Edmund Calamy, Thomas Young, Matthew Newcomen, William Spurstowe.

Smed'ley (EDWARD), b. in England in 1789; graduated at Trinity College, Cambridge, 1809; became a fellow of Sidney College; took orders in the Church of England; gained the Seatonian prize for English poems on four occasions; contributed articles on French biography, English and Roman literature to the *Penny Cyclopædia*; wrote *Sketches of the Occult Sciences* for the *Cabinet Cyclopædia*; became prebendary of Lincoln 1829, and was for several years editor of the *Encyclopædia Metropolitana* until his death, which occurred in 1836. Author of *Religio Clerici* (1818), *Lux Renata* (1827), *Sketches from Venetian History* (2 vols., 1832), *History of the Reformed Religion in France* (3 vols., 1832; New York, 1834), and of a *History of France from A. D. 843 to 1529* (1836), the latter forming vol. x. of the *Library of Useful Knowledge*. After his death appeared his *Poems and Selected Correspondence* (1837), with a memoir of his life by his widow.

Smee (ALFRED), M. D., F. R. S., b. in England in 1818; studied medicine; was admitted a member of the College of Surgeons 1840, and elected a fellow of the Royal Society 1841; was subsequently lecturer at the Aldersgate Street School of Medicine, and surgeon to the Bank of England and senior surgeon to the Royal General Dispensatory; is widely known for his thorough knowledge of electricity in all its branches; is the inventor of the useful "Smee voltaic battery," and of the system now in use for printing the Bank of England notes; he was chairman of several important companies, and took an active part in Conservative politics. Author of *Elements of Electro-metallurgy* (London, 1841; New York, 1852), *Sources of Physical Science* (1843), *The Potato Plant, its Uses and Properties* (1846), *The Eye in Health and Disease* (1847; 2d ed. 1854), *Elements of Electro-Biology* (1849), *Principles of the Human Mind* (1849), *Instinct and Reason, deduced from Electro-Biology* (1850), *Lectures on Electro-metallurgy, delivered at the Bank of England* (1851), *Process of Thought, adapted to Words and Language* (1851), *On the Stereoscope and Binocular Perspective* (1854), *General Debility and Defective Nutrition* (1859). D. Jan., 1877.

Smell. See SENSES.

Smel'lie (WILLIAM), b. at Edinburgh, Scotland, in 1740; served an apprenticeship as a printer; obtained a good education by private study; became in 1759 editor of *The Scots' Magazine*; commenced business as a publisher 1765, and issued in 1771 (3 vols. 4to) the first edition of the *Encyclopædia Britannica*, much of which was written by himself; edited with Dr. Gilbert Stuart *The Edinburgh Magazine and Review* 1773–76; wrote on many miscellaneous topics; translated Buffon's *Natural History* (18 vols., 1781–93), and was a friend of many distinguished men, including Burns, who has drawn his portrait in the sketch of the "Crochallan Fencibles." D. at Edinburgh June 24, 1795. Among his original works the most popular was *The Philosophy of Natural History* (2 vols., 1790–99), several times reprinted in the U. S.

Smel'ser, tp., Grant co., Wis. P. 1291.

Smelt (in allusion to the cucumber-like odor of the typical species), the designation of a number of species of fishes distinguished by an elongated, transparent body, greenish back, and silvery sides. (1) In England it is the name of the *Osmerus eperlanus*, a representative of the family Argentinidæ (closely related to the Salmonidæ), characterized by the moderate teeth of the upper jaw, the stronger ones of the lower, and the fang-like ones of the tongue as well as vomer. It averages about eight inches, and rarely attains a foot in length. (2) In the Eastern U. S. the name is given to a species congeneric with the English smelt (*Osmerus mordax* or *viridescens*), and in the District of Columbia, Maryland, etc., to a fresh-water fish

belonging to the family Cyprinidæ (*Hybognathus regius*); the former has teeth like the European species, the latter none. (3) In California the term is bestowed on several species of different families. (1) One is a species of the genus *Osmerus* (*O. thaleichthys*); (2) another is allied, but the type of a peculiar genus (*Hypomesus olidus*); and (3) others are representatives of the genus *Chirostoma* or *Atherinopsis* (*C. californiensis* and *C. affinis*). The first two are Argentinidæ, and distinguished by the first dorsal being rayed, and the second adipose or fatty; the *Osmerus* is armed with large fang-like teeth, while the *Hypomesus* has only small teeth. The others belong to the family Atherinidæ, and are characterized by the development of two distant dorsals, the first of which is provided with slender spines, and the second with branched rays. All the species of smelts are esteemed for the delicacy of their flesh. With the exception of the *Hybognathus* they are normally salt-water fishes, but sometimes inhabit fresh waters for all their life, or ascend the fresh-water rivers. THEO. GILL.

Smelt'ing. In its more extended use the term "smelting" applies to the entire process of reducing metals from their ores by fusion; in a more limited sense it applies to those particular metallurgical processes in which an ore or a product of other operations, such as roasting, treatment with acids, etc., is finally reduced to pure metal or some intermediate product. The fusions are conducted in shaft furnaces, reverberatory furnaces, or crucibles. Metals ready for use or sale may be produced from ores by a single smelting operation, as iron; or they may require a series of smeltings, alternated with roastings, as copper when made from sulphuretted ores. The smelting process may be simply reducing, or oxidizing and reducing, or may be designed to volatilize certain bodies, to oxidize others, and to reduce still others. Charcoal, coke, and anthracite are the fuels generally used in shaft furnaces and for heating crucibles, and bituminous coal and wood for reverberatory furnaces; but peat, gas obtained from different materials in special generators and peculiarly constructed fireplaces, and waste gases from furnaces, are used to a limited extent for particular operations in some establishments.

To remove earthy matters and foreign oxides, and to facilitate the collection of the reduced metals, slags are produced, and, according to the nature of the effect to be obtained and the substance to be removed by scorification, the charges are so constituted as to yield more or less acid or basic slags by judicious mixture of the ores treated or by addition of various fluxes, limestone and oxide of iron being generally added in large operations if a base is required, quartz or highly silicious materials if an acid is needed. Fluor-spar is an excellent flux for silicious ores. Sometimes it is desirable to liberate some sulphur to combine with the metals and form a *matte* or *regulus*, and then iron pyrites is added, or sulphate of baryta with quartz and fluor-spar, a reducing action being maintained during the fusion. It is a general rule to form if possible slags which will not fuse until the desired effect, reduction of oxides, separation of sulphides, carbonization of metals, etc., has been produced. The general products of smelting are slag and metal, or slag and *matte*, or sometimes all three at once. The slags may have to be subjected to a reducing smelting to obtain the metal retained in them, the metal to an oxidizing and scorifying smelting to purify it, and the matte to an oxidizing smelting, or, after roasting, to a reducing and scorifying smelting, during which some metals are partly removed by volatilization, as antimony, arsenic, and zinc; others by oxidation and scorification, as iron, zinc, and tin, while the desired metal is obtained in a nearly pure state or as a concentrated matte. Sometimes the result of smelting is mainly a change in the combinations of the elements, as when iron is charged in a furnace with galena, the sulphur combining with the iron and the lead being set free; this is called precipitation, and it may also be effected by employing oxide of iron, which is first converted into metallic iron by a reducing action within the furnace.

Shaft furnaces are mainly employed for reducing fusions with coke, charcoal, and anthracite, although by a proper construction, good management of fluxes, and preparation of the ores, etc. a partial oxidizing action can be produced. The fusion is almost invariably effected by the aid of a blast. Reverberatory furnaces, with wood and bituminous coal, are generally used for oxidation; a very effective reducing action can also be obtained in them by excluding the air and keeping the hearth full of reducing gases. The choice between shaft and reverberatory furnaces, where both are admissible, will generally be determined by the nature and cost of the fuel. In crucibles the results of smelting will depend entirely on the nature of the charge, oxidation and scorification being produced by certain fluxes, as nitre with quartz or borax; reduction by adding carbonaceous matters; scorification alone by using a simple flux like borax; precipitation by adding metallic iron or some substance which will yield iron by reduction; sulphurization by adding metallic sulphides, or alkaline sulphates with a reducing agent and a simple flux.

Iron is reduced from its oxides in high shaft furnaces with a hot or cold blast (*blast furnaces*). The reducing action is produced, as in all shaft furnaces, by the carbonic oxide resulting from the action of the blast on the incandescent fuel. As the descending reduced iron approaches the hottest part of the furnace it takes up some carbon, fuses, and collects in the hearth below, being covered by the liquid slag, which protects it from the blast. The carbon renders it brittle, but malleable iron can be produced from pure, rich ores at one operation, in small open-hearth furnaces, by converting the oxidizing into a reducing action by a proper adjustment of the blast and fuel. Copper is reduced at once to raw copper from its oxides in shaft furnaces; but the sulphurets must first be roasted, then smelted for matte by reducing in shaft or reverberatory furnaces, again roasted, and again smelted, and so on until a matte is produced rich and pure enough to give raw copper after another roasting and final reducing smelting. Lead is smelted directly from very pure galena in one operation by a blast on the Scotch or American hearth, the action being in the latter case chiefly a simple oxidation of the sulphur; or by two operations combined into one—a partial roasting, followed by a reaction between the oxide and sulphate of lead thus produced, and the sulphide still left, the result being sulphurous acid and lead; this is called roasting and reaction. Lead is also sometimes roasted in a reverberatory furnace, then reduced in a shaft furnace, or it may be reduced by "precipitation," as already described, in a shaft or reverberatory furnace. (See BLAST FURNACE, FURNACE, IRON, LEAD, STEEL, ZINC.) H. B. CORNWALL.

Smer'dis, the younger son of Cyrus; accompanied his brother Cambyses on his campaign to Egypt, but excited his jealousy by being the only one of all the Persians who could bend the bow sent to the Persian camp by the Ethiopian king, and was consequently ordered back to Susa. Shortly after, having dreamt that he saw his brother seated on the royal throne, Cambyses commanded Prexaspes to go to Susa and put Smerdis to death secretly. Prexaspes did so, and very few heard anything about the murder, but among those who knew the truth was one Patizeithes, a Magian, governor of the palace, whose younger brother bore a striking resemblance to the murdered prince. Afterward, when the tyranny of Cambyses occasioned much discontent among the Persians, Patizeithes represented this brother as the royal prince, and had him proclaimed king; and as Cambyses had just died in Syria from an accidental wound, the false Smerdis was accepted by the people. But some Persian nobles soon became suspicious, and at last one of them, Otanes, discovered the fraud. It was known that Cyrus had ordered the ears of Patizeithes's brother to be cut off on account of some misdemeanor, and Otanes's daughter, who was an inmate of the royal harem, ascertained that the king had no ears. Seven noble Persians then broke into the palace and killed the false Smerdis, who had reigned only seven months, and Darius, the son of Hystaspes, was elected king 521 B. C. Such is the story as related by Herodotus; that by Ctesias differs somewhat in details.

Smet, de (PETER JOHN), b. at Termonde, Belgium, Dec. 31, 1801; was trained in the seminary at Mechlin; sailed with six other novices to the U. S. in 1821; assisted in founding the University of St. Louis, Mo.; in 1838 was sent to labor with the Pottawattomies, and in 1840 was transferred to the Flathead mission. Father de Smet acquired a singular power of restraint over nearly all the Indian tribes, from the Sioux westward. He became procurator of the Indian missions, made voyages to Europe, and wrote several works in French and English, among them *Indian Sketches*, *Oregon Missions*, *Western Missions*, and many letters published in the *Annals* of the Roman Propaganda. He was a chaplain in the Utah expedition. D. at St. Louis May 23, 1872.

Smethport, p.-v., cap. of McKean co., Pa., on McKean and Buffalo R. R., contains 3 churches, a fine academy, 1 newspaper, and lumber-mills. Principal business, lumbering, mining, farming, and dairying. P. 231.
H. F. BARBOUR, ED. "MCKEAN CO. MINER."

Smew (*Mergellus albellus*), a bird belonging to the family Anatidæ, and the only known species of its genus, inhabiting the northern parts of the Old World, and accidental to North America. It is distinguished by the short narrow bill (considerably shorter than the head), whose margins are beset with short approximated lamellæ. In the male the ground color is white (whence one of the popular names, "white nun"); black pervades around and

in front of the eyes, at the occiput under the crest, at the front of the back, on the tail, and on the wings, but the scapulars and middle wing coverts, as well as secondaries and tertials, are white; in the female the head is of a reddish brown color; the length is about seventeen inches. Like its relatives, it is an excellent swimmer and diver. It makes a nest near the water, and lays therein from eight to ten eggs. Hybrids have obtained between it and true ducks, e. g. *Bucephala clangula*. The only authority for its occurrence in the U. S. is Audubon, who claims to have found a single female near New Orleans. THEO. GILL.

Smi'bert, or **Smybert** (JOHN), b. at Edinburgh, Scotland, about 1684; served his time with a common house-painter; studied painting in Italy; accompanied Dean Berkeley to America 1728; settled at Boston; painted portraits of most of the prominent men of New England and New York of that time, and exercised a considerable influence upon the styles of Copley, Allston, and Trumbull. His most celebrated painting, now in the possession of Yale College, is a group representing Dr. Berkeley, some of his family, and other persons, including himself. D. at Boston, Mass., in 1751 or 1752.

Smicks'burg, p.-v. and tp., Indiana co., Pa. P. 143.

Smi'lax [Gr. σμίλαξ], a large genus of endogenous plants of the order Smilaceæ, by some ranked as exogenous, and by Lindley placed in his proposed class Dictyogens. True sarsaparilla and China root are among the products of the genus. The U. S. have numerous species, none of them important. Several plants of this genus are fine in hot-house and garden culture. Some are herbs, others are shrubs, and many are climbers.

Smiles (SAMUEL), M. D., b. at Haddington, Scotland, in 1816; educated for the medical profession; practised some years as a surgeon at Leeds; became editor of the Leeds *Times;* was secretary to the Leeds and Thirsk Railway 1845–52, and to the South-eastern Railway 1852–66, and subsequently of the National Provident Assurance Co. Author of *Physical Education* (1837), *History of Ireland and the Irish People under the Government of England* (1844), *Railway Property, its Conditions and Prospects* (1849), *Life of George Stephenson* (1857), *Self-Help, with Illustrations of Character and Conduct* (1860), *Brief Biographies* (Boston, 1860), *Workmen's Earnings, Strikes, and Savings* (1861), *Lives of the Engineers, with an Account of their Principal Works* (4 vols., 1861–65; new ed., 5 vols., 1875), *Industrial Biography: Iron-Workers and Tool-Makers* (1863), *Lives of Boulton and Watt* (1865), *The Huguenots, their Settlements, Churches, and Industries in England and Ireland* (1867), *The Huguenots in France after the Revocation of the Edict of Nantes* (1874), *Character* (1871), and *Thrift* (1875), the two latter works being companions to *Self-Help*. Most of the works of Mr. Smiles have been republished in the U. S., and have proved of great value in stimulating the young of the working classes to the pursuit of useful knowledge.

Smillie (GEORGE D.), b. in New York City Dec. 29, 1840, son of James, a well-known landscape engraver; studied landscape painting under Hart; began to exhibit in 1864, and was speedily chosen a member of the National Academy of Design. He has been particularly successful in reproducing picturesque scenes from the Adirondacs and from the White Mountains.—His brother JAMES D., b. in New York City in 1833, was an engraver until 1862, when he visited Europe and studied painting. He was chosen a member of the National Academy 1865, was treasurer of the Society of Painters in Water Colors, and prepared the plates illustrative of Bryant's poem *Among the Trees*.

Smirke (ROBERT), R. A., b. at Wigton, near Carlisle, England, in 1752; was brought up to the business of a painter of coach panels, from which he passed to higher departments of art, being admitted as a student at the Royal Academy 1771; became distinguished for *genre* pieces, many of which were taken from Cervantes; became an academician 1791, his presentation picture being *Don Quixote and Sancho Panza;* painted many scenes illustrating passages of the Bible, Milton, Thomson, and the *Arabian Nights*, not a few of which have become widely known through engravings in illustrated editions of those works; was one of the contributors to Boydell's *Shakspeare;* made many designs for annuals, and brought out a magnificent edition of his daughter Mary's translation of *Don Quixote*, with 74 engravings (London, 4 vols. royal 8vo, 1818). D. in London Jan. 5, 1845.

Smirke (Sir ROBERT), R. A., eldest son of Robert (1752–1845), b. in London, England, in 1780; studied at Apsley School, near Woburn; was carefully educated as an architect both in England and on the Continent; was gold medalist at the Royal Academy 1799; visited Italy, Greece, and Germany; published *Specimens of Continental Architecture* (1806); was architect of the new Covent Garden theatre 1808–09, of the mint 1811, the post-office 1823–29, the Union, United Service, and Carlton clubs, most of them being examples of the so-called "classical school," and built many other important private and public edifices. His fame will rest chiefly upon the British Museum, built by him at intervals from 1823 to 1847. He was knighted 1831, and was thirty years treasurer of the Royal Academy. D. at Cheltenham Apr. 18, 1867.

Smirke (SYDNEY), R. A., son of Robert, b. in England about 1800; studied architecture; gained the gold medal of the Royal Academy 1819; practised both the prevailing styles of architecture, but with a decided preference for the Italian school; published *Suggestions on the Architectural Improvements of the West of London* (1834); assisted his brother in designing the Oxford and Cambridge University Club-house in Pall Mall, London, 1835–37; superintended the restoration of the Temple church, of which he published an account (1842); designed Exeter 'Change, the new Carlton Club, the new buildings in the Temple, restorations of Lichfield cathedral, York minster, and Savoy chapel, the custom-houses at Gloucester and Newcastle, and in 1847 succeeded his brother as architect to the British Museum, in which capacity he built the reading-room 1855, the Roman, Assyrian, and other galleries, and was the architect of several other public edifices and of many splendid country-seats. His last achievement was the new Royal Academy in Burlington House, begun 1867 and completed 1874, after which he retired from the practice of his profession. He was chosen R. A. 1860; became professor of architecture at the Academy 1861, and its treasurer 1862; subsequently trustee of that institution and of the Soane Museum; was a gold medalist of the Royal Institute of British Architects. The Elizabethan style of his later edifices presents a singular contrast to the classicism of his brother. D. Dec. 11, 1877.

Smith, county of N. Kansas, adjoining Nebraska, traversed by N. fork of Solomon River, has a rolling prairie surface and a productive soil. Cap. Smith Centre. Area, 900 sq. m. P. in 1870, 66; in 1875, 3876.

Smith, county of Central Mississippi, on Strong River, has a flat surface and an unproductive soil. Staples, cotton, rice, Indian corn, and sweet potatoes. Swine are numerous. Cap. Raleigh. Area, 620 sq. m. P. 7126.

Smith, county of N. Tennessee, on Cumberland River and Caney Fork, has a mountainous surface, well adapted for pasturage. Staples, tobacco, Indian corn, wheat, sorghum-molasses, honey, butter, and wool. Swine and sheep are raised in large numbers. Cap. Carthage. Area, 300 sq. m. P. 15,994.

Smith, county of N. E. Texas, lying between Sabine River on the N. and Neches River on the W., consists chiefly of fertile prairie, and is traversed by International and Great Northern R. R. Staples, Indian corn, cotton, and butter. Cattle and swine are quite numerous. Cap. Tyler. Area, 850 sq. m. P. 16,532.

Smith, tp., Bradley co., Ark. P. 792.

Smith, tp., Columbia co., Ark. P. 282.

Smith, tp., Cross co., Ark. P. 1515.

Smith, tp., Dallas co., Ark. P. 1030.

Smith, tp., Drew co., Ark. P. 502.

Smith, tp., Greene co., Ind. P. 670.

Smith, tp., Posey co., Ind. P. 988.

Smith, tp., Whitley co., Ind. P. 1232.

Smith, tp., Dade co., Mo. P. 504.

Smith, tp., Laclede co., Mo. P. 1146.

Smith, tp., Worth co., Mo. P. 889.

Smith, tp., Belmont co., O. P. 1777.

Smith, tp., Mahoning co., O. P. 1685.

Smith, tp., Washington co., Pa. P. 2067.

Smith (ADAM), b. at Kirkcaldy, Fifeshire, Scotland, June 5, 1723. His father died before his birth; a faithful mother's devotion carried him safely through a sickly infancy and childhood. Unable to join in the active sports of boys, he early turned to books, and formed habits of close, independent thinking which distinguished his life. His education was carried forward in the grammar school of Kirkcaldy, the University of Glasgow, and Baliol College, Oxford, with a view to his taking orders in the English Church. In Glasgow he gave chief attention to mathematics and natural science, but at Oxford he turned to the study of languages, and took especial pains to master the nice points of the English tongue. Abandoning all thought of the clerical office, he returned to his native place, and in 1748 took up his residence in Edinburgh. There he first

came before the public, delivering lectures on rhetoric and belles-lettres under the patronage of Lord Kames. Dr. Blair acknowledged his indebtedness to Smith for ideas and illustrations on style. In 1751 he was made professor of logic in the University of Glasgow, and the following year became professor of moral philosophy in the same institution. He resolved the science of morals into four parts, and accordingly discussed in his lectures, first, natural theology; second, ethics strictly; third, justice with reference to specific rules and precepts; and fourth, political expediency as affecting the honor, power, and prosperity of the state. His lectures were delivered extemporaneously, and were, for both matter and style, very popular. His first published work was the *Theory of Moral Sentiments*, issued in 1759. It called forth a high encomium from Hume, and brought him at once a wide reputation. Incidentally, this publication led to his being selected, four years afterward, to accompany the young duke of Buccleugh on his travels. He carefully improved the opportunity thus presented to become acquainted with the internal policy of other states, and to confer with distinguished economists on the Continent. He returned to England in 1766, and for ten years lived with his mother in partial retirement at Kirkcaldy. There he devoted himself to the earnest study of subjects which had occupied his attention for nearly twenty years. The result was given to the world in 1776 in his great work entitled *An Inquiry into the Nature and Sources of the Wealth of Nations*. Many principles laid down in that work were no doubt derived from the French economists, but the completeness of their compilation and the clearness with which they are set forth in this treatise fairly entitle Adam Smith to be regarded as the father of modern political economy. His book will continue to be, as it has been hitherto, a standard of reference on almost all branches of the science. Smith's biographer thus defines the main feature of this work: "Its great object is to demonstrate that the most effectual plan for advancing a people to greatness is to maintain that order of things which nature has pointed out, by allowing every man, as long as he observes the rules of justice, to pursue his own interest in his own way, and to bring both his industry and his capital into the freest competition with those of his fellow-citizens." After residing two years in London, he was appointed a commissioner of customs for Scotland, and removed to Edinburgh, where he spent the remainder of his life. In 1787 he was elected lord rector of the University of Glasgow—an honor which gave him great gratification. Mr. Smith was never married. His mother and Miss Douglass, a cousin, superintended his domestic economy until within two years of his death, which happened at Edinburgh July 8, 1790. After his decease, most of his manuscripts were, agreeably to his imperative directions, destroyed. A few that were excepted from that order were published in 1795 under the title *Essays on Philosophical Subjects*. His private character was amiable and irreproachable. His thoughts were generally dictated to an amanuensis slowly and carefully, and subjected to a considerate revision. Abstraction was a lifelong habit of his mind, and he was wont, when alone, to be speaking to himself, regardless of everything around him. Often when in company a fit of absence would come on him, and he would fall into the same practice, much to the amusement as well as interest of those present. A. L. CHAPIN.

Smith (ALBERT), b. at Chertsey, England, May 24, 1816; became a surgeon; settled at London 1841; contributed to *Bentley's Magazine*; was an early member of the staff of *Punch*; afterward dramatic critic of the *Illustrated London News*; wrote many burlesques, farces, and Christmas pieces, most of the latter being adaptations from the works of Dickens; visited Constantinople 1849; brought out an "entertainment" called *The Overland Mail* May, 1850; ascended Mont Blanc Aug., 1851, and prepared an illustrated "entertainment" descriptive of that feat, which was given by him in London with great success for several years. In 1858–59 he visited China, and afterward lectured upon the incidents of the journey. D. at Fulham, near London, May 23, 1860. Author of *A Month at Constantinople* (1850), *The Story of Mont Blanc* (1853), *To China and Back* (1859), and of posthumous volumes of sketches, *Wild Oats and Dead Leaves* (1860), and *Paris and London* (1867).

Smith (ALEXANDER), b. at Kilmarnock, Scotland, Dec. 31, 1830; was pattern designer for a lace-factory at Glasgow; published a volume of poems, *A Life Drama* (1853), which attracted great attention; was appointed secretary of the University of Edinburgh 1854; wrote *Sonnets of the War*, along with Sydney Dobell (1855), *City Poems* (1857), *Edwin of Deira* (1861), *Dreamthorp* (1863), *A Summer in Skye* (1865), *Alfred Hagart's Household* (1866), and *Miss Oona McQuarrie* (1866), of which the last four were prose works. D. at Wardie, near Edinburgh, Jan. 5, 1867. A *Memoir* by P. P. Alexander was published along with a posthumous volume of miscellanies entitled *Last Leaves* (1868).

Smith (ANDREW JACKSON), b. in Pennsylvania in 1811; was graduated from the U. S. Military Academy, and appointed in the army a second lieutenant of the 1st Dragoons, of which regiment he became major in May, 1861 (known as the 1st Cavalry since Aug., 1861), and July, 1866, colonel of the 7th Cavalry. Prior to 1861 he served almost continually with his regiment on the frontier, being engaged on several expeditions, and frequently in action with hostile Indians. In Oct., 1861, he was commissioned colonel of the 2d California Cavalry, and Mar. 17, 1862, a brigadier-general of volunteers. As chief of cavalry he served in the departments of the Missouri and the Mississippi, being engaged while in the latter department in the advance upon and siege of Corinth; transferred to the department of the Ohio in September, he was subsequently attached to the Army of the Tennessee, which he accompanied in the Yazoo River expedition, and was engaged in the assault of Chickasaw Bluffs (Dec. 27–29, 1862), and later in the assault and capture of Arkansas Post (Jan. 11, 1863). Assigned to command a division of the 13th army corps, he participated in the active service of that corps preliminary to and during the siege and assaults of Vicksburg and in the subsequent capture of Jackson, Miss. In the Red River campaign he commanded the force (composed of detachments of the 16th and 17th corps) which captured Fort De Russy, and was engaged in the battle of Pleasant Hill, and in almost constant skirmishing while covering the retreat of the army. Next ordered to Missouri, he aided in driving Price from that State, when called to reinforce Gen. Thomas at Nashville, and engaged in the battle of Nashville and pursuit of Hood's army. Recalled to Gen. Canby's command in Feb., 1865, he commanded the 16th corps in the reduction and capture of Mobile, Ala. In Jan., 1866, he was mustered out of the volunteer service, and in May, 1869, resigned his commission in the regular army. The brevets of colonel, brigadier and major general were bestowed on him for gallantry at Pleasant Hill, La., Tupelo, Miss., and Nashville, Tenn.

Smith (ASA DODGE), D. D., LL.D., b. at Amherst, Hillsborough co., N. H., Sept. 21, 1804; studied at Kimball Union Academy, Meriden, N. H.; graduated at Dartmouth College 1830 and at Andover Theological Seminary 1834; was principal of Limerick Academy, Me., 1830–31; pastor of the Fourteenth street Presbyterian church, New York, 1834–63; was professor of pastoral theology at the Union Theological Seminary, N. Y., 1843–44, and was inaugurated president of Dartmouth College Nov. 18, 1863. Author of *Letters to a Young Student* (1832), *Memoir of Mrs. Louisa Adams Leavitt* (1843), of a large number of published addresses and sermons, including twelve *Baccalaureate Discourses*, and of several contributions to theological reviews. D. at Hanover, N. H., Aug. 16, 1877.

Smith (ASHBEL), M. D., b. at Hartford, Conn., in 1806; graduated at Yale College 1824; began the study of law, and afterward graduated in medicine; in 1837 was appointed by Gen. Sam Houston surgeon-general of the Texan army; was joint commissioner with Dr. R. A. Ivion in making the first treaty with the Comanches; was minister of the republic of Texas to the courts of St. James and St. Cloud during the administrations of Presidents Houston and Jones; was recalled and appointed secretary of state by the latter, and afterward served several sessions in the State legislature; in 1846 was in the Mexican campaign; on the secession of Texas went into service and served to the end of the war; represented Harris county in the legislature. In his profession his services were rendered gratuitously, and in every yellow-fever epidemic he repaired to Houston or Galveston to place himself at the disposal of the poor and of his friends; wrote *Account of the Yellow Fever in Galveston, Texas, 1839* (Galveston, 1840), *Account of the Geography of Texas* (in French), and *The Permanent Identity of the Human Race*.

Smith (AUGUSTUS WILLIAM), LL.D., b. at Newport, Herkimer co., N. Y., May 12, 1802; graduated at Hamilton College 1825; became a teacher in the Oneida Conference Seminary at Cazenovia, N. Y.; was professor of mathematics and astronomy in Wesleyan University from 1831 to 1857, when he was chosen president of that institution, and was professor of natural philosophy in the U. S. Naval Academy from 1859 to his death, at Annapolis, Md., Mar. 26, 1866. Author of several mathematical text-books.

Smith (AZARIAH), M. D., b. at Manlius, N. Y., Feb. 16, 1817; graduated at Yale College 1837; studied medicine as well as theology as a preparation for missionary duties in the Levant; arrived at Smyrna Jan., 1843; travelled extensively through Asia Minor, having been for some time a companion of Layard; rendered great service by attending those attacked with cholera; settled at Aintab 1848,

and d. there June 3, 1851. Author of papers on meteorology and on Syrian antiquities, published in Silliman's *Journal of Science.*

Smith (BUCKINGHAM), b. on Cumberland Island, Ga., Oct. 31, 1810; spent his childhood in Florida; graduated at the Cambridge Law School 1836; practised his profession in Maine, but soon returned to Florida, where he was elected to the Territorial legislature; was secretary of legation in Mexico from Sept. 9, 1850, to Feb. 2, 1852, having acted as chargé d'affaires *ad interim* from Jan. 26 to Oct. 8, 1851; made a thorough study of Mexican history, antiquities, and of Indian philology, collecting many books and MSS.; was secretary of legation at Madrid from June 5, 1855, to Oct. 10, 1858; made important researches in the Spanish libraries and archives respecting the colonial history of Florida and Louisiana; rendered services to Messrs. Bancroft, Sparks, and Parkman in their respective historical inquiries; settled in Florida on his return, and became a judge and a member of the State senate. D. in New York City Jan. 5, 1871. He edited translations of *The Narrative of Alvar Nuñez Cabeza de Vaca* (1851) and of the *Letter of Hernando de Soto, and Memoir of Hernando de Escalante Fontaneda* (1854), each printed in 100 copies 4to at Washington, D. C., at the expense of George W. Riggs, Esq.; published in Madrid an important volume of Spanish documents on Floridian history, *Coleccion de Varios Documentos para la Historia de la Florida y Tierras adyacentes* (1857); contributed to Mr. J. G. Shea's "Library of American Linguistics" a *Grammatical Sketch of the Heve Language* (1861), and a *Grammar of the Pima, or Névome, a Language of Sonora* (1862), from a MS. of the seventeenth century printed at San Augustine; a *Doctrina Christiana y Confesionario en Lengua Névome, ó sea la Névome* (1862), and a *Rudo Ensayo, tentativa de una prevencional Descripcion geographica de la Provincia de Sonora* (1863); issued at New York *An Inquiry into the Authenticity of Documents concerning a Discovery of North America claimed to have been made by Verrazzano* (1864); prepared for the "Bradford Club" a volume of translations of *Narratives of the Career of Hernando de Soto in the Conquest of Florida, as told by a Knight of Elvas and in a Relation by Luys Hernandez de Biedma, Factor of the Expedition* (1868); furnished interesting biographical and bibliographical data concerning early writers on Florida to the *Supplement* to Duyckinck's *Cyclopædia of American Literature* (1866); and wrote for the *Historical Magazine* and other periodicals. Since his death an improved edition of the *Narrative of Cabeza de Vaca* was issued by Mr. Smith's friends in New York (1873), preceded by a biographical sketch. A portion of his library was secured for the New York Historical Society. Few American scholars have been so conversant with the materials of early American history as Mr. Smith. PORTER C. BLISS.

Smith (CALEB BLOOD), b. at Boston, Mass., Apr. 16, 1808; went with his parents to Ohio 1814; educated at Cincinnati and Miami colleges; studied law at Cincinnati and at Connersville, Ind.; was admitted to the bar 1828; founded the *Sentinel* newspaper 1832; was several years a member of the Indiana legislature; member of Congress 1843–49; was on the Mexican claims commission; practised law some years at Cincinnati; settled at Indianapolis 1858; was influential in procuring the nomination of Abraham Lincoln at Chicago 1860, who appointed him secretary of the interior Mar., 1861; became U. S. circuit judge for Indiana Dec., 1862. D. at Indianapolis Jan. 7, 1864.

Smith (CHARLES FERGUSON), b. in Pennsylvania in 1805; graduated at the U. S. Military Academy in 1825, entering the army as a lieutenant of artillery. From 1829 to 1842 he served at the Military Academy in various capacities—as instructor of infantry tactics, as adjutant, and as commandant of the corps of cadets. In the Mexican war, as captain of artillery, he served with distinction, received the brevets of major, lieutenant-colonel, and colonel for gallant and distinguished conduct in the battles of Palo Alto, Resaca de la Palma, Monterey, Contreras, and Churubusco. Appointed lieutenant-colonel of the 10th Infantry in 1855, he commanded the Red River expedition in 1856, the Utah expedition 1857–61, and for a time was in command of the department of Utah. At the commencement of disturbances preceding the civil war, he was placed in command of the city and department of Washington (Apr. 10–28, 1861). On Aug. 31, 1861, he was appointed a brigadier-general of volunteers, and ordered to Kentucky. In September he became colonel of the 3d Infantry. In the operations about Forts Henry and Donelson he acquired a high reputation as a skilful and accomplished soldier. In the severe fight for the possession of the latter stronghold he commanded the division which held the left of our investing lines, and which, led in person by Gen. Smith, stormed and captured all the high ground on the Confederate right which commanded Fort Donelson. Gen. Smith was selected to command the new movement up the Tennessee, and, Mar. 21, promoted to be major-general of volunteers, but the exposure to which he had been already subjected aggravated a chronic disease contracted in Mexico, which terminated his life Apr. 25, 1862, at Savannah, Tenn.

Smith (CHARLES HAMILTON), F. R. S., b. in West Flanders Dec. 26, 1776; entered the British army in the Netherlands as a volunteer about 1795; served in the West Indies 1797–1809; was deputy quartermaster-general in the Walcheren expedition; took part in the Netherlands campaigns 1813–16; visited the U. S. and Canada on a special mission from the foreign office; retired from the army on half pay, with the rank of lieutenant-colonel, 1820; gave special attention to history, archæology, zoology, and ethnology; wrote the article *War* in the *Encyclopædia Britannica* (8th ed. 1860); was associate author with Sir Samuel R. Meyrick of *The Costume of the Original Inhabitants of the British Islands* (1815); aided that antiquary in other publications; wrote 3 vols. of the *Naturalist's Library* (i., iv., and v., 1843), relating respectively to Mammalia, the dog, and the horse, and published a useful *Natural History of the Human Species* (1848; republished in the U. S. under the editorship of Dr. S. Kneeland, Boston, 1851). During the latter part of his life he resided at Plymouth, where he was first president of the Devon and Cornwall Natural History Society. D. at Plymouth Sept. 21, 1859. He left many volumes of MS. notes which have not been printed.

Smith (CHARLES HENRY), b. at Hollis, York co., Me., Nov. 1, 1827; graduated at Waterville College (Colby University) in 1856. As captain in the 1st Maine Cavalry he entered the service in Oct., 1861, rising through successive grades to be colonel of that regiment in June, 1863. His regiment was attached to the Army of the Potomac, and shared in all the operations of that army. For much of the time in the last years of the war Col. Smith was in command of a brigade, and remained in service until Aug., 1865, when mustered out. For gallantry and highly-distinguished services the brevets of brigadier and major general U. S. army were conferred on him. Having studied law prior to the war, he was now examined and admitted to the bar, and in 1866 was chosen State senator from Washington co. In the reorganization of the army in 1866 he was appointed colonel of the 28th regular infantry; transferred to the 19th Infantry in 1869.

Smith (CHARLES ROACH), b. at Landguard Manor, Isle of Wight, England, about 1805; was the chief founder of the British Archæological Association, and distinguished for the success of his exhumation of Roman and Saxon antiquities, especially those of Roman London. Author of *Collectanea Antiqua* (6 vols., 1848–66), *Antiquities of Richborough, Reculver, and Lymne* (1850), with *Supplements* on Lymne (1852) and Pevensey (1858), *Notes on the Antiquities of Treves* (1851), *Catalogue of the Museum of London Antiquities collected by and the Property of C. R. Smith* (privately printed 1854); edited the *Inventorium Sepulchrale* of Bryan Faussett (4to, 1856); contributed regularly to the *Gentleman's Magazine* and to the *Archæologia*; gave much attention to pomology and to the cultivation of the vine in the open air, on which subjects he also wrote. In 1870 he issued *The Rural Life of Shakspeare as Illustrated by his Works*, and still later printed a *Catalogue* of the Anglo-Saxon antiquities discovered at Faversham, Kent, bequeathed by Mr. Gibbs to the South Kensington Museum.

Smith (DANIEL), b. in Fauquier co., Va., about 1740; served in the army during the Revolution; was one of the earliest settlers of Cumberland Valley, Tenn.; was a leading member of the constitutional convention of Tennessee; filled many local offices; was general of militia; U. S. Senator 1798–99, and again 1805–09, and wrote a geography of Tennessee, accompanied by the first map of that State; both were published by Matthew Carey at Philadelphia about 1799. D. in Sumner co., Tenn., June 16, 1818.

Smith (EDMUND KIRBY), b. at St. Augustine, Fla., in 1824; graduated at the U. S. Military Academy in 1845, and entered the army as brevet second lieutenant of infantry. In the war with Mexico he distinguished himself, and was brevetted first lieutenant and captain for gallantry at Cerro Gordo and Contreras. From 1849 to 1852 he was assistant professor of mathematics at West Point. Transferred to the 2d Cavalry in 1855 with the rank of captain, he served on frontier duty, and was severely wounded in a fight with the Camanche Indians in Texas, May 13, 1859. In Jan., 1861, he became major of his regiment, but resigned Apr. 6; was soon after appointed a brigadier-general in the Confederate army, and served under Gen. Joseph Johnston in Virginia. At the battle of BULL RUN, July 21, 1861 (which see), he arrived on the field with Elzey's

brigade toward the close of the action, but was soon disabled by a shot, when Elzey assumed command. Made major-general in 1862, he was transferred to East Tennessee, and placed in command of that department. Under Bragg he led the advance in the invasion of Kentucky; he routed the Union forces at Richmond, Ky., Aug. 30, and advanced to Frankfort. Promoted to the grade of lieutenant-general, he was engaged at the battle of Perryville, Oct. 10, and in the battle of Murfreesboro', Dec. 31, 1862–Jan. 3, 1863. He was soon after made general, and in command of the Trans-Mississippi department, opposing Banks in the Red River campaign, and engaged in the battle of Jenkins's Ferry, Apr. 30, 1864. He was the last to surrender the forces under his command, May 26, 1865.

Smith (Eli), D. D., b. at Northford, Conn., Sept. 15, 1801; graduated at Yale College 1821, at Andover Seminary 1826; went to Malta as superintendent of a missionary printing establishment 1826; studied Arabic at Beyroot 1827; travelled with Dr. Anderson through Greece 1829, and with Dr. H. G. O. Dwight of Constantinople through Armenia, Georgia, and Persia 1830–31—a tour which resulted in the establishment of the important Armenian and Nestorian missions of the American Board; visited the U. S. and published *Missionary Researches in Armenia* (1832); settled at Beyroot 1833; accompanied Dr. Edward Robinson in his geographical explorations of Palestine, to which he largely contributed, 1838 and 1852; revisited the U. S. 1839 and 1845; introduced an elegant font of Arabic type, cast under his supervision at Leipsic for the mission press, 1839, and was engaged from 1847 upon a new translation of the Bible into Arabic, completed by Dr. C. C. Van Dyke. D. at Beyroot Jan. 11, 1857.

Smith (Elias), b. at Lyme, Conn., June 17, 1769; received a scanty education; became a school-teacher; was ordained a Congregational preacher 1792; preached at Lee, Woburn, Portsmouth, and at various other places; wrote several religious treatises, and founded at Exeter, N. H., Sept. 1, 1808, the *Herald of Gospel Liberty*, noted as the first religious newspaper ever published, and continued until Sept. 1, 1817. D. at Lynn, Mass., June 29, 1846.

Smith (Elihu Hubbard), M. D., b. at Litchfield, Conn., Sept. 4, 1771; graduated at Yale College 1786; resided two years with Dr. Dwight at Greenfield; studied medicine at Philadelphia; edited the first collection of *American Poems* (Litchfield, 1793); settled at New York 1793; became physician to the New York Hospital 1796; contributed essays and sonnets to the periodicals of the day; joined Drs. Miller and Mitchell in founding the New York *Medical Repository*; published *Edwin and Angelina, an Opera* (1798); edited E. Darwin's *Botanic Garden* (1798), to which he prefixed a poetical *Epistle to the Author*; was the supposed author of *André*, a tragedy printed and performed at New York in the same year, and was the centre of a genial literary circle. He was active in rendering assistance to the victims of yellow fever in New York in the summer of 1798, and fell a victim to that disease Sept. 19, 1798.

Smith (Elizabeth Oakes **Prince**), b. at Cumberland (then North Yarmouth), Me., Aug. 12, 1806, descended from Gov. Prince of Plymouth Colony, and from Dr. Urian Oakes, an early president of Harvard; resided from infancy in Portland, Me.; married there in 1823 Seba Smith, the well-known editor and humorist, whom she aided in his journalistic enterprises; obtained a considerable local reputation as a writer of prose and verse, but never appeared publicly as an authoress until after the loss of her husband's fortune in 1839, when she resorted for support to literature, settling in New York City 1842, and soon made her mark by her contributions to the magazines, which have been partially collected in several volumes, of which the best known was *The Sinless Child and Other Poems* (1843); published two tragedies, *The Roman Tribute* and *Jacob Leisler* (1853); *The Western Captive* (1850), a novel (1842), *The Salamander, a Legend for Christmas* (1848), *Woman and her Needs* (1851), *Hints on Dress and Beauty* (1852), *Bertha and Lily* (1854), *The Newsboy* (1855), *The Two Wives* (1870), *Kitty Howard's Journal* (1871), and other books. She has also lectured before lyceums, and been a prominent advocate of "woman's rights." She is now (1876) a resident of Hollywood, Carteret co., N. C.

Smith (Ethan), b. probably in New Hampshire about 1763; was Congregational minister at Poultney, Vt., and subsequently at Hopkinton, N. H., where he d. in 1849. Author of two works on prophecy and of *A View of the Hebrews, designed to Prove, among other Things, that the Aborigines of America are descended from the Ten Tribes of Israel*, which was one of the most popular of the numerous books written in support of the same view.

Smith (Francis H.), b. in Virginia in 1812; graduated at the U. S. Military Academy in 1833, and entered the army as a brevet second lieutenant of artillery; second lieutenant Nov. 30, 1833. In 1836 he resigned from the army, and in 1837 was appointed professor of mathematics at Hampden Sidney College, Va. Upon the organization of the Virginia Military Institute (which see) at Lexington, Va., in 1839, Smith was appointed its superintendent and principal professor (of mathematics), the duties of which positions he has since continued to perform. Soon after the outbreak of civil war, the professors and assistants went into the field, and Smith, as colonel of a Virginia regiment, was stationed at Norfolk and in command of the fort on Craney Island. The institute was subsequently reopened. During the campaign against Richmond in 1864, Col. Smith, with his corps of cadets, was called to Richmond to aid in the defence, and thence to Lynchburg to defend the place against the forces of Gen. Hunter. On returning to Lexington, he found most of the buildings of the institute had been burned. Steps were taken for their reconstruction, since which the institute, under the administration of Col. Smith, has maintained its successful career. Author of various educational works.

Smith (Sir Francis Pettit), b. at Hythe, England, Feb. 9, 1808; became a farmer in Kent, but amused his leisure with mechanical experiments; constructed in 1834 a model of a steam-vessel to be propelled by a screw driven by a spring; made a larger boat on the same principle, which he successfully tested in the British Channel between Dover and Folkstone 1837; introduced his invention in 1838 to the notice of the lords of the admiralty, by whom he was commissioned to construct for the British navy the screw steamer Archimedes of 237 tons, 90 horse-power (finished 1840), the success of which led to the rapid introduction of screw-vessels into the navy and the mercantile marine. In 1855 the inventor received a pension of £200 a year from the British government; was soon after presented with a service of plate and a purse of £2678 by the leading engineers of the country; was made curator of the patent-office museum, South Kensington, 1860, and was knighted 1871. D. at London Feb. 11, 1874.

Smith (George), b. in England about 1825; taught himself the Oriental languages, including that of the cuneiform inscriptions from Nineveh; obtained, by the recommendation of Sir Henry Rawlinson, the post of keeper of antiquities at the British Museum about 1865; soon discovered and deciphered many tablets of great historical importance, especially in relation to Jewish annals; was one of the editors of a volume of *Cuneiform Inscriptions of Western Asia* (1867); published at the expense of Messrs. Fox Talbot and J. W. Bosanquet the Assyrian text and an interlinear translation of an important inscription under the title *The History of Assur-bani-pal* (1871); made known in 1872 his discovery and translation of fragments of a Chaldaean account of the Deluge, which he printed in the *Transactions* of the Society of Biblical Archæology; undertook in 1873, in behalf of the *Daily Telegraph* newspaper, a new examination of the mounds of Nineveh, and found a vast number of new inscriptions from the Assyrian royal library; made another exploration for the British Museum 1874; was unsuccessful in an attempt to renew his researches 1875, but obtained permission from the Turkish government for a more thorough exploration, which he began in the spring of 1876, when, being detained in Syria, he discovered the magnificent ruins of Carchemish, the capital of the ancient Hittite kingdom, and demonstrated that region to have been the original home of the Etruscans; thereby solving a most important ethnological and philological problem. Among his other recent discoveries are tablets containing Chaldaean legends parallel to the earlier chapters of Genesis, including accounts of the Creation and the Fall. Author of *Explorations in Assyria, The Chaldaean Account of Genesis*, and *The Ancient History of Assyria*, besides many separate translations and philological papers. D. Aug. 19, 1876.

Smith (Gerrit), b. in Utica, N. Y., Mar. 6, 1797, son of Peter Smith, a proprietor of vast tracts of land in Central and Northern New York, and once a partner of John Jacob Astor in the fur-trade; graduated at Hamilton College 1818; took up his residence at Peterboro', Madison co., N. Y., devoting himself to the management of his great landed estate; became a member of and liberal contributor to the Colonization Society 1825, but withdrew from it 1835, when he connected himself with the American Anti-Slavery Society, of which he was thenceforth one of the leading members; was noted for his philanthropy in every good cause; gave away vast tracts of land in small parcels, distributed to actual settlers; was elected to Congress 1852, but resigned after a single session; was a liberal contributor to the Free Soil campaign in Kansas; gave pecuniary aid to John Brown 1859 when preparing the attack on Harper's Ferry, though, it is believed, without a knowledge of that project; was many times nominated on an anti-slavery ticket for governor of New York and for other

offices for which it was known that he would receive but a small vote; was a liberal contributor to the expenses and charities connected with the war for the Union, but joined Horace Greeley in signing the bail-bond of Jefferson Davis 1867; wrote, printed, and distributed many pamphlets on slavery and other reforms; built a church at Peterboro', in which he sometimes preached, but underwent considerable fluctuations in his religious creed. D. in New York City Dec. 28, 1874. Author of *Speeches in Congress* (1855), *Sermons and Speeches* (1861), *The Theologies* (1866), and *Nature the Basis of a Free Theology* (1867).

Smith (Goldwin), LL.D., b. at Reading, England, Aug. 13, 1823; educated at Eton; graduated with high honors at Magdalen College, Oxford, 1845; became fellow and tutor of University College; was called to the bar at Lincoln's Inn 1847; was secretary to two university commissions instituted by Parliament, and a member of the education commission 1859–66; became regius professor of modern history at Oxford 1858; was a prominent champion of the American Federal government during the civil war, when he wrote *Does the Bible Sanction Slavery?* (1863), *On the Morality of the Emancipation Proclamation* (1863), and other pamphlets on the same subject; visited the U. S. on a lecturing tour 1864, being received with distinction; published on his return lectures on *England and America* (1865) and *The Civil War in America* (1866); settled in the U. S. 1868 as professor of English history at Cornell University, which post he filled until 1871, when he removed to Toronto, Canada; became a member of the senate of the university of that city; was editor of the *Canadian Monthly* (1872–74), and took the direction of a political newspaper 1875. Author, among other works, of *Lectures on Modern History* (1861), *Rational Religion* (1861), *Irish History and Irish Character* (1861), *On Church Endowments* (1862), *The Empire, a Series of Letters* (1863), *A Plea for the Abolition of Tests in the University of Oxford* (1864), *Speeches and Letters on the Rebellion* (New York, 2 vols., 1865), *Three English Statesmen*, being sketches of Pym, Cromwell, and Pitt (1867), *The Reorganization of the University of Oxford* (1868), and *A Short History of England down to the Reformation* (1869).

Smith (Green Clay), son of John Speed Smith, b. at Richmond, Ky., July 2, 1830; served as a volunteer in the Mexican war, gaining the rank of lieutenant of cavalry; graduated at Transylvania University 1849; became a lawyer at Covington; was a member of the Kentucky legislature 1861, and a decided Union man; became colonel of the 4th Kentucky (Union) Cavalry Feb., 1862, and brigadier-general of volunteers June, 1862; was a member of Congress 1863–66; a delegate to the Baltimore convention 1864; governor of Montana Territory 1866, and subsequently a Baptist clergyman. In 1876 he was the candidate of the Prohibitionists for the Presidency.

Smith (Gustavus Woodson), b. in Scott co., Ky., Jan. 1, 1822; was graduated from the U. S. Military Academy July 1, 1842, when appointed a brevet second lieutenant in the corps of engineers; second lieutenant 1845; first lieutenant 1853. After serving two years in the construction of fortifications of New London harbor, he was called to West Point as assistant professor of engineering, where he remained until 1846, when, the war with Mexico occurring, he was sent to the field with the engineer company of sappers and miners, which he commanded during the siege of Vera Cruz and during the subsequent operations of the war, receiving the brevets of first lieutenant and captain for gallantry at Cerro Gordo and Contreras. In Nov., 1849, he was recalled to West Point, where he remained as principal assistant professor of engineering until Dec. 18, 1854, when he resigned from the army. He was subsequently employed in the construction of various government buildings and in the iron-works of Cooper & Hewitt at Trenton, N. J. From 1858 to Sept., 1861, he was street commissioner of New York City, though some time previous to the latter date he had departed for the South, and in August had been appointed a major-general in the Confederate army. On May 31, 1862, Gen. Johnston having been severely wounded that day at Fair Oaks, Gen. Smith succeeded to the temporary command of the Army of Northern Virginia, and subsequently commanded at Petersburg, Va. In 1864–65 he was commander of the State forces of Georgia, and was captured at Macon, Ga., Apr. 20, 1865. From 1866 to 1869 he was in charge of the S. W. Iron Co.'s works at Chattanooga, Tenn., and from 1870 to 1875 was insurance commissioner of Kentucky.

Smith (Henry), known as "Silver-tongued Smith," b. at Withcock, Leicestershire, England, in 1550; became a fellow-commoner of Queen's College, Cambridge, 1573; afterward studied at Oxford, but did not graduate; took holy orders; became lecturer at St. Clement Danes in the Strand, London, 1587, and soon acquired immense popularity as a preacher, displaying a prodigious memory and excelling in fluency, elegance, and eloquence, and in the practical character of his discourses, but was suspended by Bishop Aylmer in 1588. D. in 1591, and was buried at Husband's Bosworth, Leicestershire. A collective edition of his *Sermons* appeared at London (4to, 1594), and has been many times reprinted, together with a *Memoir* by Dr. Thomas Fuller (1657). Two editions appeared in London in 1866.

Smith (Henry Boynton), D. D., LL.D., b. at Portland, Me., Nov. 21, 1815; graduated at Bowdoin College 1834; was a tutor there 1836–37, and again 1840–41, between which periods he studied theology at Andover, Bangor, Halle, and Berlin; was pastor of a Congregational church at West Amesbury, Mass., 1842–47; professor of mental and moral philosophy at Amherst College 1847–50; was professor of church history in Union Theological Seminary, N. Y., 1850–54, and of systematic theology 1854–74; since then professor emeritus; was moderator of the General Assembly of the (New School) Presbyterian Church 1863–64; delivered at the meeting of that body at Dayton, O., an address on *Christian Union and Ecclesiastical Reunion*, which was directed toward that union with the "Old School" Church which was afterward consummated, and for which he prepared an essay on the doctrinal basis, *The Reunion of the Presbyterian Churches* (1867); was appointed delegate in 1867 to the meeting of the Evangelical Alliance in Amsterdam, for which he prepared a report *On the State of Religion in the U. S.*; was the founder and editor of the *American Theological Review* (1859–71), consolidated with the *Presbyterian Review* in 1862, and united with the *Princeton Review* in 1872; aided Prof. R. D. Hitchcock in the *Life, Character, and Writings of Edward Robinson* (1864); wrote a *Memorial of Anson G. Phelps* (1860), and is author, among other works, of addresses on *The Relations of Faith and Philosophy* (1849), *The Problem of the Philosophy of History* (1853), *The Reformed Churches of Europe and America* (1855); of inaugural addresses on *Church History as a Science* (1851), and *The Idea of Christian Theology as a System* (1855). He published in 1859 a *History of the Church of Christ, in Chronological Tables* (folio); was translator in part, and editor, of Gieseler's *Church History* (4 vols., 1859–63; vol. v. in preparation); editor of revised translations of Hagenbach's *History of Christian Doctrine* with large additions (2 vols., 1861–62), and Stier's *Words of the Lord Jesus* (1864–65). D. in New York, Feb. 7, 1877.

Smith (Sir Henry George Wakelyn), Bart., usually known as Sir Harry Smith, b. at Whittlesea, Cambridgeshire, England, in 1788; entered the army as second lieutenant in the rifle brigade 1805; participated in the storming of Montevideo, the unsuccessful assault on Buenos Ayres, and the capture of Copenhagen; was highly distinguished in the Peninsular campaign, being present at every important battle except Talavera; participated as assistant adjutant-general in the capture of Washington, D. C., by Gen. Ross 1814; was military secretary in the campaign against New Orleans to Sir Edward Pakenham, who fell in his arms mortally wounded; returned to England in time to serve as assistant quartermaster-general in the campaign of Waterloo; was employed thereafter for many years in garrison duty at Halifax, N. S., and in the West Indies; went to the Cape of Good Hope 1827; commanded a division in the Kaffir war 1834–35; was appointed adjutant-general to the forces in India 1839; was distinguished at the battles of Gwalior and Maharajpore, being knighted for the latter service 1844; took a prominent part in the war against the Sikhs in the Punjaub, commanding a division at Moodkee and at Ferozepore Dec., 1845; was sent to the relief of Loodianah, and took Aliwal at the point of the bayonet Jan. 28, 1846, capturing 67 guns; reinforced Lord Gough in time to enable him to win the decisive battle of Sobraon, Feb. 10, 1846; received the thanks of Parliament on the proposal of the duke of Wellington, and was made a baronet; became governor of the Cape of Good Hope 1847; conducted the Kaffir war of 1851–52, and was made lieutenant-general 1854. D. in London Oct. 12, 1860.

Smith (Henry H.), M. D., b. at Philadelphia, Pa., in 1818; studied surgery at Paris; published several works on that subject; became professor of surgery in the University of Pennsylvania 1855, and surgeon-general of the State 1861.

Smith (Horace), brother of James, b. in London, England, Dec. 31, 1779; became a member of the stock exchange, in which business he acquired a fortune; was associated with his brother in writing for several periodicals and in the production of a celebrated volume of poetical parodies entitled *Rejected Addresses* (1812); was author of numerous novels which had but moderate success, and of an anonymous volume of humorous prose sketches, *The*

Tin Trumpet (1836). D. at Tunbridge Wells July 12, 1849. A selection from the poetical works of both brothers, including the *Rejected Addresses*, and accompanied by a *Memoir*, was published by Mr. Epes Sargent (New York, 1857).

Smith (Horace Wemyss), son of Richard Penn Smith, b. in Philadelphia, Pa., in 1825; has been a frequent contributor of prose and verse to the magazines; edited the *Works* of his father (1865), the *Yorktown Orderly Book* (1865), and reprinted the "Cadwalader Pamphlet" with the "Valley Forge Letters" under the title *Nuts for Future Historians to Crack* (1856).

Smith (Isaac), b. in New Jersey in 1736; graduated at Princeton 1755; was a tutor there; studied and practised medicine; commanded a regiment in 1776; was judge of the supreme court of New Jersey eighteen years; member of Congress 1795–97; commissioner to treat with the Seneca Indians 1797; and subsequently president of the Bank of Trenton. D. at Trenton Aug. 29, 1807.

Smith (Israel), b. at Suffield, Conn., Apr. 4, 1759; graduated at Yale College 1781; settled as a lawyer at Rupert, Vt.; was boundary commissioner 1789; took an active part in procuring the admission of Vermont into the Union; settled at Rutland; was a member of the convention for the ratification of the Federal Constitution 1791; was chief justice of the supreme court of Vermont 1797; member of Congress 1791–97 and 1800–01; U. S. Senator 1801–02 and 1803–07, and governor of Vermont 1807–08. D. at Rutland Dec. 2, 1810.

Smith (James), b. in Ireland about 1720; came to Pennsylvania with his parents and settled on the Susquehanna 1729; was educated at the College of Philadelphia; admitted to the bar; became at first a surveyor near Shippensburg, afterward a lawyer at York; raised in 1774 the first volunteer company in the State for the purpose of resistance to Great Britain; was a member of the convention called to consider the expediency of abstaining from importing English goods, and one of the committee to prepare instructions for the representatives; published an *Essay on the Constitutional Power of Great Britain over the Colonies in America*, which gave a powerful impulse to the Revolution; was a member of the Pennsylvania convention of 1775 and of the provincial conference for framing a new government for Pennsylvania (June 18), in which he seconded Dr. Rush's resolution in favor of independence; was elected to the convention for forming a constitution for Pennsylvania July 15, 1775, and of the Continental Congress 1775–78; signed the Declaration of Independence, and was elected to the general assembly of Pennsylvania 1780. D. at York July 11, 1806. He was a man of great wit, and was accustomed to create a sensation by his odd gestures and drawling utterance.

Smith (James), b. in Franklin co., Pa., in 1737; was taken captive by the Indians 1755, and adopted by them, but escaped after four years; was a leader of the "Black-boys" 1763 and 1765; was a lieutenant in Col. Bouquet's expedition to the Ohio region 1764; made an exploring expedition in Kentucky 1766; attained the rank of colonel in the war of the Revolution; settled at Cane Ridge, near Paris, Ky., 1788; was a member of the Danville convention, and afterward represented Bourbon county in the general assembly of Kentucky. D. in Washington co., Ky., in 1812. Author of *Remarkable Occurrences in the Life and Travels of Col. James Smith* (Lexington, Ky., 1799; republished at Philadelphia 1831 and 1834, and edited at Cincinnati by William M. Darlington, 1870), of *A Treatise on the Mode and Manner of Indian War* (Paris, Ky., 1812), and of two controversial pamphlets, *Shakerism Developed* and *Shakerism Detected*.

Smith (James), brother of Horace, b. in London, England, Feb. 10, 1775; became a lawyer; was an associate of his brother in the production of *Rejected Addresses* and other literary enterprises; aided Charles Mathews in preparing his *Country Cousins*, *A Trip to France*, and other "entertainments;" was an invalid for several years, and amused himself by writing epigrams and *vers de société*. An early volume of imitations published by the brothers, under the title *Horace in London*, was chiefly written by him. D. at London Dec. 24, 1839. His posthumous *Miscellanies* were edited by his brother (2 vols., 1840).

Smith (Sir James Edward), M. D., b. at Norwich, England, Dec. 2, 1759; studied medicine at Edinburgh; practised his profession in London; acquired by purchase a considerable portion of the library and herbarium of Linnæus 1784; was the founder and first president of the "Linnæan Society" 1788; settled at Norwich 1796; lectured on botany at the Royal Institution for many years, and was knighted by George IV. D. at Norwich Mar. 17, 1828. Author of *English Botany* (36 vols., 1792–1807), *English Flora* (3 vols., 1823–25), and other works.

Smith (James Milton), b. in Twiggs co., Ga., Oct. 24, 1823; educated at Culloden Academy in Monroe co., Ga.; became a lawyer; in 1861 entered the Confederate service as major of the 13th Georgia regiment; rose to colonel in 1862; was a member of the 2d Confederate Congress until the close of the war; elected a member of the State legislature 1871, and became Speaker of its house of representatives; in 1872 was elected governor of the State to fill the unexpired term of Rufus B. Bullock, and re-elected in Oct., 1872.
Alexander H. Stephens.

Smith (James Y.), b. at Groton, Conn., Sept. 15, 1809; was for some years a lumber-merchant at Providence; became a cotton-manufacturer at Willimantic, Conn., 1838, and also at Woonsocket, R. I.; was several times a member of the Rhode Island legislature; mayor of Providence 1855–57, and governor of Rhode Island 1863–65. D. Mar. 26, 1876.

Smith (Jeremiah), LL.D., b. at Peterborough, N. H., Nov. 29, 1759; graduated at Rutgers College 1780; studied law; was distinguished at the New Hampshire bar and as a general scholar, being noted for vast attainments; was a member of Congress 1791–97; was appointed by Pres. Adams in 1801 a judge of the U. S. circuit court, but did not serve; was governor of New Hampshire 1809–10, and several years chief-justice of the State superior court, and an early patron and friend of Daniel Webster. D. at Dover, N. H., Sept. 21, 1842. A *Life* was published by Rev. John H. Morison (Boston, 1845).

Smith (Jerome van Crowinshield), M. D., b. at Conway, N. H., July 20, 1800; graduated at Brown University 1818; studied medicine; became professor of anatomy and physiology at the New York Medical College; settled at Boston; edited the *Weekly News-Letter* (1825–26) and the *Medical Intelligencer* for more than twenty years; was port-physician of Boston 1826–49, and mayor 1854; published travels in Egypt, Palestine, and Turkey, and many scientific and miscellaneous works, and resided some years in New York City. D. Aug. 21, 1879.

Smith (John), b. at Willoughby, Lincolnshire, England, in Jan., 1579; spent four years of his early manhood in military service in the Netherlands; was afterward engaged in wars against the Turks in Hungary and Transylvania, having, according to his own account, been taken prisoner, sold as a slave at Constantinople, and sent to the Crimea, whence he escaped, after a remarkable series of adventures, to the Russian frontiers. There is, however, reason to believe that the wonderful adventures of Smith's career in the East are wholly or in part fictitious, as also the pension and patent of nobility which he claimed to have had from Sigismund Bathory, prince of Transylvania. Returning to England, by way of Barbary, he was induced by Capt. Bartholomew Gosnold to take part in the colonization of Virginia (1606), then being carried into effect, and brought to bear with such effect his military renown upon the directory of the "London Company" that his name was placed on the secret list of seven persons appointed members of the council. During the long voyage to Virginia (1607) Smith was placed under arrest on an accusation of sedition, and, though liberated on arrival at Jamestown, Va., where the colony was located, he was excluded from his place in the council. He accompanied Capt. Newport in his voyage of exploration up James River as far as the present site of Richmond; was on their return admitted as a member of the council; took part in the movement which resulted in the removal from office of Wingfield, the president of the colony, against whom he successfully brought a suit for slander; was entrusted with the command of several expeditions into the interior, partly for the purpose of exploration, but chiefly with the object of obtaining food, as the colony was now suffering from famine, and repressed with severity the projects of some of the settlers to return to England; upon which charge he caused Capt. George Kendall to be condemned and executed. Upon one of these expeditions, in Dec., 1607, Smith was taken prisoner, and detained for some time, though kindly treated by the Indian chieftain Wahunsenacawh (afterward incorrectly called by many writers the "emperor" Powhatan). The famous incident of the preservation of his life by the intervention of Pocahontas (or Amonate) was related of this captivity, but documents recently published leave little doubt that the whole adventure is fictitious. On being carried back to Jamestown by the Indian chieftain, Smith was tried by his fellow-councillors for the death of two of his companions, said to have been killed by the Indians through his imprudence, and was condemned to be executed the next day, but his life was saved by the opportune arrival of Capt. Newport with reinforcements and provisions. In the following year Smith made two extended surveys of Chesapeake Bay and its tributary waters, of which he made a map; became president of the council Sept., 1608; had several skirmishes with hostile Indians, who at one time

facilitated the destruction of Jamestown. His departure from Virginia, to which he never returned, took place in Sept., 1609, and was attributed by himself to having been burned by an explosion of gunpowder, but another account states that he was sent to England a prisoner. In 1614 he explored with two ships fitted out by some London merchants a large portion of the North American coast, to which he gave the name of New England, and of which he formed a tolerably accurate map, and made a handsome profit by fishing and fur trading. In 1615 he undertook another voyage to New England for the purpose of founding a colony, but was captured by a French man-of-war and taken to Rochelle. Afterward he claims to have been engaged in "sea fights for the French against the Spaniards," and to have experienced several remarkable adventures. About 1616 he received the title of "admiral of New England," and was thenceforth much engaged in promoting American colonization by means of a series of publications on America, written either by or for him, in which romantic versions of his career in many lands were put forth; but many of the details are contradicted by conclusive proofs, and his several books and pamphlets are not consistent with each other upon some important points. D. in London June 31, 1631, and was buried in the choir of St. Sepulchre's church. Under the name of "Thomas Watson," Smith sent from Virginia *A True Relation of such Occurrences and Accidents of Note as hath happened in Virginia, etc.* (London, 4to, 1608), which was printed in black letter, accompanied by a map, and is the earliest tract published on the subject. It was reprinted, with an introduction and notes, by Charles Deane (Boston, 1867). He was also author of *A Map of Virginia, with a Description of the Country, the Commodities, the People, Government, and Religion, etc.* (Oxford, 1612); *A Description of New England, or the Observations and Discoveries of Captain John Smith (Admiral of that Country) in the North of America in the Year of our Lord 1614, etc.* (London, 1616; reprinted in the *Collections* (3d Series, vol. vi.) of the Mass. Hist. Soc., and in Force's *Tracts*, *New England's Trials, etc.* (1620 and 1622); *The Generall Historie of Virginia, New England, and the Summer Isles, with the Names of the Adventurers, Planters, and Governors from their First Beginning Ano. 1584 to this Present, etc.* (1626)—a work including the substance of its predecessors; two treatises on seamanship (1626 and 1627); *The True Travels, Adventures, and Observations of Captain John Smith in Europe, Asia, Africa, and America from 1593 to 1629, etc.* (1630); and *Advertisements for the Unexperienced Planters of New England, etc.* (1631; reprinted at Boston, 1865); and was engaged at the time of his death upon a *History of the Sea*, no part of which has been preserved. The *Generall Historie* and *True Travels* were republished together at Richmond (2 vols., 1829). A *Letter of John Smith to Lord Bacon*, written in 1618 to recommend to the chancellor's attention the fisheries of New England, was first printed in the New York *Historical Magazine* for 1861. There are biographies by George S. Hillard (in Sparks's Series, vol. ii.), W. G. Simms (1846), and George C. Hill (1858). Much light was thrown upon his career by the Hakluyt Society's publication of Strachey's *History of Travails into Virginia Britannia* (1849) from the original MS., and by Mr. Charles Deane's notes to his edition of Wingfield's *Discourse of Virginia* (Boston, 1859), in which publications the falsity of the Pocahontas legend was first exposed. In Bryant and Gay's *Popular History of the U. S.* (vol. i., 1876) judicious use has been made of the materials above mentioned. PORTER C. BLISS.

Smith (JOHN), known as "John Smith of Cambridge," b. at Achurch, near Oundle, Northamptonshire, England, in 1618; graduated at Emanuel College, Cambridge, 1640; became fellow of Queen's College 1644; was for several years tutor and mathematical lecturer there; took holy orders, and was esteemed "a man of great abilities, vast learning, and possessing also every grace and virtue which can improve and adorn human nature." According to Allibone, he was "the most eminent divine of both his names." D. at Cambridge Aug. 7, 1652. His *Select Discourses* were edited with a *Memoir* by Dr. Symon Patrick (London, 4to, 1660; frequently reprinted), and acquired great fame. Other *Lives* were subsequently written by John King (1820) and by Lord Hailes (1821). He figures largely in Principal Tulloch's *Rational Theology in England* in the seventeenth century.

Smith (JOHN AUGUSTINE), M. D., b. in Westmoreland co., Va., Aug. 29, 1782; graduated at William and Mary College, Va., 1800; studied medicine; settled as a physician at New York 1809; became lecturer on anatomy in the College of Physicians and Surgeons; edited the *Medical and Physiological Journal*; was president of William and Mary College 1814–26, when he resigned and resumed the practice of his profession in New York; was president of the College of Physicians and Surgeons 1831–43, and published numerous addresses, essays, and lectures, chiefly on medical and physical science and moral philosophy. D. in New York Feb. 9, 1865.

Smith (JOHN BLAIR), D. D., brother of Dr. Samuel Stanhope Smith, b. at Pequea, Pa., June 12, 1756; graduated at Princeton 1773; studied theology with his brother, then president of Hampden Sidney College, and succeeded him in that position 1779; became one of the most noted preachers of the Valley of Virginia, and very successful as a revivalist; was pastor of the Third Presbyterian church, Philadelphia, 1791–95; became first president of Union College 1795; returned to his pastoral charge in Philadelphia May, 1799, and d. there of an epidemic Aug. 22, 1799.

Smith (JOHN BLAKELY), b. in North Carolina June 11, 1820; was brought up a Presbyterian, but became a preacher of the Methodist Episcopal Church, South; joined in 1847 the Georgia conference, in which he filled responsible positions, and subsequently, after its division, in the South Georgia conference, till his death, in Georgia, Sept. 30, 1872. He was the secretary of the conference, and was a most laborious and successful minister. T. O. SUMMERS.

Smith (JOHN COTTON), LL.D., b. at Sharon, Conn., Feb. 12, 1765; graduated at Yale College 1783; was admitted to the Litchfield bar 1786; was several years a member of the legislature, of which he was clerk 1799 and Speaker 1800; member of Congress 1800–06; became a member of the council and judge of the State supreme court 1809; was shortly afterward lieutenant-governor; was governor of Connecticut 1813–18. During the celebrated Congressional debates of 1801 concerning the Federal judiciary he presided as chairman of the committee of the whole; was a man of extensive literary and historical attainments, a distinguished agriculturist and philanthropist, and president of the American Board of Foreign Missions and of the American Bible Society, and contributor to literary and scientific periodicals. D. at Sharon Dec. 7, 1845. His *Correspondence and Miscellanies* was published at New York in 1847 by Rev. W. W. Andrews.

Smith (JOHN E.), b. in Pennsylvania; on the outbreak of the civil war was a resident of Illinois, and served on the staff of Gov. Yates; appointed colonel of the 45th Illinois Vols. July 23, 1861, he was engaged in the capture of Forts Henry and Donelson, the battle of Shiloh, and the siege of Corinth; in Dec., 1862, was commissioned a brigadier-general of volunteers, and commanded a division of the 16th army corps in the Yazoo expedition, battles of Port Gibson, Raymond, Champion Hill, and Big Black River; transferred to the 17th corps in June, he commanded the 1st division in the Vicksburg campaign, and with the 15th corps was engaged in the battle of Missionary Ridge, in Sherman's Atlanta campaign and subsequent "march to the sea," and the invasion of the Carolinas. In Apr., 1866, he was mustered out of the volunteer service, and in the reorganization of the regular army (July, 1866) was appointed colonel of the 27th Infantry; transferred to the 15th Infantry Dec. 15, and 14th Infantry Dec. 20, 1870; brevetted brigadier-general for Vicksburg and major-general for capture of Savannah.

Smith (JOHN GORDON), b. at Aberdeen, Scotland, about 1788; graduated at Marischal College in his native city, and studied medicine there and at the University of Edinburgh; served in the Peninsular war as surgeon to the 12th Lancers; was subsequently librarian to the duke of Sutherland for four years, and was appointed professor of medical jurisprudence in 1828 at the University of London. He was a man of considerable ability, and his three works on medical jurisprudence are still considered very valuable: *Principles of Forensic Medicine* (London, 1821; several times reprinted), *An Analysis of Medical Evidence* (London, 1825), and *Hints for the Examination of Medical Witnesses* (London, 1829). He also wrote *Santarem, or Sketches of Society and Manners in the Interior of Portugal* (London, 1832), and contributed to the *Military Register*, and to other medical and some miscellaneous periodicals. In the latter part of his life he was much embarrassed, however, by unfortunate pecuniary circumstances, and he d. in the Fleet Prison, London, where he was confined for debt, Sept. 15, 1833. Interesting notices of him will be found in the London *Gentleman's Magazine*, 1833, vol. ii., pp. 278, 543.

Smith (JOHN GREGORY), b. at St. Alban's, Vt., July 22, 1818; graduated at the University of Vermont 1838, and at the New Haven Law School; commenced practice 1841 along with his father, John Smith (1789–1858), who was a member of Congress 1839–41, and subsequently chancellor of Vermont; aided him in developing important railway projects; succeeded his father as chancellor 1858; sat in both houses of the State legislature; was Speaker of the lower house 1862; governor of Vermont 1863–65; became president of the Northern Pacific Railway 1866.

Smith (John Hyatt), D. D., b. at Saratoga Springs, N. Y., in 1823; became a Baptist minister 1848; was some years pastor of the Eleventh Baptist church, Philadelphia, subsequently of Lee avenue church, Brooklyn, N. Y., where he became widely known as a pulpit-orator and as a leader of the "open-communion" movement.

Smith (John Jay), great-grandson of James Logan, b. in Burlington co., N. J., June 16, 1798; was from 1829 to 1851 librarian of the Philadelphia and Loganian libraries; published several volumes on antiquarian and biographical topics; edited several literary periodicals, and superintended the publication of above 100 volumes by other writers. The *Lives* of Franklin, Rittenhouse, Montgomery, Kenton, and Gen. Augustine Washington in the *National Portrait Gallery* were from his pen.

Smith (John Lawrence), M. D., M. N. A. S., b. near Charleston, S. C., Dec. 16, 1818; graduated at the University of Virginia, and at the medical school of the University of South Carolina; acted as civil engineer on the Charleston and Cincinnati R. R.; pursued his professional education for three years in France and Germany, devoting himself also to chemistry, mineralogy, and general science; returned to the U. S. 1844; commenced the practice of medicine at Charleston, S. C., where he delivered lectures on toxicology, and soon devoted himself to scientific pursuits; gave attention to agricultural chemistry, and made a thorough examination of the marl-beds near Charleston; was for more than four years (1846–51) mining engineer to the Turkish government; aided in the development of cotton-growing in Asia Minor, where he made extensive mineralogical explorations, and published a report *On the Thermal Waters of Asia Minor* (1849); was afterward instrumental in the discovery of deposits of emery and corundum in the U. S.; invented in 1851 the inverted microscope; was elected in that year professor of chemistry in the University of Virginia; subsequently removed to Louisville, Ky.; became a professor in the Medical University of that city and superintendent of its gasworks; was U. S. commissioner to the Universal Expositions of Paris (1867) and Vienna (1872); was in 1872 president of the American Association for the Advancement of Science; is a member of the National Academy of Science, and of numerous chemical, biological, mineralogical, scientific, and industrial associations; received from the emperor Napoleon III. the cross of the Legion of Honor; is author of an elaborate report to the U. S. government on *The Progress and Condition of Several Departments of Industrial Chemistry* (1867), as seen at the Paris Exposition, and has printed in pamphlets or in periodicals more than 50 scientific papers, most of which were collected into a volume entitled *Mineralogy and Chemistry: Original Researches* (Louisville, 1873).

Paul F. Eve.

Smith (John Pye), D. D., LL.D., F. R. S., b. at Sheffield, England, May 25, 1774; studied at the Independent academy at Rotherham; became a dissenting (Independent) minister, and in 1800 resident classical tutor in the theological academy at Homerton; exchanged that post in 1813 for the divinity tutorship, which he filled until 1843; was again classical tutor, and also principal from the latter date until 1850, when New College, St. John's Wood, was formed by the junction of Homerton, Highbury, and Coward colleges, and Dr. Smith retired to private life, aided by a testimonial fund of £3000. For forty-three years he was pastor of the celebrated "Gravel Pits Chapel," Homerton; took great interest in science, and was honored by membership in the Royal and Geological societies. D. at Guildford, Surrey, Feb. 5, 1851. Author of *The Scripture Testimony to the Messiah* (2 vols., 1818–21), *The Mosaic Account of the Creation and Deluge illustrated by the Discoveries of Modern Science* (1837), *Scripture and Geology* (1839), and other works. (See *Memoirs of the Life and Writings of John Pye Smith*, by J. Medway, 1853.)

Smith (John Russell), b. at Sevenoaks, Kent, England, in 1810; became a bookseller and publisher in London, and distinguished by the excellence of his bibliographical catalogues, one of which was devoted to the literature relating to the county of Kent (1837), another to the provincial dialects of England (1839), and a third to *English Writers on Angling and Ichthyology* (1856). The most valuable to Americans is the extensive and accurate *Bibliotheca Americana* (1849, 1853, and 1865; *Supplement*, 1865). He has been an assiduous collector of Shakspeariana, and was projector and co-editor of the "Library of Old Authors."

Smith (John Speed), b. in Jessamine co., Ky., July 31, 1792; served under Gen. Harrison at Tippecanoe; was his aide at the battle of the Thames 1813; sat several years in the Kentucky legislature, of which he was Speaker 1827; was member of Congress 1821–23; U. S. district attorney for Kentucky under Pres. Jackson, and for a considerable period State superintendent of public works. D. in Madison co., Ky., June 6, 1854.

Smith (John William), b. in London, England, in 1809; educated at Trinity College, Dublin; commenced legal practice as a special pleader 1831, and was called to the bar at the Inner Temple 1834. D. in London Dec. 17, 1845. Author of a *Compendium of Mercantile Law* (1834), *An Elementary View of the Proceedings in an Action at Law* (1835), and *A Selection of Leading Cases in Various Branches of the Law* (2 vols., 1837–40), which were received with extraordinary favor, especially the latter, and were reprinted in America. Mr. Smith wrote other legal works, and was a poet of considerable merit. (See *Memoir*, by Samuel Warren, in *Blackwood's Magazine*, Feb., 1847.)

Smith (Jonathan Bayard), b. at Philadelphia, Pa., in 1741; graduated at Princeton 1760; became a successful merchant at Philadelphia; commanded a company of militia at the battle of Princeton; was a member of the Continental Congress 1777–78; served many years as a judge of common pleas, and was a trustee of Princeton College and of the University of Pennsylvania. D. at Philadelphia June 16, 1812.

Smith (Joseph), D. D., b. in Westmoreland co., Pa., July 15, 1796; graduated at Jefferson College 1815, at Princeton Theological Seminary 1819; preached several years in Virginia; was principal of academies at Staunton, Va., and at Frederick City, Md.; president of Franklin College, O., and of a college at Frederick City; became general agent for the Presbyterian synods of Western Pennsylvania, Northern Virginia, and Eastern Ohio, and was pastor at Round Hill and at Greensburg, Pa., where he d. Dec. 4, 1868. Author of *Old Redstone* and of a *History of Jefferson College*.

Smith (Joseph), b. at Sharon, Vt., Dec. 23, 1805; removed while a child, with his parents, to Palmyra, N. Y., where he grew up almost without education, leading an idle and rather disreputable life, and about 1828 began to put forth vague claims as the founder of a new religion, or rather, as the restorer of the original true faith. According to his own account, he began to have visions at the age of fifteen, and on Sept. 21, 1823, the angel Moroni appeared to him, announcing that God had a work for him to perform, and that, buried in the earth in a certain spot a few miles distant, was a record inscribed upon gold plates, giving an account of the early inhabitants of America and of their fate; and with this record would be found a kind of spectacles through which alone the writing could be read. Three years after, the angel placed the plates in his hands, together with the spectacles. Smith described the plates as being about 8 inches long, 7 wide, and connected by rings so as to form a volume about 6 inches thick. The plates were inscribed on both sides with hieroglyphic characters in a language no longer extant, but which he was able to decipher and understand by the use of the miraculous spectacles, which he called the "Urim and Thummim." Smith professes to have dictated in English the contents of these plates to Oliver Cowdery, who acted as his amanuensis, the plates themselves mysteriously disappearing as they were successively transcribed. What purported to be a copy of the original characters on one of these plates was submitted to Prof. Charles Anthon, who says, "The paper was in fact a singular scroll. It consisted of all kinds of crooked characters, disposed in columns, and had evidently been prepared by some person who had before him at the time a book containing various alphabets. Greek and Hebrew letters, crosses and flourishes, Roman letters, inverted or placed sideways, were arranged and placed in perpendicular columns; and the whole ended in a rude delineation of a circle, divided into various compartments, decked with various strange marks, and evidently copied after the manner of the Mexican calendar, given by Humboldt, but copied in such a way as to betray the source whence it was derived." The manuscript as professed to be transcribed by Cowdery from Smith's dictation was printed at Palmyra in 1830 under the title, *The Book of Mormon, an Account written by the Hand of Moroni upon Plates taken from the Plates of Nephi. By Joseph Smith, Jr., Author and Proprietor;* and to it was prefixed a certificate signed by Cowdery and two others to the effect that they had seen and handled the plates. Subsequently, all three of the witnesses fell out with Smith, and declared the whole matter to be a hoax. There can be no doubt that the *Book of Mormon* was a kind of historical romance, written nearly twenty years before by Samuel Spalding, at one time a clergyman, and that he intended to publish it as such under the title *The Manuscript Found;* and that this manuscript fell into the hands of Sidney Rigdon, a printer, who surreptitiously copied it, returning the original to Spalding, who died soon after, but the manuscript was preserved by his widow. Rigdon in the mean while had set up as the foun-

der of a new faith, and fell in with Smith, and they two concocted the plan of making Spalding's romance a kind of Bible of their sect, or at least hoping to make money by its publication. The funds for the printing were advanced by Martin Harris, a neighboring farmer of some property and one of the signers of the attestation; but not being able to get back what he had spent, he disclosed the hoax as to the plates, of which he was probably a victim. The *Book of Mormon* consists of nearly a score of separate books, the first professing to be written by Nephi, who lived in Jerusalem about 600 B. C., and finally, upon the Dispersion, led a colony to America: the work is continued by others until 420 A. D., when Moroni, the last survivor of his race, sealed up the plates and deposited them in the place pointed out to Smith. The entire book bears to Mormonism about the same relation which the Pentateuch and the historical books of the Old Testament do to Christianity. (For the development of Mormonism, and its history, see MORMONS.) Smith and Rigdon soon gained a small body of followers, and in 1831 went to Kirtland, O., where they built a temple, set up a fraudulent bank, and were driven away by the citizens in 1838. Smith had in the mean time fixed upon a place in Missouri as the site of his New Jerusalem, and here his adherents had begun to gather; but becoming obnoxious to the surrounding inhabitants, they abandoned their settlement, and took refuge in Hancock co., Ill, where in 1840 they established themselves in a fine location at a bend of the Mississippi, calling their new home Nauvoo; the town increased so rapidly that in six years the population numbered 15,000. Here Smith soon began to put forth, as occasion demanded, a succession of new revelations, among others one establishing polygamy as an essential feature of the "Church of the Latter-Day Saints," and combining in his own person all civil, military, municipal, and sacerdotal authority. A newspaper was set up to oppose him, which was demolished by Smith and his adherents May 6, 1844. Warrants were issued for his arrest and that of his brother Hyrum and some others; they refused to obey the writs; the State militia were called out; the Mormons armed themselves, and a conflict was imminent. The governor of Illinois at length induced the Smiths to surrender and submit to trial, guarantying their personal safety in the interval. They were committed to jail at Carthage, the county-town, and a guard was placed for their protection. On the evening of May 27 a mob assembled, dispersed the guard, and began firing into the door and window of the jail. Hyrum Smith was shot dead; Joseph returned the fire with a revolver until his charges were exhausted, when he endeavored to make his escape by the window, but was shot in the attempt, and fell dead to the ground. A. H. GUERNSEY.

Smith (JOSEPH MATHER), M. D., b. at New Rochelle, N. Y., Mar. 14, 1789; settled as a physician in New York City 1811; was one of the founders of the Medico-Physiological Society; visiting physician to the New York State prison 1820–24; became editor of the New York *Medical and Physical Journal* 1828, and visiting physician to the New York Hospital 1829; was professor of the theory and practice of physic in the New York College of Physicians and Surgeons 1826–55, and afterward professor of materia medica; was president of the American Medical Association 1854, and published several valuable professional books, reports, and memoirs. D. in New York City Apr. 22, 1866.

Smith (JOSHUA TOULMIN), b. at Birmingham, England, May 29, 1816; educated in the public schools of Birmingham; published when nineteen years of age an *Introduction to the Latin Language* (1835), and in the following year *A Popular View of the Progress of Philosophy among the Ancients* (1836); devoted himself to the Scandinavian languages and literature, in which he became proficient; resided in the U. S. 1837–42; published at Boston his *Northmen in New England, or America in the Tenth Century* (1839), which was chiefly a translation from the *Antiquitates Americanæ* (1837); devoted himself, on his return to England, to the study of constitutional and Old-Saxon law; was called to the bar 1849; wrote several able legal treatises, especially *The Parish, its Obligations and Powers, its Officers and their Duties* (1854); illustrated in several publications the antiquities of Birmingham, and undertook the preparation for the Early English Text Society of a *History of English Guilds*, a work of immense labor, which, as well as a projected *History of Birmingham*, was left incomplete by his death at Lancing, Sussex, Apr. 28, 1869. The *History of English Guilds* appeared in 1870.

Smith (JOSIAH TORREY), b. at Williamstown, Mass., in 1815; graduated at Williams College 1842; studied theology, and was pastor of several churches. Author of two controversial works on the subject of infant baptism, and of *God's Testimony in relation to the Use of Intoxicating Beverages*.

Smith (JUNIUS), LL.D., b. at Plymouth, Conn., Oct. 2, 1780; graduated at Yale College 1802; studied law under Judge Reeve at Litchfield, Conn.; was a member of the Connecticut Society of Cincinnati in right of his father, Gen. David Smith of the Revolutionary army; practised law at New Haven; gained an important claim against the British government 1805; engaged in commerce with Great Britain; was the first proposer of a line of steamships across the Atlantic 1832; founded a company for that purpose 1836, and successfully inaugurated the enterprise by the voyage of the Sirius in the spring of 1838, but derived no pecuniary advantage from the efforts of many years; afterward introduced tea-planting into South Carolina, where he purchased an extensive estate; was there assaulted and received a fracture of the skull, from the effects of which he d. at Astoria, N. Y., Jan. 23, 1853.

Smith (LLOYD P.), son of John Jay Smith, b. at Philadelphia, Pa., in 1822; educated at Haverford College; succeeded his father in 1851 as librarian of the Philadelphia Library; compiled vol. iii. of the *Catalogue of Books belonging to the Library Company of Philadelphia* (1856); was one of the commission sent to East Tennessee in behalf of the relief association of Philadelphia 1864; published a *Report* of that visit; is author of privately-printed pamphlets upon the character of Napoleon I. and upon the political tendency of the *Life of Cæsar* by Napoleon III., and was editor of *Lippincott's Magazine*.

Smith (LYNDON ARNOLD), M. D., b. at Haverhill, N. H., Nov. 11, 1795; graduated at Dartmouth College 1817; studied medicine at Dartmouth and Williams medical schools, graduating in 1823 at the latter institution; began practice at Williamstown 1823; settled at Newark, N. J., 1827; was prominently identified with medical progress as an officer of the State and national associations; was the chief promoter of the establishment of a lunatic asylum in New Jersey, and published numerous professional memoirs in the medical journals. D. at Newark Dec. 15, 1865.

Smith (MARCUS), son of Sol F. Smith, b. in New Orleans, La., Jan. 7, 1829, where he made his début as Diggory in *Family Jars*. He appeared for many years in the leading theatres in New York, where he was an established favorite, as well as throughout the U. S. and wherever he appeared in England. D. at London in 1875.

Smith (MARTIN LUTHER), b. in New York in 1819; graduated at West Point 1842; became lieutenant of topographical engineers 1843; served in the Mexican war; became captain 1856; resigned Apr. 1, 1861; entered the Confederate army as brigadier-general; became the head of the engineer corps; planned and constructed the defences of Vicksburg, where he was taken prisoner; reached the rank of major-general, and after the war became chief engineer of Selma Rome and Dalton Railway. D. at Rome, Ga., July 29, 1866.

Smith (MATTHEW HALE), b. in Connecticut about 1810; was successively a preacher of the Universalist, Presbyterian, Episcopalian, and Baptist churches; published books giving the reasons for some of his ecclesiastical changes; studied and practised law, edited newspapers, took part in politics, and engaged in business, but returned to theology, and was for many years well known by his signature "Burleigh" as correspondent of the *Boston Journal*. Of late years he resided chiefly in New York City and vicinity. D. Nov. 7, 1879.

Smith (MELANCTHON), b. May 24, 1810, in New York; entered the navy as a midshipman Mar. 1, 1826; became a lieutenant in 1837, a commander in 1855, a captain in 1862, a commodore in 1866, a rear-admiral in 1870; retired in 1871. Served with great distinction during the civil war at the battle of New Orleans, the passage of Fort Hudson, in the sounds of North Carolina, and in both the Fort Fisher fights, and highly commended for "ability, skill, and daring" by Rear-Admirals Farragut and Porter. From 1866 to 1870 filled the office of chief of the bureau of equipment and recruiting. FOXHALL A. PARKER.

Smith (MILES), D. D., b. at Hereford, England, about 1550; educated at Corpus Christi and Brasenose colleges, Oxford; took orders in the Church of England; became deeply versed in patristic literature and in the Oriental languages; was made bishop of Gloucester 1612; was one of the principal translators of King James's version of the Bible, for which he wrote the Preface, and edited Bishop Babington's collected *Works*. D. Nov., 1624. A posthumous volume of his *Sermons* was printed in 1632.

Smith (MORGAN L.), b. in Oswego co., N. Y., in 1818; enlisted in youth as a private soldier in the U. S. army; was promoted to sergeant for bravery in the Mexican war, after which he engaged in business for some years in New York City and in the Western States, and at the beginning of the civil war raised and commanded a regiment composed

of men from Illinois and Missouri, who were pledged never to retreat from the field; was distinguished at Fort Donelson, at which time he was made a brigadier-general; took part in the Shiloh, Vicksburg, and Chattanooga campaigns; took part in Sherman's "march to the sea" as major-general in command of a division; became post commander at Vicksburg; served some years after the war as consul at Honolulu, and subsequently became a claim-agent at Washington. D. suddenly at Jersey City, N. J., Dec. 29, 1874.

Smith (Nathan), M. D., b. at Rehoboth, Mass., Sept. 30, 1762; settled in childhood in Vermont; received a limited education; served in the Vermont militia toward the close of the war of the Revolution; studied medicine at Harvard Medical School; practised at Cornish, Vt.; became first professor of the medical school established at Dartmouth College 1798; visited Europe, attending lectures in England and Scotland; was the sole creator of the medical department at Dartmouth; delivered lectures also at the University of Vermont and at Bowdoin College, and became professor in the new medical school of Yale College 1813, retaining, however, his connection with Dartmouth. D. at New Haven, Conn., Jan. 26, 1829. Author of an *Essay on Typhus Fever* (1824) and of posthumous *Medical and Surgical Memoirs* (1831).

Smith (Nathan), b. at Roxbury, Conn., in 1770; studied law under Judge Reeve at Litchfield, and practised at New Haven; was for many years State prosecuting attorney of New Haven co., and U. S. district attorney for Connecticut; was one of the framers of the State constitution; was often elected to the legislature; was a delegate to the Hartford Convention 1814, and U. S. Senator 1832–35. D. at Washington, D. C., Dec. 6, 1835.

Smith (Nathaniel), brother of Nathan Smith, b. at Woodbury, Conn., Jan. 6, 1762; received a limited education; studied law at Litchfield under Judge Reeve; commenced practice at the bar in his native town 1789; served often in the legislature; was a member of Congress 1795–99; State senator 1799–1804, and judge of the State superior court 1806–19. D. at Woodbury Mar. 9, 1822.

Smith (Nathan Ryno), M. D., LL.D., b. at Cornish, N. H., May 21, 1797; graduated at Yale College 1817; took the degree of M. D. at New Haven 1823, and was elected professor of anatomy and surgery in the University of Vermont at Burlington 1825; on the organization of the Jefferson Medical College in Philadelphia, became the professor of anatomy, but in 1827 accepted the chair of surgery in the University of Maryland; invented a sure method of lithotomy, an excellent suspensory apparatus for fractured inferior extremities, and wrote *Surgical Anatomy of the Arteries* (1832) and other medical works; in 1838 became professor of practical medicine in the Transylvania University, Lexington, Ky.; in 1840 returned to the University of Maryland; in 1867 visited Europe. D. at Baltimore, Md., July 3, 1877. Paul F. Eve.

Smith (Oliver Hampton), b. at Trenton, N. J., Oct. 23, 1794; emigrated to Indiana 1817; studied and practised law; became district attorney 1824, member of Congress 1827–29, and U. S. Senator 1837–43. D. at Indianapolis Mar. 19, 1859. Author of *Recollections of Congressional Life* and of *Early Indiana Trials, Sketches, and Reminiscences* (Philadelphia, 1858).

Smith (Persifer Frazer), b. at Philadelphia, Pa., Nov., 1798; graduated at Princeton 1815; studied law; settled at New Orleans; became adjutant-general of Louisiana; was colonel of Louisiana volunteers under Gen. Gaines in the campaigns of 1836 and 1838 in Florida; commanded the brigade of Louisiana volunteers under Gen. Taylor on the Rio Grande May, 1846; was appointed colonel of the mounted rifles May 27, 1846; was brevetted brigadier-general for services at Monterey and major-general for gallantry at Contreras and Churubusco, where he bore the brunt of the battle; was distinguished in the engagement at the Belen gate of the City of Mexico; was a commissioner to treat for an armistice Aug. 22; appointed civil and military governor of the City of Mexico Oct., 1847, and of Vera Cruz May, 1848; subsequently commanded the departments of California and Texas; was appointed brigadier-general U. S. A. Dec. 30, 1856, and was appointed to command the contemplated expedition to Utah a few days before his death, at Fort Leavenworth, Kan., May 17, 1858.

Smith (Richard), b. in county Wexford, Ireland, Jan. 30, 1823; came to the U. S. 1841, and settled in Cincinnati. After working at the carpenter's trade for nearly three years, he obtained a position as reporter on the *Daily Chronicle*; was appointed superintendent of the Cincinnati chamber of commerce 1849, and became in the same year editor and proprietor of the *Price Current*. In 1854 he bought an interest in the *Cincinnati Gazette*, of which a few years later he became managing editor—a position he still holds (1876). J. B. Bishop.

Smith (Richard Penn), son of William Moore Smith, b. at Philadelphia, Pa., Mar., 1799; was admitted to the bar 1821; wrote for the *Union* newspaper; was the successor of Duane as editor of the *Aurora* 1822–27; wrote many poetical pieces for periodicals; published several successful plays, including *Caius Marius*, a tragedy written for Edwin Forrest; was author of a *Life of David Crockett* (1836), and the novels *The Forsaken* (1831) and *The Actress of Padua*. D. near Philadelphia Aug. 12, 1854. His *Miscellaneous Works* (1856) were edited by his son, H. W. Smith, with a biographical sketch by Morton McMichael.

Smith (Richard Somers), b. at Philadelphia Oct. 30, 1813; was graduated from the U. S. Military Academy July 1, 1834, when assigned to the 2d Infantry as brevet second lieutenant, but served on topographical duty until 1836, when he resigned to follow the profession of civil engineering. In 1840 he was reappointed in the army with rank of second lieutenant of infantry, first lieutenant 1846; transferred to the 4th Artillery 1848. For fifteen years (1840–55) he was assistant professor of drawing at the Military Academy, when he again resigned (Jan. 13, 1856) from the army, this time to accept the chair of mathematics and drawing in the Brooklyn Polytechnic Institute, which position he retained until 1859. From 1859 to 1861 he was a director of the Cooper Union; on the 14th of May of the latter year he re-entered the army with rank of major, and was assigned to the 12th Infantry. He served on mustering and disbursing duty until the latter part of 1862, when he rejoined his regiment, and was engaged in the battle of Chancellorsville, May 2–4, 1863. Soon after this (May 30) he relinquished his commission to accept the presidency of Girard College, Philadelphia, which high position he continued to hold until 1868, and from 1868 to 1870 was professor of civil engineering in the Polytechnic College of the State of Pennsylvania; since the latter date he has been at the head of the department of drawing at the U. S. Naval Academy at Annapolis. In 1857, Columbia College conferred the degree of A. M. upon him. Author of *A Manual of Topographical Drawing* and *Manual of Linear Perspective*. D. Jan. 24, 1877.

Smith (Robert), D. D., F. R. S., b. in England in 1689; displayed from childhood great fondness for mathematics and the physical sciences; took orders in the Church of England; became mathematical preceptor to the duke of Cumberland and instructed the king in mechanics; succeeded his cousin and friend, the celebrated Roger Cotes, as professor of astronomy at Cambridge 1716; edited Cotes's *Harmonia Mensurarum* and other writings 1722, and his *Lectures on Hydrostatics and Pneumatics* (1737), both enriched with commentaries; published his chief work, *A Complete System of Optics* (2 vols., 1738), and his *Harmonics, or the Philosophy of Musical Sounds* (1749), and succeeded Bentley as master of Trinity College 1742. D. at Cambridge Aug., 1768. By his will he left £2000 to Trinity College and £2500 to the university for the support of the astronomical professorship and the maintenance of two annual prizes for proficiency in mathematics and natural philosophy.

Smith (Robert), D. D., b. at Londonderry, Ireland, in 1723; came to Pennsylvania with his parents in childhood, settling at the head-waters of Brandywine Creek, Chester co.; was educated at a school taught by Rev. Samuel Blair, whose sister he married; was settled in 1751 as pastor of a Presbyterian church at Pequea, Lancaster co., Pa., where he established a classical school and theological seminary, in which he trained his sons, Rev. Drs. Samuel Stanhope and John Blair. D. at Rockville, Pa., Apr. 15, 1793.

Smith (Robert), D. D., b. in the county of Norfolk, England, in 1732; educated at the University of Cambridge, where he became a fellow; took orders in the Church of England 1756; became rector of St. Philip's, Charleston, S. C., 1759; served as a volunteer in the war of the Revolution; preached for a time in Queen Anne co., Md.; presided over Charleston College 1786–98, and was consecrated at Philadelphia as the first Protestant Episcopal bishop of South Carolina Sept. 13, 1795. D. at Charleston Oct. 28, 1801.

Smith (Robert), brother of Gen. Samuel, b. at Carlisle, Pa., Nov., 1757; served as a volunteer at Brandywine; graduated at Princeton 1781; studied law, which he practised with distinction at Baltimore; was for some years a member of the Maryland legislature; was secretary of the navy in the cabinet of Pres. Jefferson 1802–05, attorney general Mar.–Dec., 1805, and secretary of state under Pres. Madison 1809–11; was for some years president of the American Bible Society and of the Maryland Agricultural Society, and provost of the University of Maryland. D.

at Baltimore Nov. 26, 1842. Author of an *Address to the People of the U. S.* (1811).

Smith (Robert Angus), Ph. D., F. R. S., b. near Glasgow, Scotland, Feb. 15, 1817; educated at the University of Glasgow; studied chemistry under Liebig at Giessen 1839–41; became a professional chemist; labored with zeal and success to improve the sanitary condition of towns and mines, especially in Lancashire; made valuable *Reports* to the board of health and to the British Association on the air and water of towns (1848), a subject to which he returned in the columns of the *Chemical News* 1858, where he demonstrated the considerable difference between city and country air; was employed by the royal mines commission to analyze the air of many mines, and prepared an elaborate *Report*; published an *Inquiry into the Action of Carbonic Acid on the Circulation of the Blood*; was appointed inspector general of alkali works 1863; made important researches on the comparative advantages of disinfectants, resulting in favor of the use of carbolic or phenic acid; published a *Memoir of Dr. John Dalton, and History of the Atomic Theory up to his Time* (1857), a volume on *Disinfectants and Disinfection* (1869), and *Air and Rain, the beginnings of Chemical Climatology* (1872). His latest researches have been devoted to a search for solid bodies in the air. He is the author of the memoirs on the arts in Ure and Hunt's *New Dictionary of Arts and Manufactures*.

Smith (Robert Payne), D. D., b. in Gloucestershire, England, Nov., 1818; graduated with high honor at Pembroke College, Oxford, 1841; obtained there a Sanskrit and two Hebrew university scholarships; took orders in the Church of England; became under-librarian of the Bodleian; published (in Latin) a *Catalogue* of the Syriac MSS. in that library; edited and translated from the Syriac the *Commentary* of Cyril of Alexandria on Luke (1858); translated from the same language the *Ecclesiastical History* of John of Ephesus (1860); commenced for the delegates of the Clarendon Press a *Syriac Lexicon*, based on that of Castell (parts i. and ii., 1868–70); is author of *The Authenticity and Messianic Interpretation of the Prophecies of Isaiah vindicated in a Course of Sermons preached before the University of Oxford* (1862), *Prophecy a Preparation for Christ* (1865), being the Bampton lectures for that year, and the *Commentary on Jeremiah* (1875) in the series known as the *Speaker's Commentary*. Dr. Smith became regius professor of divinity in the University of Oxford Aug., 1865, and dean of Canterbury Jan., 1871, in succession to Dr. Henry Alford. He visited the U. S. as a delegate to the General Conference of the Evangelical Alliance in Oct., 1873. He is a member of the Old Testament revision company.

Smith (Robert Vernon). See Lyveden, Baron.

Smith (Samuel), b. at Burlington, N. J., in 1720; was a member of the colonial assembly, treasurer of West Jersey, and author of a *History of New Jersey from its Settlement to 1721* (1755). D. at Burlington in 1776.

Smith (Samuel), b. at Carlisle, Pa., July 27, 1752; removed in childhood to Baltimore; was some years in his father's counting-house; made a commercial voyage to Europe; became a captain in Smallwood's Maryland regiment Jan., 1776; participated in the battles of Long Island, Harlem, and White Plains, and in the retreat through New Jersey; became major in Gist's battalion Dec. 10, 1776, and lieutenant-colonel 1777; was at the attack on Staten Island and at the battle of Brandywine; was placed by Washington in command of Fort Mifflin, which he gallantly defended from Sept. 26 to Nov. 11, when he was severely wounded and forced to remove to the Jersey shore; received the thanks of Congress and an elegant sword; was at Valley Forge and at the battle of Monmouth, after which he resigned his commission in the army, but continued to serve as colonel of militia; was a member of the Maryland constitutional convention 1776; member of Congress 1793–1803 and 1816–22; U. S. Senator 1803–15; and again 1822–33, serving much of the time as chairman of the finance committee, and occasionally as president *pro tempore* of the Senate; was major-general of militia at the defence of Baltimore against the British 1814; quelled a formidable mob in 1835, and was thereupon elected mayor. D. at Baltimore Apr. 22, 1839.

Smith (Samuel Emerson), b. at Hollis, N. H., Mar. 12, 1788; graduated at Harvard 1808; became an eminent lawyer; settled at Wiscasset 1812; was justice or chief-justice of common pleas for several terms, governor of Maine 1831–34, and commissioner to revise the statutes 1837. D. at Wiscasset Mar. 3, 1860.

Smith (Samuel Francis), D. D., b. at Boston, Mass., Oct. 21, 1808; graduated at Harvard 1829; studied theology at Andover Seminary; became a Baptist clergyman 1832; edited the *Baptist Missionary Magazine* at Boston 1832–33; was a prominent contributor to Dr. Lieber's *Encyclopædia Americana*; was pastor of a church at Waterville, Me., and professor of modern languages in Waterville College 1834–42; pastor at Newton, Mass., 1842–54; edited the *Christian Review* 1842–49, and since 1854 has been editor of the publications of the Baptist Missionary Union. He has been a frequent contributor to periodical literature; published (with Rev. Baron Stow) *The Psalmist* (1843); edited a volume of *Lyric Gems* (1844); wrote a *Life of Rev. Joseph Grafton* (1845), and is author of many well-known songs, including "My Country, 'tis of Thee," and "The Morning Light is Breaking."

Smith (Samuel Harrison), son of Jonathan Bayard Smith, b. at Philadelphia, Pa., in 1772; graduated at the University of Pennsylvania 1787; edited the *New World* 1796–1800, and on the removal of the seat of government founded at Washington, D. C., Oct. 31, 1800, the well-known newspaper *The National Intelligencer*, which he edited until 1810, and became commissioner of revenue 1813. D. at Washington, D. C., Nov. 1, 1845.

Smith (Samuel Stanhope), D. D., LL.D., son of Dr. Robert, b. at Pequea, Pa., Mar. 16, 1750; graduated at Princeton 1769; was educated at, and became a teacher in, his father's classical academy, pursuing meanwhile the study of theology; was tutor at Princeton 1770–73; was ordained to the Presbyterian ministry 1774; labored as a missionary in Western Virginia; was the first president of Hampden-Sidney College 1775–79; became professor of moral philosophy at Princeton 1779, also professor of theology 1783; vice-president of the college 1786, and president 1795; was a member of the committee appointed to draw up a system of government for the Presbyterian Church 1786; was an eloquent and effective pulpit-orator and distinguished for courtly manners; published *An Essay on the Variety of Complexion in the Human Species* (1788), a volume of *Sermons* (1798), *Lectures on the Evidences of the Christian Religion and on Moral Philosophy* (1809), and a *System of Natural and Revealed Religion* (1816); completed the *History of the U. S.*, begun by his brother-in-law, Dr. David Ramsay, and published a number of separate sermons and discourses. He married a daughter of his predecessor, Dr. Witherspoon, and resigned the presidency on account of ill-health 1812. D. at Princeton Aug. 21, 1819. Two volumes of his *Sermons* were published posthumously 1821, preceded by a brief *Memoir*.

Smith (Seba), b. at Buckfield, Me., Sept. 14, 1792; graduated at Bowdoin College 1818; became a journalist at Portland; married Miss Elizabeth Oakes Prince 1823; won a wide reputation as a humorist by his *Letters of Major Jack Downing* (1833); lost his property 1839; settled in New York 1842; devoted himself successfully to literature, as did also his wife (see Smith, Elizabeth Oakes Prince); published *Dewdrops of the Nineteenth Century* (1846), *My Thirty Years out of the Senate* (1859), *Powhatan, a Metrical Romance* (1841), *New Elements of Geometry* (1850), and *Way Down East, or Portraitures of Yankee Life* (1855), besides a vast number of uncollected verse and prose essays which appeared in various periodicals. D. at Patchogue, L. I., July 29, 1868.

Smith (Solomon Franklin), generally known as Sol Smith, b. at Norwich, Chenango co., N. Y., Apr. 20, 1801; learned the printer's trade; edited at Cincinnati the *Independent Press* 1822–23, and at Mobile the *Mercantile Advertiser* 1837–38; joined a company of strolling players; became a leading comic actor and manager; retained for many years great popularity in the Western and Southern States; became a lawyer at St. Louis, Mo., 1853, and sat in the legislature of 1861 as a Unionist. D. at St. Louis Feb. 14, 1869. Author of *Theatrical Apprenticeship* (1845), *Theatrical Journey-Work* (1854), and an *Autobiography* (1868).

Smith (Sydney), b. at Woodford, Essexshire, June 3, 1771; was educated at Oxford, where in 1790 he gained a fellowship of £100 a year; resided a few months in Normandy, where he mastered the French language, and in 1794 became curate of a lonely parish on Salisbury Plain. In 1796 he went to Edinburgh as private tutor to a young gentleman; remained there five years, officiating also in an Episcopal chapel; became intimate with Brougham, Jeffrey, and other brilliant young men, who in 1802 started the *Edinburgh Review*, Smith acting as original editor and contributing seven articles to the first number. Soon after this, he went to London, where he became a popular preacher, and in 1804–06 delivered courses of lectures on moral philosophy, contributing also to the *Edinburgh Review* until 1827. In 1806 he was presented with the living of Foston-le-Clay, in Yorkshire, worth £500 a year, but situated in a desolate region, "twelve miles from a lemon," as he phrased it. In 1809 he went to Heslington, near York,

leaving Foston in charge of a curate, hoping to exchange it for a more desirable benefice. Not succeeding in this, he returned in 1814, built a comfortable rectory, in which he lived until 1828, when the chancellor, Lord Lyndhurst, appointed him canon of Bristol, and gave him the rectory of Combe-Florey. In 1831 he was made resident canon of St. Paul's, upon which he took up his abode in London, where he passed the remainder of his life in the discharge of his official duties, in literary labor, and in the pleasures of society, in which he was a great favorite for his wit and rare conversational powers. In 1843 the death of his brother placed him in possession of a considerable fortune, a portion of which he invested in the public stocks of Pennsylvania; the State failing to make provision for payment of the interest, he sold out his stock for a little more than half its nominal value, and, although his absolute loss is said not to have exceeded £50, he was greatly vexed, and wrote a *Petition to Congress* and *Letters on American Debts* (1844) which were full of humorous invective. Among his most characteristic productions are his *Letters on the Subject of the Catholics, to my brother Abraham, who lives in the Country, by Peter Plymley* (1807–08; published anonymously), which had a large share in bringing about Roman Catholic emancipation. He published at various times several volumes of sermons, many occasional discourses, and political and social essays. Collections of his writings, more or less complete, have been frequently published, both before and after his death, the latest, not including his sermons, having been issued in a single volume in 1869. His early lectures on moral philosophy were edited by Francis Jeffrey, and published under the title *Elementary Sketches of Moral Philosophy* (1849). Several volumes of selections from his various works have appeared, the best of which is *Wit and Wisdom of Rev. Sydney Smith*, accompanied by a biographical sketch and notes, by Evert A. Duyckinck (1856). His memoirs have been written by his daughter, the wife of Sir Henry Holland (1855). D. in London Feb. 22, 1845.

A. H. Guernsey.

Smith (Sir Thomas), LL.D., b. at Saffron-Walden, Essex, England, Mar. 28, 1514; educated at Queen's College, Cambridge, where he became fellow 1531; became Greek lecturer 1533, and public orator 1536; visited France and Italy 1539–42, graduating in law at Padua; became regius professor of civil law at Cambridge 1542; aided Sir John Cheke in introducing into England an improved Greek pronunciation; took holy orders; held the rectory of Leverington, Cambridgeshire, and the deanery of Carlisle; was knighted by Edward VI.; made secretary of state 1548, and sent as ambassador to Charles V. at Brussels in July of the same year; was imprisoned in the Tower on the fall of the Protector Somerset; went as ambassador to Henry II. of France Apr., 1551, to negotiate a marriage between Edward VI. and a daughter of the French monarch; lived in retirement during the reign of Mary; was again ambassador to France 1559, 1562, 1567, and 1572; became provost of Eton 1554, privy councillor and assistant secretary of state 1571, chancellor of the order of the Garter 1572, and succeeded Burleigh as secretary of state June, 1572, holding that office until his death, in Essex Aug. 12, 1577. He was highly esteemed for learning and for loyal public service. Author of a treatise on Greek pronunciation, written about 1535, but not printed until 1568, at the same time with a dialogue on English orthography, and left in MS. a learned work, *De Republica Anglorum, the Maner of Government or Policie of the Realme of England* (London, 1583), which reached a 12th ed. 1681. His *Life* was written by Strype (1698), who pronounces him "one of the best scholars of his age, a good Physician and Chymist, an excellent Mathematician, Astronomer, and Arithmetician, a cunning Politician, a great Historian, and a compleat Orator."

Smith (Thomas), b. at Boston, Mass., Mar. 10, 1702; graduated at Harvard 1720; studied divinity; went to Falmouth (now Portland), Me., as chaplain 1725; remained there as first minister, and received a colleague, Samuel Deane, 1764. D. at Portland May 23, 1795. His *Journals*, together with those of his colleague Deane, were edited (1849) with biographical notices and a summary history of Portland, by Hon. William Willis, forming valuable historical material.

Smith (Thomas Mather), D. D., b. at Stamford, Conn., in 1797; graduated at Yale College 1816, and at Andover Seminary 1820; married a daughter of Rev. Dr. Woods; became pastor of a Congregational church at Portland, Me., 1822; was subsequently settled over churches at Fall River, Mass., Catskill, N. Y., and New Bedford, Mass.; transferred his allegiance to the Protestant Episcopal Church while at the latter place, receiving ordination from the hands of Bishops B. B. Smith and Eastburn 1845; was professor of systematic divinity in the theological school at Gambier, O., 1845–63, and president of Kenyon College at the same place 1859–63. D. at Portland, Me., Sept. 6, 1864.

Smith (Thomas Southwood), M. D., b. at Martock, Somersetshire, England, Dec. 21, 1788; graduated in medicine at Edinburgh 1816; settled at London 1820; became physician to the London Fever Hospital; was one of the founders of the *Westminster Review*; was an intimate friend of Jeremy Bentham, who left him his body for dissection; wrote most of the articles on anatomy, medicine, and physiology in the *Penny Cyclopædia*; served on a government commission to inquire into the condition of factory children 1832; presented to the poor law commission in 1838 a report on the *Physical Causes of Sickness and Mortality which are capable of Removal by Sanitary Regulations*, which led to the appointment of the sanitary committee of the House of Commons 1840, and of the "health of towns commission" 1840; made in 1847 a report on the measures required for the health of London, which procured the establishment in the following year of the metropolitan board of health, and received in his later years a pension of £300 a year. D. at Florence, Italy, Dec. 10, 1861. Author of *Illustrations of the Divine Government* (Glasgow, 1816), *The Use of the Dead to the Living*, *A Treatise on Fever* (1830), *A Lecture delivered over the Remains of Jeremy Bentham* (1832), *Animal Physiology*, and *The Philosophy of Health* (2 vols., 1835–37). Dr. Southwood Smith is deservedly considered the founder of modern sanitary science.

Smith (Truman), b. at Roxbury, Conn., Nov. 27, 1791; graduated at Yale College 1815; was admitted to the bar 1818; sat in the State legislature 1831–32 and 1834; was member of Congress 1839–43 and 1845–49; had a decisive influence in procuring the nomination of Gen. Taylor for the Presidency; was U. S. Senator 1849–54; settled in New York City in the practice of his profession soon afterward; was appointed by Pres. Lincoln judge of the court of arbitration established by the treaty of 1862 with Great Britain, and was subsequently a judge of the court of claims arising from the rebellion. Author of *An Examination of the Question of Anæsthesia* (1859; 2d ed. 1867), in which he supports the claims of Dr. Horace Wells.

Smith (William), D. D., b. at Aberdeen, Scotland, in 1726; graduated at the University of Aberdeen 1747; came to America 1750; was tutor in the family of Gov. Martin of New York; accepted the charge of a college at Philadelphia 1751–52; went back to England to be ordained in the Church of England 1753; was inaugurated (May, 1754) first provost of the institution now known as the University of Pennsylvania; was skilled in writing verse, an able and patriotic educator and preacher; pronounced orations, at the request of Congress, on the deaths of Gen. Montgomery and of Dr. Franklin, and many others on public occasions, which were separately published. D. near Philadelphia May 14, 1803. His *Works* were edited by Bishop White (8 vols., 1803). A *Life* is in preparation by his great-grandson, Horace Wemyss Smith.

Smith (William), b. in New York City June 25, 1728; graduated at Yale College 1745; studied law; became an eminent member of the New York bar; was appointed a judge of the supreme court 1763, and a member of the council about 1769; was a loyalist during the war of the Revolution; went to England 1783, and was appointed chief-justice of Canada Nov., 1786. D. in Canada Dec. 3, 1793. Author of a *History of the Province of New York from its First Discovery to the Year 1732* (London, 1757; new eds. 1776, 1792, 1814, and 1829–30).—His son William, b. in New York June, 1770, became clerk of the Parliament of Canada, and was author of a *History of Canada from its First Discovery* (Quebec, 2 vols., 1815).

Smith (William), LL.D., b. in North Carolina in 1762; educated at Mount Zion College; was admitted to the bar at Charleston, S. C., 1792; was a member of Congress 1797–99, U. S. Senator 1816–23 and 1826–31; was twice president *pro tem.* of the Senate; was a distinguished supporter of the doctrine of "State rights;" sat at various times in the legislature, and acted as a judge of the State supreme court; declined a nomination to the U. S. Supreme bench; received in 1831 the nomination of his own State for the Vice-Presidency; spent his later years in Alabama, and d. at Huntsville June 26, 1840.

Smith (William), F. G. S., known as "the father of English geology," b. at Churchill, Oxfordshire, England, Mar. 23, 1769; became in early life a land-surveyor, and in the practice of his profession was led to notice and make maps of the succession of geological strata; afterward visited for that purpose nearly all the counties of England, producing an admirable series of maps, collecting a large museum of fossil remains, and demonstrating the identity of the formation which yielded the same fossils. He published a treatise on *Irrigation* (1806), *Mineral Survey, or*

Delineations of the Strata of England and Wales (1815, with 16 colored maps), *Strata identified by Organized Fossils* (1816–19), *Stratigraphical System of Organized Fossils* (1817); issued between 1819 and 1824 no less than twenty-one colored geological maps of English counties; delivered lectures in most of the provincial towns of England; superintended the model farm of Sir John V. B. Johnstone at Hackness, Yorkshire, 1828–34; received in 1831 from the Geological Society the Wollaston medal for his important discoveries; was honored by Trinity College, Dublin, with the degree of LL.D. 1835; selected for the government the dolomitic stone-quarries of Anston, Yorkshire, as supplying the best building material for the new houses of Parliament (1838), and in his later years received a pension of £100 a year. D. at Northampton Aug. 28, 1839. His *Life* has been written by his nephew, Prof. John Phillips (1844).

Smith (William), b. in King George co., Va., Sept. 6, 1797; educated at Plainfield Academy, Conn.; was admitted to the bar 1818; became proprietor of a line of post or stage coaches through Virginia, North Carolina, South Carolina, and Georgia, by which he acquired a fortune; was repeatedly elected to the State legislature; was a member of Congress 1841–43, and again 1853–61; governor of Virginia 1846–49; became brigadier-general in the Confederate army, and was wounded at Antietam.

Smith (William), LL.D., D. C. L., b. in London, England, in 1813; educated at the University of London, where he gained the first prizes in Latin and Greek; studied law at Gray's Inn, but never practised; was for some years professor of Greek, Latin, and German in the Independent colleges of Highbury and Homerton, and on their consolidation as New College, St. John's Wood, accepted the professorship of the Greek and Latin languages and literature; became classical examiner in the University of London 1853, and editor of the *Quarterly Review* 1867. He is widely known by his excellent series of classical dictionaries, having published those upon *Greek and Roman Antiquities* (1840), *Biography and Mythology* (1843–49), and *Geography* (1852–57), as well as by his *Dictionary of the Bible* (1860–63) and *Dictionary of Christian Antiquities* (vol. i., 1875). He has prepared numerous classical schoolbooks, an *English-Latin Dictionary* (1870), a *Biblical and Classical Atlas* (1875), and a series of *Student's Manuals* of ancient and modern history, etc., in the preparation of which he was assisted by his brother Philip, who is also author of a valuable *Ancient History* (3 vols., 1864–65).

Smith (William Andrew), D. D., b. at Fredericksburg, Va., Nov. 29, 1802; became a preacher of the Methodist Episcopal Church, South; in 1846 became president of Randolph-Macon College; in 1866 resigned, and after serving as pastor two years became president of Central College; was a leading member of every General Conference from 1832 to 1866; was appointed at the General Conference of 1866 one of the commissioners on the part of the Southern Church to settle the property question with the Northern Church; wrote *Lectures on the Philosophy and Practice of Slavery* (Richmond, 1860). D. at Richmond, Va., Mar. 1, 1870. T. O. Summers.

Smith (William Farrar), b. in St. Alban's, Vt., Feb. 17, 1824; graduated at the U. S. Military Academy July 1, 1845, when appointed brevet second lieutenant of topographical engineers. After a year's service with his corps on lake survey duty, he then passed two years at West Point as assistant professor of mathematics; then engaged on surveys in Texas, on the Mexican boundary commission, and in Florida until 1855, when again at West Point for a year. In 1856 he was placed on lighthouse construction duty, and in 1859 appointed engineer secretary of the lighthouse board. On the outbreak of civil war he was for a month on mustering duty in New York, when attached to the staff of Gen. Butler at Fort Monroe. On the 16th of July he was appointed colonel of the 3d Vermont, and was engaged in the first battle of Bull Run on the staff of Gen. McDowell. Commissioned brigadier-general of volunteers (Aug. 13), he served in the defences of Washington until Mar., 1862, and in the Virginia Peninsular campaign of 1862 commanded a division before Yorktown and in the battles of Williamsburg, Fair Oaks, White Oak Swamp, Savage Station, Glendale, and Malvern Hill; promoted to be major general of volunteers July 4, 1862, he led his division in the Maryland campaign, at South Mountain and Antietam. In Nov., 1862, he was assigned to the command of the 6th corps, and engaged at Fredericksburg; transferred to 9th corps Feb., 1863. On Mar. 4, 1863, his appointment as major-general, not having been confirmed by the Senate, expired by constitutional limitation, and he resumed his rank of brigadier. In Oct., 1863, he became chief engineer of the department of the Cumberland, and in November of the division of the Mississippi; he directed (Oct. 27) the throwing of a pontoon bridge across the Tennessee River at Brown's Ferry, below Chattanooga, and capture of heights overlooking it, and participated in the battle of Missionary Ridge. In Mar., 1864, he was confirmed as major-general of volunteers, and in May assigned to the 18th corps, which he commanded in the battles of Cold Harbor, June 1–3, and siege of Petersburg, until July 19, 1864, when relieved and placed on special duty. In Nov., 1865, he resigned his volunteer commission, and in Mar., 1867, his commission as major of engineers in the regular army. For gallantry in battle and gallant and meritorious conduct in the field he was brevetted from lieutenant-colonel to major-general. Since 1864 he has been president of the International Telegraph Co.; appointed police commissioner New York City 1875, and soon after chosen president of the board.

Smith (William Loughton), LL.D., b. probably in South Carolina about 1745; was a member of Congress 1789–97; an able supporter of the administration of Washington and Adams, and an active opponent of Jefferson, against whom he published a pamphlet; was minister to Portugal 1797–1800, and to Spain 1800–01. D. in South Carolina in 1812. Author of a volume of *Speeches*, published at London 1794, an *Address* (1794) to his constituents on the difficulties pending with England, a *Comparative View of the Constitutions of the States* (1796), and various other political pamphlets.

Smith (William Moore), son of Dr. William (1726–1803), b. at Philadelphia, Pa., June 1, 1759; published a volume of *Poems* (1785); became under Jay's treaty general agent for American claims against England, and visited England in that capacity to close up the business 1803. D. in Philadelphia in 1821.

Smith (William Prescott), b. in Baltimore, Md., in 1822; received a common-school education, which he extended by private study; was in youth an ardent Whig politician and a frequent contributor to the press; became in 1850 identified with the management of the Baltimore and Ohio Railway; was for many years master of transportation, afterward general manager, of the Washington branch; was an energetic promoter of many other lines of railway and an officer in several companies; was appointed collector of internal revenue for Maryland 1866, and travelled in Europe 1867. D. at Baltimore Oct. 1, 1872.

Smith (William Rudolph), son of William Moore Smith, b. at the Trappe, Pa., Aug. 31, 1787; edited in early life the Huntingdon *Museum*; wrote the life of Wythe for Sanderson's *Signers*; settled in Wisconsin as a lawyer 1837; became attorney-general 1853, and was many years president of the State Historical Society. D. at Quincy, Ill., Aug. 29, 1868. Author of *Observations on Wisconsin Territory* (1838) and of a *History of Wisconsin* (4 vols., 1854 *seq.*).

Smith (Gen. William Russell), b. in Alabama about 1813; educated at the University of Alabama; practised law at Greenesboro'; served as a captain of mounted infantry against the Creeks 1836; became an editor at Mobile; founded the Tuscaloosa *Monitor* 1838; was mayor of Tuscaloosa 1839; was a circuit judge 1850–51; a Whig member of Congress 1851–57, when he was chiefly noted for a speech in denunciation of Kossuth; opposed secession, but sat in the Confederate Congress 1861–65; was afterward president of the State university. Author of *The Bridal Eve, College Musings, Alabama Justice* (1841), *Uses of Solitude* (1860), *As It Is, a Novel* (1860), a volume of legal reports (1862), and other volumes of prose and verse.

Smith (Sir William Sidney), b. at Westminster, England, in 1764; entered the navy at the age of twelve as midshipman under Lord Rodney; was captain in the Swedish service in the naval war with Russia, and received a Swedish order of knighthood for gallantry in action; served with distinction under Lord Hood at Toulon 1794; was taken prisoner by the French at Havre 1796, and confined two years in the Temple, Paris, whence he escaped 1798; was given command of a squadron in Turkish waters the same year; captured a French flotilla at St. Jean d'Acre Mar. 16, and successfully defended that fortress against Napoleon May, 1799; proceeded to Egypt; negotiated the treaty of El Arish Jan., 1800; was wounded at the battle of Alexandria 1801; was knighted and received a pension 1815; became admiral 1821, and lieutenant-general of marines 1830. D. at Paris May 26, 1840.

Smith (William Sooy), b. in Tarlton, Pickaway co., O., July 22, 1830; graduated at the Ohio University in 1849, and at the U. S. Military Academy July 1, 1853, when appointed brevet second lieutenant of artillery; second lieutenant July 9. Resigned June, 1854, to engage in civil engineering; was employed on public works a year, when, in 1855, he became principal of the Buffalo high school. Resuming his profession in 1856, he was employed (1857) by an iron bridge-building company at Trenton, N. J.,

and in 1859 placed in charge of the construction of a bridge over the Savannah River, the foundations of which consisted of pneumatic piles. In the civil war he served as colonel of the 13th Ohio Vols. in West Virginia till Jan., 1862, when transferred to the Army of the Ohio, and engaged at the battle of Shiloh, Apr. 7. Commissioned brigadier-general of volunteers Apr. 15, he participated in the siege of Corinth; commanded a division at the battle of Perryville; was chief of cavalry department of the Tennessee July–Oct., 1863, and division of the Mississippi Oct., 1863–July, 1864, when compelled by ill-health to resign. Has since been extensively engaged in sinking pneumatic foundations for bridges and other structures, and is patentee for various improvements in the process. Member of government board for testing American iron and steel 1875–76.

Smith (William Stephens), b. in New York in 1755; graduated at Princeton 1774; served in the war of the Revolution, reaching the rank of lieutenant-colonel; was successively aide to Sullivan, Steuben, and Washington (July, 1781); married the only daughter of John Adams, whom he accompanied on his mission to England as secretary of legation 1785; became surveyor of New York; sat three years in the State assembly; was chosen president of the New York Society of Cincinnati 1804, and was a member of Congress 1813–16. D. at Lebanon, N. Y., June 10, 1816.

Smith (Worthington), D. D., b. at Hadley, Mass., in 1795; graduated at Williams College 1816; studied theology at Andover; was licensed to preach 1819; was pastor of the Congregational church at St. Alban's 1823–49, and president of the University of Vermont from 1849 to his death at St. Alban's Feb. 13, 1856. His posthumous *Select Sermons* (1861) were edited by Prof. Joseph Torrey, who prefixed an appreciative *Memoir*.

Smith Centre, city, cap. of Smith co., Kan., is surrounded by a fine agricultural region; rich deposits of magnesia, limestone, and coal exist throughout the county. It contains good schools and 1 newspaper.

Will D. Jenkins, Ed. "Smith Co. Pioneer."

Smithfield, tp., De Kalb co., Ind. P. 1342.

Smithfield, tp., Fayette co., Ia. P. 638.

Smithfield, p.-v. and tp., Somerset co., Me. P. 704.

Smithfield, tp., Madison co., N. Y., includes the v. of Peterboro'. P. 1227.

Smithfield, p.-v. and tp., cap. of Johnston co., N. C., on Neuse River. P. of v. 415; of tp. 2864.

Smithfield, p.-v. and tp., Jefferson co., O. P. of v. 515; of tp. 1761.

Smithfield, tp., Bradford co., Pa. P. 1790.

Smithfield, p.-v., Henry Clay tp., Fayette co., Pa.

Smithfield, tp., Monroe co., Pa. P. 1443.

Smithfield, tp., Providence co., R. I. P. 2605.

Smithfield, p.-v., Newport tp., Isle of Wight co., Va. P. 652.

Smithfield, v., Averill tp., Jefferson co., West Va. P. 361.

Smithfield, tp., Roane co., West Va. P. 1046.

Smithland, p.-v., cap. of Livingston co., Ky., on Ohio River at the mouth of the Cumberland. P. 690.

Smith's, tp., Tuscaloosa co., Ala. P. 616.

Smith's, tp., Dauphin co., N. C. P. 662.

Smith's, tp., Robeson co., N. C. P. 1684.

Smiths'borough, p.-v., Tioga tp., Tioga co., N. Y., on Erie R. R. P. 304.

Smith's Bridge, tp., Macon co., N. C. P. 708.

Smiths'burg, p.-v., Cavetown tp., Washington co., Md., on Western Maryland R. R. P. 459.

Smith's Creek, tp., Warren co., N. C. P. 1062.

Smith's Falls, p.-v., Lanark co., Ont., Canada, on Rideau Canal and on Brockville and Ottawa Railway, at the junction of the Perth branch. It has a populous suburb called Elgin. The chief industries are the manufacture of stoves and farming implements. P. 1150.

Smith's Ferry, p.-v., Ohio tp., Beaver co., Pa., on Ohio River and Cleveland and Pittsburg R. R.

Smith's Grove, p.-v., Warren co., Ky.

Smith's Island, tp., Somerset co., Md. P. 399.

Smith's Mills, p.-v., Hanover tp., Chautauqua co., N. Y. P. 128.

Smith'son (James Lewis **Macie**), F. R. S., b. in England about 1765; was a natural son of Hugh Smithson, first duke of Northumberland, by Elizabeth Macie, whom in his will he describes as "heiress of the Hungerfords of Stadley, and niece to Charles, the proud duke of Somerset;" was consequently half-brother to the Earl Percy of Lexington fame; was educated at Oxford, graduating at Pembroke College 1786 under the name of Macie; was chosen a fellow of the Royal Society in the following year; devoted himself to science, especially chemistry; became an associate and friend of Davy, Banks, and Wollaston; published in the *Philosophical Transactions* eight papers, besides several in the *Annals of Philosophy* and other scientific periodicals; took the name of Smithson between 1791 and 1803; was much interested in geology, and was at one time vice-president of the Royal Society. D. at Genoa, Italy, June 27, 1829. For an account of his munificent bequest to the U. S., and its employment in the maintenance of a national scientific institute, see Smithsonian Institution.

Smithsonian Institution, located at Washington, D. C., in the centre of one of the largest of the U. S. government reservations, is a scientific establishment founded on the bequest of James Smithson of England for the "increase and diffusion of knowledge among men." The amount first received was $515,169; the "residuary legacy," $26,210.63; total sum derived from the bequest, $541,379.63. In 1867, under act of Congress authorizing the increase of the fund to $1,000,000, $108,620.37, resulting from the savings of income and the increased value of investments, was added to the amount then in the treasury of the U. S., making the entire sum to the credit of Smithson $650,000.

Smithsonian Institution, Washington, D. C.

Besides this, in 1874 a special fund of $1000, known as the bequest of James Hamilton of Carlisle, Pa., the interest on which is to be "appropriated biennially for a contribution, paper, or lecture on a scientific or useful subject," was placed in the treasury of the U. S., making the amount $651,000, which sum bears interest at 6 per cent. in gold. In addition, the institution holds bonds and certificates of the State of Virginia amounting at par to $88,125.20, worth at present (Jan. 1, 1876) about $37,000, the coupons of which are sold annually and the proceeds added to the income of the establishment. All the moneys now or hereafter to be deposited in the treasury of the U. S. to the credit of the Smithson fund constitute a perpetual deposit, of which, by law, only the interest can be drawn. This interest, payable semi-annually, amounting to $39,060, is augmented by conversion into currency. The sum thus obtained, with the proceeds of sales of coupons of State bonds and savings from the previous year's income, constitutes the income for the operations of the year.

The Smithson bequest was accepted by act of Congress approved July 1, 1836, and the first instalment of proceeds from the legacy was brought from England by Hon. Richard Rush, commissioned for the purpose. This money was in English sovereigns, which were transformed into American gold, netting $515,169. To satisfy legal requirements, formal litigation was had in the British courts. Interest was allowed by the U. S. from the date of the receipt of the money into the treasury (Sept. 1, 1838). The remainder of the bequest (residuary legacy) was received in 1867, netting $26,210.63. The Smithsonian Institution was established by act of Congress approved Aug. 10, 1846. By the provisions of this act the establishment is administered by a board of regents composed of the chief-justice of the U. S. Supreme Court, three Senators, appointed by the Vice-President of the U. S., three Representatives, appointed by the Speaker of the House, and six citizens, chosen by joint resolution of Congress; no two regents are allowed from any one State; two of the citizen members must be residents of the District of Columbia. The Representatives serve two years, unless reappointed; the Senators for their respective Senatorial terms; and the citizens for six years. The services of the regents are gratuitous, travelling expenses being allowed them when attending the sessions of the board. The board meets annually in January. The act also authorizes the regents to select one of their number as chancellor or president of the board, and three of the members as an executive or finance committee; further, that the secretary or director of the institution shall also be secretary of the board of regents. The secretary appoints his own assistants, and conducts the active operations of the establishment. Once a year he reports to the board, and by law they in turn report to Congress, as to the operations, expenditures, and condition of the establishment. According to the provisions of the act, the interest on the fund is drawn on the requisition of the executive committee, certified by the chancellor and secretary. This interest, converted into currency, is deposited with the treasurer of the U. S., and can be drawn only by check of the secretary of the institution, who is thus also the disbursing officer. Besides the board of regents, the President and Vice President of the U. S. and the cabinet officers during the time they hold their respective offices, and such other persons as they may elect honorary members, are by law constituted an "establishment" (or board of visitors) styled the "Smithsonian Institution." By this name they are known and have perpetual succession. The President of the U. S. is the presiding officer of this "establishment." The following is a list of the officers of the institution: *Presiding officer, ex-officio*, U. S. Grant, President of the U. S.; *Chancellor*, Morrison R. Waite, chief-justice of the U. S.; *Secretary or Director of the Institution*, Spencer Fullerton Baird, who was elected May 17, 1878; *Chief Clerk*, William J. Rhees; *Corresponding Clerk*, D. Leech; *Bookkeeper*, Clarence B. Young.

From the inauguration of the institution to the present time the regents appointed by the two houses of Congress have generally been selected from among the members who had already acquired a national reputation as eminent jurists or upright statesmen, not a few among them being known for great erudition or profound attainments in the science of literature; while those from the citizenship of the several States have usually been chosen on account of probity of character, high social position, and literary or scientific reputation. The present board is composed as follows: Mr. Morrison R. Waite, chief-justice of the U. S., chancellor; Hon. T. W. Ferry, Vice-President of the U. S.; *Senators*, H. Hamlin, J. W. Stevenson, A. A. Sargent; *Representatives*, Hiester Clymer, B. H. Hill, G. W. McCrary; *Citizens*, Rev. Dr. John Maclean, N. J., Hon. Peter Parker, Washington, Hon. George Bancroft, Washington, executive committee; Dr. Asa Gray, Mass.; Prof. J. D. Dana, Conn.; Prof. Henry Coppée, Pa.

The Smithsonian building is one of the most imposing edifices in the U. S. The architecture is the latest variety of the Rounded style of the twelfth century, and is known as the Norman, Lombard, or Romanesque. The semi-circular arch, stilted, is employed throughout in doors, windows, and other openings. It is the first edifice of the twelfth century, and of a non-ecclesiastical character, ever erected in this country. The design, by James Renwick, Jr., of New York, is a main centre building of two stories, with two wings connected by intervening ranges, each having on the principal front a cloister with open-stone screen. The material is a lilac-gray freestone from the new red sandstone formation where it crosses the Potomac, and is called "Seneca," after the name of a creek about 23 miles above Washington, where it is obtained. Comparatively soft when first quarried, it hardens by exposure, ultimately acquiring a toughness and consistency enabling it to withstand atmospheric changes and resist severe mechanical wear and tear. The main building, 205 by 57 feet, and 58 feet to top of corbel course, has in the centre of its N. or principal front two towers, of which the higher is 140 feet. On the S. front is a massive tower 37 feet high. On the N. E. corner is a double campanile tower 17 feet square and 117 in height. There are nine towers in all. The entire length of the Smithsonian building is 447 feet from E. to W.; greatest breadth, 160 feet. The E. wing is 82 by 52 feet, and 42½ feet high to top of battlement. The W. wing, including its projecting apsis, is 84 by 40 feet, and 38 feet high; each of the connecting ranges, including its cloister, is 60 by 49 feet. The first story of the main building consists of one large room, 200 by 50 feet, and 25 feet high, with two rows of pillars to support the ceiling. The upper story is one large room, of the size of that of main building, lower floor; it is unobstructed by any supports. These two halls, together with the large room in the W. wing, contain the collections of the National Museum. The upper story of the E. wing is the dwelling of the director and his family. The operations of the institution proper are confined to part of the lower story of the E. wing and two or three large rooms in the connecting range between the main building and E. wing. The building is substantially erected, and mostly fire-proof. The foundation-walls are 8 feet deep and 12 feet thick at the bottom, diminishing to 5 feet 6 inches at the ground surface; walls of main building to second story, 2½ feet thick; above, 2 feet; wing walls, 2 feet; central towers, 3½, diminishing to 2 feet. Roof of main building, slate on iron frame.

The cornerstone was laid May 1, 1847, with Masonic ceremonies, in presence of Pres. Polk and cabinet; oration by Hon. George M. Dallas.

On Jan. 24, 1865, the Smithsonian building was partially destroyed by fire from a defective flue. The damage was confined to the W. end and upper centre. Among other things consumed was Stanley's gallery of Indian paintings, the property of their author. This loss is almost irreparable in an ethnological as well as an historic point of view; the only remaining collection of a similar character is that of Catlin, now offered for sale to the government by his heirs. The lecture-room, widely known for its favorable acoustic and optical properties, was also destroyed. Active scientific operations, however, were not impeded, and but little abridged, by this calamity, the restoration of the building being gradual and defrayed by small appropriations annually for several years from the income. The building is now wholly reconstructed, and is fireproof.

By law the Smithsonian is the depository of the National Museum, of which the secretary of the institution is the curator. For the last few years this museum has been, and is now, supported entirely by the government; previously, part of its maintenance was from the Smithson funds. It is the only lawful place of deposit of "all objects of art and of foreign and curious research, and all objects of natural history, plants, and geological and mineralogical specimens, belonging, or hereafter to belong, to the U. S., which may be in the city of Washington in whosesoever custody." The nucleus of these collections consists in the specimens brought home by the Wilkes and other early exploring expeditions. Through the agency and influence of the institution these have been greatly augmented, and the museum may now be said to be rich in objects in several of the departments incident to such an establishment, particularly ethnology, ornithology, and ichthyology. Few specimens are purchased, additions being made through gift and by exchange. The collections are accessible to specialists, to whom they are an interesting and exhaustless field for investigations and the basis of contributions to the literature of the natural sciences. Students of natural history, also, to a limited number, are permitted to

study the collections, making return for the privilege by assisting in the classification and arrangement of the specimens. A taxidermist and a modeller are employed, who mount the zoological specimens and make casts of fishes and also of ethnological objects—lent for the purpose—for the public exhibition-halls. Each specimen, after being recorded and classified, is neatly labelled and arranged to the best advantage for display. The museum is visited by thousands of strangers annually.

In the early history of the institution it established a system for the interchange of American and foreign scientific thought. By this system, which has now attained great proportions, societies and individuals are brought into close communion by the interchange of publications, the privilege being accorded at the expense of the institution for ocean transportation. The support of the system costs annually about $6000—an expense only justified by the fact that the enterprise has received world-wide indorsement as among the most efficient means of carrying out the second clause of the will of the benevolent founder of the institution, which enjoins the "*diffusion* of knowledge among men." Having latterly been adopted as the channel of exchange for the publications of the national government, it has now become familiarly known as the "Smithsonian system of international exchanges," or, in other words, the medium of exchange of scientific and literary materials between the U. S. and the other nations of the earth. The effect of this enterprise cannot be too highly estimated. By this means thousands of works embracing the details of the latest inventions and discoveries are brought to America, while in turn a knowledge is disseminated abroad of whatever is doing in the U. S. to advance the welfare of the people. The packages of exchanges of the institution are transmitted by the principal transportation companies of Christendom either without charge or at reduced rates, and passed through all custom-houses free of duty. To attend to the distribution of the packages, as well as to collect and forward returns, the institution has paid agents in several of the principal cities of Europe, while at other points the leading scientific societies cheerfully perform these services. There are now about 2200 foreign societies in correspondence with the institution, exclusive of individuals, all of which freely share the benefits of this arrangement.

The Smithsonian Library was several years ago transferred to the care of the Library of Congress, and now forms the National Science Library. It consists of about 75,000 volumes, embracing the transactions and proceedings of the older scientific establishments of Europe, many of which cannot now be obtained, which have been secured by exchange of Smithsonian publications. The library continues to be enriched by works constantly received by the institution from abroad.

For a number of years the institution conducted an extensive series of meteorological observations made by voluntary observers; but after the successful establishment of the U. S. signal-service bureau, the continuance of this branch of operations was placed in charge of that department of the government. The observations collected by the institution, and extending over a period of more than twenty-five years, have been reduced and discussed, the results forming the basis of memoirs and charts of rainfall, temperature, the winds, etc. These works constitute invaluable data for a projected discussion of the climatology of the U. S. The Smithsonian was also the first to inaugurate a system of daily telegraphic weather-signals, which, however, was interrupted by the war, and never resumed.

The institution issues three series of publications. The first is a quarto entitled *Contributions to Knowledge*; the second, an octavo styled *Miscellaneous Collections*; and the third, an octavo *Annual Report*. The first and second series are printed at the expense of the institution. The memoirs are published separately for presentation to specialists, and for sale to others desiring them at the cost of paper and printing. From time to time these separate memoirs are made up into volumes of uniform size and presented to colleges, public libraries, and other educational and scientific establishments—the first series to those of the *first* class only. The annual reports are printed by Congress, and distributed gratuitously to teachers and others, *applying*, who may be deemed suitable recipients. Of the volumes of the first or quarto class, twenty-one have thus far been issued; of the second, twelve; and of the third, the reports, one each year since 1846, inclusive. The *Contributions to Knowledge* are memoirs pertaining to every branch of physical science, and contain positive additions to knowledge based on original research; they are usually the results of investigations to which the institution has in some way rendered assistance. The miscellaneous collections are monographs designed to facilitate the study of natural history, and to induce individuals to engage therein as a specialty. The annual report is made up of a statement to Congress of the operations, expenditures, and condition of the institution, and an appendix containing translations from works not generally accessible to American students; biographies, original and other, of distinguished scientists; ethnological and meteorological essays; extracts from correspondence; accounts of unusual phenomena, etc. etc. of interest to the general as well as the scientific reader. Papers presented for publication in the first and second series are submitted to competent commissions for examination, with a view—*first*, to their being additions to the existing knowledge of the subjects to which they pertain; and, *second*, as to whether, as such, they are worthy of publication by the institution. When a memoir is accepted, the names of the commission are given on the reverse of its title page as vouchers for its publication. Apart from the presentation to the author of a few copies of his paper and the payment of the expense of experiments, computations, etc. incurred in its preparation, no remuneration is made for communications, association of the author's name with that of Smithson being considered,—and thus far in all cases accepted—as a sufficient *honorarium*.

By the terms of the will, the bequest of Smithson was to "found at Washington an institution for the increase and diffusion of knowledge among men;" hence, the objects of the institution are, first, to *increase*, and, second, to *diffuse*, knowledge. These two objects are entirely distinct, and should not be confounded. The first is to enlarge the existing stock of knowledge by the addition of new truths, and the second to disseminate knowledge thus enlarged among all mankind. The distinction is everywhere recognized by men of science. Unlike the college or university, the mission of the institution is to add to, rather than merely teach, what is already known. No restriction is made in favor of any particular branch of knowledge. The plan adopted to increase knowledge is that of stimulating men with powers for original investigation to make researches in the different departments of science by offering to publish to the world an account of their discoveries, and by assisting their investigations as far as the means of the institution will allow; that for diffusing the knowledge thus acquired is by means of publications, and their presentation to public institutions on condition that they shall be accessible at all times to any who may desire to consult them, and to specialists.

The institution is not a national, but an individual, establishment, and is to bear and perpetuate the name of its founder. The bequest is for the benefit of *mankind*, and therefore all unnecessary expenditures on local objects is a perversion of the trust. That Smithson did not intend the benefits of his gift for the exclusive enjoyment of any one people is plainly indicated by the terms of the instrument conveying the legacy. Moreover, that such was not his intention is further evident from his own declaration that the "man of science is of no country; the world is his country, and mankind are his countrymen." In accordance with this view, the secretary of the establishment early in its history contended that the support of a library, a museum, or a gallery of art, as prescribed by the act establishing the institution, was foreign to a just conception of the liberal idea of the testator, and a misappropriation of his benevolent measure. With this view, he has from the first strenuously endeavored to so administer the trust as that the greatest good might result to the greatest number, and thus realize to the fullest extent the philanthropic design of the donor. This conception of the intention of Smithson has received the unqualified indorsement of all friends to the advance of civilization, and is enforced by the devotion of the life of the testator to the increase of abstract science, as gathered from a study of his history, as well as from the letter of his will. Impressed with the justice of this view, Congress several years ago authorized the incorporation of the Smithsonian Library with the Library of Congress, the latter providing for it fireproof, roomy quarters, and cataloguing, binding, and otherwise caring for the books. But for this timely legislation a proper maintenance of this single local object would in time have consumed the entire income. The books are still the property of the institution, and can be reclaimed at any time on payment of the cost of their binding. In like manner, the National Museum, which by law is deposited in the Smithsonian building, and which for many years was partially supported from the Smithson fund, has latterly received its entire maintenance from the government. The Gallery of Art has been transferred to the Corcoran Art-Gallery in Washington. Also, in accordance with the policy of the institution to abandon any field of enterprise which can be as well cultivated through other established agencies, its entire system of meteorological operations has been transferred to the meteorological bureau of the general government, while its

herbarium and entomological collections have been deposited with the U. S. department of agriculture, which employs a botanist, approved by the institution, and an entomologist. Thus, by degrees, and after a period of more than a quarter of a century in its history, the institution is, happily, left free to pursue the laudable objects for which it was founded by the generous foreigner who entrusted its management to the care of the U. S.; which objects are the "increase and diffusion of knowledge among men."

DANIEL LEECH. APPROVED BY JOSEPH HENRY.

Smith'sonite, mineral *carbonate of zinc* ($ZnO.CO_2$), named after the English chemist Smithson, who was the founder of our Smithsonian Institution. It crystallizes in rhombohedrons of glassy lustre, white when pure, with the hardness of apatite, and density when pure and normal = 4.455 at 0°; Naumann and Levy both give 4.45. Smithsonite occurs in many American localities; abundantly at Lancaster, Pa., near Bethlehem, Pa., and at the Perkiomen lead mine. H. WURTZ.

Smith's Ranch, p.-v., Sonoma co., Cal.

Smith's River, tp., Del Norte co., Cal. P. 564.

Smith's River, tp., Patrick co., Va. P. 3366.

Smith'ton, p.-v., Bowling Green tp., Pettis co., Mo., on Missouri Pacific R. R. P. 309.

Smith'town, p.-v. and tp., Suffolk co., N. Y., on Smithtown Bay, Long Island Sound, and on Hicksville and Port Jefferson branch of Long Island R. R. P. 2136.

Smith'ville, p.-v., Strawberry tp., Lawrence co., Ark. P. 126.

Smithville, p.-v., West Hampton tp., Burlington co., N. J., on Camden and Burlington County R. R., 18 miles N. E. of Philadelphia, has 1 church, good schools, 1 newspaper, the largest wood-working machinery establishment in the world, iron and brass foundries, machine and forge shops, and grist-mills. P. about 1000.

H. B. SMITH, ED. "NEW JERSEY MECHANIC."

Smithville, tp., Chenango co., N. Y. P. 1405.

Smithville, p.-v. and tp., cap. of Brunswick co., N. C., on Cape Fear River. P. of v. 810; of tp. 1583.

Smithville, p.-v., Greene tp., Wayne co., O.

Smithville, tp., Abbeville co., S. C. P. 1519.

Smithville, tp., Marlboro' co., S. C. P. 1823.

Smithville, p.-v., cap. of De Kalb co., Tenn., 65 miles E. of Nashville, has 4 churches, a public library, a good school, 1 hotel, 2 flouring-mills, 1 tannery, and the county jail. P. about 400. M. L. FORD, ED. "WOODBURY PRESS."

Smithville, p.-v., cap. of Charlotte co., Va.

Smoke [Ang.-Sax. *smoca*], the product of an imperfect combustion. If coal, which is chiefly composed of carbon, hydrogen, nitrogen, and oxygen, be burnt perfectly, the result will be carbonic acid, steam, and nitrogen, which substances will escape through the chimney-top and blend with the atmosphere under the form of invisible and incombustible gases and vapor. But as the combustion of coal in the way in which it is generally burnt is very imperfect, inflammable gases and vapors and large quantities of fine particles of carbon issue together with the above substances, form soot and black and brown smoke, contaminate the air, and cause a considerable loss of fuel. As coal-smoke is a great nuisance, and in large towns and manufacturing districts even a serious evil, much attention has been paid to the matter of burning it. This is attended with great practical difficulties, arising from the necessity of preventing the smoke from cooling, and of supplying the combustible gases and vapors with the necessary amount of oxygen in order to make them burn with flame; but these difficulties are nevertheless not greater than may be generally overcome, as they have been in many single cases.

Smo'ky, tp., Ellis co., Kan. P. 18.

Smoky, tp., Trego co., Kan. P. 40.

Smoky Hill, p.-v. and tp., McPherson co., Kan. P. 348.

Smolensk, government of European Russia, bounded E. by the government of Moscow, and traversed by the Dwina, which runs to the Gulf of Livonia, and the Dnieper, which flows to the Black Sea. Area, 21,814 sq. m., consisting generally of extensive plains interspersed with morasses. The climate is cold but healthy; the soil is fertile and well cultivated, yielding large crops of rye, the principal product, and of hemp and flax. Tobacco and hops are also cultivated. On its extensive pastures large numbers of fine cattle are raised, while its vast forests, abounding with game, furnish a large amount of valuable timber. Much attention is paid to the raising of bees, and honey and wax are largely exported. Copper, iron, and salt are found in considerable quantities. Its manufactures are unimportant. P. 1,163,594.

Smolensk, an old fortified town of Russia, capital of the government of Smolensk, on the Dnieper, is surrounded with massive walls surmounted by towers. It has a magnificent cathedral, several good educational institutions, manufactures of leather and soap, and a large export-trade in grain. P. 22,977.

Smol'lett (TOBIAS GEORGE), b. at Dalquhurn House, Cardross, Scotland, in 1721; lost his father in early childhood; was educated at Dumbarton school by the care of his grandfather, Sir James Smollett of Bonhill, a member of the Scottish Parliament; studied also at Glasgow, where he served an apprenticeship to a surgeon; went to London at the age of nineteen, carrying a tragedy entitled *The Regicide*, which he unsuccessfully offered to the theatrical managers; accepted the position of surgeon's mate in the navy; participated in the unfortunate expedition against Cartagena 1741; resided for some time in Jamaica; returned to England 1746; married in 1747, Miss Anne Lascelles, whom he had known in Jamaica; published in 1748 with great success his first and best novel, *The Adventures of Roderick Random*, in which he made good use of his West Indian experiences; visited Paris 1750; published *The Adventures of Peregrine Pickle* (4 vols., 1751); after endeavoring to obtain medical practice at Bath, settled at Chelsea 1753, in which year he wrote *The Adventures of Ferdinand, Count Fathom*; published a translation of *Don Quixote* (1755); issued *A Compendium of Authentic and Entertaining Travels* (7 vols., 1757), in which he embodied his own experiences at Cartagena; edited for some time a Tory organ, the *Critical Review*; was fined and imprisoned three months for a libel on Admiral Knowles (1759); wrote in fourteen months a *Compleat History of England, deduced from the Descent of Julius Cæsar to the Treaty of Aix-la-Chapelle* (4 vols., 1757–58), to which he subsequently added a *Continuation from 1748 to 1760* (4 vols., 1763), bringing the author £2000, and of which the later volumes have been often reprinted as a supplement to Hume; translated *Gil Blas* (4 vols., 1761); wrote in prison his *Adventures of Sir Launcelot Greaves* (1762); edited the *Briton*, a newspaper in defence of Lord Bute (1762–63); aided Thomas Francklin and other writers in bringing out a translation of the *Works of Voltaire* (37 vols., 1761–70); made a journey through France and Italy 1763–66, which furnished materials for a work of *Travels* (2 vols., 1766); is supposed to have written (between 1759 and 1764) the accounts of France, Italy, and Germany in the *Modern Universal History*; satirized Bute and the elder Pitt in his *Adventures of an Atom* (1769); went for his health to Italy 1769, and wrote on the journey *The Expedition of Humphry Clinker* (3 vols., 1771), his most amusing book. D. at Monte Nero, near Leghorn, Italy, Oct. 21, 1771. Many complete editions of his novels and poems have been published. Biographies were written by Dr. Robert Anderson (1796), Dr. John Moore (1797), and Thomas Roscoe (1840). PORTER C. BLISS.

Smolt. See SALMON.

Smug'gling [Dutch, *smokkelen*], the offence either of bringing into the country articles entirely prohibited, or of defrauding the customs revenue by secretly importing goods upon which duties are laid without paying such duties or without paying the full amount required by law. As the whole subject of the customs revenue is the creature of statute, the offences which consist in its evasion or violation are also of a statutory origin, and in this country they belong exclusively to the jurisdiction of the national legislature and judiciary, being included in the power of Congress to regulate all foreign commerce. The existing law is contained in the *U. S. Rev. Stat.*, especially in tit. xxxiv., chap. 10, §§ 3058 to 3094, although some provisions are scattered through other chapters relating to the imposition and collection of duties. The following penalties may be enforced for various acts which are collectively embraced in the general description of smuggling: (1) The guilty person is liable to a fine of not more than $5000 and not less than $50, or to imprisonment for not more than two years, or to both. (2) The goods fraudulently introduced or attempted to be introduced are to be seized, and, if condemned by the court, are to be forfeited and sold. (3) The vessel in which the goods are thus imported may be likewise seized, condemned, and forfeited if the owner or managing agent was consenting to and guilty of the offence. (4) Any vehicle, conveyance, team, beast, etc., by means of which goods are wrongfully brought into the country by land may also be seized and forfeited; but no such conveyances belonging to and used by common carriers, whether persons or corporations, are liable to forfeiture unless the owner, superintendent, or agent in charge is consenting or privy to the illegal importation. (5) Various pecuniary penalties may be visited upon the owners or masters of vessels for certain specific violations of the

law, such as resisting or hindering the revenue officers, and the like; which penalties are made liens upon, and may be summarily enforced against, the vessels themselves. Cases involving any of the foregoing forfeitures or pecuniary fines are reported to the proper U. S. district-attorney, and it is his duty to prosecute the delinquent or to procure a condemnation of the property in the national courts. The customs officers are clothed with very large powers in order to detect and punish any fraudulent importation or concealment, or failure to pay the full duties required by the law. They may board and search all vessels lying in port, and all those bound to the U. S. while not more than four leagues from the coast. They may also search all persons coming into the country, all trunks, boxes, or other baggage, papers, envelopes, all conveyances and means of transport, stores, warehouses, and other buildings—in short, all places or things where the goods themselves or the evidence of their wrongful importation may possibly be concealed. Finally, by means of an order of the court they may obtain an inspection of the books of account and business-papers of merchants and others suspected of or charged with the wrongful non-payment of duties. When the property seized is condemned and sold, the proceeds, after paying the costs and expenses, are distributed, part to the U. S., part to the principal customs officers of the district, and part to the informer if there was any distinct from the officer himself who detected the offence and procured the seizure. JOHN NORTON POMEROY.

Smut [Ang.-Sax. *smitta*]. The diseases of grain in which the kernels become converted into masses of black powder are popularly called *smuts*. In England the term *bunt* is often applied to similar diseases. The diseases known as smuts are all caused by fungi belonging to the order Ustilagineæ. The common smut of Europe, also found in this country, is *Ustilago segetum*; it is very common on oats. The most frequent and striking smut, however, which is found in America is *Ustilago maydis*, which produces the distortions of the ears of Indian corn with which every one is familiar. The smut in wheat is *Tilletia caries*. It is this form which is called frequently bunt. The smut on rye is *Urocystis occulta*. The smuts are by no means, however, confined to grains, but are abundant on other plants, and, although generally confined to the floral organs, in some species are found on the leaves and stalks. (For a further account of smuts see USTILAGINEÆ. For a more systematic account of this group of fungi see UREDINES.) W. G. FARLOW.

Smybert. See SMIBERT.

Smyr'na, city of Asia Minor, situated at the bottom of the Hermæan Gulf, whose entrance lies opposite the island of Mitylene. The Leleges, a piratical Greek tribe, first built a fort on Mount Pagus and a closed port at its foot about 1500 years before our era. In 1420 (B. C.) Tantalus, king of one of the Lydian tribes, erected the city of Tantalis upon a hill on the N. E. side of the inner bay; the remains of its acropolis and of his own tomb are yet standing, as well as those of its port, the Naulochos, whence sailed the Lydian ancestors of the Tyrrhenians to Italy. Repeated earthquakes having destroyed his father's capital, Pelops removed its inhabitants to Greece and gave his name to its peninsula (B. C. 1362). Fifty years later Theseus built a city farther inland, on the site of the present village of *Boornabat*, and named it Smyrna after his wife, an Amazon. Soon after this occurred the Trojan war, by which the Phrygian power was broken, and the country began to swarm with Greek colonists. In their division of the soil the Hermæan Gulf became the boundary-line between Æolia on the N. and Ionia on the S., and Smyrna was for centuries the bone of contention between the two states. It was first possessed by the Ionians; then the Æolians took and walled it. But it had already changed its site, being erected on the banks of the sacred Meles, a remarkable stream which rushes out of a pond at the foot of the hills and enters the sea but 1500 yards from its source. Here stood the temple of Diana, and many mosaic pavements, columns, and broken statues still attest the veneration of the ancients. Here Homer sang his immortal verse; for, though seven cities dispute the honor of having given him birth, the ancients generally admit the claims of Smyrna. The Ionians had repossessed their city but about 100 years when Alyattes, king of Sardis, took and dismantled it in 628. Thence for four centuries her people dwelt in an unwalled town and in the villages of the neighboring plain (as at the present day), until Alexander the Great, being warned of Jupiter in a dream, ordered a new city to be built on the slopes of Mount Pagus; which was done by his generals Antigonus and Lysimachus (B. C. 320–300), the Lelegian castle being repaired and converted into an acropolis. From this time Smyrna increased in wealth and prosperity, becoming, as it has been ever since, the chief commercial city of Asia Minor. When that country became subject to the Romans, they made it the seat of a *conventus juridicus* (Pliny, v. 31), and it suffered but a temporary injury from the siege there sustained by Trebonius, one of Cæsar's murderers, and its capture by Dolabella; for Strabo at the beginning of our era calls it "the most beautiful city of Ionia." "It was" then, as now, "built on a hill, but the greater part in the plain near the harbor, the Metroum, and the Gymnasium. The divisions of the streets were excellent, and as nearly as possible in straight lines." (Strabo, xiv. 1, 37.) The remains of ancient Smyrna fully attest the high degree of civilization acquired by its inhabitants; columns, statuary, and articles in precious metals and gems have been dug up for centuries, many of which are now adorning the museums and private collections of Europe. Christianity was probably introduced into Smyrna during the first century of our era, and Polycarp, one of its early bishops and a disciple of St. John, suffered martyrdom in 167 A. D., and Pionius, a pious presbyter, in 249. Smyrna sent its bishop, Eutyches, to the œcumenical council held at Nice in 325. The names of only thirty bishops down to the year 1721 have been preserved. Smyrna is one of the seven apocalyptic churches; and it is worthy of note that it alone is commended, with Philadelphia, in the epistles to the seven churches, and that these two cities are still flourishing, while the other five are little better than a mass of ruins. Smyrna has, however, repeatedly suffered from earthquakes, the most notable instance being in 177 A. D., when it was rebuilt by the emperor Marcus Aurelius. In modern times a similar calamity occurred in 1688 and in 1778, and the city was mostly destroyed by fire in 1797 and 1844; many inhabitants were also carried off by the plague in 1812 and 1837. Under the Byzantine empire Smyrna was the capital of a province or thema, and in 900 was erected into an independent archbishopric by Leo the Wise. By this time, however, the Moslems had overrun the peninsula, and their ships were beginning to contend for the mastery of the sea. Tzachas, a Turkish pirate, took possession of the city (1080), but was driven out by a Greek fleet under John Ducas, who greatly damaged the place. It was repaired by John Vataces (1222), and erected into an archbishopric with eight dependent bishoprics. The conquests of the Moslems by land meanwhile brought them nearer the western coast of the peninsula; and though the empire of the Seljookides was falling to pieces, Aïdin, a Turkish prince, carved himself a state out of ancient Ionia and gave his name to its capital, the former *Tralles*, near the Meander. He took Smyrna in 1313; but a fleet of crusaders, surprising the city, built the fort of St. Peter by the sea, and confined the Turks to the castle on Mount Pagus. The Roman Catholic worship was first introduced at this time (1346), and despite many vicissitudes it has been maintained ever since. Soon after (1401), occurred the devastating irruption of Tamerlane, who vanquished Sultan Bayezid in the plains of Angora. He came to Smyrna, and, resolving to take the fort of St. Peter, ordered his soldiers to fill up the port, carried the place by storm, and butchered all who fell into his hands. The Mogul emperor soon after withdrew to his own country, and Smyrna was occupied by Kineit, from whom it was wrested by Sultan Moorad II. (1424). The brave knights of St. John made several vain attempts to obtain possession of a place of such commercial importance, and the Venetians sacked it in 1473, but the Turks finally built the Sanjak Castle at the entrance of the bay and effectually closed the narrow channel (1630). Since that event Smyrna has been in the undisturbed possession of the Osmanli sultans, but its European population has so much increased that the Turks universally call it the city of the Giaours. It early became the chief, almost the only, port in Turkey for foreign commerce until the invention of steam navigation overcame the currents of the Dardanelles and the Bosphorus. Its population has increased from 90,000 in 1631 (Tavernier) or 27,200 in 1702 (Tournefort) to 187,000 in 1868, of whom only 40,000 are Turks; there are no less than 20,000 persons of European birth or descent, who are amenable to Turkish law only in their estates, and are otherwise governed by the codes of the countries to which they respectively belong, administered by their consuls.

Modern Smyrna is built in part upon the slopes of Mount Pagus, but mostly on the low ground at their foot formed in good measure by a torrent from the S., and extending to a tongue of land called "the Point." Its eastern limit is formed by the above-mentioned torrent and the "caravan bridge," beyond which lie the Turkish cemeteries, thickly planted with fine cypresses. The sea face is 2 miles in extent N. and S., and its irregular line is now being corrected by a long stone wharf. The streets are either parallel or at right angles to the sea, but they are straight only in the Armenian quarter, having been laid out anew by that public-spirited people after the fire of

1844. The houses, usually two stories high, are now generally built of wooden beams encased in stone, to preserve them at once from fire and the earthquake. There are several free hospitals, each nation usually having its own, the Turks and Jews excepted. The Greeks have 3 churches, the Armenians 1, the Roman Catholics 3, the Protestants 4 chapels, and the Jews 1 synagogue. The mosques are mostly ancient churches or *tekkes*. Smyrna is the best supplied with schools of any city in the empire, and has 2 French, 1 Greek, and 1 Armenian weekly paper. Smyrna is the chief mart for European commerce in Asia Minor. Its exports consist of silk, opium, drugs, dyes, and gums, gall nuts, wool, valonea, dried figs, and raisins, and fresh fruits; and the imports are coffee, sugar, cochineal, indigo, tin, iron, lead, broadcloth, cotton goods, rum, brandy, spices, and machinery. The warehouses are near the sea; lighters are used on account of the shallowness of the water near the shore. There are usually both foreign and Turkish naval ships in port, sometimes an entire fleet, though the preference is usually given by the latter to the Bay of Voorla (*Clazomenæ*), half way out of the gulf. The defences of Smyrna consist of a battery on the shore near the great military barracks, and of the ruinous castle at the entrance of the bay, which contains some old brass cannon large enough for a man to sit within, with stone balls to match. The harbor is secure, but the yearly deposits from the Hermus at its entrance must ere long cut off Smyrna from the sea, as has occurred at Ephesus and Nice. Smyrna possesses the only railways yet built in Asia Minor—the one extending S. to Aidin, a distance of 83 miles, with Ephesus lying about half way; and the other to Philadelphia, by Magnesia and Cassaba, 113 miles in all. Many steamers, Austrian, French, Russian, English, Greek, Italian, Spanish, Turkish, and Egyptian, place it in direct communication with all the principal ports of the Mediterranean and the Black Sea. Smyrna yet presents some venerable ruins—the castle on the hill, the great theatre beneath it, and the stadium, the scene of Polycarp's martyrdom. The fort of St. Peter is well preserved, and still shows the escutcheon of the old knights. Smyrna is the starting-point for visiting the "seven churches of Asia." The beauty of its neighborhood is justly celebrated, and its country villas are unrivalled in the empire. Magnesia is situated at the foot of Mount Sipylus, and in the plain below Antiochus was vanquished by Scipio. On the same mountain is the bust of Niobe, the oldest Grecian sculpture in existence; and not far away, beyond Nif, may be seen the bas relief of Sesostris, so called. Ephesus, Aphrodisia, Hierapolis, and Sardis also offer interesting remains. The region is sometimes overrun and made insecure by bands of brigands. The province is governed by a pasha, who resides alternately in Smyrna and Aidin, the latter being preferred, in spite of its unhealthiness, on account of its large Turkish population. H. J. Van Lennep.

Smyrna, p.-v., Kent co., Del., on Delaware R. R., 60 miles S. of Philadelphia, has 4 churches, a library, town-hall, and seminary, 1 bank, 1 newspaper, 3 hotels, 2 iron-foundries, 2 shipyards, and 2 flouring and 1 large ship-lumber and planing mill. Business, fruit-growing and agriculture. P. 2110. J. H. Hoffecker, Ed. "Times."

Smyrna, tp., Jefferson co., Ind. P. 1486.

Smyrna, tp., Aroostook co., Me. P. 159.

Smyrna, p.-v. and tp., Chenango co., N. Y., at junction of New York and Oswego Midland with Utica Chenango and Susquehanna R. R. P. 1668.

Smyrna, tp., Carteret co., N. C. P. 905.

Smyrna, p.-v., Rutherford co., Tenn., on Nashville and Chattanooga R. R.

Smyrna Landing, v., Kent co., Del. P. 158.

Smyth, county of S. W. Virginia, on the head-waters of Holston River, consisting chiefly of an elevated, fertile valley, bounded S. E. by Iron Mountain and N. W. by Walker's Mountain, has deposits of limestone, rock-salt, and gypsum, and is traversed by Atlantic Mississippi and Ohio R. R. Staples, Indian corn, wheat, oats, butter, and cheese. Cap. Marion. Area, 500 sq. m. P. 8898.

Smyth (Andrew Woods), M. D., b. near Londonderry, Ireland, Feb. 15, 1833; arrived at New Orleans in 1849, where he began the study of medicine; graduated in the medical department of the University of Louisiana 1859. He has been a resident student and house-surgeon of the great charity institution of that city his whole professional life, and in it he performed (May 15, 1864) the operation, the first and only one recorded, of tying successfully the arteria innominata. In some twenty attempts, made by the most eminent surgeons, all had failed; his success was attributed to ligating also, where secondary hæmorrhage had occurred, the vertebral artery, which prevented regurgitant hæmorrhage. Dr. Valentine Mott, who was the first to tie the innominata, said on his deathbed that Dr. Smyth's successful operation had afforded him more consolation than all others of similar character. Paul F. Eve.

Smyth (Charles Piazzi), son of Admiral W. H. Smyth, b. about 1820; received a scientific training in his father's private astronomical observatory at Bedford; was employed for some time under Mr. Maclean in the observatory of the Cape of Good Hope; was appointed royal astronomer for Scotland; made a valuable series of observations from the Peak of Teneriffe 1856; published *Teneriffe, an Astronomer's Experiment, or Specialities of a Residence above the Clouds* (1858), being the first work ever illustrated by stereoscopic views; visited Russia, giving an account of his tour and scientific observations in a book, *Three Cities in Russia* (2 vols., 1862), and made a thorough examination of the Great Pyramid of Egypt, which he considers to have been built under divine inspiration as a standard of a system of weights and measures. This theory is set forth and defended in three works—*Our Inheritance in the Great Pyramid* (1864), *Life and Work at the Great Pyramid* (3 vols., 1867), and *Antiquity of Intellectual Man* (1868).

Smyth (Egbert Coffin), D. D., b. at Brunswick, Me., in 1829; graduated at Bowdoin College 1848; became a Congregational minister, and was appointed professor of natural and revealed religion at Bowdoin 1856. Author of several published sermons and discourses, etc.

Smyth (James Carmichael), M. D., b. in Scotland in 1741; studied medicine at Edinburgh and at Leyden; was employed in the medical department of the British army; had charge of the French prison at Winchester 1780; discovered the means of arresting contagion by the employment of three mineral acids, for which he received a grant from Parliament 1802; became physician-extraordinary to George III., and d. in 1821. Author of several medical treatises, especially on contagion and on hydrocephalus.

Smyth (Sir James Carmichael), Bart., son of the above, b. in Scotland about 1775; served in the British army in Canada 1812–15; major-general 1825; baronet 1821, and governor of British Guiana from June, 1833, to his death, Mar. 4, 1838. He prepared for the confidential use of the duke of Wellington *A Précis of the Wars in Canada from 1755 to the Treaty of Ghent in 1814* (London, 1826).

Smyth, or **Smith** (Sir John), cousin through his mother to King Edward VI., b. in England about 1530; was distinguished as a soldier during the continental wars of Elizabeth, and as ambassador to Spain. D. about 1598. Author of *Certain Discourses concerning the Formes and Effects of Divers Sorts of Weapons,* etc. (London, 1590; reprinted in Lilly's *Bibliotheca Anglo-Curiosa,* 1869), and *Instructions, Observations, and Orders Militarie* (1594).

Smyth (John), b. in England about 1552; graduated at Christ's College, Cambridge, 1575; became a fellow; took orders in the Church of England; was reproved by the heads of the university 1586 for having advocated a judaic observance of Sunday, but persisted in his teachings; connected himself with the Puritans; was minister at Gainsborough to a congregation with which he emigrated to Amsterdam 1606; was converted to Baptist principles by Dutch theologians; caused a separation among the Puritan refugees in Holland, and maintained controversies with Ainsworth, Robinson, and others. D. at Amsterdam in 1610. Author of *A True Description of the Visible Church* (1589), *The Difference of the Churches of the Separation* (1608), *Parallels, Censures, Observations,* etc. (1609), *The Character of the Beast,* etc. (1609), and a posthumous *Declaration of the Faith of the English People remaining at Amsterdam* (1611), etc.

Smyth (Thomas), D. D., b. at Belfast, Ireland, July 14, 1808; was educated at Belfast and at London; came to the U. S. 1830; studied divinity at Princeton, and was pastor of the Second Presbyterian church at Charleston, S. C., from 1832 until his death, Aug. 20, 1873. Author of numerous works, chiefly in illustration and defence of the Presbyterian form of church government; also of *The Unity of the Human Race proved to be the Doctrine of Scripture, Reason, and Science* (1850) and *The True Origin and Source of the Mecklenburg Declaration of Independence.*

Smyth (Thomas A.), b. in Ireland; came to the U. S. in childhood; settled at Wilmington, Del.; entered the Union army 1861; made brigadier-general June 3, 1864, for gallant conduct at the battle of Cold Harbor; became commander of the 2d division of the 2d army corps, and was mortally wounded near Farmville Apr. 6, dying at Petersburg Apr. 9, 1865.

Smyth (William), b. at Liverpool, England, in 1766; graduated at Peterhouse, Cambridge, 1787; became tutor to a son of R. B. Sheridan, through whose influence he was appointed professor of modern history at Cambridge

1807, retaining that post until his death, at Norwich June 26, 1849. Author of *Lectures on Modern History* (2 vols., 1840), republished in the U. S. with additions by Pres. Jared Sparks (Boston, 2 vols., 1841), and *Lectures on the French Revolution* (3 vols., 1840).

Smyth (WILLIAM), b. at Pittston, Me., in 1797; graduated at Bowdoin College 1822; was for forty years professor of mathematics in that institution, and author of a series of textbooks on algebra and geometry. D. at Brunswick, Me., Apr. 3, 1868.

Smyth (WILLIAM HENRY), D. C. L., F. R. S., b. at Westminster, England, Jan. 21, 1788, son of J. B. Palmer Smyth of New Jersey, a loyalist of the American Revolution, who claimed descent from the famous Capt. John Smith; entered the British navy 1805; served at Cadiz 1810; was detailed by the lords of the admiralty to make a hydrographical survey of the coasts of Sicily and the adjacent islands, which resulted in the publication of his *Atlas and Descriptive Memoir on Sicily* (1824); was promoted to commander Sept., 1815; completed a survey of the coasts of the Adriatic 1817; made a final survey of the Mediterranean 1821; published a large number of charts of different portions of that sea; became post-captain 1824, and rear-admiral 1853; resided successively at Bedford and at Cardiff, erecting a private astronomical observatory at each place, and was known for many years as an enthusiastic lover of science; was a member and officer of many societies, and president of the Royal Astronomical Society, and in 1857 became hydrographer to the admiralty. D. near Aylesbury Sept. 9, 1865.

Snail [Ang.-Sax. *snægel*, "little snake"], a name given to the terrestrial shell-bearing gasteropod mollusks generally, and frequently extended to the similar forms inhabiting the waters. The terrestrial species were formerly combined by many authors in a single family (called Colimacés by Lamarck), but the incongruity of this assemblage, and the wide differences between the inoperculate and operculate types, were soon recognized; they were then differentiated into the Pulmonifera inoperculata (including slugs and snails) and Pulmonifera operculata. It was subsequently recognized that even such a distribution did not adequately express the fundamental differences between the several types. It is now generally admitted that the terrestrial snails are divisible into three categories—viz. (1) Pulmonata, including the inoperculate forms, as well as allied forms living in the water, and also the slugs; (2) certain operculigerous forms (Cyclostomidæ, Aciculidæ, etc.) which are closely allied to the aquatic Littorinidæ, etc., and consequently Pectinibranchiata, in the extended sense of the word; and (3) other operculigerous types (Helicinidæ, Proserpinidæ, etc.) which are most nearly related to certain other aquatic forms very different in structure from the former—*e. g.* Neritidæ, Trochidæ, etc.—and representative of another order, the Rhipidoglossa. It is thus seen that the form of the shell, and even the presence or absence of a shell, are of very inferior systematic significance, and entirely subordinate to differences in structure of the animal. Those differences are chiefly exhibited by the modifications of the nervous system, the heart, the dentition of the lingual ribbon, and the organs of generation. (See, further, GASTEROPODS, etc.) THEODORE GILL.

Snake. See SERPENT.

Snake-Bird. See DARTER.

Snake'bite, tp., Bertie co., N. C. P. 1336.

Snake'-Eel (*Ophisurus*), a genus of marine eels, allied to the common eel, but found only in warm latitudes. It is remarkable for the absence of the caudal fin, the end of the tail being much like that of a snake.

Snake'-Fish, a name given on some parts of the English coast to the *Cepola rubescens*, otherwise called BAND-FISH (which see), and in some of the West Indies and Bermuda to the *Synodus* (or *Saurus*) *lacerta*.

Snake Indians. See SHOSHONES.

Snake (or **Lewis**) **River** is the largest tributary of the Columbia. It rises in Shoshone Lake, in the U. S. National Park, within the limits of Wyoming Territory. Its source has an elevation of 7792 feet. It takes a devious course, flowing to the S., N. W., S. W., N. W. again, then northward, forming for a long distance the boundary between Idaho on the E. and Oregon and Washington Territory on the W. Finally, its course is to the W. and S. W. Its mouth is in Washington Territory. Its upper valley is broken, with some fertile areas; lower down, the country is to a great extent open, and in part is fine prairie-land. The stream has numerous rapids, and its great cataract in Idaho rivals Niagara in grandeur and exceeds it in height. The Snake River is over 1000 miles long, and has a large volume of water.

Snake'-Root, a popular name for many plants believed to be efficacious in the cure of snake-bites. In the U. S. the name is applied to the following among others: (1) the black snake-root or sanicle (*Sanicula marilandica*), a common umbelliferous plant, with a root of an aromatic taste, of some value as an anti-spasmodic. (2) The *Eryngium yuccæfolium*, buttonsnake-root, or rattlesnake master, is diaphoretic and expectorant. (3) The Seneca snake root (see SENEKA). (4, 5, 6) *Liatris spicata*, *squarrosa*, and *scariosa*, called also buttonsnake root, blazing star, rattlesnake master, etc., showy, composite flowered plants, with stimulant and diuretic properties. (7) The *Eupatorium ageratoides*, common in the Northern States, and a good tonic, is called white snake root. (8, 9) The *Aristolochia serpentaria*, the well known Virginia snake root, which has valuable stimulant and tonic powers and a pleasant fragrance. *A. reticulata* of the South-west produces much of the snake-root of commerce, and is of good quality. (10) The *Cimicifuga racemosa*, or black snake-root, is a valuable sedative and expectorant. (11) *Asarum Canadense*, or wild ginger, is called snake-root and Canada snake-root in New England. It is a fragrant plant, with properties much like those of *Aristolochia serpentaria*, but much more pungent. This list illustrates the vagueness of the popular names of plants and the importance of scientific classification. The list might be considerably extended.

Snake Spring, tp., Bedford co., Pa. P. 631.

Snake'-Stone, a small piece of stone, bone, or other substance which is placed upon the bite of a poisonous serpent for the purpose of absorbing or charming away the poison. The vulgar in almost all countries have faith in this and other like means of cure, such as the mad stone, which is applied to the bite of a rabid dog. In India, snake-stones are often used, and there are several apparently well-authenticated instances of their seeming efficacy. It is probable that some of these stones may have a strong absorptive power for the snake-poison, for they are often porous, and the unlimited faith which the bitten persons have in this means used for cure is doubtless a powerful adjuvant.

Snake'-Weed, the common name of the BISTORT (which see), so called from the root being *twice bent* on itself. This root also contains starch, which renders it nutritive; hence in Siberia it is roasted and eaten.

Snake'-Wood. See LETTER-WOOD.

Snap'dragon, a popular name for plants of the genus *Antirrhinum*, herbs of the order Scrophulariaceæ. Many fine flowering varieties are cultivated, mostly belonging to *A. majus* and *A. latifolium*, Old-World plants of easy culture.

Snap'per, a name applied to a number of different kinds of fishes in the Southern U. S. and West Indian islands. The most noteworthy are the species of *Lutjanus* and *Sebastes*. (1) The *Lutjani* are forms distantly related to, and somewhat resembling, the porgy of the U. S., and are numerous in species. One member of the genus (*Lutjanus caxis*, or gray snapper) is a visitor to the coast of the U. S. as far N. as New Jersey, but only young fishes have been hitherto found. (2) The *Sebastes viviparus* is known about Massachusetts Bay as the *Sebastes*, and may be readily known by its compressed body, 5-lobed preoperculum, large eyes, and reddish body. It belongs to the family Scorpænidæ. THEODORE GILL.

Snap'ping-Turtle, the designation in the U. S. of several species of tortoises. (1) The common snapping-turtle of the Northern and most of the Southern U. S. is the *Chelydra serpentina*. This has the head moderately large, and covered with a soft skin, and the marginal scales of the shell are in a single row. It is said sometimes (though very rarely) to attain a length of about four feet and a weight of fifty pounds. It is found from Canada southward, and from the Atlantic seaboard westward to the Plains. (2) A species which in some parts of the Southern States at least replaces the *Chelydra serpentina* is the *Macroclemys Temminckii*. This animal has the head very large and broadly triangular, and it is covered with numerous horny plates; the marginal scales of the shell are in two rows. It reaches a very large size; sometimes it is reported weighing as much as 100 pounds. It is confined to the Southern States, extending from Florida to Western Texas and northward up to Missouri in the West. It is perhaps more generally known as the alligator turtle. Both of these species belong to the family Chelydridæ, and are distinguishable from all the other turtles of the U. S. by the long and imperfectly retractile neck and tail, and the cruciform plastron or lower shell. They owe their name to their habit of snapping at their food or enemies. They are formidable opponents, their bite being severe, and it is difficult to relax their hold. They are by many esteemed for food, and especially for making soup. They have a musky odor, which is rather strong. In the early summer they

lay from twenty to forty eggs in a hole dug by themselves. (3) In some sections of the U. S. the name is also applied to the soft-shelled turtles, or Trionychidæ, which also snap abruptly at food or obstacles to their progress. THEO. GILL.

Sneeds'ville, p.-v., cap. of Hancock co., Tenn. P. 177.

Sneek, town of the Netherlands, province of Friesland, is neatly built, intersected by canals, and surrounded by flat meadow lands. It carries on a very large trade in cattle, butter, and cheese. P. 9395.

Sneeze'-Wood, the beautiful and durable timber of *Pteroxylon utile* (order Sapindaceæ), a tree of South Africa. When sawing or rasping it, joiners are much troubled by the sneezing which its fine dust provokes. Its wood is very inflammable, even when green.

Sneez'ing, or **Sternutation,** a convulsive movement by which the lungs and chest-walls are expanded and then suddenly contracted, forcing the breath out violently through the nose. It is produced by reflex action, there being some irritation of the pituitary membrane of the nose which originates the action. The sneezing tends to remove the irritating substance from the nose. There are a large number of irritating substances whose presence in the nostrils will induce sneezing. When it is a symptom of cold, it indicates that catarrhal inflammation has induced a state of things similar to that produced by a foreign substance in the nose.

Snell (EBENEZER STRONG), LL.D., b. at North Brookfield, Mass., Oct. 7, 1801; graduated at Amherst College in 1822; was instructor in Amherst Academy 1822–25, and in Amherst College 1825–34, when he became professor of mathematics and natural philosophy. He published revised editions of Olmsted's textbooks on natural philosophy and astronomy. D. at Amherst, Mass., Sept. 18, 1876.

Snell (THOMAS), D. D., b. at Cummington, Mass., Nov. 21, 1774; graduated at Dartmouth College 1795; taught in the academy at Haverhill one year; was licensed to preach 1797; was ordained pastor of the Second Congregational church at North Brookfield, Mass., June 27, 1798, and filled that post sixty four years, until his death May 4, 1862. Twenty-four of his sermons and discourses were separately published, several of them being anniversary addresses of interest to the student of local history.

Snell (WILLEBRORD), b. at Leyden in 1591; studied mathematics and natural science; succeeded in 1613 his father as professor of mathematics at the University of Leyden. D. there Oct. 31, 1626. He discovered the law of the refraction of light, and laid thereby the foundation of the science of optics. He was also the first to calculate the size of the earth by means of a trigonometrical measurement of an arc of a meridian. The whole method of proceeding which he employed in this undertaking he has described in his *Eratosthenes Batavus, sive de Terræ Ambitus vera Quantitate* (Leyden, 1617). He also wrote *Cyclometricus* (Leyden, 1621), etc.

Snell'ing, p.-v., Merced co., Cal., on Merced River, in a mining and stock-raising region.

Snelling (JOSIAH), b. at Boston, Mass., in 1782; entered the U. S. army as lieutenant of infantry 1808; was distinguished at the battles of Tippecanoe (1811) and Brownstown (1812), and subsequent engagements on the Canada frontier; became lieutenant-colonel of rifles and inspector general 1814; colonel of the 5th Infantry 1819; was a principal witness against Gen. Hull on his trial, and published *Remarks on Gen. Hull's Memoirs* (1825). D. at Washington, D. C., Aug. 20, 1828.

Snelling (WILLIAM JOSEPH), son of Col. Josiah, b. at Boston, Mass., Dec. 26, 1804; educated at West Point; became a trapper in Missouri; engaged in developing the lead mines at Galena, Ill.; began to figure as a writer, both of prose and verse, about 1828; was connected with several newspapers; wrote for the principal magazines; published *Truth, a New Year's Gift for Scribblers* (1832), a spirited metrical satire on several American poets; *Tales of the North-west*, containing accurate sketches of Indian life; *The Polar Regions of the Western Continent Explored* (1831); contributed to the *N. A. Review* and to *The Boston Book*; wrote for William Apes, the Pequod Indian preacher, his little book on *Indian Nullification* (1835), and was for several years editor of the Boston *Herald*. D. at Chelsea, Mass., Dec. 24, 1848.

Sne'then (NICHOLAS), b. at Fresh Pond (now Glen Cove), L. I., Nov. 15, 1769; was in early life a farmer; was ordained an itinerant Methodist preacher 1794; labored four years in New England; became private secretary to Bishop Asbury; was chaplain to Congress 1809; emancipated a large number of slaves acquired by marriage 1829; was prominent in the organization of the Methodist Protestant Church 1828; removed to Indiana 1829. D. at Princeton May 30, 1845. Author of several volumes of theological and controversial essays and sermons.

Snet'ter's, tp., Darlington co., S. C. P. 771.

Sniabar, tp., Jackson co., Mo. P. 2707.

Sniabar, tp., Lafayette co., Mo. P. 1550.

Snia'tyn, town of Austria, in Galicia, on the Pruth, was formerly fortified; has a fine castle and a trade in cattle and leather. P. 10,663.

Sni'der Rifle, so called from its inventor, the essential features of which are that the breech-block revolves around an axis on the right of and parallel to the axis of the bore, and the firing-pin passes obliquely from the nose of the hammer through the breech-block to the centre of the base of the cartridge. This was the first form of breech-loaders adopted by the British government, which in 1866 directed that the old Enfield muzzle-loaders should be altered to breech-loaders upon this system.

Snipe [Dutch, *snip*], a name given to many birds of the family Scolopacidæ. The most prominent species in the U. S. are the *Gallinago Wilsoni* (American snipe), *Macrorhamphus griseus* (gray snipe), *Tringa maculata* (jack or grass snipe), *Tringa cornutus* (robin snipe), and *Totanus semipalmatus* (stone snipe). The *Tringæ* are, however, more generally known as sandpipers, and the *Totani* as tattlers. (See SCOLOPACIDÆ.)

Snipe'-Fish, a name given to the *Centriscus scolopax*, the type of the family Centriscidæ, on account of the elongated snout, comparable to the bill of a snipe. It is also called trumpet-fish.

Snohomish, county of N. W. Washington Territory, extending from the Cascade range on the E. to Puget's Sound on the W., watered by several large streams, is covered in great part with forests, and is noted for its cranberry-marshes along the sound. Staples, lumber, potatoes, and hay. Cap. Snohomish. Area, 1350 sq. m. P. 599.

Snohomish, p.-v., cap. of Snohomish co., Washington Territory, on Snohomish River.

Snor're Stur'leson, b. in 1178 at Hwamma, on the western coast of Iceland, belonging to one of the most prominent families in the island, descending from the royal family of Norway, and settled at Hwamma since the earliest days of the colonization. He was educated at Oddi by Jon Loptson, the most learned man in Iceland, and a grandson of Sæmund Sigfusson, the author of the *Elder Edda*. In 1204 he married the richest heiress in Iceland, and thus became, by his family connections, his education, and his wealth, the most prominent man in the country—a position which he vindicated by the magnificence and splendor of his life, by his shrewdness and energy as a politician and magistrate, and by his eminent talents as an orator and skald. But many of his passions were mean, and all his ways were crooked. A deadly hatred arose between him and his brother, and bitter feuds with other families made his life a perpetual warfare. He sought support in Norway, where he enjoyed a great reputation; but his egotism, avarice, and passion for intrigue led him into fatal mistakes, and he was murdered at the instigation of the Norwegian king, Hakon, by his two sons-in-law in 1241, at Reikholt, where ruins of his splendid mansion are still to be seen. His life gives a very characteristic and highly interesting picture of the culmination and decline of the Icelandic republic. Of his literary productions, the most important is *Heimskringla*, giving the history of Norway to the death of Magnus Erlingson in 1177. It was translated into Danish by Peder Clausson in 1559, but not published until 1697, by Peringskjold (Stockholm). The best edition is that begun by Schöning and finished by Werlauf (Copenhagen, 1777–1826), with a Latin and Danish translation. There is also an English translation by Samuel Laing (3 vols., London, 1844). The *Younger Edda* also bears Snorre's name, but only parts of it belong to him.

Snow [Ang.-Sax. *snâw*]. When vapor condenses at a temperature below 32° F., it freezes or passes into a crystalline form, producing snow. Snow-flakes, though assuming a great variety of forms, usually present the outline of a hexagon or a six-pointed star. In high and middle latitudes the ground is covered with snow each winter, but within the tropical regions no snow falls at or near the level of the sea, for the temperature of the lower atmosphere is always sufficient to melt it, even if it is formed in the upper air. In the northern hemisphere the limit of the fall of snow at the sea-level is an irregular line passing mainly between 25° and 40° N. lat.; in the southern it is more regular, lying in the continents between lats. 37° and 38°. In general, this line is nearest to the equator in the regions most exposed in winter to polar winds, as on the eastern coast of Asia and of North America. As the heat of the air decreases upward, the formation of snow is always

possible upon high mountains, even under the equator. At the summit of the Andes and the Himalayas, for example, the moisture condensed during the rainy season falls in the form of snow, while it rains on the slopes and plains below. Thus, in all latitudes from the equator to the poles the tops of high mountains are covered with a layer of permanent snow, which the summer heat is not sufficient to melt. The lower limit of perpetual snow, called the *snow-line*, is found within the tropics about 3 miles above the level of the sea. In temperate latitudes it descends to a little less than 2 miles; and at the northern limit of the continents it is about half a mile, or even less, above the level of the sea; while on the arctic islands vast fields of snow remain permanently very near the seashore.

The height of the snow-line, as observed in different latitudes, is given in the following table:

Latitude.	New World.	English feet.	Latitude.	Old World.	English feet.
75° N.	North Greenland	2,3 0	75° N.	Bear Island	600
54°	Unalashka	3,500	71°	Mageroe, Cape North	2,300
48°	Mt. Baker, Or., about	8,000	67°	Sulitelma, Lapland	3,800
43°	Rocky Mountains	12,500	61°	Scandinavian Alps	5,300
39°	Rocky Mountains	14,500	50°	Altai Mountains	7,000
38°	Sierra Nevada	11,000	46°	Alps, N. side	8,800
19°	Popocatepetl, Mexico	14,900	46°	Alps, S. side	9,200
5°	Tolima, Colombia	15,300	43°	Caucasus	11,000
1° S.	Andes of Ecuador	15,800	35°	Hindoo Koosh	13,000
17°	Andes of Bolivia, W. side	18,500	31°	Himalaya, S. side	16,200
17°	Andes of Bolivia, E. side	15,700	31°	Himalaya, W. side	17,400
33°	Andes of Central Chili	14,700	12°	Abyssinian Mountains	14,000
42°	Andes of Patagonia	6,000	3° S.	Kilima Njaro	16,000
54°	Andes of Sts. of Magellan	3,700	44°	New Zealand Alps	7,500

This table shows that though the height of the snow-line decreases toward the poles, its greatest altitude is not at the equator, but near the tropics, and that it is also subject to great irregularity of elevation.

Two conditions regulate the altitude of the snow-line—the quantity of fallen snow, and the amount of heat to melt it. Thus, in the sub-tropical zones, which have less snow and no less summer heat, the snow-line is higher than at the equator. In similar latitudes the coast-regions, exposed to moist winds, have a lower snow-line than the interior of the continents with their scanty snows, dry atmosphere, and hot summers. The peaks of the Sierra Nevada bear perpetual snow 3500 feet lower than the Rocky Mountains in the same latitude. The S. slope of the Himalayas, which condenses the vapors brought by the warm monsoons, has a snow-limit, on an average, 2000, and in some places 4000, feet lower than the N. slope on the dry and sunny plateau of Thibet. In the Alps the line of snow is somewhat higher on the southern slopes, exposed to the warm summer wind from Italy. In passing from the dry climate of Central Chili to the rainy region farther S., the snow-line descends from 14,700 feet to 6000. A vast amount of snow in the latter region, and a wet, cloudy summer, account for the change. In the Rocky Mountains, in a latitude corresponding to that of the Patagonian Andes, the snow-line has an altitude of 12,500 feet—that is, full 6000 feet higher.

Glaciers.—One of the most interesting phenomena connected with the regions of permanent snow, though extending far below their bounds, are the glaciers. Long before reaching the snowy regions the tourist, ascending the Alpine valleys, stumbles with amazement upon vast masses of ice hundreds of feet in thickness, imbedded in green valleys and stately forests, often near flourishing villages and cultivated fields. These prove to be the lower ends of long bodies of ice, whose heads may be traced to the glistening heights in the distance. Seen from above, glaciers look like vast streams of ice, which descend from the lower edge of perpetual snows—like long icicles from a snow-covered roof. They fill the beds of the Alpine valleys, following their windings, and terminate abruptly in a massive wall of ice. From beneath, through a large icy vault, the turbid waters of the melting glacier escape in turbulent torrents, which are the fountain-heads of all the great alpine rivers. Like streams, again, when the slope is gentle their surface is smooth; when precipitous, the mass of ice breaks up in deep crevices, and the glacier assumes the form of a gigantic frozen cataract, but beyond the precipice it becomes even again. In the lower portion, where the air is warmer and the melting more rapid, the shattered mass is sometimes resolved into sharp points of considerable height, called the *needles of the glacier*. The great glaciers of the Alps extend downward, from 3000 to 6000 feet below the snow-line, and are from 10 to 15 miles in length. Along their course, like the great river-systems, they usually receive several tributaries or minor glaciers, which unite in one channel. The several glaciers, though strongly compressed, are united only by their margins, and each preserves its individual structure, often to the end of its journey.

The most astonishing fact in regard to the glaciers, the explanation of which has taxed the ingenuity of many physicists, is that of their motion. Glaciers descend with a steady though imperceptible motion along the valleys they occupy. A rapid slope or a greater mass accelerates, and a gentle slope or a smaller mass retards, the motion. In the same glacier the rate is always greater in summer than in winter. In glaciers of the first order the ordinary progress is from 10 to 20 inches a day, but sometimes, as in the Mer de Glace on Mont Blanc, it reaches 2 feet or more. The bottom and sides are retarded by friction against the rocky walls of the valley, while the top and centre, moving more freely, are more and more in advance. Hence the lower end of the glacier, when free to expand—as that of the Rhone in Switzerland—terminates in a convex semicircle. The *termination* of a glacier, notwithstanding the constant descent, occupies from year to year about the same average position, for the melting in summer is generally sufficient to dissolve the extremity as rapidly as it advances. Heavy snows, however, followed by a cloudy and cool summer, which diminishes the amount of melting, may cause the glacier to extend beyond its usual limit; while a dry winter or an unusually hot and clear summer may reduce both the length and thickness below the average. The glaciers are thus a beautiful provision for relieving the regions of perpetual frost from the excess of snow, which is thus carried down to be melted in the more genial atmosphere below.

Glaciers, like mountain-torrents, transport fragments of rock of all sizes which have gradually crumbled from the peaks and slopes above them. On the surface of all great glaciers are narrow and well-defined bands of rocks and rubbish, called *moraines*, each of which is composed, from beginning to end, of the same kinds of rock. All these rocks falling at the end of the glacier accumulate in a *terminal moraine*, which usually forms a semicircular wall across the valley. The constant friction of these vast masses of ice on the surface of their rocky beds rounds off the projections over which they pass, and smooths and polishes even hard granite and marble. The fine mud, composed of the hardest particles of these crystalline rocks, adhering to the ice, is the polishing powder. Coarser grains cut on the polished surface systems of fine parallel scratches, and larger pebbles form parallel furrows, all indicating the direction of the moving ice. Old moraines, polished and grooved rocks, and other evidences of glacier-action, so different from that of water, show that in a time long past vast glaciers, several thousand feet in thickness, existed in New England and other parts of America, in Switzerland and other parts of Europe, where no permanent snows are now found.

The geographical distribution of glaciers depends upon both climatic conditions and the structure of mountains favoring large accumulations of snow. The mountain-systems in the middle latitudes, with abundant snows and alternate warm and cold seasons, are most favorable to the formation of glaciers. The best known, and probably the most remarkable, glacier region is that of the High Alps, in the heart of which are Mont Blanc, Monte Rosa, and the Bernese Alps. The Pyrenees have only few and small glaciers. Late explorers have found glaciers of large proportions in the Caucasus and Himalayas. In the Scandinavian Alps are many which descend in the deep western fiords nearly to the sea-level. In the New World glaciers are less frequent. They are entirely wanting in the tropical Andes, the constancy of temperature throughout the year, as well as the structure of the snow covered peaks, being adverse to their formation. In the snowy Patagonian Andes, however, they are numerous and well defined. In the high Sierra Nevada polished and grooved rocks, showing the former presence of great glaciers, are found down to 1000 feet above the sea-level, but no glaciers have been discovered. Farther N., on Shasta Peak and Mount Ranier, genuine glaciers of small dimensions have been noticed. By far the most extensive glaciers are found on the snow-

covered islands of the polar oceans. The gigantic Humboldt Glacier, discovered by Dr. Kane on the shores of Smith Sound, is 60 miles in breadth, rises 300 feet above the water, and extends an unknown distance into the interior. Similar, though perhaps less extensive, glaciers occupy nearly all the valleys of Greenland, Spitzbergen, and other arctic, and also antarctic, islands. Large masses of ice, broken from the ends of these glaciers, form the enormous icebergs or mountains of ice which are so numerous in the polar seas, and are transported by the currents even to middle latitudes. These must not be confounded with the vast ice floes, such as that on which the nineteen members of the crew of the Polaris floated down during a perilous voyage of nine long months from the Arctic Sea to the lower latitudes. The ice-floes are flat, and often scores of square miles in extent. They are formed by the freezing of the surface of the sea, and subsequently broken up by the action of the winds and tides. A. GUYOT.

Snow (CALEB HOPKINS), M. D., b. at Boston, Mass., Apr. 1, 1796; graduated at Brown University 1813; became an eminent physician in his native city; published a valuable *History of Boston* (1825; 2d ed. 1828), and a *Geography of Boston and Adjacent Towns* (1830). D. at Boston July 6, 1835.

Snow′ball, the *Viburnum opulus*, a cultivated shrub of the order Caprifoliaceæ, called also Guelder rose. To this species belongs the high bush cranberry of the U. S., whose fruit is edible. The species is native to Europe and North America. The snowball is a variety with handsome globular cymes of sterile flowers.

Snow′-Berry, the *Symphoricarpus racemosus*, a handsome shrub (order Caprifoliaceæ) common in the U. S. in many parts, and half naturalized in European shrubberies. Its persistent, white, inedible berries are well known and familiar objects. The name is also given to *Chiogenes hispidula* (order Ericaceæ), a creeping woody plant, whose leaves and white edible berries have the taste of the checkerberry (*Gaultheria*). It is common in the Northern U. S. and Canada.

Snow′-Bird, a name common to the several species or varieties of the genus *Junco* inhabiting the U. S. These belong to the family Fringillidæ, and have a small conical

The Common Snow-Bird.

bill, the wings rather short, the middle toe shorter than the short tarsus, the outer toe rather longer than the inner, and extending to the claw of the middle one, and the tail nearly as long as the wings, slightly emarginate, and decidedly rounded; the color is blackish or ash above, white on the belly, and not developed in streaks anywhere; the outer tail feathers are white. The several forms generally rather exceed six inches in length, of which the tail forms a little more than half. They are distributed over different regions of the U. S. Much difference of opinion has prevailed respecting the taxonomic value of the variations, some (*e. g.* Baird in 1858) admitting as many as five distinct species, while others (*e. g.* Ridgway in 1873) combine them as varieties of a single polymorphic species. Of these, the form *hyemalis* is the only Eastern type, while four are found in the West. They are birds of passage in the Eastern and Middle States, those of corresponding temperature going N. to breed while yet snow may be on the ground, and returning in the late fall. They feed on seeds and berries. The nests are built on the ground; they lay about four eggs, about three-quarters of an inch long and of a yellowish-white color dotted with reddish brown.

THEODORE GILL.

Snow′-Bunting, or **Snowflake**, the popular name of the *Plectrophanes nivalis*, a species of the family Fringillidæ. In common with the other species of the genus, it has a very long hind claw, which is little curved, the tarsi are longer than the middle toes, and the lateral toes are equal and extend to the base of the claw of the middle one; the distinctive characters of the species are the comparatively small bill and the shortness of the hind toe (it is not longer than the middle one); the general color is white, the middle of the back, inner tail feathers, and ends of wing-quills black. It somewhat exceeds six inches in length, of which the tail forms less than half. The species ranges over the whole northern hemisphere, and in the U. S. descends southward in winter to about the latitude of 35°. Individuals associate together in flocks of from about a dozen to several hundreds, and are often conspicuous during snowstorms, whence the name of the species. It breeds mostly in the northern regions, and forms a nest on the ground, in which it lays its eggs, which are whitish, generally spotted with brown. THEODORE GILL.

Snow Creek, tp., Mitchell co., N. C. P. 385.

Snow Creek, tp., Stokes co., N. C. P. 1781.

Snow Creek, p.-v. and tp., Franklin co., Va. P. 2549.

Snow′den, tp., Allegheny co., Pa. P. 1258.

Snowden (JAMES ROSS), b. at Chester, Pa., in 1810; was Speaker of the Pennsylvania house of representatives 1842–44; State treasurer 1845–47; treasurer U. S. mint 1847–50, and director of the mint 1853–61; wrote the articles on U. S. coinage in the *National Almanac* (1863), also in Bouvier's *Law Dictionary* (1868); published seven annual *Reports* on the mint, and many addresses and pamphlets on coinage, currency, and allied subjects; was author of two beautifully illustrated volumes descriptive of the ancient and modern coins in the U. S. mint (1860) and of the medals and other objects of interest in the same collection (1861); of a volume on *The Mint at Philadelphia* (1861), *The Coins of the Bible and its Money Terms* (1864), and *The Cornplanter Memorial, an Historical Sketch of Gy-ant-wa-chia, "the Cornplanter," and of the Six Nations of Indians* (Harrisburg, 1867), containing the report of Samuel P. Johnson on the erection of the monument at Jennesadaga (Warren co., Pa.) to the memory of that distinguished Indian chieftain. D. Mar. 21, 1878.

Snow′drop, the *Galanthus nivalis* (order Amaryllidaceæ), a small herb much cultivated in gardens for its snow-white flower, appearing in earliest spring. A native of the Alps, it is naturalized in Northern Europe, and is becoming so in the U. S.

Snowdrop Tree, a popular name for *Halesia tetraptera* and *H. diptera* (order Styracaceæ), small trees or large shrubs native in the Southern U. S. They bear showy white clusters of flowers, which appear in spring somewhat before the leaves. They are very fine in cultivation. A third species is *H. parviflora*, from Florida.

Snow′flake, a popular name for the white flowers of *Leucojum vernum*, *æstivum*, and *autumnale*, European herbs of the order Amaryllidaceæ, cultivated also in American gardens. They are hardy bulbous plants. The bulb of the first-mentioned species has long been employed in the Old World as an emetic, and probably all have acro-narcotic powers.

Snow Hill, p.-v. and tp., Wilcox co., Ala. P. 4115.

Snow Hill, p.-v. and tp., cap. of Worcester co., Md., on Pocomoke River, at the S. E. terminus of Wicomico Pocomoke and Worcester R. R., is an important shipping-point for fruit and oysters, and has 1 weekly newspaper. P. of v. 960; of tp. 2834.

Snow Hill, p.-v. and tp., cap. of Greene co., N. C. P. of v. 320; of tp. 2650.

Snow-Line. See SNOW, by PROF. A. GUYOT, LL.D.

Snow Shoe, p.-v. and tp., Centre co., Pa., at the N. terminus of Snow Shoe branch of Bald Eagle division of Pennsylvania R. R. P. 1162.

Snow-Shoes, a pair of flat rackets or shoes, of which the broad surface prevents the wearer from sinking in the snow. They are either made of wood alone, or consist of a light frame crossed and recrossed by thongs. Snow-shoes of a long, narrow variety are used in Northern Europe, which serve as skates when necessary.

Snuff. See TOBACCO.

Snuffer. See Porpoise.

Sny'der, county of Central Pennsylvania, on Susquehanna River, has a mountainous surface, with abundance of iron and coal, and is traversed by Pennsylvania R. R. and Pennsylvania Canal. Staples, wheat, Indian corn, oats, hay, butter, and wool. Tanneries and flour-mills are numerous. Cap. Middleburg. Area, 260 sq. m. P. 15,606.

Snyder, tp., Blair co., Pa. P. 1412.

Snyder, tp., Jefferson co., Pa. P. 792.

Snyder (Simon), b. at Lancaster, Pa., Nov. 5, 1759; learned the tanner's trade in youth; became in 1784 a merchant and miller of Selinsgrove, now in Snyder co., Pa.; was in 1789 a member of the State constitutional convention; Speaker of the Pennsylvania house of representatives 1802–08; was several times a candidate for governor, and was elected in 1808, 1811, and 1814, and was a member of the State senate 1818–19. D. at Selinsgrove, Pa., Nov. 9, 1819.

Snyders (Frans), Flemish painter, b. at Antwerp in 1579; was a contemporary of Rubens, with whom he worked in concert, and a friend of Van Dyck, who painted his portrait. D. in 1657. His great power was in painting wild animals in the excitement of combat or the chase. His hunting-pictures are in the grand style. But his kitchen-scenes are equally remarkable in their way for execution of minute details, the color, and the arrangement and relief of culinary vessels. His pieces are common in the European galleries. O. B. Frothingham.

Soane (Sir John), F. R. S., originally called Swan, b. at Reading, England, Sept. 10, 1753, son of a bricklayer; was taken at an early age as errand-boy into the family of Dance the architect; displayed such intelligence as to be ultimately treated as a pupil; was subsequently a pupil of Holland; was sent to Italy for three years (1777–80) as a traveling student at the cost of the Royal Academy, on the recommendation of Sir W. Chambers; made a diligent study of the remains of Roman architecture; was appointed architect to the Bank of England 1788; executed plans for the country-seats of many of the opulent gentry, especially in Norfolk and Suffolk, a volume of which was printed in 1788; married a wealthy lady; became clerk of the works to St. James's Palace and the Houses of Parliament 1791, architect to the royal woods and forests 1795, surveyor to Chelsea Hospital 1807, and professor of architecture at the Royal Academy 1806; published a volume of his plans of *Public and Private Buildings* (1828) and a *Description* of his own house and museum (1827); was knighted 1831, and d. at Lincoln's Inn Fields Jan. 20, 1837. He bequeathed his house and museum and a sum of £30,000 to the nation for the benefit of students in the arts, but subject to vexatious conditions in regard to admission. His skill as an architect is not rated very high by modern critics.

Soap [Fr. *savon*; Ger. *Seife*; Lat. *sapo*]. Soaps are salts of the fat acids with various metallic bases, chiefly soda-base and potassa-base. All the true Oils and Fats (which see) are decomposed by the alkaline hydrates, by certain metallic oxides, and also by acids, high steam, and hot water. Glycerine, the sweet principle of fats, is thus set at liberty, and the fat acids combine with the base, forming soap, or are set at liberty. This process is known as *saponification*; and it is this characteristic which readily distinguishes the fats and oils, properly so called, from oils of the petroleum series, for example, as also from wax, paraffine, etc. By this process potassium and sodium hydrates produce soluble soaps, while calcium, magnesium, zinc, barium, and lead-oxides, and the like bases, produce insoluble soaps. As a rule, soaps formed by sodium-base are *hard soaps*, while those produced from potassium-base are *soft soaps*. Castor oil, however, forms with potassa a hard and brittle soap. A fundamental distinction between the hard and soft soaps is found also in the fact that in the former the glycerine is removed in the mother-liquor or "spent ley," while in the latter it remains mingled with the semi-fluid mass. Moreover, it is not possible to dry the potassium soaps, owing to the very hygroscopic character of the base, while soda soaps may be so completely dried as to admit of grinding to powder. The nature of the fats and oils, as also of glycerine, has been sufficiently explained under each of these heads, and need not be recapitulated here.

Saponification takes place slowly in the cold, much more quickly by aid of heat, and the presence or absence of air is immaterial. The result depends on the nature of the fat or oil, as well as on the base; *e. g.* if the fat is complex—containing, for example, stearine, palmitine, oleine, etc.—then as many new salts are formed as there are fatty acids to combine with the base. The operation is not attended by the production of acetic or carbonic acid; but a small portion of nitrogen is set free in the saponification of hog's lard, due, probably, to impurities in this fat. Hog's lard, 100 parts, digested with 60 parts of potassic hydrate and 400 parts of water for two days at a temperature of 70°–90° (C.), is converted into mother-liquor and soap; the mother-liquor contains free potash, with carbonate and acetate of potash, an odorous principle, and glycerine; the soap contains stearate (margarate), palmitate, and oleate of potassium, a small quantity of acetate of potassium, and a yellow coloring-matter. The carbonic acid and the greater part of the acetic acid in the mother-liquor were previously formed in the potassium hydrate, which had been purified by alcohol; the remaining very minute trace of acetic acid existed ready formed in the lard. To saponify 100 parts of hog's lard requires 18 parts of potassium hydrate, the product consisting of normal stearate, margarate, and oleate of potassium, with excess either of acid or alkali. When 100 parts of lard are boiled for sixty hours with 9 parts of potassium hydrate and a small quantity of water, a homogeneous mass is obtained, almost wholly soluble in boiling alcohol, and forming a solution which does not redden litmus. A large quantity of boiling water, however, decomposes this mass into soluble soap and unaltered neutral fat. Hence, the alkali saponifies exactly the quantity of fat which it can afterward neutralize; and the soap thus produced forms with the excess of fat an emulsion which does not produce grease-spots—a property on which the power of soap to remove grease-spots chiefly depends. (*Chevreul.*) Ammonia and its carbonates act only in a very imperfect way to saponify oils and fats. The potassium bicarbonate and monocarbonate saponify hog's lard with the aid of heat, while borax and biborate of potassium, even with prolonged boiling, saponify only about 2 per cent. of lard. Saponification by calcium hydrate, as described by Chevreul, is a process of great technical importance in the preparation of stearine candles, since it is by this means that the fat-acids are conveniently removed from combination with glycerine. The product of saponification by lead-oxide is familiarly known as lead-plaster or diachylon, lead, like lime, forming insoluble soaps with the fat-acids. Saponification by superheated steam and water, as in the process of Tilghman, Wilson, Fouché, and others, at a regulated heat of not over 400°, has become very important since the demand for pure glycerine has rendered it essential that an adequate supply of this remarkable body should be had at a cheap rate for the production of nitro-glycerine. The decomposition of the fats by hot steam was recognized and used by Gay-Lussac, Chevreul, and others as early as 1825; but at that time, there being little use for glycerine, no care was taken to prevent its destruction by too high a heat, breaking it up into acroleine and a blackened residue. In the form of apparatus now in use, with ample refrigeration and successive compartments, this process of saponification gives the fat-acids separate, for the most part, from the glycerine, which goes over with the vapor of water to the compartments more distant from the still, where the temperature is lower. This process is also especially adapted to the production of stearine candles (see Stearic Acid), and depends on the fact that the various fatty and oily substances break up completely in an atmosphere of steam, without decomposition of the glycerine, at a temperature which differs but little with the various glycerides. Saponification by acids—*e. g.* by sulphuric acid—is a process which has been extensively used, but the decomposition of fats by steam and hot water has practically superseded all other methods where the object is to obtain glycerine in a state of purity. The glycerine obtained from the lime saponification of fats is never quite pure, and the cost of purification is too great. The glycerides, as has already been remarked under Fats, appear to take up the elements of water during the process of saponification, being probably compound ethers formed by the union of glycerine with the fatty acids, minus a certain number of molecules of water. Thus, by the experiments of Lecanu, 100 parts of stearine yield 8 parts of glycerine and 96.86 parts of stearic acid when both products are obtained as dry as possible, making 104.86—the excess being due to the elements of water taken on. The experiments of Chevreul support this view. Thus he found—

100 parts yield—	Glycerine	Soap acids.	Sum.	Solid at—
Stearine from mutton suet	8.0	94.6	102.6	53° C.
" " beef suet....	9.8	95.1	104.9	52°
" " hog's lard...	9.0	94.65	103.65	52°
Mutton suet..................	8.0	95.0	104.5	52°
Hog's lard	8.82	95.9	104.72	43°
Human fat..................	9.66	96.48	105.84	31°
Oleine from hog's lard	9.0	94.0	103.0	
" " human fat.....	9.8	95.0	104.8	

Gmelin (*Handbook*, vii. 235) has calculated the composi-

tion of stearine on the basis of its being a compound of 1 molecule of glycerine with 2 of stearic acid, minus 8 molecules of water, also for 6 and 4 molecules of water respectively, and finds the two last assumptions giving ratios closely corresponding to the results of saponification—viz.:

	(b)		(c)	
	96.55	and	91.90	stearic acid,
	8.76	"	8.23	glycerine,
	104.91	and	103.13	sum.

In the production of soap by the action of caustic potash on stearine (glyceritic stearate) the products, as before stated, are glycerine and potassium stearate; thus:

$$\underset{\text{Stearine.}}{\left.\begin{matrix}(C_{18}H_{35}O)_3\\(C_3H_5)'''\end{matrix}\right\}O_3} + \underset{\text{3 molecules pot. hydrate.}}{\left.\begin{matrix}K_3\\H_3\end{matrix}\right\}O_3} = \underset{\text{Glycerine.}}{\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3} + \underset{\text{3 molecules of potassium stearate}}{\left.\begin{matrix}(C_{18}H_{35}O)_3\\K_3\end{matrix}\right\}O_3}$$

While caustic alkalies are required completely to saponify neutral fats, and usually the aid of heat also, the fat-acids, stearic, palmitic, oleic, etc., when once separated from combination with glycerine, are readily saponified by the alkaline carbonates. Thus, the "red oil"—oleic acid chiefly—obtained as a by-product in the manufacture of stearine candles is used largely in the production of soaps.

Formerly in North America and Russia much larger quantities of potash were obtained in clearing up forests than now, and hence potash soaps were produced in proportionate quantity. These were, especially in Germany, converted into hard or soda soaps by utilizing the property of the potash-salts in decomposing common salt or sulphate of sodium, forming chloride or sulphate of potassium and soda soap. Moreover, the enormous production of caustic soda at a cheap rate consequent on the adoption of Leblanc's soda process, stimulated by the great demand for bleaching-powders, from which sodium salts are a by-product, has wellnigh put an end to the use of potash in producing soap, excepting as an element of domestic economy in those regions where potash is still a common product. Thus, in Canada and some of the Northern U. S. "potashes" and "pearlashes" are still articles of considerable importance. Dr. L. C. Beck, in his *Researches on the Commercial Potash of the State of New York* (*Am. Jour. Sci.* [2], xxix. 266, 1836), gives tables of analyses of this commodity which show that it contains from 60 to 70 per cent. of potassium hydrate, with chloride of sodium (added as a falsification), chloride of potassium, sulphate of potassium, and insoluble matter (iron, manganese, silica, etc.) making up the difference. In domestic economy it is the practice in New England and New York to saponify the drippings of the kitchen, chiefly beef and mutton suet, with the crude potash of commerce in the cold. The following empirical receipt has become traditional for domestic soft soap: Fat, 12 pounds; potash, 9 pounds; water, 12 gallons. The fat and alkali are placed together in a cask, and the water is added, three gallons at a time, boiling hot, once in twenty-four hours, until all is used. The process of saponification sets in soon, but is not completed until after many days, and is hastened by frequent stirring with a strong stick. When saponification is complete, all lumps of unaltered fat disappear, the soap has a silky lustre when stirred, and the consistency of a jelly, trailing off in slender threads from a stirrer, and is a powerful detergent for all the coarser purposes of the household, being greatly preferred by the cook for washing crockery and scrubbing floors above the common resinous hard soaps. Such a soap is obviously an impure potash fat soap in caustic ley, and not an actual soap: all the glycerine of the fats is of course present also in this crude product. We will return to soft soap after considering first hard soap and the manufacture of soaps generally.

As a technical art, soap boiling depends on the use of caustic leys of a suitable strength for the saponification of fats, oils, and resins, with the production of soaps which are hard or soft, as already explained. It is not our purpose to go in any detail into the discussion of the soap-boiler's art, the full consideration of which would require an elaborate treatise. A few general principles must suffice. The "*ley*" of the soap-boiler is a dilute alkaline liquor prepared by the action of slaked lime (calcic hydrate) on a boiling solution of 3 parts of potassium carbonate in 12 parts of water, or the same quantity of sodium carbonate (soda ash) in half this quantity of water. The carbonic acid of the alkali is transferred to the lime, and when the clear liquor ceases to effervesce with a dilute acid, it is known that the ley is fully caustic; 2 parts of quicklime slaked in 6 parts of hot water suffice for the above quantity of alkaline carbonates. The reason why *dilute* solutions are used is that concentrated alkaline solutions attack calcic carbonate, sending a portion of the alkali back to the condition of carbonate again. By using pure lime and a longer time (both elements of little cost) the soap-boiler saves fuel by acting on his alkali carbonate in the cold, and with equally good results, the ley marking 10° to 12° B. The Baumé hydrometer for alkaline solutions reads 18° B. for a ley of sp. gr. 1.138, which is equivalent to 15 per cent. of potash or 12.8 per cent. of soda, if the liquor is free of impurities. As soda leys are now generally prepared from reasonably pure sodium carbonate, the indications of the hydrometer are more trustworthy than when, as formerly, crude potashes were used, dense with chlorides, sulphates, and other impurities for which the hydrometer offered no correct test. The yet older fashion of a floating egg or bit of hard soap to test the alkaline strength of a ley was really a test only of a certain density, which might or might not be alkaline.

The manufacturer of *hard soap* having provided a stock of alkaline liquors (leys) of various strengths, charges his soap-pan with a quantity of neutral fat or oil, and adds weak liquors of about 1.050° density. Soap-pans are now made of iron plates riveted at the joints, and of various sizes, from 10 to 15 feet in diameter and of proportionate depth, set over fire-chambers, or more frequently heated by steam, either in jackets or injected from numerous small holes pierced in pipes introduced into the liquors. They vary in capacity with size, of course, holding from 20 to 30 tons of soap. As the temperature rises, and the oil and alkali liquor mingle, a uniform milky emulsion is formed, in which neither oily globules nor water are visible on cooling a portion of the fluid. The operator watches for this change, and adds more solution of alkali or water, as the case may require, until the emulsion forms and all alkaline taste has disappeared, using the tongue as a test. Stronger liquors are now added gradually to complete the displacement of the glycerine, which was commenced by the weak liquors, and the boiling continues until a strong alkaline taste is detected. The workman then adds more fat or oils, and repeats the use of stronger leys until gradually the soap-pan is nearly filled, taking care that at the last there shall be no excess of alkali. During this series of operations he often also adds a portion of resin, which by virtue of its constitution undergoes a species of saponification with alkalies, and adds to the product more than its value in weight and volume. Now comes the next important stage of the soap-boiling operation, in which, by the addition of salt, the emulsion of oils and alkali is decomposed, the salt taking the water and causing the precipitation of the newly-formed soap in a curdy or granulated state, floating on the dense "spent leys" in which is found the glycerine and salt, but no alkali. This mother-liquor, after the separation of the soap is complete, is withdrawn and rejected as having no value. The imperfectly-developed soap is now a second time subjected to a like series of operations as at first; it is brought by boiling to a homogeneous state, more oils or fats and strong alkaline liquors are added until the whole has a decided alkaline taste, and more salt is then added to cause the separation of the soap from the alkaline solution, and the whole mass is kept boiling for some time until all the fats, etc., are completely saponified. This completes the chemical part of the operation if the soap contains no rosin; and after allowing time for subsiding of the dregs, the "curd" is transferred by skimmers to the "frames," where it cools and becomes solid preparatory to cutting up for use. If, however, the soap contains rosin, it requires a further treatment before framing—viz. the curds, after removal of the spent liquor and dregs, are melted with more water and boiled by steam or fire, or both. A homogeneous compound results, containing an indefinite quantity of water, which is permitted to rest for two or three days, when it separates into a stratum of a definite compound containing about 65 per cent. of fat acids, 6.5 of soda, and 28.5 of water, and resting on a lower stratum of an indefinite compound containing much more water and the dregs or sediments of the operation. This lower stratum, called "nigre," contains also an excess of alkali, and forms with the addition of fat and salt the staple of another "boil" for more soap. The nigre which accumulates with each "boil" is used as a mottling for clouded soaps, or may otherwise be worked up in subsequent operations. A strong preference at one time existed for mottled soaps, founded on the fact that in such soaps no excess of water could exist; the substances which impart the mottled appearance, being heavier than soap, were held in suspension only in consequence of its thick and pasty condition. To remove entirely the mottled appearance and render the soap white requires the use of more water, so that in the thinner liquid soap the foreign bodies constituting the mottling may sink to the bottom of the pan. This additional quantity of water is not again removed, but is sold with the soap. It is, however, now possible, from the resources of modern art, so completely to simulate the appearance of genuine mottled soap, by

adding mineral and other colors during the process of hardening to soaps containing much more than the normal quantity of water, that this sign has lost its value, and such mottlings are justly regarded now as only evidence of impurity from the introduction of bodies foreign to soap. Good hard white soap contains—

Fat acids	61.0 or	1 molecule	315
Soda	6.2 "	1 "	32
Water	32.8 "	17 "	153
Sum	100.0 or	molecules	500

The soaps vary chiefly with the fats or oils from which they are produced, and may be considered as forming two principal classes—viz. soaps made from *vegetable* oils and those from *animal* oils and fats.

A. VEGETABLE HARD SOAPS.—*Marseilles or Castile Soap.*—In Southern Europe soap is largely made of olive oil mixed with about 20 per cent. of rape-seed oil. This soap is noted for its firmness, freedom from the depraved animal odors found too often in tallow soaps, and in general for its excellent qualities. In this country it is commonly sold by the apothecary as "castile" soap. Without the addition of rape-seed oil the soap from olive oil is so hard as to crumble when cut, and is difficult to dissolve in water. This soap has a peculiar mottling—like granite, and not in streaks of color, as in the imitations made from animal fats. The best olive-oil soap is made in Spain and Portugal, also in Provence and Aix (see OLIVE OIL) from oil hot-pressed from the olives after the virgin and table oils have been extracted: 100 parts of new and good oil produce 175 parts of finished soap when no rape oil is used, by which the product is reduced to 170 parts or less. The richness of olive oil in margarine or palmitine is the reason for the superior quality of the soap it produces. Its manufacture is minutely described by Pelouze and Fremey in their *Traité de Ch.*, v. 951. They state that the consumption of soda is 72 parts for each 100 parts of oils used, and the cost of the manufacture at Marseilles is about 17¼ francs for each 100 kilogrammes of oils employed. The detail of manipulation is essentially that already given. The marbling of the Marseilles soap is due to iron, which is sometimes added as sulphate, and is changed to sulphide by the alkaline sulphide present in the soda. By exposure to the oxidizing influence of air the dark stains of ferric sulphide are changed to a reddish color. Dr. Normandy found the foreign castile (or Marseilles) soap (sp. gr. = 1.0705) to contain fat acids, 76.5; soda, 9; water and coloring-matter, 14.5 = 100. The English imitation (sp. gr. = 0.9669) gave fat acids of pasty consistence, 75.2; soda, 10.5; water with a little coloring-matter, 14.3 = 100.

Cocoanut-oil Soap—Marine Soap.—The soap made from the oil of the cocoanut is remarkable for its extreme hardness, and consequently for the very large amount of water it can hold without becoming soft. It has a disagreeable odor, which is with difficulty removed. The oil requires for its saponification a very strong ley, and is aided by the use of potash. This soap is not easily decomposed by weak saline liquors, and is hence used to wash in salt water, whence its name of "marine soap." This quality of carrying a large amount of water has led to the use of cocoanut-oil soap as a means of mottling weak soda soaps from tallow, etc., and is the basis of Blake & Maxwell's patent of 1857 for the use of cocoanut oil in connection with palm oil, tallow, etc. Such soap can be made to hold up manganese oxide, ultramarine, etc., in connection with far more water than can be introduced into a genuine castile soap. Dr. Normandy found a cocoanut-oil soap which contained soda, 4.5; cocoanut lard, 22.0; and water, 73.5 = 100. This remarkable soap was sufficiently solid, but it dissolved in water with great ease.

Rosin Soap—Common Yellow Soap.—It has been remarked already that rosin boiled with alkaline liquors, whether caustic or carbonated, is converted into a soapy emulsion. It is not a true soap, but from its plastic, viscid nature it is found to be a good vehicle for diluting true soaps from tallow or other fats. Rosin does not neutralize alkali, and hence it requires the presence of at least an equal quantity of grease to form with it a soap which will not corrode fibres or attack the skin. Indeed, the amount of rosin ought not to exceed a fourth, or at most a third, part the quantity of fats employed. As already stated, the process of manufacture for rosin soap varies from that of soap from oils or fats alone by the omission of the last boiling. By itself, rosin does not form a hard soap, and unless it is thoroughly treated by strong liquors it leaves on the hands or any surface washed with it a resinous varnish and offensive odor of rosin. It forms, when carefully prepared and not in excessive quantity, a very serviceable soap, which quickly forms an excellent lather and is very cheap. Glasgow rosin soap gave Dr. Normandy soda, 6.5; fat and rosin, 70.0; water, 23.5 = 100.

Castor-oil Soap and *Palm-oil Soap* are both soda soaps, although the oil of the castor bean forms a hard soap with potash, and is remarkable, like the cocoanut-oil soap, for the large quantity of water which may be combined with it—as much as 70 per cent. The palm oil is saponified like tallow soap; it is used chiefly as an addition to yellow rosin soap, as the unbleached oil has a decided yellow color, and its strong and rather agreeable odor serves to disguise the disagreeable odor of rosin soap, which also acquires in addition a certain transparency, due to the palm oil.

B. TALLOW AND OTHER ANIMAL-FAT SOAPS.—We have already anticipated under the heads of FATS and OILS (which see) nearly all that is needful to say of hard soaps from animal fats and oils. The old German hard soap was prepared from crude tallow by ley of ashes or potashes, giving an imperfect soap, which in the subsequent boiling is converted into soda soap by salt, which, being at the same time supplied with an excess of alkali, produces a neutral soda soap, and is then boiled down to "curd" with salt. This art long preceded the knowledge of chemical principles underlying it; was derived, in fact, from very ancient experience, which has been since confirmed and explained by the researches of modern science. The indications of saponification, advancing by all the grades of the process, are so distinct that no thought was entertained at first of working with weighed quantities. All that was required was to add more ley or more fat, according to appearance, until the proper state had been attained. In all respects the teachings of this empiric experience led to the same result which chemical knowledge has since illustrated and confirmed, and an outline of which has already been given. The use of crude tallow has been abandoned in favor of purified grease, and pure caustic soda, supplied now to all the world in unlimited quantity packed in iron casks, renders useless the old methods of leaching ashes for potash ley or of boiling up soda-ash with lime. Thus neatness, cleanliness, and the abatement of nuisances have kept company with economy and the improved methods of modern art. Experiment in the large way shows that 100 pounds of tallow produce 150 to 155 pounds of perfect curd soap, weighed as soon as it is cut; and if some boilers obtain more, it is because water is added in competition with soap of an inferior quality.

Oleic Soap, or Red Soap.—This soap, alluded to in the beginning as resulting from the lime-saponification of animal fats in the stearic-acid manufacture, is an important product wherever the manufacture of stearine candles is carried on. As the glycerine has already been removed, the saponification of the oleic acid is readily effected even by alkaline carbonates. It is also mingled with neutral fats, and saponified by soda-ley of 18° B. Campbell Morfitt's patent for a process for producing soap from red oil depends on treating the oleic acid in a steam-heated copper while agitated by a steam twist with carbonate of soda, etc., in equivalent proportion in the state of fine powder, added in successive portions, with or without rosin, according as a coarser soap or a fine toilet-soap is required. The relative proportions of oleic acid, water, and rosin in this soap being adjusted at the beginning, there is no waste ley; the soap is said to come quickly, does not shrink by air-drying, and is in all respects represented as an excellent soap.

Soft Soap.—The so-called "soft soap," such as is made in domestic economy, by the recipe already given, or by the soap-boiler's art, is not an actual soap, but a more or less impure solution of a potash soap in caustic ley with free glycerine, forming at common temperatures a smeary jelly, more or less transparent, and of a silky appearance when stirred. If an attempt is made to purify this soap by separation of the glycerine and excess of alkaline ley by solution of salt, it results simply in the production of hard soda soap, on principles already explained. In the manufacture of soft soap by boiling, caustic leys are made from leached ashes or American potashes, exactly as when soda-leys are used, and of graded strength, 9°–11° solutions being first used with gentle heat. The fatty bodies used are kitchen drippings, tallow, fish-oil, linseed, rape seed, and other drying oils. As soon as the complete combination is effected, and the thick fluid falls in strings from the stirrers with a shining appearance and somewhat turbid, the clarification commences with the gradual addition of a stronger ley at regular intervals until the soap passes from its turbid state to a clear, transparent slime. The boiler judges by empirical rules the state of progress toward completion of the saponification. By the presence and extent of turbidity in a drop cooled on a plate of glass, he judges if combination has been effected, and the cause of failure. If such a drop from the middle of the pan on cooling remains clear, the soap is complete; a gray margin indicates a want of ley in proportion to its breadth; and if this deficiency is great, the specimen is fluid and slimy. If the

proper quantity of ley has been exceeded, the soap is said to be overdone, which is indicated by a gray skin spreading over the whole drop, instead of forming a ring or rim only; the soap is then granular, and when wet easily detached from the glass (*vitreous*). An excess of water is driven off by evaporation with a brisk fire and beating the froth as it rises with stirrers. As the soap thickens, the froth subsides, the soap sinks and becomes darker, white bubbles are borne on the surface overlapping each other, called by the workman *laminations;* and the noise occasioned by this action has led to the saying "the soap talks." The soap is now finished, and all the tests proving satisfactory, the fire is extinguished; and when the soap is sufficiently cool, it is packed for sale. As some kinds of oil, like that of hempseed, impart an esteemed greenish color to soft soap, while other varieties of soap are yellow, the greenish tint is artificially imparted to the yellowish soap by indigo. The detergent power of soft soap is very great, owing largely to its strong alkaline condition, and is hence much esteemed in scouring wool, coarse linens, and for other like uses in the dyehouse. As it normally retains as inseparable from it the excess of alkali, the free glycerine and other impurities, there is no guaranty, as in the case of hard soaps, for its purity, much less any definite molecular constitution which can be established by an analysis. Hence, many methods have been practised for reducing its cost—as, for example, the so-salled *bone-soap,* formed by the addition of the gelatine from ground bones, dissolved or partially decomposed by potash. In another plan hydrochloric acid is used to dissolve out the mineral matter of bones, leaving the gelatine, which, when carefully washed free of acid, is added during saponification to the fat. The soap with bones is called "Liverpool poor-man's soap;" it is an open fraud, since gelatine and phosphate of lime can act only as useless diluents of soap. But this fraud is harmless compared with the use of the intestines of animals, skin, sinews, hoofs, hair, stinking fish, and other animal refuse which are subjects of *patents* for so-called saponification in forming soft soap. Even naphtha, a non-saponifiable oil, and dextrine, are "protected" in a like manner. Soft soap contains, according to quality, fat acids, 50 to 40 parts; potash, 9.5 to 11.5 parts; and water, 38.5 to 50.5 parts in 100.

Silicated Soaps contain either soluble silica, or sand and powdered pumice, fuller's earth, and alumina. These substances act only mechanically as detergents, and may be permitted when a proper reduction in price is allowed. Sand soap contains as much as 75 per cent. of its weight of sand, such as is used for scouring floors, and the French *savon-ponce* ("pumice soap") has from 20 to 26 per cent. of ground silica or pumice. These comparatively worthless mechanical mixtures have been replaced by soap in which "soluble glass," or silicate of sodium, is employed with advantage. This feeble alkaline compound has by itself a considerable detergent power, and when mixed with ordinary soap an article is produced of greatly-reduced price and quite useful for many domestic and manufacturing operations. Messrs. Gossage received the award of a prize medal at the Paris International Exhibition of 1862 for this manufacture, which is now carried out on an extensive scale. These silicated soaps are quite strongly alkaline, owing to the nature of the soluble glass; this excessive alkalinity is reduced for some purposes by combining, with the soap, rosin or fatty acids, as in the ordinary process of soap-making. Carbonic and sulphurous acid gases are likewise passed into the liquid for the purpose of partially neutralizing the excess of alkalinity.

Toilet Soaps are made from very pure and sweet materials—sweet almond oil, beef's marrow, refined sweet lard, saponified without heat and perfumed with various essential oils. Very pure curd soap is also used for the foundation of toilet soaps, for which purpose the soap is reduced to thin shavings, melted over a water-bath with rose and orange-flower water, and common salt—24 pounds of soap, with 4 pints each of rose and orange-flower water, and about half a pound of salt. When cold next day, it is cut in small bits and dried in the shade, again melted down with the same proportion of orange and rose water, strained, cooled, and dried again. The heavy animal odor is thus removed, when it is powdered and left in a clean place exposed to air for some days. After this, it is ready to receive the desired perfume, and may be colored with aniline tints, ultramarine, etc., and moulded in forms for use. *Shaving cream* is made by beating up lard with once and a half its weight of potash-ley of 17° B., and perfuming and coloring to taste. *Glycerine soap* is prepared by mixing pure glycerine with a toilet soap, or with the transparent soap produced from its solution in alcohol. It mollifies the skin in cold weather.

Properties of Soap.—Besides the common properties of soap as a detergent, already familiar, we note that every kind of soap in use contains a variable quantity of water, partly in chemical combination; and its power of absorbing water is also very various, being from 7½ per cent. in hard soda soaps to 162 per cent. in soft potash soaps of oleic acid when previously dried by artificial heat. Soap is perfectly soluble in alcohol, as also in hot water, both solutions becoming of the consistency of a jelly on cooling. In this state, mixed with camphor and oil of rosemary, the alcoholic tincture of soap is familiar as opodeldoc, or *linimentum saponis compositum* of the Pharmacopœia. Tincture of white soap is readily decomposed by salts of calcium and magnesia, and is familiar to the chemist, when made of normal strength, as the most convenient test for the hardness of natural waters ("Clark's test"). Potash soap is more soluble in water than soda soap. The sodium stearate is hardly affected when placed in 10 parts of water, while potassium stearate thus treated forms a stiff jelly. Sodium oleate dissolves in 10 parts of water—postassium oleate in 4 parts, and it forms a jelly even with 2 parts. Cold water partially decomposes the alkaline oleates, palmitates, and stearates (common soap), the neutral salts being resolved into alkali, which dissolves, and an acid salt, which precipitates. This explains why in using soap, even with pure water, its transparency is always disturbed, while the alkaline property, and consequent detergent power, of soapsuds is due to the liberation of a portion of caustic potash or soda, which attacks and removes the grease of foul linen, etc. The insolubility of soap in common salt has been fully explained, and the consequent important use of this property in the soap-boiler's art.

The value of soap depends mainly on the amount of dry soap (the real soap or alkaline salt of the fatty acids) in any given specimen. The loss in weight of a given amount of soap cut in thin shavings, when completely desiccated in a drying oven, at 212° F., is hygroscopic water, which should not for best hard white soap exceed 20 per cent., for mottled soap 25 per cent., and for yellow soap 30 per cent. The fat acids vary from 60 to 70 per cent., and the alkalies from 7 to 9 per cent., according to quality. As before mentioned, soaps made from cocoanut oil contain normally much more water, and in the yellow soaps from 10 to 20 per cent. of the fatty acids are replaced by rosin.

The analysis of soap is not altogether an easy problem, and many methods have been proposed, of which we mention the following: *Bolley's Method.*—One gramme of the soap, cut in thin shavings, is dissolved in a small beaker by ether and acetic acid. The solution quickly divides into two layers, the upper of which is an ethereal solution of the fatty acids, with or without rosin, as the case may be, and the lower is a watery solution of sodium or potassium acetates and of the salts contained in the soap. If there are insoluble matters left behind, these are separated by filtration after removing the ethereal solution by a pipette, and weighed. The fatty acids and resin are left by evaporation on a tared watch-glass and weighed. The saline solution is evaporated to dryness in a platina vessel, ignited, and the alkalies determined as usual. *Gräger's Method.*—One hundred grammes of the soap in thin shavings is dissolved in 30-per-cent. alcohol, and the solution is made up to the volume of a litre with alcohol of the same strength. The insoluble matter left behind contains all the foreign bodies, with some sodium or potassium carbonate; 10 cubic centimètres of this solution, made clear by standing, are diluted with water and precipitated by calcium chloride. This lime-soap of the fatty acids is washed, dried at 212° F., and weighed. Gräger finds 100 parts of this precipitate to correspond to 100.5 parts of anhydrous sodic stearate; if palmitic and oleic acids are also present, the result seems not to be sensibly varied. The methods of decomposition by sulphuric acid, with the use of standard solutions and oil of turpentine, the determination of density by aid of white wax, etc., are less simple, and probably not more exact, than the methods already cited. (For more full details respecting the manufacture of soap, consult Richardson and Watts, *Chemical Technology;* Muspratt's *Chemistry;* Watts, *Dictionary of Chemistry;* and Ad. Wurtz, *Dictionnaire de Chem.*) B. SILLIMAN.

Soap′-Berry, the fruit of *Sapindus saponaria* and *inæqualis,* West Indian trees of the order Sapindaceæ. The pulp is a powerful detergent, much stronger than ordinary soap, and the hard shining seed has been exported and used for making buttons, which are very durable. In the Southern U. S. there grows another soap-berry tree, *Sapindus marginatus,* which is sometimes forty feet high. There are various tropical species of which the pulp is edible, but the seed is often poisonous. The name *Sapindus* was invented by Linnæus from *sapo Indicus,* "Indian soap."

Soap Creek, tp., Davis co., Ia. P. 817.

Soapstone. See STEATITE.

Soap Test. See SOAP.

Soap'wort, a name sometimes applied as a general name for the plants of the order SAPINDACEÆ (which see), on account of the soapy quality of the fruits of many species. It is also the name for plants of the genus *Saponaria* (order Caryophyllaceæ) and other plants of the same order, which are sometimes utilized for their detergent powers. There are in many parts of the world vegetables which are excellent substitutes for soap. In some instances this cleansing power depends upon the principle *saponine*, found in plants of widely diverse natural orders.

Sobieski. See JOHN III., SOBIESKI.

Socastee, tp., Horry co., S. C. P. 725.

Soc'cage, or Socage, a term of the English law, denoting a species of feudal tenure by which lands are held from a superior lord, and also the services rendered therefor by the tenant to the lord, by means of which this tenure is supported. The nature of feudalism, its system of tenures, and the military character of the services which prevailed during its more flourishing stages are described in the article on the FEUDAL SYSTEM. The distinguishing feature of the tenure by soccage consists in its services, which are not military, but are nevertheless such as may be performed without personal derogation by a freeman, and are fixed and certain both in respect to time and amount, being an annual and definite payment of money, grain, cattle, or other articles of value, products of the soil, in the nature of rent. This tenure existed in the times succeeding the Norman Conquest, when military feuds were almost universal, and was probably a remnant of the Saxon institutions. At that early day the amount of land thus held was small, the holders themselves were insignificant, and their duties were quite servile. In the subsequent generations, as the military spirit died out, and the burden of the military services became unendurable, the advantages of the soccage tenure were gradually, and at last universally, acknowledged. A change went on from one species to the other, until the uncertain military services by which land had formerly been held were almost wholly replaced by the fixed and certain payments of money or of products which characterized the simpler form of tenure. At length, after this great social revolution had been accomplished, Parliament legalized the proceeding; by a statute of 12 Chas. II. all military tenures, with certain formal exceptions, were abolished, the tenure by soccage was substituted in their stead, and nearly all the land in England is now held by its means. While the feudal system was at its most flourishing period this tenure was subject to many of the incidents which belonged to the purely military fiefs—fealty, aids, reliefs, fines for alienation, and escheats—wardship and marriage alone being excepted; but these burdens have long been removed by legislation. The origin of this term is in dispute. One etymology refers it to the Low Latin *soccus* or *socca*, and French *soke*, a "plough," because the original services were of a servile and rustic character. Blackstone and some others derive it from the Saxon *soc*, "free," "a privilege," basing their opinion upon the immunities enjoyed by the holders of this description. The latter theory mingles up two very distinct epochs, and confounds the primitive socmen with the later tenants in soccage. The oldest records speak of *sokemanni* as inferior to the *milites*, and class them with villains and roturiers. They seem to have been in nearly the same social condition as the Roman *coloni*, and perhaps the origin of the feudal socmen may be found among the remnants of the Roman laborers in Britain. At all events, it is not probable that the subject Saxons enjoyed any such special favor from their Norman conquerors that the proud word "free" or "soc" was used to designate their condition.

JOHN NORTON POMEROY.

Social Circle, p.-v., Walton co., Ga., on Georgia R. R., has a growing trade. P. 405.

So'cialism holds an intermediate position between pure communism and simple co-operation. Unlike communism, it does not advocate the absolute abolition of property, but aims simply at a more just and equitable distribution of it. Every man according to his capacity, and every capacity according to its work, is the great maxim laid down by Saint-Simon; and to carry out in reality this maxim is the great goal of all socialistic movements. On the other hand, it does not confine itself, like co-operation, to a mere regulation of the relation between capital and labor, restricting or even excluding competition, transferring the profit from capital to labor, etc., but attempts a complete reconstruction of society. With the ideas of co-operation for its basis of operation, it approaches communism partly by extending the compass of these ideas, but chiefly by employing them as means to a moral end. Communism is a religious tenet, co-operation an economical scheme, socialism a moral reform. It is the vices of mankind, and the miseries resulting from these vices, to which socialism wishes to put an end, and it seeks its means not in a new religious issue, but in a new social organization; hence its name.

Socialistic tendencies—that is, the employment of political and economical measures for moral purposes—were not entirely unknown in the ancient states; the Gracchian movement in the history of Rome is a striking instance. During the Middle Ages they seem to have been completely forgotten, and their reappearance in the period of the Reformation was short and full of turbulence and confusion. But with the French Revolution socialistic ideas became a principal element of all social science, and were made the subjects not only of passionate discussion, but also of practical experiments. The first to revive these ideas or to bring them into general notice was François Noël Babeuf (1764-97), with his paper, *Le Tribun du Peuple*, founded in 1794. The idea from which Babeuf started was that of equality. The Revolution had established the equality of all French citizens before the law: "Nous la voulons au milieu de nous, sous le toit de nos maisons," said the Babouvists. "There shall be no other differences than those of age and sex. All men have nearly the same faculties and the same needs; they ought, consequently, to have the same education and the same food." Before this principle the idea of personal property disappeared, and it became the duty of the government, its highest function, to regulate the application of labor and the distribution of its fruits. After the death of Babeuf, his system, Babouvism, was for some time entirely forgotten, until in 1834, Buonarotti again attempted its propagation, especially through the papers *Moniteur Républicain* and *Homme Libre*. A much greater influence was exercised by Saint-Simon (1760-1825). He developed no system, but the rich and fertile hints which his various writings contain were brought into a rapid growth a few years after his death by a number of gifted disciples. The weekly *Le Producteur* was established by Cerclet and Olinde Rodrigues, and in 1829, Bayard gave a series of public lectures on the system of Saint Simon—that is, its political and economical side—which attracted great attention. Communism is not taught here, but property is made merely personal—that is, it cannot be inherited. Every man has to make a fresh start, and his success will depend on his capacity and labor. After his death his property falls to the state, which is the great property-holder, and assumes the corresponding duties with respect to the education of its members, etc. In the next year followed a series of lectures by Enfantin on the moral or speculative side of the system, in which Saint-Simon was represented as the restorer of harmony to human nature, as the redeemer from the terrible dualism of nature and spirit which Christianity has sanctioned, if not introduced. The impression of these lectures and of the writings of the school was quite general, and very favorable. A Saint-Simonian family was organized in the Rue Monsigny, and for some time it prospered much. But dissensions broke out between Bayard and Enfantin on some very important questions. Bayard retired, and Enfantin led the enterprise into fantastic extravagances. Finally, the interference of the police and pecuniary difficulties brought the experiment to an end. In strong opposition to the Saint-Simonians, Fourier (1772-1837) developed his system of socialism, based on a more intimate knowledge of human nature. The principal feature of his scheme is the *phalanstery*, a community, or rather a household, of about 1800 persons, in which labor and enjoyment are divided according to the natural inclinations of the individuals. It was Fourier's conviction that if only one phalanstery could be established, other communities, other nations—yea, the whole human race—would soon fall into the same order; but the experiments which have been made at Condé-sur-Vègres, near Versailles, and in Brazil, have failed.

Several very interesting socialistic experiments have been made in the U. S., and will be found described under their proper heads; but as yet socialism has had its greatest importance as a ferment only. (For its connection with COMMUNISM and CO-OPERATION see those articles; and for further details on the subject see Stein, *Der Socialismus und Communismus des heutigen Frankreichs* (1844) and *Geschichte der socialen Bewegungen in Frankreich* (1849-51); Le Play, *L'Organisation du Travail* (1871) and *La Reforme sociale en France* (1872); Noyes, *History of American Socialism* (1870); Nordhoff, *The Communistic Societies of the United States* (1875); Holyoake, *History of Co-operation* (1875).)

CLEMENS PETERSEN.

Social Science, or Sociology. These are terms of modern origin, used, as yet, quite indefinitely to comprehend the systematic investigation, in various lines of research, of principles and laws affecting the welfare of mankind in society. In this department they correspond to the vague term "natural science" as applied to the grouping of phenomena and laws pertaining to the mate-

rial creation generally. The distinctive characteristic of social science is that it studies man's social nature and deals with existing social forces, aiming chiefly to find relief for existing evils. In a broad sense it includes political economy. But that branch has been developed by itself more fully than anything else embraced under the common term, and may be regarded almost as a distinct science. Apart from this, social science has mainly to do (*a*) with the laws of *health* and the causes of disease, endemic and epidemic, seeking to devise measures for improving the sanitary condition of communities and to provide curative means through hospitals, dispensaries, etc.; (*b*) with the tendencies to gross and corrupting *vice* which spring from undue indulgence of the sensual appetites, seeking restrictions and remedies especially for prevalent drunkenness and prostitution: (*c*) with *crimes* against human law and government, studying the conditions which favor their multiplication, the counteracting agencies, and particularly the means and institutions for the punishment and reform of criminals: (*d*) with the causes of wretched and degrading *poverty*, and the best modes of administering private and public charity for its relief; (*e*) with the principles on which *society is organized*—to discover, if possible, what radical causes are working to degrade, and what radical changes may serve to elevate and refine, the entire social life and relations of men. The range of the science is immense. The problems have been more or less studied through all history. Aristotle's *Politics* presents the subject in essentially the same phases with those which appear in the discussions of our day. The chief means of advancing this science now are national and international associations, which are enlisting some of the best minds of the age in the practical questions involved, and specific philosophical treatises, like those of Herbert Spencer, which open lines of profound thought on fundamental principles. A. L. Chapin.

Social Wars [*i. e.* wars with "allies," *socii*]. (1) The war (B. C. 91–88) between Rome and her Italian allies. After the assassination of M. Livius Drusus (91 B. C.), who desired to grant citizenship to the Italians, the allies, including the Marsi, the Peligni, the Lucanians, the Samnites, and many others, rose in arms and proclaimed a new republic. A bloody war followed, and notwithstanding the great victories of Sulla, Marius, L. Cæsar, and others, the Romans were compelled to make many concessions, and in the end the Italians received substantially all the privileges they called for. Over 300,000 men were slain in this war. (2) In Athens the first social war (357–355 B. C.) was between that city and her allies, Chios, Cos, Byzantium, and Rhodes. The allies sought and gained their independence. (3) The second Athenian social war was between Athens and the Achæan and Ætolian leagues (220–217 B. C.).

Societies, Literary and Scientific. The number of associations formed for the promotion of literary or scientific research is one of the distinctive features of the nineteenth century. Though no etymological or other exact line of division can be established between "societies" and "Academies" (which see), it may nevertheless be noted that the associations styling themselves "academies" are usually of earlier origin than the "societies," are frequently under the direct patronage of government, and may be regarded rather as *conservators* than as *promoters* of literature and science; while the "societies" sprung from the modern scientific movement are usually but slightly trammelled by official bonds, and consist of bodies of working investigators, more anxious to extend the domain of knowledge than to celebrate the glories of former discoveries. The title of "royal" conferred upon several English scientific societies must not be construed to imply too much, as the connection between royalty and royal societies is often very remote.

The most ancient among the learned societies of Great Britain are the Royal Society of London (1662), the Antiquarian Society (1707), the Society of Arts (1753), the Royal Academy (1768), the Medical (1773), the Linnæan (1788), and the Royal Institution (1800), besides the royal societies of Dublin (1731) and Edinburgh (1783). In the present century more than 200 similar associations, having more or less a national character, have been incorporated in Great Britain. The more important of these, naming them in the order of time, have been, the Geological Society of London (1807, incorporated 1826), the Royal Astronomical (1820), the Royal Asiatic (1823), the Royal Society of Literature (1823), the Zoological Society of London (1826), the Royal Geographical (1830), the Statistical (1834), the Electrical Society of London (1837), the Society for the Diffusion of Useful Knowledge (1828), the Microscopical (1839), the Chemical (1841), the Philological (1842), the Phonetic (1843), the Ethnological (1843), the Archæological Association (1843), the Social Science Association (1857), the Anthropological Society (1863), and the Society of Biblical Archæology (1871). Several of these—viz. the Royal Society, the Astronomical, Geological, Linnæan, and Chemical societies—have formed a species of alliance, having been jointly concerned in the erection of the new Burlington House as a "palace of learning" for the accommodation of their libraries, collections, and reading-rooms, as well as their halls of sessions. The British Association for the Advancement of Science has been noticed under other headings. Scientific societies are much less numerous on the continent of Europe than in Great Britain or the U. S., their freedom of activity being much restrained by the pretensions of the elder "academies." There are, however, flourishing modern geographical societies in Austria, Russia, France, and Germany. In Mexico and Brazil there are several flourishing societies directly connected with the government, the most important being in each case that devoted to geography and statistics. Among the leading societies of comparatively modern growth in the U. S. are the American Association for the Advancement of Science, elsewhere noticed, the Oriental, Geographical, Philological, and the Social Science Association. Pure science finds, however, so few devotees in the U. S. that the larger part of the branches of research, which in England have separate associations, are in the U. S. grouped into a very few and by no means active bodies. Porter C. Bliss.

Society. See Academy and Societies, Literary and Scientific.

Society for Promoting Christian Knowledge, founded in 1698, is the oldest and one of the greatest religious associations connected with the Church of England. Its objects are—(1) To promote and encourage the erection of charity schools in all parts of England and Wales; (2) to disperse, both at home and abroad, Bibles and religious tracts, and in general to advance the honor of God and the good of mankind by promoting Christian knowledge, both at home and in other parts of the world, by the best methods that should offer. The society is thus at once an educational association, a missionary, Bible, and religious-tract society, but it limits its activity chiefly, though not exclusively, to the British dominions. Its annual revenue is about £100,000.

Soci'ety Hill, p.-v., Macon co., Ala. P. 1185.

Society Islands, a group of islands in the South Pacific Ocean, between lat. 16° and 18° S., and between lon. 148° and 155° W., consist of one large island, Tahiti or Otaheite, and a number of small isles, comprising altogether an area of 450 sq. m., with 13,847 inhabitants. The islands are mountainous. In the centre some of them rise to the height of 6000 or 8000 feet, but they all have a belt of low land extending between the foot of the mountains and the sea, and they are generally surrounded by coral reefs. The soil is very fertile and the climate delicious. All tropical fruits grow luxuriantly, and European fruits which have been introduced succeed well. The inhabitants are Malays; most of them are Christians. They form an independent state under the French protectorate.

Socin'ians and **Socinianism** are the historical designations of the advocates and doctrines of the most thoroughly organized system of anti-Trinitarianism that has ever existed. We propose to present in this article a sketch (*a*) of the history of the sect, and (*b*) of their doctrines.

I. History.—The Trinitarian doctrine, as defined in the Nicene and Athanasian creeds (see article God), has been substantially held as a fundamental element of Christianity by all the great divisions of the ancient churches, Eastern and Western, and by all the churches springing out of the Reformation. It was denied by the early obscure Jewish-Christian sect of the Ebionites and by some sects of Gnostic origin. The negative tendency in a higher form was afterward embodied in the Arian party, which, after threatening to obtain control of the general Church as established by the imperial government during the middle of the fourth century, was finally expelled from the whole empire by Gratian 378, and confined to its Gothic and Burgundian adherents. Afterward, by means of the triumphs of Justinian on the eastward and of the Franks on the westward of the Alps, these nations were converted to Catholic Trinitarian Christianity about the end of the fifth century. At the era of the Reformation the first anti-Trinitarians were certain individuals who appeared at different points, chiefly among the German Anabaptists. Among these were Martin Cellarius (b. in Stuttgart 1499, educated at Wittemberg, at first a disciple and coadjutor of Luther, d. at Bâle 1564), John Denk (d. at Bâle 1528), Lewis Hetzer (at first a fellow-laborer of Zwingli, executed for polygamy at Constance 1529), and John Campanus (studied at Wittemberg, and d. after long imprisonment at Cleves 1574). One of them, named Spiritus, supposed by Dr. Rees to have been Adam Pastor, a Frisian Anabaptist,

first carried Unitarian doctrine to Poland in 1546, which afterward became the seat of the denomination. Michael Servetus (b. in Spain 1509, and educated at the University of Toulouse) was a man of diversified learning, of considerable talent, and of restless spirit. He resided at different times at Bâle, Strasbourg, Lyons, and Vienne. In 1531, at Strasbourg, he published his first work, *De Trinitatis Erroribus*. In 1532, at Haguenau, he published his *Dialogorum de Trinitate, Libri duo*, and at Vienna, in 1553, his *Christianismi Restitutio*. He was then imprisoned by the Roman Catholics for heresy. Escaping, he went to Geneva, where he was burnt in October of the same year as a blasphemer and disturber of the peace.

In Italy, where during the preceding century religious faith had been generally superseded among the educated by a semi-pagan humanism, many prominent persons, affected by the religious excitement of the Reformation, adopted rationalistic views. In the second quarter of the sixteenth century, at Vincenza, a small town in the district of Venice, a society existed consisting of persons denying the divinity of Christ and related doctrine. It was dispersed in 1546, previous to which, it is said, Bernard Ochinus and Lælius Socinus joined it. The latter, born in Siena in 1525, was educated as a lawyer, but devoted his life and great talents to theological speculations. He has been correctly designated "the spiritual father of Socinianism," while his nephew, Faustus Socinus, was "the founder of the sect." He remained ostensibly a member of the Reformed Church at Zurich, although by personal influence, wide correspondence, and extensive journeys disseminating his opinions. He visited Poland in 1551, and again in 1558, and died in Zurich in 1562. His nephew, Faustus Socinus (b. 1539, and d. 1604), was indoctrinated by his uncle, settled first in Bâle, was called into Transylvania to assist Blandrata in his controversy with Francis David, and settled permanently in Poland 1579. After the removal of Spiritus to Poland in 1546, Francis Lismanin, a Corsican monk and confessor of the queen, Bona Sforza, had been converted to Unitarianism in 1551. He was soon reinforced by Peter Conezius and George Blandrata, a native of Piedmont, and through the influence of Lismanin appointed physician to the queen. At this time all the Protestant synods held in Poland embraced promiscuously the ministers of all the Reformed societies, whether Lutheran, Calvinistic, or anti-Trinitarian. In 1566 the latter were expelled from communion, and forced to form an independent ecclesiastical organization. The Unitarian Church thus formed comprised persons of very dissimilar opinions. "They all concurred in maintaining the supremacy of the Father, but with respect to Jesus Christ, some thought him to be a God of inferior nature, derived from the Supreme Deity; others held the doctrine of Arius, conceiving him to have been the first created Spirit, who became incarnate with a view to effecting the salvation of mankind; while a third party believed him to be a human being. These last were divided into two classes—the one believing the miraculous conception of Jesus; the other considering him to have been the son of Joseph as well as Mary." Some also held that although a man only, he was entitled to divine honors since his exaltation at the right hand of God and assumption of the government of the Church, while others denied this.

From the advent of Faustus Socinus these various elements were, through his superior genius, wrought into a homogeneous ecclesiastical organization, and brought into substantial agreement with the theological views of his uncle; and ultimately the denomination and system of theology took their historical designation of "Socinian" from these great leaders, but during their earlier history they were called Pinczovians, from Pinczow, the place of their first settlement, and afterward Racovians, from Racow, a town built for them by a Polish nobleman, and their metropolis of learning and influence. They flourished exceedingly for the greater part of a century, converting to their views many of the Polish nobility; they established colleges which attained great reputation, attracting multitudes of Roman Catholic and Protestant youth, and they produced a number of theological speculators and polemics of great learning and ability, whose works attained a vast circulation. In 1563, Blandrata went into Transylvania to attend the prince, John Sigismund II., as a physician, where he succeeded in bringing over to his own opinions Francis David, at that time superintendent of the Reformed churches. These together secured a large following, but the prosperity of the sect was greatly impaired by the bitter controversy which subsequently arose between Blandrata and David, the former affirming, and the latter denying, that divine honors are to be paid to Christ. David was condemned by the diet held at Weissenburg in 1579, and died in prison in November following. After a long struggle with their opponents the Socinians were suppressed in Poland in 1660. Those who refused to renounce their opinions went into Transylvania, Hungary, and Prussia, and the majority into Holland, where they were merged with the Mennonites and low Arminians. A few churches of their order yet remain in Transylvania.

A first catechism was written by George Schoman (d. 1591). Faustus Socinus (d. 1604) left another incomplete. Valentine Schmalz and Jerome Moscorovius produced the *Racovian Catechism*, the standard of the Socinian churches. It appeared in Polish in 1605, and was published in German 1608, and in Latin 1609. An English edition, produced in Amsterdam 1652, was ordered to be burnt the same year by the English Parliament. It was again translated and published in English in 1818, with a history of the Polish Socinians by Dr. Thomas Rees. After their expulsion from Poland, Andrew Wissowatius and other learned men, finding refuge in Holland, collected their more important writings and published them in 8 vols. folio, comprising the works of Socinus, Crelius, Schlichtingius, and Wolzogenius; to which a 9th vol. has been added, containing the writings of Przipcovius and Andrew Wissowatius, and a 10th vol., containing the works of Brenius. This collection is known by the title of *Bibliotheca Fratrum Polonorum*.

II. Their Doctrine. 1. *The Scriptures*.—They admit that a supernatural revelation is essential as a means to effect the salvation of men. They regard Christianity as a new law, revealed and executed by Jesus Christ. This revelation is contained in the Scriptures of the Old and New Testaments, and especially in the latter. These are authentic, sufficient, and perspicuous. Yet, as they can contain no elements inconsistent with reason, they are to be interpreted in a sense agreeable to reason; which rule of interpretation in their hands led practically to the conclusion that although containing a divine revelation, and virtually infallible, they contain minor errors.

2. *Theology*.—(1) The divine unity is inconsistent with personal distinctions. (2) Free self determination is more fundamental in the divine nature than either justice or love. (3) By the act of creating the world, God has voluntarily limited his omnipresence as to his essence, and by creating free agents he has voluntarily limited his power and his knowledge, because free-will is self determined, and future contingent events are not the object of knowledge. (4) "There is no such justice in God as requires absolutely and inexorably that sin be punished. There is, indeed, a perpetual and constant justice in God, but this is nothing but his moral equity and rectitude, by virtue of which there is no depravity or iniquity in any of his works." (Socinus, *Prælect. Theol.*, c. 16.) Hence he can pardon any repentant and reforming sinner without a satisfaction to justice. (5) The Holy Ghost is the impersonal power and efficacy of God.

3. *Anthropology*.—The guilt of Adam's sin is not imputed. Man was created naturally mortal, and since Adam has gradually acquired an hereditary tendency to sin, which of itself does not involve guilt. Responsibility is limited by ability. Man, animated by the promises of God, is able to turn unto God; and when he does so turn and believe, God seals his promises more and more on his heart by the Holy Spirit. (*Rac. Cat.*, sec. 5, ch. 10.)

4. *Christology and Soteriology*.—(1) Christ, as to his essential nature, is a mere man, but one miraculously generated by the power of the Holy Ghost in the womb of the Virgin. Hence he was from birth without sin. At his baptism he was supernaturally sealed with the Holy Ghost, and qualified and endowed with authority for his office as Prophet, Priest, and King. He was also taken up to heaven and admitted to the vision of God, and instructed in divine things. While on earth he revealed the will of God to his disciples with divine authority. After his death, he was raised to the throne of God, endowed with the divine attributes of omniscience, omnipotence, and supreme dominion. He is the rightful object of divine worship and of invocation. He saves his people as Prophet and King, the office of Priest being merged in the other two. He will judge the world at the last day, and raise believers to share in his own glory. (2) As God's justice demands no satisfaction, Christ's death saves us as an exhibition of divine love; it subdues obduracy, confirms hope by sealing God's promises; it was the necessary means to his resurrection, by which he brings life and immortality to light by an ocular demonstration.

5. *The Church and Sacraments*.—The Church they defined as the company of those who believe saving doctrine. As to what this doctrine is, they allowed, within the limit of the recognition of the divine mission of Christ, the largest freedom of opinion. Socinus discarded the term "sacrament," and held that the Supper was the only sacred rite which Christ intended to be permanently observed. The authors of the Racovian Catechism in its final form

teach that baptism and the Lord's Supper are the two Christian rites. These they regard as only memorials and symbols and badges of church membership. They pronounce infant baptism an error, but advise its toleration. (See, as above mentioned, the *Bibliotheca Fratrum Polonorum*; Dr. Toulmin's *Life of Socinus*; Dr. Thomas Rees's *Racovian Catechism, with Hist. of Unitarianism in Poland* (London, 1818); *De Tribus Elohim* of Hieron. Zanchius ([illegible]); *Socinianismi Confutatio* (Amst., 1664) of John Hornbeck; *Vindiciæ Evangelicæ* of Dr. John Owen (Oxford, 1655; vol. xii. of Goold's Edin. ed. of Owen's Works); *Hist. Person of Christ*, by Dr. J. A. Dorner (div. 2, vol. ii.); Princip. Cunningham's *Hist. Theol.*, vol. ii.)

A. A. HODGE.

Socinus (FAUSTUS and LÆLIUS). See SOCINIANS and UNITARIANISM.

Sociology. See SOCIAL SCIENCE, by A. L. CHAPIN.

Socopatoy, tp., Coosa co., Ala. P. 1267.

Socor'ro, town of New Granada, South America, is in a fertile and densely-peopled district, and is well built. P. 15,000.

Socorro, county of S. W. New Mexico, adjoining Arizona, intersected by the Rio Grande, drained by the head-waters of Gila River, and traversed by a spur of the Sierra Madre, is chiefly barren, but has some fertile valleys. Some minerals are found. Sheep-raising is almost the only industry, the other staples being wheat, Indian corn, and wine in limited quantities. Cap. Socorro. Area, 11,500 sq. m. P. 6603.

Socorro, p.-v., cap. of Socorro co., New Mex., on the Rio Grande. P. 921.

Socorro, v., El Paso co., Tex., on the Rio Grande. P. 627.

Soc'otra, an island in the Indian Ocean, off the eastern coast of Africa, in lat. 12° 39′ N., lon. 54° 1′ E., belongs to the imamat of Muscat. Area, about 1000 sq. m. P. about 5000, Arabs and negroes. The interior of the island is high, mountainous, and mostly unproductive, but the coast land, generally from 2 to 4 miles broad, is low, level, and fertile. The island produces good tobacco and dates, and the best aloes known; and has superior sheep and goats.

Soc'rates, son of Sophroniscus and Phænarete, b. at Athens in 470 B. C. (or 469, in May or June), drank the cup of poison 399 B. C. (in April or May?). His father was a sculptor, and Socrates in his early years worked at the same occupation. A draped group of Graces which stood at the entrance of the Acropolis at the time of Pausanias is said to have been his work. He alludes to his mother (*Theætetus*) as a midwife, and likens to her art his own skill in drawing out ideas by conversation. He had a brother by his mother's side named Patrocles. In his youth he learned geometry and astronomy and practised gymnastics. He is reported by Plato (*Phædo*) as having studied the work of Anaxagoras on *Nature*, probably under the instruction of Archelaus, the disciple of Anaxagoras; and according to Xenophon (*Mem. I.* and *IV.*), he had a critical knowledge of the writings of the early wise men, as well as of the Ionic school of philosophy. His master, Archelaus, taught not only physical but also moral speculations concerning justice, laws, etc. He probably met Parmenides when about twenty years of age, and mastered the Eleatic view of negative dialectic (which proved its theories by showing up the contradictions of its opponents), and was thoroughly instructed in the docrines of the Sophists—possibly may have received direct instruction from Prodicus. It is said that having early lost the patrimony inherited from his father, the wealthy Crito assisted him in his education, and employed Evenus to instruct him in poetry, Theodorus in geometry, and Damo in music, and that the celebrated Aspasia had a share in his culture. He married, and had three sons. Xantippe, his wife, has come down in history as the typical scold. Socrates is represented as using the violence of her temper as a means of cultivating his patience. He took part in three military campaigns with his fellow-citizens—that of Potidæa (432 B. C.), wherein he saved the life of the young Alcibiades, who was wounded; that of Delium (424 B. C.), in which he saved the life of Xenophon, and himself received assistance against his Bœotian pursuers from Alcibiades in the disastrous retreat which followed, and wherein his own cool bravery was conspicuously manifested; and that of Amphipolis (422 B. C.). He proved himself to have an extraordinary capacity to endure cold, heat, and fatigue. He walked barefoot upon the ice and snow of Thrace in his usual clothing, while others were clad in furs. By this time he had become noted for his peculiar mode of instruction by means of conversations which he held with people of all classes at the public resorts. Aristophanes in the *Clouds* held him up to ridicule as the arch-Sophist, as a dreamer morally worthless and physically incapable, (as Grote remarks) nearly at the time when Socrates was exposing his life for his country on the battle-fields of Delium and Amphipolis. The personal appearance of Socrates was such as to shock the Athenian sense of the beautiful: with a turned-up nose, projecting eyes, bald head, thick lips, round belly, he resembled a satyr or Silenus; he wore a miserable dress, went barefoot, and would frequently stand still in sudden fits of abstraction, rolling his eyes, staring on vacancy. Aristophanes found in him the choicest subject for comedy. Modern historical criticism has justified in large measure the poet, and pointed out his patriotic desire to save his native city from the decline in morals and political ideas which he saw impending from the prevalent tendency to reflection and sentimentalism—the cultivation of independent subjectivity or individualism (the right of private opinion) as contradistinguished from implicit, unreflecting obedience to customs and laws. This he traced, correctly enough, partly to the teachings of the Sophists or private teachers of culture, among whom Socrates was acknowledged to belong by his contemporaries, notwithstanding his radical differences from them in doctrine. In common with Socrates, the Sophists cultivated reflection—to make up the mind on internal personal grounds. Dialectics was the art of the advocate and orator, so much needed before the courts and popular assemblies of Athens—the art to make the worse appear the better reason; an art which could be applied to good purposes or to bad ones, and not in itself a corrupt art. It was the same art that is cultivated in the debating societies and "moot courts" of young lawyers of our own time. Plato and Aristotle were the first to bring the name "Sophist" into odium as a perverted species of philosophizing. Aristophanes condemned equally *all* species of philosophic reflection. Isocrates calls Plato a Sophist, and Aristotle calls Aristippus, the disciple of Socrates, a Sophist. Socrates laid great stress on the fact that the Sophists taught for pay—a distinction of little weight except for purposes of exciting the democracy against them. The Sophists were professional teachers of the higher order of culture current at the time, and only the wealthy and aristocratic could afford to employ them; hence their art was an aristocratic art. Alcibiades and Critias, the former an aristocrat, the latter a tyrant, did not do honor to the teaching of Socrates. They evidently were attracted to him for his unrivalled skill in dialectics, his power to see the end of a long cross-examination, his ironical affectation of ignorance, whereby he humiliated his opponents when they were convicted of their inconsistency and contradiction, by their own admissions. They came to learn the Sophistic culture from him, and not his moral lessons. Socrates was selected as representative of his profession by Aristophanes because of the notoriety of his personal appearance and his missionary habit of practising his art among all classes without price. In *The Clouds* it is portrayed as teaching a vain and profitless semblance of wisdom, corrupting in its influence upon youth, and undermining all true discipline and morality. Thales, Xenophanes, and Pythagoras in the sixth century B. C. had attempted to disenthrall the reflective intellect of their countrymen from the phase of religious personification, which explained everything directly by personal causes—the deities of polytheism. From these there descended three more or less distinct lines of philosophy: (*a*) From Thales the physical philosophers, who attempted to find the elements out of which the totality is composed, as well as the moving principle which arranges it. They explain one appearance by another form of it, and show all from one. These are the Ionics, the Atomists, Empedocles and Anaxagoras. Oceanus, Tethys, Poseidon, and the Styx become simply "water," or Zeus, Hera, Vulcan, Apollo, etc., become air or fire. (*b*) From Xenophanes come the Eleatics, who have recourse to an abstract principle entirely above or behind perception—the One, Pure Being, the All. (*c*) From Pythagoras come the Mystics, who interpret the religious mysteries into other *technique* in part, and in part retain the original forms. From the Eleatics had come dialectics. Zeno taught how to establish the abstract principle of the One or Being by exhibiting the self-contradiction in all opposing doctrines. Dialectic, accordingly, had an aggressive, negative force (against some doctrine), and a positive import only (through the principle of excluded middle) as it established one doctrine by proving its contrary untenable. An acquaintance with dialectic came to be considered a necessary part of a good education. The doctrines of Gorgias the Nihilist present for us the best example of the Sophistic form of it, as derived from Eleatic sources. But the Sophists were equally influenced by Anaxagoras, whose first principle, Reason (νοῦς), justified the wholly subjective tendency of their doctrine. If Reason

or thought is the only substantial thing, then, of course, said Protagoras, "Truth is relative, depending upon the point of view of the individual, and man is the measure of all things—of things that are, that they are; and of things that are not, that they are not." But this principle is ambiguous, and after the first Sophists had sufficiently differentiated this phase of it, so that its consequences could be plainly perceived in the sapping of all fixed principles of ethics, religion, and science, rendering all conviction impossible and the justification of any baseness practicable by argument, then came the reaction through Socrates, who discovered a firm ground in the universal and necessary ideas of Reason which underlie all thought as its logical condition. These ideas are objective as well as subjective, and do not depend upon caprice in any wise, nor can they be disposed of by ratiocination, for all other principles go down in the dialectical process, but these alone remain firm. Hence, the Sophistical stand-point—as negative and partial, confounding what is subjective and relative with what is positive and eternal in the nature of things—is set aside for the more comprehensive insight of Socrates, who announces a constructive basis, once more, from which human institutions, morality, conventionality, law, and religion may be defended against the all-destroying skepticism of the former. Socrates considered physics a useless and unprofitable investigation, and believed that the study of man was the only worthy occupation. But having been a pupil of Anaxagoras or Archelaus, and having the external semblance of the Sophistical profession, Aristophanes made no scruple to place in his mouth the physical doctrines expressly repudiated by him: "Not Zeus, but the clouds rain; you never saw rain without clouds." But, Socrates, who moves the clouds? "Ethereal rotation." "Ah!" rejoins his interlocutor, "rotation? That had escaped me; so Zeus no longer exists, but Rotation reigns in his place!" Aristophanes would not make any nice distinctions in favor of Socrates, for to him all philosophizing was destructive of the old traditions and naïve obedience of ethical custom. Twenty-four years after the appearance of *The Clouds*, Meletus, a poet, seconded by Anytus, an influential demagogue, and Lycon, an orator, hung up an indictment against Socrates accusing him of being "guilty of crime—first, for not worshipping the gods whom the city worships, but introducing new divinities of his own; next, for corrupting the youth. The penalty is death." Lycon is said to have felt aggrieved at what Socrates had said of the orators (see his attack on orators in Plato's *Gorgias*); Meletus, for his treatment of the poets; Anytus, a rich leather-dealer, had been driven from Athens during the rule of the Thirty, and as Socrates was supposed to sympathize with the Tyrants, and especially with Critias, the most detested of them all (having taught him when a young man), his feeling toward the accused may be explained. Moreover, a son of Anytus had become interested in the conversations of Socrates, and the latter had interceded with the father to educate his son for something better than a leather-seller. To produce aspiration for a career above the family vocation was "corrupting the youth." Socrates had cross-examined with his dialectic skill and bitter irony most of the celebrated statesmen, orators, poets, Sophists, and artisans of Athens. None had forgotten their humiliation at his hands; a few had sought help and instruction from him afterward, but most of them avoided his presence and desired revenge. Very many of these were to be found among the 500 (557, according to Diogenes Laertius) judges who sat at his trial. It was remembered that Socrates had opposed the popular will; when president of the Prytanes, he had refused to put to vote the question whether the ten admirals who had neglected the burial of the dead after the battle of Arginusæ should be put to death, as demanded by the angry multitude. He would not sanction what he believed to be unjust and illegal; a violent storm had prevented the recovery of the bodies of the slain. But it was not remembered that he had opposed equally the injustice of the Thirty, having commented severely on their ordinance forbidding "to teach the art of words"—*i. e.* such as he and the Sophists practised—an ordinance for the suppression of the higher class of teachers. Critias and Charicles had peremptorily commanded him to abstain after this from all conversation with youth. Again, he alone of the five who had been ordered by the Thirty to bring back Leon to suffer at their hands, refused to take part in the matter; only their overthrow saved him from death for this. In his defence before his judges he was so bold and free-spoken that he produced a very unfavorable impression, and was accordingly adjudged to be guilty, by a small majority. According to custom, he was allowed to name the punishment he preferred to substitute for the penalty of Meletus; he gave it as his opinion that he deserved to be subsisted in the Prytaneum at public expense for the rest of his life as a benefactor of the state, but upon the solicitation of his friends agreed to ask a fine of thirty *minæ*. This haughtiness so incensed the judges that they voted by a majority of eighty votes for his death. The execution was delayed for thirty days, until the return of the sacred ship from Delos. Socrates refused to avail himself of the means of escape from prison offered him by Crito, thus attesting his law-abiding character. He drank the cup of hemlock with perfect composure after a conversation with his friends upon the immortality of the soul, being assured that he was merely setting out upon a happy journey, and that by his death he attested the steadfastness of his convictions to his disciples, and thereby accomplished far more than by living.

As to the best authority regarding the actual teachings of Socrates, there has been much dispute. He has left behind no writings of his own, and we know him chiefly through his two disciples, Xenophon and Plato. It is supposed that the *Memorabilia* of the former give us a more accurate picture of his method and ethical doctrines, while the *Dialogues* of the latter present us with highly idealized portraitures, and offer us the further-developed doctrines of Plato through the mouth of Socrates. Aristotle testifies that to Socrates belongs the honor of the invention of induction and accurate definition of terms. His dialectic rests on induction. More important even than this was his practical application of the Delphian precept, "Know thyself," as the condition of virtue. Aristotle (*Nich. Eth.*) says that his fundamental idea is the union of theoretical insight and practical virtue. That virtue is a knowing is a very radical statement, and altogether incomprehensible unless one considers its relation to the time in which it was uttered. Relieved of its exaggeration, perhaps it means only that self consciousness is essential to responsible action. It expresses the transition from the morality of custom and habit, mere conventional use and wont, to morality as conscious right-conduct, resting on reflection and moral principles. In this, therefore, Socrates is the most significant personage in the ethical history of the race. All beyond him lies in the region of unsophisticated use and wont, or prescriptive ethics, like that of the Chinese and other Oriental civilizations; on the hither side the chief interest is the ever-widening influence of the individual consciousness of moral necessity, the long and gradual discipline of mankind into independent, responsible wills, endowed with "rights of conscience." In the ante-Socratic principle the individual takes the impulse of his volition from without—from auspices or auguries, nothing being undertaken without them. Individual conscience and personal decision date from the epoch of Socrates, and their growth from that time is the progress of the world-history. The new principle in its appearance with Socrates is as yet undeveloped, and involved with much that is foreign to it and contradictory of it. His dæmon (δαιμόνιον) or "genius" is a relic of the old, and is akin to those immediate stages of psychical life which we know under the names somnambulism, dreaming, premonition, (what is genuine in) "animal magnetism," and is a return of the conscious mind to its fœtal stage of existence, to instinct—the transplanting, as it were, of the augury from external appearance to internal impression. On the other hand, it was related to the consciousness of principles, and as such formed a factor of what we call conscience. There is no individual responsibility without conscious determination of the will, and even the perverse action of the conscious will is higher than mere unconscious action: a wicked man is a higher order of being and more precious in the sight of God than a good, obedient ox or horse. Socrates seems to have exaggerated this view so far as to make all virtue to be correct knowledge, and all vice to be ignorance, thus ignoring the will altogether. This, however, is not surprising when we consider the novelty and the greatness of his insight into knowledge as a factor of true moral action. Nor, if we consider the ultimate consequences of perfect insight, can we regard him as wrong in holding that ignorance is the occasion of all wickedness, although we insist that moral responsibility implies knowledge of the right, and assert that wickedness is perversity of will in the face of better knowledge.

The panegyrics pronounced upon the character of Socrates are not surpassed. That of Alcibiades in Plato's *Symposium* is perhaps the finest—that of Xenophon more sober and weighty: "Knowing him to be such a man as I have described—so pious toward the gods as never to undertake anything without first consulting them; so just toward men as never to do the slightest injury to any one, while he conferred the greatest benefits on all who came in contact with him; so temperate and chaste as never to prefer pleasure to what was right; so wise as never to err in judging of good and evil, nor needing the aid of others in order properly to discriminate between them; so able to discourse upon and accurately define the subjects we have mentioned; so

skilful in penetrating the hidden characters of men, and seizing the fittest time to reprove the erring and turn them to the paths of virtue, —I cannot but regard him as the most excellent and happy of mankind." The sources of information as to his life are Xenophon's *Memorabilia*; Plato's works, especially the *Apology*, *Phædo*, and *Symposium*; Aristotle's *Metaphysics* and *Ethics*; Diogenes Laertius (book ii.); and, among others of modern writers, the essays of Schleiermacher, Boeckh, Zeller, Van Heusde, Hegel, Forchhammer, Brandis, Rötscher, and Grote are very satisfactory.

WILLIAM T. HARRIS.

Socratic Philosophy. See SOCRATES.

So'da. (The term is apparently Spanish in origin, *soda* or *sosa* meaning "barilla" in that tongue; Fr. *soude*; Ger. *Soda*, chemically *Natron*; Dutch, *souda*.) This word is quite differently applied in strict chemical language and in common parlance. In the former it signifies at the present day anhydrous oxide of the metal SODIUM (which see), Na_2O. What is commercially called soda, however, is the compound formed by the action of water upon the former, generally designated, even by chemists, "hydrate of soda" or "sodic hydrate," though there is the strongest reason for believing that this compound contains no water, as such. (See below.) The *carbonates of soda* also are often called "soda" commercially.

Anhydrous soda (in precise nomenclature, *disodium monoxide*).—It is formed when metallic sodium burns in dry air. Karsten prepared it also by mixing and heating together equal equivalents of metallic sodium and "sodic hydrate." It is gray in color, melts at incandescence, and is not susceptible of electrolysis. It is not so volatile as the "hydrate." Karsten found its density = 2.805, its true density at zero, when pure and homogeneous, as deduced from its molecular volume (see VOLUMES, MOLECULAR), being 2.762.

Sodic Hydrate ($Na_2H_2O_2$) or *Caustic Soda* (properly *disodium dihydrogen dioxide*).—The hydroxyl school of chemists formulate it as Na.OH, a compound, *hypothetically*, of sodium and hydroxyl; or sometimes as NaO.H, a compound of hydrogen and "natroxyl." According to older views, it was really hydrate of soda—as it is still, without reason, called by all—with the assumed composition $Na_2O.H_2O$. In its formation, however, from soda and water, 18 volumes of liquid water condense, with great heat-evolution, to 15 volumes—a fact in itself conclusive against the presence of water, *as such*; moreover, no water can be expelled by heat from the compound, which, when heated, volatilizes as a whole. Whatever view be taken, therefore, of its constitution, the hydrogen cannot be believed to exist in the molecular condition that it has in water. Caustic soda is prepared commercially from the carbonate by the action of lime. Three parts of crystallized carbonate (*sal-soda*) are dissolved in five times as much boiling water, and one part of quicklime, slaked and mixed to a cream with three parts of water, is gradually added, with continued ebullition. The caustic solution is then decanted after settling, and boiled down rapidly with the access of air. From the residue pure caustic soda may be dissolved out by alcohol, which is then distilled off; but for most commercial, manufacturing, and medical uses the residue is merely melted and cast into sticks, which are preserved in bottles. Much caustic soda is also made by heating or boiling together the Greenland mineral *cryolite* with hydrate of lime. "*Sodic hydrate*" is white, opaque, crystalline, melts below incandescence, has a density at zero of 2.136 (Filhol, 2.13). Caustic soda is used largely, in the form of solution or soda-ley, for making soap. The following table, from Dalton, is a very valuable one:

Density of solution.	Percentage of Na_2O.	Boiling-points, Fahrenheit.
2.00	77.8	600°
1.85	63.6	472°
1.72	53.8	300°
1.63	46.6	280°
1.56	41.2	265°
1.50	36.8	255°
1.47	34.0	248°
1.44	31.0	242°
1.40	29.0	235°
1.46	26.0	228°
1.32	23.0	224°
1.29	19.0	220°
1.23	16.0	217°
1.18	13.0	214°
1.12	9.0	213°
1.06	4.7	212°

According to Dalton, the *saturated* solution of caustic soda at 60° F. has the density 1.5, boils at 255° F., and contains 36.8 per cent. of anhydrous soda. This corresponds to 47.5 per cent. of caustic soda, or the "hydrate." There is another table of densities of soda-leys which is more detailed than Dalton's, but does not go nearly so high, by Tünnermann. It gives throughout a little less soda for a given density than the figures of Dalton, and will be found in Gmelin's *Handbook of Chemistry*; in Watts's *Dictionary of Chemistry*, v. 339; and in Storer's *Dictionary of Solubilities*, p. 455. Commercial caustic soda, sold for making soap and other uses, should make a clear, colorless solution in water, which should not effervesce with a dilute acid, when neutralized should give no white precipitate with nitrate of silver or chloride of barium, and should have no odor of sulphuretted hydrogen when moistened.

Salts of Soda.—The most important salts or compounds of soda are the *acetate, borate, carbonates, hypochlorite, hyposulphite, nitrate, phosphates, silicates, sulphate, sulphite,* and *tungstate*. *Acetate of Soda.*—This is a commercial article, prepared on a large scale by the manufacturers of wood-vinegar or pyroligneous acid. Its composition is $C_4H_6Na_2O_4.6H_2O$. Its true density at zero is 1.424 (Buignet 1.42). It is a white salt in prismatic crystals, which effloresce in the air, soluble in three parts of cold water. Heat converts it into a mixture of carbon and carbonate. It is used in medicine and as the source of commercial acetic acid by distilling with sulphuric acid. *Borates of Soda.*—Of these the most important is BORAX (which see). The composition of common borax crystals is $Na_2O.2B_2O_3.10H_2O$ (there being a misprint in the previous statement of composition). *Carbonates of Soda.*—Of these there are two of great importance—the neutral or normal carbonate, commercially *sal-soda* or "*washing soda*," and the bicarbonate, commercially "*cooking soda*." *Sal-soda* ($Na_2O.CO_2.10H_2O$) crystallizes in splendid large, transparent crystals, which are monoclinic. The densities indicate three modifications, of which the dominant one is 1.467 (Buignet 1.463). This salt effloresces in the air very rapidly, falling down to a white powder, which contains but half as much water as before. It dissolves in twice its weight of cold water. On exposure to a gentle heat it loses all water, and becomes dry anhydrous carbonate. This latter is a product of enormous value in the arts, used chiefly in the glass and soap manufactures. *Cooking Soda* (*disodium dihydrogen dicarbonate*, $Na_2H_2.C_2O_6$).—This is made by exposing the last compound to an atmosphere of carbonic acid gas, which is absorbed, with evolution of heat and separation of water. It is sometimes called *soda saleratus*. Commercial bicarbonate of soda is a white granular powder, which requires thirteen times its weight of water for solution. It is of very large consumption in medicine and in cookery. *Hypochlorite of Soda*, or *Labbaraque's liquor*, used as a disinfectant (see HYPOCHLOROUS ANHYDRIDE); *Hyposulphite of Soda* (see SULPHUR, ACIDS OF); *Nitrate of Soda* (see NITRIC ACID and NITRE); *Phosphates of Soda* (see PHOSPHATES); *Silicates of Soda* (see GLASS and WATER-GLASS).

Sulphate of Soda, or *Glauber's Salt* (*sal mirabile*, $Na_2O.SO_3 10H_2O$), forms large transparent monoclinic crystals. The writer has distinguished, from the densities, five distinct modifications, the lightest having at zero 1.358 (Thomson 1.35), and the heaviest 1.528 (Filhol 1.52). This salt occurs native in most mineral springs, and as the mineral species *mirabilite*, there being several abundant American localities. It is manufactured in enormous quantities, in the decomposition by sulphuric acid of common salt, in the process of making soda from the latter. (See SODA-ASH.) Glauber's salt is highly efflorescent, falling to a white powder in the air, and in time losing all its water of crystallization. It dissolves in three times its weight of cold, and in its own weight of boiling, water. It has a remarkable propensity to form *supersaturated solutions*. Glauber's salt is a mild saline cathartic, but is not so much used in medicine at the present day as formerly, its taste being somewhat nauseous. *Sulphite of Soda* (see SULPHUROUS ACID and SULPHITES); *Tungstate of Soda* (see TUNGSTEN).

HENRY WURTZ.

Soda-Ash. This is the technical and commercial name given to crude soda, as first produced in the process of manufacture, before having gone through any refining processes. In former times, previous to the invention of the process of Leblanc, which arose out of the French revolution of 1789, the only source of the alkali soda was from the ashes of marine and seashore plants, or KELP (which see). The trade in kelp ceasing during the wars of the Revolution, the committee of public safety called upon French chemists to find some new source of soda, all the *potash* attainable being needed for gunpowder. Hence, Leblanc's method of obtaining it from common salt first arose. This consists in converting the salt first into sulphate by means of sulphuric acid, and then heating this together with charcoal and carbonate of lime, which gives (theoretically) a mixture of carbonate of soda and sulphide of calcium. This process is now carried on, particularly in England, on an enormous scale in many large chemical works, all the soda used for making soap, glass, and a multitude of other products indispensable to civilization being

thus procured. To render the details of the process intelligible would require much space and many cuts of furnaces and other apparatus, and reference must be made for this to the standard works on chemical technology, as, for example, that of Richardson and Watts.

The crude soda-ash, sometimes called "black ash," as it leaves the furnace is a very complex mixture of substances, containing chiefly, however, carbonate of soda, caustic soda (hydrate), carbon, carbonate of lime, and sulphide, or, according to some, *oxysulphide*, of calcium. It is treated with hot water or steam on a furnace-hearth to break it up, and then the carbonate is leached out with hot water in an ingenious apparatus contrived to accomplish much work with little water. The great defect of Leblanc's system is the loss of all the sulphuric acid or of the sulphur used in making it. Hence, other methods of obtaining carbonate of soda from salt have been much sought after. One now being experimented with largely, and said to be in successful operation in Europe, is that due originally to Dyar and Hemming of decomposing concentrated brine with a strong solution of bicarbonate of ammonia, which engenders chloride of ammonium and nearly insoluble bicarbonate of soda. The chloride of ammonium is readily reconvertible into bicarbonate, to be used over again. There seems some probability that this may soon altogether supersede Leblanc's process, but the details of manipulation needed for industrial success have not yet been made public in reliable form. H. WURTZ.

Soda-Water. See AËRATED WATERS.

So'dium [Lat. and Ger. *Natrium*], one of the elements of matter, a very important and remarkable metallic substance of which anhydrous soda is the oxide. Sodium was first obtained in 1807 by H. Davy by the electrolysis of caustic soda ("hydrate"). Its occurrence in nature is chiefly as common salt (chloride of sodium) in the ocean, and as a constituent of soda-silicates, chiefly the feldspars *albite* and *oligoclase*, on the land. A cubic foot of ocean-water contains about 6440 grains, not far from 1 pound avoirdupois, of metallic sodium, and a cubical tank 14 feet on each side filled with sea-water will contain more than 1 ton of this alkali-metal. A cubic foot of rock-salt contains over 52 pounds of sodium, and, according to volumic researches of the writer, very closely half its bulk of that metal. Sodium is a metal probably more abundant in its occurrence than iron, and probably not necessarily much more difficult or expensive to obtain in approximate purity than the latter metal, and yet, by reason of the fewer uses developed for it, the cost of sodium is thirty or forty times that of the purest iron. Sodium is one of the elements most essential to animal life, being a constituent of all blood. It is also found in the vegetable organisms that dwell in the ocean and along its coasts, but plants dwelling on land above the sea-level contain potassium more abundantly than sodium.

Preparation.—Davy's original method, by electrolysis, has been regarded, so long as an electric circuit of the old voltaic kind had to be resorted to, as too costly; but undoubtedly, in due course of the rapid improvements now going on in the conversion of heat into dynamic electrolytic energy by means of the magneto-electric machine, Davy's original mode of obtaining sodium from caustic soda will again be found available for the production of this metal on a large scale very readily and economically; and as it is only through sodium that we can now obtain the metals aluminum, magnesium, and calcium, that are destined to be of so great importance, much of the future of human art and industry depends upon the improved production of sodium. Gay-Lussac and Thénard first prepared sodium in quantity by the action of metallic iron at an intense heat on fused caustic soda, but the method now in use is that of Brunner, which consists in distilling a mixture of *charcoal* and *carbonate of soda*, the transformation being essentially as follows:

$$Na_2CO_3 + C_2 = Na + 3CO\,;$$

a current of carbonic oxide gas resulting, which sweeps along with it the metallic sodium in vapor. The latter is condensed by passing the gases through a thin, flat cast-iron condenser of peculiar form, which becomes, and remains throughout, hot enough to prevent the metal from solidifying within it, and thus clogging it up. It is so contrived also that a sharp pointed iron rod may be driven in through it into the retort to clear it out when in danger of choking up and thus leading to a dangerous explosion. The sodium trickles out of the condenser in melted form, and is prevented from taking fire and burning in the air by being received in a vessel of melted paraffine. The latter should be double, each part having a close-fitting lid to be applied in case the paraffine should kindle. The temperature required is that at which carbonate of soda volatilizes, so that a very voluminous smoke of carbonate of soda is evolved with the carbonic oxide, which probably contains also some caustic soda, and which it is exceedingly difficult to coerce. Sodium works must therefore be so located that annoyance will not arise from this, and must be provided with powerful ventilation. This also gives rise, of course, to great waste of material. Another heavy expense of the sodium-process is the rapid destruction of retorts. The writer has found it most advantageous to use horizontal cylindrical retorts made of thin boiler plate, with a lapped joint. These are jacketed with another sheet of boiler plate clamped closely on, which is readily applied, and is largely instrumental in protecting the lower side of the retort, where exposed most to the fire, from being rapidly burned through. This jacket is readily renewed when itself burned through, and by turning round the inner retort so as to bring fresh surfaces next the fire, and by renewing the jacket, retorts may be made to stand several more successive charges than when unprotected. Care must be taken that the carbonate of soda and charcoal are free from *silica* and *phosphates*, which energetically attack the iron of the retort and perforate it from the inside. Deville introduced the admixture of powdered *chalk* with the mass, to prevent its passing into liquid fusion, but this may introduce silicates, and an excess of coarsely-powdered charcoal has been used instead. It is very important also that the fire should be fed in some way which will not check combustion and cool the retort during the distillation of the sodium, which is extremely liable to lead to disaster. *Gaseous fuel* or a *petroleum-vapor* furnace would be eminently adaptable to this art, and would greatly promote economy, of time, labor, and retorts.

Sodium is a brilliant silver-white metal, of the softness of wax within the normal range of temperatures, but becoming somewhat harder at 20° below zero. Its color is stated, when the surface is chemically clean and bright, to have a tinge of *rose-red*, brought out very distinctly by repeated reflections. Its density is variable, the new geometrical law of condensation of the writer (see VOLUMES, MOLECULAR) indicating three allotropes, having the following true densities at zero:

	Experiment.	True density at 0°.
Davy	.9348	.943
Gay-Lussac and Thénard	.97223	.9755
Schröder, at 4° C.	.985	.9922

The exact fusing-point of sodium is a little in doubt, Bunsen finding that it *melts* at 204° F., while Regnault found it to *solidify* at 207.5° F. It crystallizes in octahedrons of the dimetric or tetragonal system. Its vapor, unlike that of potassium (which is green), is colorless. When exposed to the air, it rapidly absorbs oxygen, and moisture if present, forming either anhydrous oxide (Na_2O) or caustic soda ($Na_2O_2H_2$). When water touches it, there is an intense reaction, with evolution of H gas, and formation of the latter compound, or hydrates thereof. If the quantity of water is small, the heat produced is so high that the metal takes fire, and burns with a very large monochromatic yellow flame and most intense heat, producing more or less peroxide of sodium, with protoxide. In oxygen gas it burns almost entirely to peroxide (Na_2O_2).

In the preservation of sodium it must be kept immersed under the surface of some liquid which is free from oxygen, the heavy oils of coal-tar being better for this purpose, apparently, than rectified petroleums, which seem to absorb oxygen slowly and transmit it to the sodium, which thus becomes soon encrusted with a product not yet examined. HENRY WURTZ.

Sodium Compounds, Medicinal Uses of. *Caustic soda* produces effects closely resembling caustic potassa, but it is little used. *Sodium carbonate* and *bicarbonate* also resemble the corresponding potassium salts, but are milder in their effects. They are much used as simple alkalies in digestive derangements, or as alkaline washes in skin diseases. *Sodium biborate* (borax), being feebly alkaline in reaction, has something of the same effect as the carbonates. It is mostly used locally, in solution, as a weak alkaline application to the skin or a mouth-wash. A crystal of borax held in the mouth and allowed slowly to dissolve is an excellent means of temporarily relieving huskiness of the voice. *Sodium acetate* may be used for the same purposes as the potassium salt. *Sodium phosphate* is a mild saline purge, and has the advantage of possessing little taste. *Sodium sulphate* (Glauber's salt) is an active cathartic, but on account of its offensive taste has been superseded by magnesium sulphate. *Sodium nitrate* is a neutral salt without striking properties, and is but little used in medicine. The effects of the *sulphite* and *hyposulphite* are spoken of under the heading HYPOSULPHITES (which see). *Sodium and potassium tartrate* is described under POTASSIUM COMPOUNDS. *Sodium chloride* (common salt) is used for medicinal purposes, mostly as an emetic, in strong solution in warm water. *Solution of*

chlorinated soda is a powerful and valuable antiseptic and disinfectant. EDWARD CURTIS.

Sodium, Compounds of. Sodium, like other metals, forms different classes of compounds with oxygen, with sulphur, with the halogens, with mercury to *amalgam*, and with other metals to *alloys*.

Oxides.—Of these one, the compound Na_2O, has already been described. (See SODA.) Another is the peroxide or dioxide, Na_2O_2. This is formed by burning sodium in oxygen, but to obtain it free from Na_2O the mass must be heated in oxygen until it absorbs no more. The product is white when cold, and yellow when hot. If *slowly* introduced into water, to avoid heating, hydrates may be obtained, which may be crystallized. Its density, and those of its crystalline hydrates, appear to be as yet unknown.

Sulphides.—Of these there is a series, the only one of much interest being the lowest one, Na_2S. This forms large octahedral crystals of density about 2.5.

Haloid Salts.—The most important of these is chloride of sodium, common salt. (See SALT.) The iodide, bromide, fluoride, and cyanide of sodium are of no great practical interest, and for these the chemical textbooks must be consulted.

Sodium Amalgam.—Pure quicksilver and sodium, when brought together, unite, with highly explosive violence, to an amalgam, which possesses very extraordinary qualities. This amalgam has assumed much interest within the last twelve years by reason of its introduction into use, by the present writer, in 1864, as an agent in the amalgamation of the precious metals in their ores, and their extraction from the same; the adhesion of the quicksilver to these metals being enormously intensified by the presence of a very minute amount of sodium, and the quicksilver itself being prevented from breaking up into minute globules, which are difficult to recover again in coherent form. Quicksilver, or gold or silver amalgam, which has become already broken up in this way (or "floured," as it is technically termed by the miners and millmen), is also caused to coalesce again instantly into one mass by the addition of a minute proportion of amalgam of sodium. Similar discoveries to these were published also in 1865, in England, by William Crookes, and in some of the metallurgical books are now attributed to that chemist; but it is matter of history that both the American publication and the American practical application anteceded those in England by many months. The preparation of the sodium amalgam successfully on a large scale, without continual and dangerous explosions, is only possible by the method invented by the writer, which is not to be found in the works of reference. This depends upon a very simple device, that of forming first a poorer pasty amalgam by melting up a rich sodium amalgam with some additional quicksilver, to which the sodium is then added in lumps the size of half an egg. Each lump suddenly melts down upon the surface of the pasty amalgam, combining therewith with a great development of heat, but without any serious explosion or danger of any, and forming a thin broad cake of rich amalgam, which is very hard, and has about the composition Hg_3Na. These cakes are immediately removed with tongs, and thrown into a kettle to be melted down under a thin layer of paraffine. As the heat produced raises the remaining pasty amalgam to a point of very liquid fusion, and to a temperature at which combination with sodium would be very explosive, it is necessary to wait a few minutes until the mass has cooled again. It is better, therefore (to save time), to divide the mass of pasty amalgam operated on into a number of portions in as many iron pans. Each can be then successively treated with sodium, and the time occupied in cooling not be lost. By this method one operator, with an assistant, has often made several hundred pounds of hard amalgam of sodium in one day without an explosion. If the amalgam is to be preserved or transported in glass bottles, it should be cast into quite thin sheets before being broken up for bottling, on account of its great weight, and the bottles should be thick and strong. *Moisture* being the great enemy of sodium amalgam, the bottles should be tied over with sheet caoutchouc or thin rubber-cloth. India-rubber bags have been much and successfully used for containing sodium-amalgam, as being less fragile than glass. They are closed by tying tightly with twine. Sodium-amalgam is largely used in chemical laboratories as a reducing agent. It is so powerful in this way that it will precipitate the earthy metals barium, strontium, and calcium from their solutions. In a large number of cases in which organic compounds are to be deoxidized or subjected to the action of "nascent hydrogen," sodium-amalgam is employed.

Alloys of Sodium.—Those with LEAD have been mentioned under that head. The most interesting alloy is the *permanently liquid* one with POTASSIUM (which see).

HENRY WURTZ.

Sod'om, a city of ancient Syria, memorable in the earliest records of the Hebrews for its connection with Abraham and Lot, and its miraculous destruction by a storm of brimstone and fire (Gen. xix. 24, 25). The exact situation of Sodom and its allied cities, Gomorrah, Admah, Zeboim, and Bela or Zoar, has been for 2000 years a subject of endless discussion, the usual conclusion having been that the "cities of the plain" occupied the present basin of the Dead Sea, which was accordingly supposed to have been formed at the time of the destruction of those cities. But many modern critics have pointed out that the text of Genesis makes no such statement, the Dead Sea not being mentioned in that connection. Strong geographical evidence has been adduced by Mr. George Grove (in Smith's *Dict. of Bible*, s. v.) to show that the *Kikkar*, or plain of the five cities, was in fact the lower valley of the Jordan, where he would accordingly place the site of Sodom and the allied cities. In support of this view an etymological coincidence may be further alleged, that the plain of *Sodom* will thus be identical with the region elsewhere referred to in the Pentateuch as the "vale of *Siddim*" and the "plain of *Shittim*," both which names offer a strong resemblance to Sodom. De Sauley identified Sodom with a spot still called *Usdum* to the S. W. of the Dead Sea, but his views have met with little acceptance. Robinson places Sodom near the southern extremity of the Dead Sea. George Warington (in *Journal of Sacred Literature*, Apr., 1866) adduces strong reasons for translating Sodom "hollow," and applying it to the entire crevasse of which the valley of the Jordan and the Dead Sea are but a part: and this view, supported as it is by the etymological resemblances above noted, is perhaps the safest conclusion.

PORTER C. BLISS.

Sodo'rus, p.-v. and tp., Champaign co., Ill., on Toledo Wabash and Western R. R. P. of v. 300; of tp. 1458.

So'dus, p.-v. and tp., Berrien co., Mich. P. 906.

Sodus, p.-v. and tp., Wayne co., N. Y., on Lake Ontario, and on Lake Ontario division of Rome Watertown and Ogdensburg R. R. and on Sodus Point and Southern R. R. P. of v. 516; of tp. 4631.

Soerabay'a, or **Surabaya**, town of Java, in the East Indies, capital of a Dutch province of the same name, on the northern coast of the island, opposite Madura, at the mouth of the Kediri. It has a good harbor, is strongly fortified, and contains barracks, magazines, hospitals, and other military establishments. It communicates regularly with Samarang, Batavia, and other places by steamboats, and carries on an important trade, exporting annually rice, coffee, cotton, sugar, tobacco, and cocoanuts to the value of more than $5,000,000, and importing over $3,000,000 worth of manufactured goods. Its shipbuilding is also extensive. P. about 90,000, of whom from 3000 to 4000 are Europeans, the rest Javanese, Arabs, and Chinese.

Soerakar'ta, or **Surakarta**, town of Java, in the East Indies, capital of a Dutch residency of the same name, on the left bank of the Solo, is connected with Samarang by railway. It contains a magnificent palace of the native emperor, who lives here as a pensioned rather than as a tributary prince; the Dutch fortress is opposite the emperor's palace. The trade of the city, especially in pepper, vanilla, and cacao, has increased much in the last few years. P. about 50,000.

Soest, town of Prussia, province of Westphalia, in the Middle Ages was one of the most flourishing cities of the Hanseatic League, but has since much decreased. It is still a handsome town, however, surrounded with substantial walls, containing a fine cathedral of the fifteenth century, and carrying on trade in corn and cattle. P. 12,404.

Sofa'la, a Portuguese settlement on the south-eastern coast of Africa, in lat. 20° 10′ N., sometimes denotes the whole coast-region from the mouth of the Zambesi to Delagoa Bay, comprising several Portuguese settlements, such as Teté, Inhambane, Senna, and others. The city of Sofala is a most miserable place, consisting of 18 mud huts, situated in an utterly unhealthy salt-swamp; but the surrounding territory, though unhealthy to Europeans, is very fertile, and it is only the indolence, cowardice, and treachery of the native inhabitants which have hitherto impeded all progress. The low coast-land swarms with wild elephants, rhinoceroses, and lions.

Sof'tas, The [probably from the Arab *soffah*, "bench"], generally, all persons attached to the mosques in any capacity whatever, but more especially applied to the students who are initiated in the upper branches of religious instruction in the mosques, and who, like the fellows of an English university, constitute a corporation long after the completion of their learned pursuits. Some of them supply candidates for the offices of imaums and mollahs, but the larger part of them hang rather loosely on society. In

Mohammed's time they were poor men who slept in the mosques and had a sheltered bench outside; hence they were called "men of the bench." At present they form a large and influential body in Mohammedan society. Their number in Constantinople is estimated at from 10,000 to 20,000, and during the late revolution they entirely controlled the mob, which they excited by appealing to the slumbering religious fanaticism.

Sogdia'na, formerly a territory of Central Asia, separated N. from Scythia by the Jaxartes, S. from Bactria by the Oxus, comprised nearly the same regions as the present Toorkistan, the city of Bokhara still bearing the name of *Sogd*. It was conquered by the Persians under Cyrus, and fell after the death of Alexander the Great to Syria; it was subsequently conquered by the Toorkomans. In the time of Alexander the country was remarkable for its forests and game, but the historians of Alexander's campaigns, who speak of the numerous and large cities of the country, seem not to be perfectly reliable.

Soglia'no al Rubico'ne, town of Italy, province of Forli, on a high hill near the source of the torrent Fiumicino or Rubicone, about 17 miles from Rimini. This town first appears in history as a rural possession of the family of Sulla. It was a fief of the Malatesta house for many centuries, and is now a more than usually active and thriving town. P. 6239.

Sohar', town of Oman, Arabia, on the Sea of Oman, has a good harbor, some manufactures of woollen, cotton, and silks, and considerable trade with Persia, though it has suffered somewhat by the rise of Muscat. It is surrounded by a wall, defended by a castle, and generally well built. P. about 20,000.

Sohn (Karl Ferdinand), b. at Berlin Dec. 10, 1805; studied painting under Schadow, whom he accompanied in 1826 to Düsseldorf, in 1830 to Italy; was appointed professor in the Academy of Düsseldorf in 1838. D. at Cologne Nov. 25, 1867. Among his most celebrated pictures are *Rinaldo and Armida* (1827), *Diana and Actæon* (1833), *The Judgment of Paris* and *Romeo and Juliet* (1836), *Tasso and the Two Leonoras* (1838), besides a number of portraits, especially of women.

Soignies', town of Belgium, province of Hainaut, on the Senne, has large breweries and distilleries, and important quarries in its vicinity. P. 6769.

Soils, Chemistry of. See Agricultural Chemistry, by S. W. Johnson, A. M.

Soissons', town of France, department of Aisne, on the Aisne, is an old but well-built city, with manufactures of cloth and hardware, and an important trade in grain. P. 10,404.

Sokoto. See Saccatoo.

Solana'ceæ [from Solanum, which see], a natural order of gamopetalous exogenous herbs, shrubs, and trees, often containing powerful narcotic principles. Among the poisonous plants of the order are belladonna, henbane, mandrake, stramonium, and tobacco. Some, however, as generally used, are not poisonous: such as the true potato, the egg plant, and the tomato. The capsicums, chillies, or pod peppers, moreover, are not poisonous, but very pungent with a volatile acridity. Most of the 1600 species of the order are tropical. In affinity the order is between the Scrophulariaceæ and the Convolvulaceæ, but most nearly related to the former, which might be regarded as an irregular-flowered division of it. It is marked by having the corolla plaited (or rarely imbricated) in the bud; stamens as many as its lobes, and alternate with them, all perfect; numerous seeds, small and mostly terete embryo, with narrow cotyledons, in copious fleshy albumen. The juice is watery and mawkish or nauseous. Asa Gray.

Solan'der (Daniel Charles), M. D., LL.D., F. R. S., b. at Nordland, Sweden, Feb. 28, 1736; studied at Upsala under Linnæus; graduated in medicine; made a scientific and botanical tour in Russia; visited the Canary Islands on a Swedish war-vessel; settled in England Oct., 1760; was soon employed at the British Museum in drawing up a catalogue of the collections; was appointed assistant in the natural history department 1763; chosen F. R. S. 1764; prepared a catalogue of the Brander collection of fossils 1766; accompanied Sir Joseph Banks in the first voyage of Capt. Cook around the world 1768–71, and was appointed sub-librarian at the British Museum 1773. D. at London May 16, 1782. Author of botanical papers in the *Philosophical Transactions*, and left to the British Museum numerous unpublished MSS. embracing his botanical researches. It was chiefly through the influence of Dr. Solander that the artificial system of botanical classification proposed by Linnæus was generally adopted by English naturalists, and he rendered important assistance to Ellis in the preparation of his great work, *The Natural History of Zoophites* (1786).

Solan Goose. See Gannet.

Sol'anine [Lat. *solanum*, "nightshade"], a natural organic alkaloid found in various species of the genus *Solanum*, including the *black nightshade*, *potato*, *bittersweet*, and others. It is doubtful, however, whether the alkaloids obtained from these different sources are exactly the same, or only nearly related. Solanine is a solid crystalline substance, readily soluble in alcohol. Its analyses by different chemists have yielded discordant results, the proportion of nitrogen varying, for example, from none at all (*Otto Gmelin*) to 3.6 per cent. (*Moitissier*). The latter makes it to be $C_{21}H_{35}NO_7$. It is very poisonous, producing paralysis of the lower extremities before death. This symptom has been observed in the case of cattle poisoned by eating the green shoots of potatoes, which contain solanine largely. H. Wurtz.

Solano. See Simoom.

Sola'no, county of W. California, bounded S. E. by Sacramento River, S. by Suisun Bay, and traversed by California Pacific R. R. The surface is variegated with plains, valleys, and high rounded hills, with little timber, and an abundance of marble and limestone; it is one of the best agricultural counties in the State. Staples, wheat, barley, wine, hay, wool, and dairy products. Cap. Suisun City. Area, about 800 sq. m. P. 16,871.

Sola'num [Lat.], a genus of herbs and shrubs of the order Solanaceæ, most or all of which contain the poisonous principle *solanine*. The common potato and the egg-plant, however, as ordinarily used, are not poisonous, though there is little doubt that traces of the poisonous principle exist within the plants. The U. S. have several native species, mostly Southern. There are a great many tropical species, some of them of great use in local therapeutics, but none are extensively employed in the medical practice of civilized lands except perhaps the *S. dulcamara*, or bittersweet. Several afford edible fruits, that of the egg-plant (*S. melongena*) being the most important.

Solar Cycle. See Cycle, by Pres. F. A. P. Barnard.

So'lar Sys'tem. The solar system consists of the sun, together with the planets, comets, and meteors which revolve around it as the centre of their motions. The term "planets" includes bodies of three distinct classes: (1) the major planets, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; (2) the minor planets, or asteroids (now numbering 169), revolving between the orbits of Mars and Jupiter; (3) the satellites, or secondary planets, 18 in number, of which the earth has one, Jupiter four, Saturn eight, Uranus four, and Neptune one. The magnitude of Mercury, the smallest of the major planets, is 1000 times greater than that of the largest asteroid. A general view of the planetary elements is presented in the following tables:

	Mean distance from the sun.	Period in mean solar days.	Longitude of perihelion	Longitude of asc. node	Eccentricity.
Mercury	35,560,000	87.96926	75° 7' 14"	46° 33' 9"	0.2056048
Venus	66,419,000	224.70079	129 27 14	75 19 52	0.0068433
Earth	91,875,000	365.25637	100 21 21	00 00 00	0.0167711
Mars	139,988,000	686.97965	333 17 54	48 23 13	0.0932611
Jupiter	478,008,000	4332.58482	11 54 53	98 54 20	0.0482388
Saturn	876,376,000	10759.21982	90 6 12	112 21 44	0.0559956
Uranus	1,762,475,000	30686.8208	168 16 45	73 14 14	0.0465775
Neptune	2,760,104,000	60126.72	47 14 37	130 6 52	0.0087195

	Inclination.	Mean longitude at epoch *	Equatorial diameter in miles.	Volume.	Mass.	Density	Sid. rotation. d h m s
Sun	...	...	854,000	1,240,285	1	0.253	25 0 0 0
Mercury	7 0' 8	327 15 20	2,958	0.0518	$\frac{1}{3000000}$	2.020	24 5 28
Venus	3 23 31	245 33 15	7,549	0.8686	$\frac{1}{400000}$	0.903	23 21 24
Earth	...	100 46 43	7,926	1.0000	$\frac{1}{320000}$	1.000	23 56 4
Mars	1 51 5	83 40 31	4,915	0.2345	$\frac{1}{3000000}$	0.147	24 37 23
Jupiter	1 18 40	160 1 20	88,294	1303.9	$\frac{1}{1048}$	0.229	9 55 26
Saturn	2 29 28	14 50 41	71,823	667.5	$\frac{1}{3502}$	0.144	10 29 17
Uranus	0 46 30	28 26 42	33,124	73.37	$\frac{1}{22000}$	0.180	?
Neptune	1 46 59	335 8 59	35,910	93.47	$\frac{1}{19700}$	0.178	?

Elements of the Moon.

Mean distance from the earth in miles	238,800
Mean sidereal revolution in days	27.321661
Mean synodical revolution in days	29.530589
Mean inclination of orbit	5° 8' 40"
Mean revolution of nodes in days	6793.391080
Mean revolution of apogee in days	3232.575343
Mean eccentricity of orbit	0.05490708
Mass (earth's as 1)	$\frac{1}{81}$
Diameter in miles	2160
Density (earth's as 1)	[illegible]

* The epoch is Jan. 0, 1850.

Elements of Jupiter's Satellites.

Number	Sidereal revolution.	Distance in radii of Jupiter.	Diameter in miles.	Mass, that of Jupiter being 1.
	d. h. m.			
1	1 18 28	6.05	2352	0.000017328
2	3 13 14	9.62	2099	0.000023235
3	7 3 43	15.35	3436	0.000088497
4	16 16 32	26.99	2929	0.000042659

Elements of Saturn's Satellites.

Name.	Sidereal revolution.	Distance in radii of Saturn.	Diameter in miles.
	d. h. m.		
Mimas	0 22 37	3.360	1000
Enceladus	1 8 53	4.312	?
Tethys	1 21 18	5.339	500
Dione	2 17 41	6.839	500
Rhea	4 12 25	9.552	1200
Titan	15 22 41	22.145	3300
Hyperion	21 7 7	28.000	?
Iapetus	79 7 53	64.359	1800

Elements of Uranus's Satellites.

Name.	Sidereal revolution.	Mean distance in radii of Uranus.
	d. h. m.	
Ariel	2 12 28	7.44
Umbriel	4 3 27	10.37
Titania	8 16 55	17.01
Oberon	13 11 6	22.75

Elements of Neptune's Satellite.

Sidereal revolution	5*d.* 21*h.* 8*m.*
Distance in radii of Neptune	12.00
Maximum elongation.	18″

It may afford some idea of the dimensions of our system to remember that a cannon-ball flying outward from the sun with the uniform velocity of 500 miles per hour would not reach the orbit of Neptune in less than 630 years. As to the place occupied by the sun and its attendant orbs among the fixed stars, it is sufficient to remark that *Alpha Centauri*, presumably the nearest of those bodies, is 7000 times more remote than Neptune.

Solar System, Origin of the.—It has been inferred from a great variety of facts that the present form and order of our planetary system are the result of a *progressive development* in accordance with the laws of gravitation, cohesion, and chemical affinity. The planets all move in the same direction, and the planes of their orbits are nearly coincident. These phenomena, with various others for which gravitation fails to account, were formerly regarded as ultimate facts. That they are the result, however, of physical causes, and that the latter are a legitimate object of scientific research, is now admitted by all men of science. Laplace suggested a probable explanation in his celebrated nebular hypothesis; and recently Mr. Proctor has proposed a new theory, differing in some essential features from that of the author of the *Mécanique céleste*. In either hypothesis, however, the formation of cosmical masses was a process of gradual accretion. In regard to the *origin* of planetary nuclei, the ring of asteroids between Mars and Jupiter affords undoubtedly some striking indications. The distance of Flora, the innermost of the group, is 2.20; that of Hilda, the most remote, 3.95. The interval between these extremes includes the following distances at which the periods of minor planets would be commensurable with that of Jupiter:

(1) 3.27: where 2 periods would be equal to 1 of Jupiter.
(2) 2.25: " 7 " " " " 2 "
(3) 2.50: " 3 " " " " 1 "
(4) 2.95: " 7 " " " " 3 "
(5) 2.82: " 5 " " " " 2 "
(6) 3.81: " 8 " " " " 5 "

In the case of planetary masses at intermediate distances the perturbations by Jupiter would be distributed around the orbits. In other words, any change produced in a particular direction at one time would be counteracted by a similar disturbance at the opposite part of the orbit at another. The case is different, however, when the periods are commensurable. A planetoid, for instance, at the distance 2.5—between the orbits of Thetis and Hestia—would make precisely three revolutions while Jupiter completes one. It is obvious, therefore, that all its conjunctions with that planet, for an indefinite period, must occur in the same parts of its path. Consequently, its orbit would become more and more eccentric, until, if the nebulous ring had considerable density, the disturbed matter would be brought into contact, either in aphelion or perihelion, with masses having somewhat different velocities. The planetary nucleus formed in this manner would be at some distance from the primitive orbit of the particle disturbed. A gap or chasm in the asteroid zone would thus be produced at the distance 2.5. Similar reasoning will of course apply to any other distance at which the period of an asteroid would have to that of Jupiter a simple relation of commensurability. Let us now inquire whether the actual distribution of the mean distances sustains the conclusions derived from physical considerations.

The mean interval between the consecutive orbits of the 163 known asteroids is 0.0108. The widest chasms are the following:

(1)	3.3210—3.2210 = 0.1000
(2)	2.2661—2.2029 = 0.0632
(3)	2.5265—2.4726 = 0.0539
(4)	2.9779—2.9213 = 0.0566
(5)	2.8140—2.7807 = 0.0333
(6)	3.9505—3.5602 = 0.3903

The least of these gaps is three times greater than the average interval between consecutive orbits. *It will be seen, moreover, that those distances at which the periods of asteroids would be commensurable with that of Jupiter fall, without exception, in those widest chasms.* It is to be expected, indeed, that a few minor planets may yet be found within the zones now apparently vacant; but the irregularity of distribution, which has been increasing from year to year, is now too great to be obliterated by future discoveries. This clustering tendency may be further illustrated as follows: Within a space equal in breadth to the first gap, *and immediately adjacent to it*, seventeen minor planets are known to exist. Between 2.80 and 2.90, the interval containing the distance at which five times the period of a planet would be equal to twice that of Jupiter, only five have been detected; while in the equal space immediately interior—from 2.70 to 2.80—there are twenty-six. Finally, between 2.45 and 2.55, the space in the middle of which an asteroid's period would be one-third that of Jupiter, the number of known minor planets is four; while in the equal space interior and adjacent there are twenty-five, and in that exterior twenty-three. The only physical explanation of which these remarkable facts appear to be susceptible is that derived from some form of the nebular hypothesis.

It has been shown, moreover, that in Saturn's rings the great division is situated where the periods of discrete particles revolving in accordance with Kepler's third law would have simple relations of commensurability with the four inner satellites. The matter, therefore, which originally occupied this part of the annulus would, as the result of perturbations, be brought into contact with either the exterior or interior portions. The existence of the wide and permanent division of the ring is thus explained in the same manner as that of similar gaps in the zone of asteroids.*

The instances of nearly commensurable periods in the Jovian and Saturnian systems, as well as among the primary planets, are well known, and are too numerous and remarkable to be accidental coincidences. The preceding facts in regard to Saturn's rings and the zone of minor planets suggest an obvious cause for the formation of nuclei where their periods would have this observed relation to that of the disturbing body. As these nuclei would receive accretions of matter from portions of space both interior and exterior to their respective orbits, their distances from the central body during their planetary growth would not be liable to great variation.

The rotation-periods of the primary planets were regarded until recently as wholly disconnected. The discovery of an "analogy" between these periods was first announced in 1849 at the Cambridge meeting of the American Association for the Advancement of Science. This law or harmony was derived from the nebular hypothesis. Should it, therefore, be sustained by future discoveries, as it is by known facts, it would constitute a strong confirmation of the cosmogony of Laplace. It may be briefly stated as follows: Let P be the point of equal attraction between any planet and the one next interior; P′ that between the same and the one next exterior. Let also D = the sum of the distances of the points P P′ from the orbit of the planet, which sum we shall call the diameter of the sphere of the planet's attraction; D′ = the diameter of any other planet's sphere of attraction found in like manner; then it will be found that *the* SQUARE *of the number of rotations made by a planet during one revolution around the sun is proportional to the* CUBE *of the diameter of its sphere of attraction.* Some uncertainty still exists in regard to the masses of several planets, as well as to their periods of rotation. The exact truth of the above law cannot therefore be affirmed. It agrees too closely, however, with the known elements of the system to be regarded as wholly an accidental coincidence.

* See *Monthly Notices* of the Roy. Astr. Soc., vol. xxix. p. 100.

The planets exterior to the zone of asteroids may be regarded as forming a system by themselves, their motions being little affected by the comparatively small bodies within Jupiter's orbit. A discussion of the mutual perturbations of these major planets has recently developed the following harmonies: I. *The mean motion of Jupiter's perihelion is exactly equal to the mean motion of the perihelion of Uranus; and the mean longitudes of these perihelia differ by exactly 180°.* II. *The mean motion of Jupiter's node on the invariable plane of the planetary system is exactly equal to that of Saturn; and the mean longitudes of these nodes differ by exactly 180°.* The discoverer of these curious relations, Mr. J. N. Stockwell, remarks, however, that "the perihelion of Jupiter may differ from its mean place to the extent of 24° 10′, and that of Uranus to the extent of 47° 33′; and therefore the longitudes of the perihelia of these two planets can differ from 180° to the extent of 71° 43′. The nearest approach of the perihelia of these two planets is, therefore, 108° 17′. In like manner, the longitudes of the nodes of Jupiter and Saturn, on the invariable plane, can suffer considerable deviations from their mean positions. The actual position of Jupiter's node may differ from its mean place to the extent of 19° 38′, while that of Saturn may deviate from its mean place to the extent of 7° 7′. It therefore follows that their longitudes on the invariable plane can differ from 180° by only 26° 45′. Their nearest possible approach is 153° 15′, while their present distance apart is 166° 27′."

DANIEL KIRKWOOD.

Solar Time. See DAY.

Sol'der [remotely from the Lat. *solido*, *solidare*, to "unite," to "consolidate"], an alloy employed to unite pieces of metal together by fusion upon the proposed joint. There are many solders, each designed for some special use. The soft solders are usually of lead and tin, or lead, tin, and bismuth; these melt at a low temperature. (See LEAD.) The hard solders cannot be melted at a low temperature; they are commonly of zinc and copper.

Sol'dier [Fr. and Ger. *soldat*; Dutch, *soldaet*; Sp. *soldado*; It. *soldato*]. Webster derives the word from the Lat. *solidus*, a piece of money, the pay of a soldier. Bardin (*Dict. des Armées*, etc.) quotes a variety of forms of the word from mediæval writers, which renders, he says, little surprising the disagreement of etymologists concerning its root. The Ger. *sold* ("pay"), the Latin *sodalis* ("companion"), the Latin *soldarius*, the Low Latin *solidatus* ("who receives a stipend"), are referred to. Cæsar uses the word *soldurius* in reference to a kind of vassals or retainers in Gaul who devoted themselves to the service of some prince, which may have changed into *solidarius* ("a man *paid* or receiving pay"), though the Gauls referred to do not seem to have served for pay.

The etymology which makes the soldier *sodalis* ("companion") would be more congenial to the military profession than that which ignores all but the mercenary in the word by which he is distinguished. "There are," says Rousseau, "callings (*métiers*) so noble that to exercise them for money is to show one's self unworthy of belonging to them; such is that of the soldier" (*homme de guerre*). The word, however, has not, etymologically even, a stigmatic sense, but simply a distinctive one—the recipient of a regular stipend (daily, monthly, or yearly "wages")—as distinguished from those professions which receive *fees* for specific services, or from all occupations which are *not* salaried.

"The military profession is essentially noble; for there is no utility more just and more universal than the protection of the repose and greatness of one's country." (Charron, quoted by Gen. Ambert in his *Soldat.*) "Notwithstanding what moralist-philosophers may say, the profession of arms will always be ranked above all others." (Hallam, *ibid.*) "It is the distinguished profession, because its risks, its successes, its misfortunes even, conduct to greatness." (Montesquieu, *ibid.*) When, says Gen. Ambert, Michael Angelo would personify *Thought*, the garb he chose was that of a *soldier* (referring to the statue of the younger Lorenzo de' Medici in the sacristy of the church of San Lorenzo, Florence, sometimes styled *Il Pensiero*).

The general sense of the word *soldier* as now used is "one who is engaged in military service as officer or private; one who serves in the army; one of an organized body of combatants." (*Webster.*) "Whoever belonging to the military service of the state receives pay is a soldier." (Scott's *Military Dict.*) This latter procrustean application of an etymological sense which barely lurks in the usual acceptation of the word is scarcely tenable, even in a purely technical sense. Washington served the state without pay; La Fayette and the Orleans princes (see also the article on PARIS, DE, COMTE)—true soldiers in every legitimate sense—held commissions and served in our armies without pay. The definition of Webster's is a far better rendering of the primary meaning. In a more general sense we may mean an experienced warrior, or even one whose aptitudes, tastes, and knowledge are eminently military, even though he may never have *served*. In the "Articles of War" and *U. S. Army Regulations* the word is exclusively used in the minor sense of an *enlisted* man—a *private* soldier—as distinguished from *officers* (*commissioned to command* or exert authority,—*e. g.* Art. 2: "It is earnestly recommended to all *officers* and *soldiers* diligently to attend divine service," etc.; and Art. 20: "All *officers* and *soldiers* who have *received pay* or who have been duly *enlisted* in the service of the U. S.," etc. etc.).

It may be remarked that, while the Baptist's injunction, "Be content with your wages," to *soldiers* who came to him (a perennially appropriate admonition), would imply that while even in his day the idea of stipend, salary, or "wages" was associated with the military service, the word used has no such sense. The *miles* of the Vulgate (whence our words *militant*, *militia*, *military*, etc.) refers to the legion (tria-*millia*), and the original Greek στρατιώτης (from στρατός, an "encampment," whence we have "strategy," the radical sense being that of extension or spreading out) means one who belongs to an army, the army being thought of as encamped.

J. G. BARNARD.

Soldier, p.-v. and tp., Monona co., Ia. P. 193.

Soldier, tp., Shawnee co., Kan. P. 1430.

Soldiers' Homes are institutions of a permanent character founded by government for the benefit of men worn out or disabled in the military service of their country. They should not be classed among charitable institutions, because the beneficiaries have in some way rendered an equivalent for the benefits provided for them, or have contributed to their maintenance, and no others can obtain those benefits. These homes take the place, for the enlisted soldier who has served faithfully, of the provision made by the retired list for commissioned officers.

In the U. S. the founding of a soldiers' home dates from Mar. 3, 1851, when an act of Congress was passed and approved "to found a military asylum for the relief and support of invalid and disabled soldiers of the army of the U. S." For years before this, however, the principal officers of the army, particularly Major-Gen. Winfield Scott, had given the subject attention, and had made special efforts to procure the needed legislation. Feb. 27, 1829, a report was made by the committee on military affairs in Congress upon the subject of establishing an "army asylum fund," and submitting letters from the major-general commanding, and other officers of the U. S. army, containing an expression of their views in relation thereto. In Feb., 1840, Gen. Robert Anderson (then captain and assistant adjutant-general U. S. army) embodied in a letter to Hon. John Reynolds his views upon the benefits and advantages which would follow the establishment of such an institution, and suggested a plan for providing for one. This letter was made the basis of a report dated Jan. 7, 1841, by the military committee, submitting a bill embracing the measures suggested therein, and advising the necessary legislation for an object which commended itself "by every attribute and motive of patriotism, benevolence, national gratitude, and economy." In 1844, Gen. Scott gave the subject special prominence in his annual report, and upon this the military committee again reported as before. Reports were also made Mar. 5, 1846, and Jan. 19, 1848, the former upon a memorial of the officers of the army stationed at Fort Moultrie and the petition of the officers of the 2d U. S. Infantry, and the latter upon a memorial of the officers of the army then in Mexico; and in each case the committee approved the bill reported Jan. 7, 1841. In Feb., 1848, Gen. Scott transmitted to the secretary of war a draft for $100,000 as part of the tribute levied by him on the City of Mexico for the benefit of the army, and he expressed the hope that it might be allowed to go to the credit of an army asylum. Again, in Nov., 1849, in another letter he says, referring to the same matter: "The draft was made payable to me, and in order to place the deposit beyond the control of any individual functionary whatever I endorsed it 'The Bank of America will place the within amount to the credit of the army asylum, subject to the order of Congress.' The funds were at first turned into the public treasury, and subsequently, in the act to found the asylum, were, with a balance of $18,791.19 remaining from the same levy, appropriated for the support of the institution. The act also defines the class of men entitled to the benefits of the asylum—viz. soldiers of twenty years' service, pensioners (who must surrender their pensions), and men disabled by wounds or disease in the service and in the line of duty. It designated as a board of commissioners, *ex officio*, to administer the affairs

of the asylum, the general-in chief commanding the army, the generals commanding the Eastern and Western military divisions, the chiefs of the quartermaster's, commissary, pay, and medical departments, and the adjutant-general of the army. It appropriated an unexpended balance [illegible] of a previous appropriation "for the benefit of discharged soldiers disabled by wounds," and provided for a perpetual revenue, "stoppages and fines adjudged against soldiers by sentence of court-martial," "forfeitures on account of desertion," a certain portion of the hospital and post fund of each station, moneys belonging to estates of deceased soldiers and unclaimed for three years (the latter to be repaid to legal heirs on demand), and also for the deduction of twenty five cents per month, with the consent of the soldier, from the pay of each enlisted man. By act of Congress approved Mar. 3, 1859, the provisions of the original act were changed to reduce the number of commissioners to three—the commissary-general of subsistence, the surgeon-general, and the adjutant general of the army; to substitute the name "soldiers' home" for "military asylum;" to reduce the soldier's contribution to twelve and a half cents per month; and to extend the benefits of the "home" to the soldiers of the war of 1812.

Temporary asylums were established in 1851 at New Orleans, La., Greenwood's Island, Miss., and in Washington, D. C. The first named was continued only about one year. In Mississippi the purchase of a tract of about 110 acres having been completed early in 1853, it was occupied till 1855, when the inmates were removed to a branch asylum at Harrodsburg, Ky., where an estate of about 200 acres had been purchased early in 1853. This in turn was discontinued in 1858, under an act of Congress approved Mar. 3, 1857, to abolish that branch and sell the property.

The principal and only permanent home for the regular army was established in the District of Columbia in 1851–52. It is located about 3½ miles due N. from the Capitol in the city of Washington. The original purchase of land was 256 acres. To this was added in subsequent years up to 1869 about 16 acres, and in 1872 the adjoining estate of "Harewood," containing 191 acres, was purchased from W. W. Corcoran, Esq., of Washington. A portion of these spacious grounds is cultivated for farm and garden produce for the benefit of the home inmates, a portion in orchards and flower-gardens, and the remainder is a grand park. The natural topography of the ground favors the construction of numerous extended drives winding through groves of shade and ornamental trees of every native and foreign variety, and over the open ground commanding fine views of the city, the Potomac River, and the surrounding country for miles. The park being open to the public, except on Sunday, the old soldiers derive much amusement from watching the many vehicles constantly passing through their home. The home (building) is of white marble. The original building, commenced in 1852, and completed in 1857, was of Norman design, 151⅓ feet long by 57 feet wide, with a clock tower, and would accommodate 150 inmates, besides affording rooms for offices, library, mess-room, etc. An additional story and Mansard roof, constructed since, give increased accommodations for about 400 inmates. The whole number of inmates, transient and permanent, admitted up to the year 1876, was about 1800. A neat chapel, built of red stone, was completed in 1871. Religious worship, Protestant and Roman Catholic, is regularly observed. The home is supplied with a library of about 3000 volumes, and with newspapers and magazines, both foreign and domestic. In 1874 a portrait-statue in bronze, ten feet high, of Lieut.-Gen. Winfield Scott, executed by Launt Thompson of New York, was erected upon the most prominent point in the grounds. In 1876 a model hospital was completed, not only for the sick, but as an infirmary for the aged and helpless inmates. The officers of the home are a governor, a deputy governor, and a secretary and treasurer, who, with a medical officer, are detailed from the army. Inmates receive $1 per month pocket-money, and a per diem for any labor they can perform. A small monthly stipend is allowed to some beneficiaries, who, having families, are permitted to live elsewhere than at the home.

Under an act of Congress approved Mar. 3, 1865, amended by an act approved Mar. 21, 1866, to found "the National Asylum for disabled volunteer soldiers"—which name was changed to "Home" by act approved Jan. 23, 1873—soldiers' homes have been established near Augusta, Me., Hampton, Va., Dayton, O., and Milwaukee, Wis., for the benefit of volunteer soldiers disabled by wounds or disease contracted in the U. S. service during the war of the rebellion (1861–65). The volunteer homes are under the management of a board of twelve commissioners, the President of the U. S., the secretary of war, and the chief-justice of the U. S. being members *ex-officio*, and nine others elected by joint resolution of Congress for a term of six years, who must be citizens of the U. S. and residents of States which furnished troops for the suppression of the rebellion, but no two can be residents of the same State. The revenue for the support of these homes was at first from a source similar to that for the regular home, but is now provided by annual appropriations in Congress.

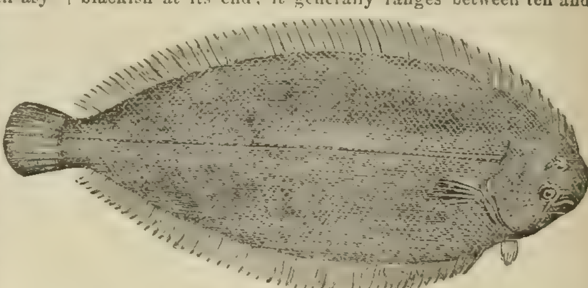
The principal institutions of a similar character in Europe are Chelsea Hospital, at Chelsea, a suburb of London; Kilmainham Hospital, a sister institution near Dublin, Ireland; the Hôtel des Invalides, in Paris, France, noted as the locality of the tomb of the great Napoleon; and an institution of the same name at Berlin, Prussia.

O. W. Longan.

Soldin′, town of Prussia, province of Brandenburg, has manufactures of leather, tobacco, earthenware, and tiles. P. 5489.

Sole [Lat. *Solea*], the name given to fishes of the order Heterosomata in different English-speaking countries. (1) In England it is distinctive of the *Solea vulgaris*, to which it properly alone belongs. This species is a typical representative of the family Soleidæ, in which the scales are ctenoid, the vertical fins not confluent, the pectorals of both sides developed, and the color dark brown on its upper and white on its lower side, with the pectoral fin blackish at its end; it generally ranges between ten and twenty inches in length, and between one and ten pounds in weight, although the latter dimensions are rarely attained. It is found along almost the entire coast of Europe, and is one of the most esteemed of fishes; the flesh is white and firm, and is in season in all months of the year except the spawning-time, which takes place toward the end of winter. It is chiefly taken on the English coast by trawling. A recent attempt has been made (1875), at the expense of Mr. Kidder of Boston, under the superintendence of Prof. Baird, U. S. commissioner of fisheries, to introduce it into the Massachusetts waters. (2) The name is extended, with a qualifying adjective, to related species on the British coast; *e. g.* the *Solea* (*Pegusa*) *aurantiaca*, or lemon sole. (3) Occasionally it is used for the *Achirus lineatus* of the Eastern U. S., the nearest American ally of the European species, but this is more popularly known as the hog-choker, coverclip, or calico: it is a worthless fish. (4) In California it is applied to several species of true Pleuronectidæ—*e. g. Parophrys vetula*, *Lepidopsetta umbrosa*, *Psettichthys melanostictus*, and *Orthopsetta sordida*. These have few characters in common, and belong even to different subfamilies, *Parophrys* and *Lepidopsetta* being Pleuronectinæ, in which the mouth is small; *Psettichthys*, one of the Hippoglossinæ, characterized by a large mouth and the narrow lateral insertion of the ventrals; and *Orthopsetta*, a genus of Rhombinæ, distinguished by the large mouth and the insertion of the ventrals by a long base on the ridge of the abdomen. They are not much esteemed.

Theo. Gill.



The Common Sole of Europe.

Solebury, tp., Bucks co., Pa. P. 2791.

Sol′ecism, a violation of the laws of syntax or of the laws of thought, was derived from Soli (Σόλοι), a city in Cilicia, founded by colonists from Attica, but subsequently notorious for the bad and utterly corrupted manner in which its inhabitants spoke the Greek language.

Soledad, tp., Los Angeles co., Cal. P. 265.

Sole′idæ [from *Solea*, the Latin name of the typical form], a family of fishes of the order Heterosomata, distinguished by the form of the body, which has been likened to the sole of the foot. The body is oblong or elongated, and nearly equally developed above and below the lateral line; the scales are small (ctenoid or cycloid), or absent; the lateral line mostly straight (sometimes double or triple); the head small, and with a rounded projecting snout, and

more or less hooked upper jaw; the eyes are approximated, and the upper is further forward than the lower; the opercula concealed by the scales; the mouth unsymmetrical, and rather small and curved; teeth generally confined to the blind side of the jaws, and villiform (sometimes wanting); branchial apertures restricted above; branchiostegal rays typically seven; dorsal, anal, and caudal fins typically separate, sometimes confluent; the dorsal commences on the snout, the anal under the pectoral fin; pectorals small or (in some genera) absent; ventrals small and variously developed. The vertebræ are very numerous, but unequally distributed, in the typical forms the abdominal or rib-bearing ones being only eight or nine in number, and the caudal about forty. The family is well distinguished by the physiognomy from the Pleuronectidæ, especially so far as the European and American species are concerned, but some Australian types lessen the distance between them. Species are found in every sea except the extreme polar ones, but are most abundant in the tropics: about 100 have been distinguished. The most notable is the sole (*Solea vulgaris*) of Europe. Two species are found along the eastern American coast—*Achirus lineatus* and *Plagusia plagiusa*—but are of no economical importance. None are known from the Pacific coast, the several species called sole at San Francisco being true Pleuronectidæ. (See SOLE.) THEODORE GILL.

Solemn League and Covenant. See COVENANT, NATIONAL, OF SCOTLAND.

Solemn League and Covenant. This international politico-religious agreement figures very prominently in the history of Scotland and England during the Puritan revolution. It was drawn up in 1643. It agrees in spirit with the "National Covenant" of 1638, but has a wider scope, extending over the three kingdoms, while the National Covenant was purely Scotch. It aims at a complete uniformity in religion throughout Scotland, England, and Ireland (which was an impossibility, as the result proved), and grew out of the intense religious ardor of an age in which Church and State, ecclesiastical and political interests, were blended. It consists of six articles—pledging the subscribers to preserve the established Presbyterian religion in Scotland, to extend it to England and Ireland, to put down popery, prelacy, superstition, heresy, and immorality, to uphold the rights of Parliament and a constitutional monarchy, and to defend every member of the confederation. The first article is the most important, and reads thus: "We noblemen, barons, knights, gentlemen, citizens, burgesses, ministers of the gospel, and commons of all sorts, in the kingdoms of England, Scotland, and Ireland, . . . with our hands lifted up to the most high God, do swear: That we shall sincerely, really, and constantly, through the grace of God, endeavor, in our several places and callings, the preservation of the Reformed Religion in the Church of Scotland, in doctrine, worship, discipline, and government, against our common enemies; also the Reformation of Religion in the kingdoms of England and Ireland in doctrine, worship, discipline, and government, according to the Word of God and the example of the best Reformed churches; and we shall endeavor to bring the churches of God in the three kingdoms to the nearest conjunction and uniformity in Religion, Confession of faith, form of Church government, Directory of Worship and Catechising, that we and our posterity after us may, as brethren, live in faith and love, and the Lord may delight to dwell in the midst of us."

The immediate occasion of the Solemn League and Covenant was the joint application of the Long Parliament and the Westminster Assembly of Divines to the Scotch Convention of Estates and the General Assembly, then in session at Edinburgh, for effectual aid in the war against the usurpations of Charles I. The English desired a civil league, the Scotch a religious covenant, having been used to the system of covenanting from the days of the Reformation. Both schemes were combined, and the religious feature made prominent. Alexander Henderson, the moderator of the General Assembly, and a man second only to Knox in the esteem of the Scotch people, drew up the document. It was unanimously ratified by the General Assembly and the Convention of States Aug. 17, 1643. The people went into it with the *perfervidum ingenium Scotorum*, and signed it with eagerness all over the country, from city to city, from village to village, from parish to parish. The members of both houses of the Long Parliament and the divines of the Westminster Assembly adopted and solemnly signed the Covenant in St. Margaret's church, under the shadow of Westminster Abbey, Sept. 25, 1643. The adherents of Parliament throughout England followed the example, notwithstanding the king's prohibition. The two countries entered into a treaty Nov. 29, 1643, by which the Scotch promised, on the basis of the Covenant thus ratified, to furnish an army of 18,000 foot, 2000 horse, and 1000 dragoons, for the common war against royal and prelatical tyranny; England to refund the expenses after the conclusion of peace. The united army fought and conquered under the banner of the Covenant. But the positive end was not attained, and was in fact unattainable. No human power could bring England and Scotland under one system of doctrine, government, and worship. Presbyterian uniformity was as impracticable and undesirable as Episcopal uniformity, and could only be conceived of in an age which had no idea of toleration and liberty of conscience. The Covenant was weakened in England by the dissensions between Presbyterians and Independents and the establishment of the Commonwealth under Cromwell. The Scotch still adhered to the monarchy and favored its restoration. With the Restoration the Solemn League lost its significance, and was burnt by a hangman (1662). Charles II. had indeed twice signed it and sworn to it in exile—at Spey June 23, 1650, and at his coronation at Scone Jan. 1, 1651—but he broke his oath as soon as he ascended the throne in 1662, and re-established the royal supremacy and episcopacy, not only in England, but even in Scotland. The Covenanters or Cameronians continued to adhere to the Solemn League, and fought for it with the heroic spirit of martyrdom through all those troubled times,

"Whose memory rings through Scotland to this hour."

(See the relevant chapters in the general histories of Scotland (Burton, etc.) and England; the special histories of Puritanism by Neal, Marsden, etc.; the histories of the Church of Scotland by Cunningham, Stephens, Hetherington, etc.; also Baillie's *Letters and Journals* (ed. by Laing); John Stoughton, *The Church of the Civil Wars*, i. 293, 320; Masson, *Life of John Milton*, iii. 6–15.) PHILIP SCHAFF.

So'lenhofen Beds, a famous group of lithographic slates of the Middle Oolite, found at Solenhofen in the Pappenheim district, near Eichstadt in Bavaria. They not only afford the best lithographic stone, but they are singularly rich in well-preserved fossils, including many insects, several saurians, seven species of *Pterodactylus*, and the wonderful bird ARCHÆOPTERYX (which see).

Solenocon'chæ [Gr. σωλήν, "channel," and κόγχη, "shell"], mollusks belonging to the class Gasteropoda, subclass Prosopocephala, of which they form the thirteenth order. (See CONCHOLOGY and GASTEROPODS.)

Solenog'lypha [from Gr. σωλήν, "tube," and γλυφίς, "notch"], a sub-order of ophidians, including venomous serpents. The superior maxillary bones are excessively abbreviated anteriorly and posteriorly, and thereby assume a vertical aspect, and are thus adapted to support the venom-fangs; they are each united to the anterior frontal at its upper extremity and to the ectopterygoid at the lower extremity of its posterior face by ginglymoid articulations; the fangs (except in *Causus*) are completely tubular, by reason of the obliteration of all external trace of the enfolded canal and the complete enclosure of the poison-channels. Other characters are attributed by Cope, but given as "not universal"—*e. g.* the tympanic bones are much elongated, and thereby entail a great breadth of the head behind, and the contradistinction between it and the neck, so conspicuous in the familiar species; a deep pit; the pupils of the eyes are generally erect and elliptical; the occipital region is scaly. The sub-order includes the most poisonous and dreaded snakes, at least of America, for some equally dangerous in Asia, Australia, and Africa belong to the sub-order Proteroglypha. By Cope four families are recognized—viz. (1) Crotalidæ, including the rattlesnakes and copperheads; (2) Viperidæ, typified by the vipers of Europe and Africa; (3) Causidæ and (4) Atractospidæ, small groups represented by African snakes. THEODORE GILL.

Solenos'tomi [from Gr. σωλήν, "tube," and στόμα, "mouth"], a sub-order of the order Lophobranchii, contradistinguished from the Syngnathi by the development of two dorsal fins, the anterior of which has simple and the posterior articulated rays, as well as by the existence of ventral fins. THEODORE GILL.

Solenostom'idæ [from *Solenostomus*—σωλήν, "tube," and στόμα, "mouth"—the generic name], a family of fishes of the order Lophobranchii. The body is compressed and has a short tail; the armature is developed as large star-like ossifications covered with a thin skin; the head is produced into an elongated tube forward; the mouth is small, and at the extremity of the tube; the branchial apertures are very narrow; branchiostegal rays four and very fine; dorsal fins two, on elevated bases, the anterior with five inarticulated rays; the posterior with many articulated rays; anal fin elongated, also on an elevated base; caudal fin elongated; pectoral fins well developed; ventral fins arising opposite the anterior dorsal, close together, and

each with seven rays; in the males they are free, but in the females they coalesce by their inner sides with the integuments of the breast, and a large egg-pouch is thereby formed. The vertebral column has about eighteen abdominal and [illegible] caudal vertebræ; the intestinal canal is [illegible], and has a stomachic dilatation, but no pyloric appendages. The family is represented by a single known [illegible] of three species, all of which are in[illegible] the Asiatic seas, one (*S. cyanopterum*) ranging from Zanzibar to China, while the others (*S. paradoxum* and *S.* [illegible]) are confined to Amboyna. According [illegible], "There is a peculiar provision for the retention of the eggs in the sac, and probably for the attachment of the embryo. The inner walls of the sac are lined with long filaments, arranged in series along the ventral rays, and more numerous and longer at the base of the rays than in the middle of their length, behind which they disappear entirely." These are most developed when eggs are in the sacs, and some are about half an inch long and have mamilliform appendages. THEODORE GILL.

Solesmes′, town of France, department of Nord, manufactures calicoes, handkerchiefs, felt hats, and earthenware. P. 6000.

Soleure′ [Ger. *Solothurn*], canton of North-western Switzerland, comprises an area of 255 sq. m., with 74,713 inhabitants, of whom 62,072 are Roman Catholics and 12,148 Protestants; they all speak German. The surface is covered by offshoots of the Jura Mountains, which here are very rich in iron and marble. The soil is fertile, and produces more corn and wine than demanded for home consumption. Rearing of cattle, sheep, and swine is extensively carried on. Manufactures are confined to iron goods, glassware, and watches.

Soleure [Ger. *Solothurn*], an old town of Switzerland, capital of the canton of Soleure, at the foot of the Jura Mountains, on both sides of the Aar. It has a fine cathedral, several interesting museums and collections, and manufactures of linen, tobacco, and watches. P. 5916.

Solfeggio. See SOLMIZATION.

Solferi′no, village of Northern Italy, province of Brescia, is celebrated for the battle in which the French and Italians utterly defeated the Austrians (June 24, 1859).

Sol′ger (KARL WILHELM FERDINAND), b. at Schwedt, Prussian province of Brandenburg, Nov. 28, 1780; studied at Halle and Jena; was appointed professor of philosophy at Berlin in 1811. D. there Oct. 20, 1819. He wrote *Erwin, Vier Gespräche über das Schöne und die Kunst* (2 vols., 1815), and *Philosophische Gespräche* (1817). His posthumous writings and letters were edited by Tieck and Raumer (1826), his *Vorlesungen über Æsthetik* by Heyse (1829). In 1808 he published an excellent translation of Sophocles. His treatises on beauty and art may be considered as representative of the ideas of the romantic school.

Soli. See CILICIA.

Solic′itor [Lat. *sollicitator*], an officer of the court of chancery, corresponding to the attorney of the common-law courts, whose function is to bring and defend suits therein on behalf of litigant parties. Until very recently the solicitors and the attorneys were distinct branches of the legal profession in England. The statute of 23 and 24 Vict. ch. 127 (1860) provided for the admission of persons as attorneys and solicitors after serving a specified period of clerkship and passing an examination, but no one could practise in the courts of equity until he had been enrolled as a solicitor. The recent consolidation of all the higher courts of England into one "supreme court of judicature" (1875) has produced a corresponding amalgamation or identification of these two professional classes—the attorneys and the solicitors—into one. In the very few States of this country where a separate court of chancery exists—as in New Jersey—the office of solicitor is retained, although each member of the bar may, and usually does, become an attorney of the law-courts, a solicitor in chancery, and a counsellor in both. In the great majority of the States no such division is even nominally kept up, and the lawyer upon his admission acquires at once the functions of the English attorney, solicitor, and barrister.
JOHN NORTON POMEROY.

Solids [Lat. *solidus*], in geometry, magnitudes having three dimensions, length, breadth, and thickness, in contradistinction to surfaces, which have only two, length and breadth, lines, which have only one, length, and points, which have none. In physics that state of matter in which the attractive force of the molecules is greater than the repulsive, in contradistinction to that in which the two forces are nearly equal, and which is called *liquid*, and that in which the repulsive is greater than the attractive, and which is called *gaseous*.

Sol′idus [Lat. for "solid"], the later Latin name for the Roman gold coin called *aureus*. Originally worth about \$5 of our currency, its weight and value gradually declined, while *aurum* seems to have become *cuprum*, until the French *sol* or *sou*, one of its representatives, was worth less than one cent. The *soldi* formerly struck in Italy were also historical representatives of the old *solidus*. (See SOLDIER.)

So′lingen, town of Rhenish Prussia, was famous for its manufactures of iron and steel goods, especially sword-blades, in the Middle Ages, and it has maintained its reputation. In the town and circle 8000 men produce 1,000,000 pairs of scissors, 2,000,000 dozen knives, and 500,000 sword-blades annually, which are sent to almost every market in the world. P. 14,040.

Soli′nus (CAIUS JULIUS), surnamed GRAMMATICUS, lived in the latter part of the second or the first part of the third century, and wrote a work, still extant, under the title of *Polyhistor*, in which he gives a brief sketch of the world as it was known to him, accompanied with historical notices and remarks on the origin, habits, religious rites, and social condition of the various nations. The whole, however, is derived from the *Natural History* of Pliny, and has no independent value. In the Middle Ages the book was much read. Editions by Salmasius (1689) and by Götz (1777), and an English translation by Golding (1587).

So′lis, de (ANTONIO), b. at Alcalá de Henares, Spain, July 18, 1610; was educated for the law at the University of Salamanca; produced at the age of seventeen his successful comedy, *Amor y Obligacion*, which revealed such poetical talent as to introduce him to the notice of Calderon and to determine his vocation for literature; enjoyed the patronage of the count of Oropesa, viceroy of Navarre, who made him his secretary; obtained a lucrative post in the state department 1642; was appointed secretary by Philip IV. about 1655, and historiographer of the Indies 1665; wrote a celebrated *Historia de la Conquista de Mexico* (1682), more valuable as a Spanish classic than as an American history; took holy orders 1666, and thenceforth wrote chiefly on sacred subjects. D. at Madrid Apr. 19, 1686. Among his comedies, *Triumfos de Amor y Fortuna*, *El Alcazar del Secreto*, *La Gitanilla de Madrid*, and *Un Bobo hace Ciento* are esteemed masterpieces. A volume of lyrics, *Varias Poesias*, appeared in 1682, and a posthumous collection of fourteen plays in 1732, and a volume of his letters 1737. There are many editions of his *History*, which has enjoyed great popularity in French and Italian versions, and was translated into English by Thomas Townsend (London, 1724).

Solis, de (JUAN DIAZ), b. at Lebrija about 1470; became a skilful pilot; accompanied Vicente Gomez Pinzon upon the voyage in which he is supposed to have discovered Yucatan (1506), and again in the exploration of the northern coasts of Brazil 1507–08; was appointed royal pilot on his return to Spain; was sent with Pinzon on a new voyage of exploration in South America, in which they reached lat. 40° S.; was deprived of his post and thrown into prison 1509, in consequence of a quarrel and lawsuit with Pinzon; was appointed chief pilot on the death of Vespucius, and in 1512 was allowed to equip at private expense another squadron, with which he discovered the Rio de la Plate, and returned there three years later, when he was murdered by Indians on the northern bank of that river (then called "Rio de Solis"), near Maldonado, in 1516.

Solitaire′, the *Pezophaps solitaria*, a bird formerly inhabiting the island of Rodriguez, near the Mauritius. When the island was settled by the French Huguenots in 1691 it was found abundantly. It was something larger than the turkey, and did not use its wings for flight. It was a slow runner, and defended itself with its wings and beak. Its flesh was good. A rude wood-cut, a description by François le Guat, and a few bones are all that remain of this bird. It is generally supposed to have been of the dodo family, but may have been of the ostrich tribe.

Solitaire, a kind of puzzle, consisting of a disk with thirty-three hollows, all but one of which contain a single ball. The game is to jump over and remove each of these balls, going over only one ball and two spaces at a move, and never moving diagonally, until only one ball remains. The game is to be played by a single person, whence the name. There is also a game called solitaire, which is played by a single person with ordinary playing-cards.

Soller′, town of Majorca, on the north-western coast of the island, has a good harbor and exports large quantities of oranges and other kinds of fruit. P. 6990.

Sol′ly (EDWARD), F. R. S., b. in London, England, Oct. 11, 1819; educated at Berlin; became chemist to the Royal Asiatic Society 1838, lecturer at the Royal Institution 1841, and professor of chemistry in the Military College at Addiscombe 1845; gave especial attention to the applications

of chemistry to agriculture and technology; is author of many scientific memoirs and of *Rural Chemistry* (1843) and *Syllabus of Chemistry* (1849).

Solly (SAMUEL), M. D., b. in England in 1805; became a distinguished London surgeon; was lecturer on practical anatomy at St. Thomas's Hospital 1833–39, assistant surgeon of the same institution 1840, and surgeon 1850; member of the council of the Royal College of Surgeons 1856; professor of human anatomy and surgery 1862, and member of the court of examiners and senior vice-president 1867–70. D. in London Sept. 24, 1871. Author of *The Human Brain, its Configuration, Structure, Development, etc.* (1836), and *Surgical Experiences* (1865).

Solmiza'tion, Solfeggio, or **Solfaing** [Fr. *solmisation*, from the notes *sol, mi*], in music, the art of giving to each of the seven notes of the scale its proper sound or relative pitch. The acquiring of a true intonation of the scale, first by regular gradation upward and downward, and then by skips from one degree to another, is an object of primary importance in vocal music. To facilitate this, various expedients have been devised, but chiefly the association of the several sounds with articulate utterances, such as the numeral words, *one, two, three*, etc. Many centuries ago certain syllables, void of any special meaning, but containing the several vowel sounds, were selected for this purpose, and have since come into general use. Their origin is referred to Guido, a monk of the tenth century, who derived them from the initial syllables of words in a popular hymn. (See GAMUT.) These syllables, originally six in number, were *ut, re, mi, fa, sol, la*, to which the syllable *si* has since been added for the seventh of the scale. In the course of time objection was made to the syllable *ut*, on the ground of its want of euphony; and in consequence it was rejected by the Italians, who substituted for it the syllable *do*. With these modifications the system of Guido is received in the schools both of Italy and England, whence it has come into use in the U. S. and other parts of America. WILLIAM STAUNTON.

Solmo'na [*Sulmo*], town of Italy, province of Aquila degl' Abruzzi, in the plain S. W. of Chieti. It is not an ill-built town, and among other respectable edifices the cathedral and the church of the Annunziata are especially noteworthy. Sulmo was one of the towns which experienced the terrible vengeance of Sulla for having taken part with Marius; it was also several times almost utterly destroyed by the barbarians, but again rose to prosperity under the Normans. The bishop of Solmona is immediately subject to the Holy See. P. 15,019.

Solo'fra, town of Italy, province of Avellino, pleasantly situated in a valley in the midst of the Apennines, about 12 miles N. E. of the town of Avellino. Solofra is remarkable for the skill of its goldsmiths, and especially for the delicacy of the gold-leaf produced by them. The leather manufactured here is also of a superior quality. Many other articles are made by the inhabitants, who are exceptionally intelligent and industrious. The ruins of the ancient *Sabatium*, the refugees from which are said to have founded Solofra, are traceable in the neighboring flats of the Ogliara. P. 5771.

Sol'omon, tp., Cloud co., Kan. P. 513.

Solomon, tp., Saline co., Kan. P. 581.

Solomon [*Shĕlômô, Salômôn, Salomo, Suleiman*], probably the last son of David and second child of Bathsheba, b. 1033, called by the father Solomon, "the peaceful one," in token of the peace of the kingdom or his own peace of mind; called by Nathan, in token of David's forgiveness, Jedediah, "the darling of the Lord" (in which to the father's name the name of Jehovah is added). His birth, name, and character had been foretold to David. His mother, once a willing adulteress, was crafty and ambitious. The child was trained by Nathan (Jehiel) the prophet-priest in all Hebrew learning; he afterward studied the learning of other nations. David had solemnly sworn to Bathsheba that Solomon should succeed him, and he openly proclaimed him king when Adonijah tried to seize the throne. He was soon after formally "established" (1015). He reigned thirty nine years and six months. He at first pardoned Adonijah, but soon after slew him and Joab, banished Abiathar, and severely rebuked his own mother, who were all implicated in new intrigues, and slew Shimei, the last bitter leader of Saul's house. He began his reign humbly and wisely, asking God for wisdom, which was granted. In his fourth year he began his great work, the "house of the Lord." David had planned it after the tabernacle, and had gathered enormous treasures for it. In building, Solomon was helped by Hiram, king of Tyre, with timber and stone from Lebanon, and skilled artisans. It was completed in seven years, and its dedication was the crowning day of Jewish history, and in the service Solomon appears as the supreme head of the nation. He built his own palace from his seventh to his twentieth year. In it were the wonderful and beautiful "house of the forest of Lebanon," the tower of David, around which hung many golden shields, the porch, and the celebrated ivory "throne of the house of David." He peacefully consolidated the empire which his father had conquered, and recaptured, fortified, or built cities or stations for commerce or protection at strategic points—the towers of Lebanon, Hamath, Megiddo, Gaza, Bethhoron, Baalath, and probably Tadmor and Baalbec. He built reservoirs, aqueducts, many wonderful buildings, and laid out "paradises" and gardens. He started the hitherto pastoral or agricultural Hebrews on the new road of commerce, sending ships to "Ophir," India, and Arabia in the East from the new-built port of Ezion-geber on the eastern arm of the Red Sea, and from Jaffa and Tyre westward to "Tarshish," Spain, and England (?). He reorganized and enlarged the civil service of David. Many kings were his tributaries; untold wealth and the wonders and curiosities of many countries flowed into or through the land, so that "silver was nothing accounted of in his day." Everywhere there were signs of great delight and prosperity. Many foreigners were attracted by his splendor and wisdom, notably Balkis (?), the queen of Sheba, with her marvellous retinue. His harem grew to number 1000 inmates, and thus to accord with Oriental ideas of his royal magnificence. Contrary to the law of Moses, he not only multiplied wives, but by his marriages formed alliances with many heathen nations. He married a daughter of Pharaoh (Vaphres, Psusennes?). In his old age his "strange" wives led him to commit or permit gross and vicious idolatry. He allowed the worship in sight of the Lord's house, led thereto by his "liberal" views and motives of state policy. Before his death, Edom and Syria revolted, tribal jealousies arose in Israel, and Jeroboam, formerly a superintendent of building, began to plot the division of the nation, in which he was aided by the alienation of the people coming through the intolerable oppression and taxation that were necessary to meet the enormous expenses of the court. He left one son, Rehoboam, who succeeded him, and from whom ten tribes revolted. Solomon appears as a person of fascinating beauty and grace, impetuous, generous, sympathetic, and at first humble; of fine humor, noble intellect, endowed with the prudence of his father's family and the almost supernatural sagacity of his mother's grandfather, Ahithophel; a man of broad views, a far sighted statesman, most learned in the science of the day (from his writings the rabbins say Aristotle drew all his philosophy (?), and in the East he has always been regarded as the master of all magic). He was an organizer of splendid executive powers, a great builder and artist, poet, philosopher; and had from the Lord pre-eminently "an understanding heart to judge." In religion he was first devout, then æsthetic, then formal, then indifferent, then idolatrous. He was in later life guilty of great oppression and a growing disregard of human rights. He followed the evil example of David in the matter of polygamy, thereby destroying family sanctity and leading the people to impurity; above all, he forsook Jehovah and followed strange gods. The question of his repentance has been greatly discussed. Against it is urged the silence of the Bible and the mere philosophical results to which he comes in Ecclesiastes. This view has been held by Tertullian, Cyprian, Gregory the Great, Augustine, and the Latin Fathers generally. For it is urged, Neh. xiii. 26; God's covenant in 2 Sam. vii. 14; Ps. lxxxix. 30 ; the final teachings of Ecclesiastes, and the typical relation he bears to the Messiah. This view is favored by Irenæus, Hilary, Cyril, Ambrose, Jerome, and the Greek Church generally. Solomon appears as a voluminous author; his extant writings are Proverbs, Ecclesiastes, and the Song of Songs. ISAAC RILEY.

Solomon Ben Gabirol, a Jewish philosopher and poet, b. in Malaga, Spain, about 1020; lived for a time at Saragossa; wrote a Hebrew hymn, *Kether Malkuth* ("Crown of Royalty"), which has been incorporated into the Hebrew liturgy. His philosophical works were written in Arabic, one of them, the *Source of Life*, being cited by several Christian writers of the Middle Ages, the name of the author appearing as Avicebron, Avencebrol, and other corruptions of the Heb. "Ben Gabirol" or the corresponding Arab. "Aben Gebiol." D. at Valencia (or, according to some, at Ocaña) about 1075.

Solomon Ben Isaac, surnamed YARKI or IARCHI, and generally known under the name of RASHI, an abbreviation of RABBI SHELOMOH YITZ'HAKI, b. at Troyes, France, about 1040; became rabbi at the synagogue, and d. there July 13, 1105. He wrote commentaries on the Talmud and the Bible which rank very high in Jewish theology. His

commentaries on the Bible have been translated into Latin by Breithaupt (3 vols., Gotha, 1710–14), and parts of them into German—Genesis by Hayman (Bonn, 1833) and the whole Pentateuch by Lucas (Prague, 1833–38).

Solomon City, p.-v., Dickinson co., Kan., on the Kansas Pacific R. R. and Solomon River, 100 miles W. of Topeka, has churches, good schools, 1 newspaper, several flouring-mills run by water-power, and 2 hotels. Salt and gypsum manufacturing is carried on.

WILSON & ADMIRE, EDS. "GAZETTE."

Solomon Islands, a group of islands in the Pacific Ocean between New Britain and Queen Charlotte's Islands, and between lat. 5° and 12° S. Although they were discovered in 1567 by Mendana, they are as yet very little known. The inhabitants are negrillos, and very savage. They are cannibals.

Solomon Rapids, tp., Mitchell co., Kan. P. 65.

Solomon's Seal, a popular name for the liliaceous herbs of the genera *Polygonatum*, *Smilacina*, and *Majanthemum*. They are found in both continents, and there are quite a number of species, some common to Europe and North America. The roots are popularly esteemed as a vulnerary, and have some use in domestic medicine. The name properly belongs only to the species of *Polygonatum*; the "seal" is the circular depressed scar left on the rootstock by the death and separation annually of the flowering stem.

Solomon, Song of. See CANTICLE.

Solomon's Temple. See JERUSALEM, by REV. HOWARD CROSBY, S. T. D., LL.D.

Solomon, Wisdom of. See WISDOM, BOOK OF.

So'lon, p.-v., Big Grove tp., Johnson co., Ia., on Burlington Cedar Rapids and Minnesota R. R.

Solon, p.-v. and tp., Somerset co., Me. P. 1176.

Solon, tp., Kent co., Mich. P. 911.

Solon, p.-v. and tp., Cortland co., N. Y. P. 872.

Solon, p.-v. and tp., Cuyahoga co., O. P. 899.

So'lon, the son of Exekestides, filled the office of first archon in Athens (Ol. 46, 3; B. C. 594), and in that capacity established there the constitution framed by him. This is the best-attested circumstance in the life of Solon, for which Plutarch is the principal authority. Plutarch's sources of information were the Alexandrian grammarians, especially Didymos Chalkenteros, the most copious of all compilers, and among the older biographers Hermippos: most important of all are the fragments of Solonic poems which Plutarch has taken up literally into his narrative. The section of Aristotle's *Politica* (ii. 12) which treats of the legislation of Solon is a compilation of later date. Solon is the noblest representative of the many-sidedness which distinguished the Athenian more than all other Hellenes. An Eupatrid by birth, he engaged also in trade and commerce by sea—a combination of activities usual in the Grecian coast-cities, especially Korinth and Athens. By this means it was possible for him, after finishing all exercises, as well in music and poetry as in gymnastics, to become acquainted with the entire coast-world of the Archipelago. It was a time of fermentation in society; Psammetichos had opened the Nile-region to the Greeks (B. C. 666); the first money had been coined in Ægina; navigation took all at once a gigantic stride forward; young adventurers gained in a few years great riches, and those parts of the communities engaged in trade took form as a new middle class, and stood defiantly opposed to the ancient families; property in land was outstripped by movable capital; around Athens on all sides—in Argos, Korinth, Sikyon, Megara—the old system of things had been broken, the ruling families had been overthrown, and through the downfall of the constitutions single tyrants had come to power, who shone by their riches, employed mercenary troops, and pursued a narrow policy of self-aggrandizement. In this revolutionary time, spite of all splendor, the best possessions of the nation were endangered—namely, the free citizen class and the sovereign authority of the law. For this reason Solon deemed it the work of his life to give his native city the benefit of all progress in culture which the times offered, without causing her to break with the past and be exposed to the deplorable evils connected with a revolution. A written criminal code, such as Drakon had issued (B. C. 621), was not able to supply the want; a thorough, peaceful reform of the state was needed, which should reconcile the differences which tore the communities asunder. This was the thought of Solon: like all best reformers, he was, to use Aristotle's expression, one of the "middle citizens" (μέσοι πολῖται), who, standing outside of and above parties, are alone in a position to secure the proper adjustment of their differences. For a moral and political renovation of the state was needed more than all else a vigorous self-consciousness. But the Athenians were feeling depressed; Megara held possession of Salamis, and was consequently mistress of the sea: the Athenians were like captives in their own land, and in deep despondency had renounced their own coast-islands. Inflamed by Solon's inspiring poetry, they conquered Salamis (*circa* 604). This was a turning-point for the history of Greece. From that day Megara sank, and Athens rose resistlessly to power. The second step was the summoning of Epimenides from Krete, whose extraordinary personality served to expiate the previous civil dissensions and regulate anew the religion of the city. The reform in the worship of Apollo is probably connected with this event, for in earlier time Apollo was merely the god of the Ionian nobility—a patrician god. It was therefore a real advance toward unity that all citizens now sacrificed to Apollo, and that the religious distinction between Ionians and non-Ionians in Attica was set aside. By this means also Athens was connected anew with Delphi; and after freedom had been established within her own borders, she engaged, under the leadership of Solon and in alliance with Sikyon, in the "holy war" (*circa* 600) to defend the rights of the Delphic god.

Solon was the first man in Athens: he was at liberty to secure for himself absolute power for life, but it was his firm resolve to accomplish his purpose without any violation of law. As recognized mediator between all parties, and solely by the force of his genius, his impressive words, and his pure personality, he carried out the most important reforms, applying them to the evils of society at the very root. The radical evil was that the small land-owners were hopelessly in debt. Owing to a hard debtor-law, they forfeited even their freedom; a wretched proletariat was thus formed, and the land fell more and more into the hands of the great capitalists. Solon caused Athens to alter its standard of coinage (probably after the example of Korinth) by adopting also for silver the Eubœan gold-standard. The result was a lighter drachma, in which debts could be legally paid, so that the poor obtained a relief of 27 per cent. Other measures of alleviation were also introduced: the debtor-laws were made milder, and fixed limits set to the acquisition of large estates; and the surprisingly great success of this legislation (Seisachtheia) in lightening the burdens of the people is most plainly attested by the glorious poem of Solon, in which he calls Mother Earth to witness that she has been happily freed from the burden of many pawn-pillars (which were set up in the ground as tokens of alienated lands). Then followed the great political reform—the conversion of the state, ruled by families, into a timocracy. Here also it is probable that the way had been led by Korinth, the city from which the Romans borrowed their regulation by which the citizens were divided into property-classes. But the measure adopted was not movable capital, but the net proceeds of property in land, by far the greater share of which was in the hands of the noble families. It seemed to them, therefore, only a new guaranty of their privileges that none could hold office as archons except the members of the first class, the Pentakosiomedimni (with a minimum of 500 bushels of barley net income, corresponding to a taxable capital of 6000 drachmæ or one talent), while the citizens of the second class, the knights, with 300, and those of the third (Zeugitæ), with 150 medimni as minimum of each year's income, had access to the council and to the remaining offices. The mass of the people, the Thetes, who did not belong to the three classes, could not become members of the council nor fill any office, but took part in the public assemblies. No one, therefore, was excluded from public life, and even the meanest helped frame the laws which he had to obey. The prerogatives of the first class were also no longer dependent upon birth, but could be forfeited by a careless domestic economy, and won by others through industry. The love for agriculture was encouraged, the worth of landed property was increased, and even commoners could take full share in the management of public affairs if they reached that degree of prosperity which seemed necessary for the attainment of culture and independent leisure. The rating of the citizens was not done with a view to a regular assessment, but merely served as a standard for determining what each could do for his native city in case of need. The council of 400, representing the three classes, and which, changing every year, administered the current business of government, was a political school for the citizens, and made a rupture between government and people impossible. It was the organ of contemporary progress, while the Areopagus, to which the experienced men of affairs were advanced, kept a conservative check on progress. The latter body could at discretion exercise a plenary power in controlling the commonwealth and in interposing to prevent any dangerous departure from custom. In law, the important reform was carried through that the archons could no longer render final decision in

suits, but that appeal to the commonwealth could be made in every case. The statutes by which the sacred, public, and private law was administered were inscribed on three- and four-sided wooden frames, and brought to the notice of all. On private life also the laws took a firm hold: they emancipated the citizen from the family; they gave to the head of every household the free disposal of his acquired property; they allowed the claims of aged parents on their children for maintenance only on the condition that they had given them a careful education; they checked the luxurious adornment of tombs and extravagant display in the dirges for the dead.

In all his reforms Solon's purpose was to purify the public morals, banish all barbarous influences, and bring to perfection whatever was peculiarly Hellenic. He united religion, state, and house in a harmonious whole; every citizen was made responsible for the commonwealth, and on the other hand the prosperity of the state was based upon the stability of the family. The legislation of Solon is the greatest work of art which political wisdom has produced, the clarified expression of the Athenian consciousness—a work based upon the needs of the times, inasmuch as Solon gave a place in his laws to whatever of good had struggled to the light in the time of the tyrants, while he avoided violence and lawlessness like theirs. It is true that Solon's external success was slight, and he himself was to live to see a tyranny in Athens, but his laws remained in force; they protected the city like a palladium, and up to the latest times the Athenians found their better self in Solon's laws.

After the decisive year of office, during which he ruled Athens with dictatorial power, Solon is said to have travelled ten years in foreign countries—a tradition not unworthy of belief, even though the stories of his meeting with Kroisos, Amasis, etc., are apocryphal. People are fond of exemplifying in single persons the distinction between Hellenes and barbarians, which reached its full expression in Solon. Solon lived retired in Athens until his death (*circa* 55, 2; 559), surrounded by a narrow circle, of whom Mnesiphilos, the teacher of Themistokles, was one. Solon is the most attractive and venerable figure which the history of the Hellenes can show. He was a poet of the first order, a sage, a statesman who knew how to realize practically the most ideal aims—a character unstained and virtue-proof. ERNST CURTIUS.

Solor′, an island of the Malayan Archipelago, off the eastern extremity of Flores, in lat. 8° 47′ S., lon. 123° 8′ E. Area, 105 sq. m. P. 15,000, who are mostly engaged in fishing and trading. Sulphur and edible birds' nests are the principal articles of exportation. The inhabitants are Malays, partly Mohammedans, partly Christians.

Solothurn. See SOLEURE.

Sol′stice [Lat. *sol*, "sun," and *sistere*, to "stand" or "cause to stand," in the sense of stopping or arresting motion]. The inclination of the earth's equator to the ecliptic or plane of its annual motion about the sun is the cause that the latter is during one-half the year on the northern polar side of the equator, the other half on the southern, causing the vicissitudes of summer and winter to the respective hemispheres. The distance from the sun N. or S. of the equator (or DECLINATION, which see) is thus constantly varying. The two points at which this apparent northern or southern motion ceases (or at which its progressive increase of declination appears to be *arrested*) are the summer and winter solstices. At these periods the day is the longest or shortest, according as the earth is in the summer (June 21) or winter (Dec. 21) solstice. (See EQUINOX.) J. G. BARNARD.

Soluble Glass. See WATER-GLASS.

Solu′tion, Solvents, and **Solubility** [Lat. *solvo*, sup. *solutum*, to "loose" or "release," to "set free," to "melt," to "enfeeble"]. Solution may be defined as the transformation of matter from either the *solid* or the *gaseous* state to the *liquid* state through the mediation of a liquid which is called the *solvent*. Solution may therefore be stated as *combination* of a liquid with either a solid or a gas to form a *homogeneous* liquid. (See LIQUIDS, by HENRY WURTZ.)

An important question in chemistry has always been to define solutions in a chemical sense. The universally admitted conception of chemical combination involves *definite proportions* of the constituents, any excess of one or the other remaining as a mere mechanical admixture. In solution we have, however, combination to a homogeneous whole in proportions which within certain limits appear indefinite, and subject to no law as yet recognized in our books. While, also, in the formation of recognized chemical compounds there are sudden and enormous leaps or fluctuations of equilibrium between different kinds of matter brought into juxtaposition, following upon changes of temperature and other conditions which involve always definite quantities or weights of matter, in the case of solutions, on the contrary, we apparently have a justification of the dogma of Linnaeus, that *Natura non facit saltum*, there being here a *gradual* passage from one condition of equilibrium to another. There are few more difficult subjects than this in all science up to this time; and to account for the phenomena of *true* solutions—cases in which two liquids, or a solid and a liquid, are found to unite to a homogeneous liquid compound without *condensation or expansion of volume*, and without *rise or fall of temperature*; cases which are undoubtedly common—we can only resort to the supposition that these are what may be called uniform molecular mixtures, or a mechanical mingling of the chemical molecules of the two bodies, without acting chemically on each other to form new kinds of molecules—a state of things hard to understand when the two bodies have differing densities.

The writer is one of those who find it impossible to admit that those other cases of solution (so called) in which changes occur of *volume* and of *temperature*—cases which are equally common—can be anything more or less than ordinary combinations between the atoms of the solvent and of the body dissolved to form new chemical molecules. The mere fact that in many cases it has not been found possible to isolate the new compounds in *crystalline* forms, or to identify them in other ways, appears to be wholly immaterial, even as negative evidence, as to their non-existence. It will undoubtedly be found, when the elaborate thermo-chemical researches now in progress by several eminent chemists have reached a sufficiently advanced stage, that the maximum evolution of heat in all such cases will correspond to definite equivalent combinations, thus furnishing positive evidence of the view here taken. This, indeed, has already been found in no unimportant number of cases. In the mean time, this question has been attacked by the writer from a position in some measure distinct from that of thermo-chemistry, though closely related thereto—that of volumic chemistry; and such investigations have satisfactorily proved that those cases of solution involving change of volume conform to the same new geometric law which he has found to govern other chemical combinations.* (See VOLUMES, MOLECULAR.) HENRY WURTZ.

Sol′way Frith, an inlet of the Irish Sea, 33 miles long, from $2\frac{1}{2}$ to 20 miles broad, and forming the boundary between England and Scotland. It is noted for the swiftness and strength of its ebb and flow, the spring tide rushing in with a wave from 3 to 6 feet high, and with a speed of from 8 to 10 miles an hour. It receives the Esk, the Derwent, and several minor streams.

So′lyman II., the Magnificent, sultan of the Ottoman empire 1520-66, b. about 1495, a son of Selim I., whom he succeeded. His reign denotes the culmination of the power and prosperity of the Turkish empire, and he himself was one of the greatest characters the Turkish nation has produced. He possessed eminent military and administrative talents, and was personally a man of many great virtues and some fine attainments. He had a real love of justice, never broke his word, was honest in all his dealings, and worked with zeal, and not without success, for the introduction of justice and honesty in the Turkish administration; his countrymen call him *Kanuni*, the "lawgiver." He was industrious and energetic, and the goal of his gigantic exertions was by no means the mere gratification of his personal ambition; he knew what the organization of a strong people, the establishment of a solid empire, meant. He was temperate in his habits, prudent in his expenses, and well informed. He studied mathematics, and had a real enthusiasm for history. Under him the Turkish language superseded the Persian at the court and in literature. Even his vices—his violence, which came like a hurricane, and his cruelty, which shrunk at no amount of blood and flame—characterized his race and his religion rather than himself personally. During the first part of his reign he was much occupied in the southern and eastern parts of his dominion. He quelled an insurrection by Ghazali Bey in Syria in 1521, another by Ahmed Pasha in Egypt in 1523, and made three campaigns against Persia, of which the second (1534-36) and the third (1548-50) occupied several years and resulted in the conquest of Armenia, Georgia, Irak, and Shirvan. But these undertakings were merely disturbances and diversions; his real ambition and policy were directed toward Western Europe, and more than once European civilization and Christendom

* Our American chemist, Sterry Hunt, in a paper published in the *American Journal of Science* for Mar., 1853, put forth the following remark, far in advance of that day: "Solution is chemical union, as is indicated by the attendant condensation; mechanical mixtures are not accompanied by any change of volume." A highly interesting discussion of the subject of solution, with many original suggestions, by another American chemist, Isidor Walz, will be found in the *American Chemist* for Feb. 1875.

were seriously endangered by his victories. Europe had two bulwarks against the Turks—Hungary, inhabited by a chivalric, warlike race, which, although allied to the Turks, hated them as only brothers can hate; and Rhodes, where the Knights of St. John were settled. But in 1522, Solyman expelled the knights from Rhodes, and in 1526 he completely routed the Hungarians at Mohacz. The way to Western Europe stood open to the Turks, both along the Danube to Germany, and across the Mediterranean to Italy and Spain. Solyman tried both roads, but found in both the same hinderance. In 1527 he supported John Zapolya in Hungary against Ferdinand of Austria, took Buda in 1529, and appeared before Vienna with an immense army. But Vienna he could not take; the art of siege he did not understand. Four times he tried in vain. After losing over 100,000 men, he gave up the attempt, and concluded peace, retaining a large part of Hungary as a Turkish province. The war was afterward renewed several times. Solyman conquered Croatia, separated Transylvania from Hungary, and established John Zapolya's son, John Sigismund, as ruler there; won many battles against the Hungarians and Austrians, but the fortress of Vienna he could neither take nor pass. In 1534 he appointed the famous Barbary pirate, Khair-ed-Din (generally called Barbarossa), admiral, and soon his fleet drove the Venetians away from their last possession in the Morea and the Archipelago, and conquered Tunis and Algeria, from which a descent was to be made on Italy and Spain. In 1535 an alliance was formed with France, and in 1542 a French-Turkish fleet pillaged Nice. A reconciliation afterward took place between Francis I. and Charles V., and the latter succeeded in reconquering Tunis, but the Turkish fleet swayed the Mediterranean along the whole northern coast of Africa, and the attitude of Turkey became more and more threatening. Meanwhile, Charles V. had given Malta to the Knights of St. John in 1530, and in 1557 they began to build and fortify the capital of Lavaletta. Solyman could not permit the formation of a strong military station at this point, and in 1565 led an immense armament against the city; but again his attempts in the art of besieging were foiled, and he was repulsed with great loss. In 1566, during a campaign in Hungary, while besieging the fortress of Sziget, commanded by Zrinyi, the difficulties in carrying this point threw him into a fit of rage, and apoplexy killed him Sept. 5, 1566. CLEMENS PETERSEN.

Somali Land, a territory of Eastern Africa extending along the Gulf of Aden and the Indian Ocean from Zeilu, in lat. 11° 18′ N., to the mouth of the Jub, in lat. 0° 14′ N. It is mountainous, rich in myrrh and incense, and inhabited by Arabic tribes, mostly nomads and very ill-famed on account of their savage and predatory habits. The principal port is Berbera, in lat. 10° 22′ N. It has an excellent harbor. During the hot season it is a deserted place, but in winter a large and lively city, built of tents and comprising a population of more than 20,000 people, who gather here to exchange the products of their industry.

Somateria. See EIDER DUCK.

Somatol′ogy [Gr. σώματα, "bodies," and λόγος, a "discourse"], that part of physical science which treats of the general properties of bodies or masses of matter. Somatology may also be called *molar physics*, but as we now draw most of our explanations of molar phenomena from molecular physics and from chemistry, the dividing line can scarcely be longer preserved. The space assigned for this head admits only of a synoptic catalogue or classification of the divisions of the subject, with a few partial definitions. The classification here adopted is substantially that of Prof. Joseph Henry, secretary of the Smithsonian Institution.

The general properties of bodies so far discovered are:

1, Extension, } necessary to our perception of matter.
2, Impenetrability, }
3, Figure, or form.
4, Divisibility.
5, Porosity.
6, Compressibility.
7, Dilatability.
8, Mobility, }
9, Inertia, } ultimate properties, according to the molecular hypothesis.
10, Attraction, }
11, Repulsion, }
12, Polarity.
13, Elasticity.

Except Nos. 8 to 11 inclusive, these properties are referable to the generally accepted hypothetical constitution of matter, as made up of *chemical molecules*. The above synopsis does not include the *peculiar* properties, not general, but special to these molecules—subjects of the science of *chemistry*, which investigates the properties and composition of *molecules*, or those collocations of ultimate atoms which combine to form chemical compounds.

Extension.—Bodies occupy or extend throughout space. Quantity of space is volume. Molecules must also occupy volumes. (See VOLUMES, MOLECULAR, by HENRY WURTZ.)

Impenetrability signifies that two bodies cannot occupy the same space simultaneously. In chemistry, the present writer believes that he finds (*American Chemist* for Mar., 1876, p. 342) evidence that impenetrability does not apply to chemical molecules, but that the essence of chemical combination resides in the possibility of two molecules coalescing into one, sometimes with condensation of volume, and therefore necessarily with occupation of the same space. This, however, is dependent upon the atomic hypothesis.

Form.—Figure or form is either organic or inorganic. The latter are either crystals or amorphs. (See ISOMERISM.)

Divisibility.—Infinite divisibility of *space* does not prove infinite divisibility of matter. Atoms, if existent, must be indivisible by man whatever space they may occupy. If they occupy space only by virtue of their motion or energy, this energy is doubtless indestructible by man. Even the simplest form of *molecule*, containing but atoms of one element, is doubtless indivisible by human power. Chemical facts, however, prove the divisibility of some matter far beyond all power of human perception and conception.

Porosity and Compressibility.—These two are to a certain extent joint properties. That all bodies are indefinitely compressible, as formerly assumed, is not in accordance with any facts as yet positively known. The molecules, even in compact solids, however, do not occupy the whole space; and the atoms occupy but an insignificant space, except by virtue of their motion. Most solids, except *perfect* crystals, are liable to have *gross* pores, or actual cavities, which may be seen when magnified. Liquids and gases can have none such. In gases, as now viewed, the very large spaces that would necessarily exist between the molecules are incessantly occupied by them in their incessant motion, so that no porosity, as usually defined, can exist. Indeed, the same should probably be said of *homogeneous* liquids and solids. The energy—that is, the motion of the molecules—must be the agency that causes and preserves the porosity, such as it is, between the molecules.

Dilatability.—According to modern molecular views, the dilatation of bodies by increase of temperature, as well as that resulting from removal of pressure, are referable to increased energy of motion; this property is virtually merged into the next one, being due to molecular mobility.

Mobility.—Relative or measurable motion is more easily understood than defined. Absolute motion is of course indefinable. It is generally accepted that absolute freedom from motion does not exist in the known universe.

Inertia.—This, like motion, is incapable of explanation, or reference to any other cause. It involves the generalization that matter in itself has no volition or inherent power to change. It may really, however, be included in the expression that *Matter is subject to laws.*

Attraction and Repulsion.—The laws of *gravitation*, those of *electricity* and *magnetism*, and the related branches, with those of *cohesion*, *adhesion*, and *capillarity*, are referable to these ultimate or unexplainable attributes of matter. But the phenomena called *chemical*, usually also assigned to an assumed attractive force called *affinity* or *elective attraction*, do not seem to the present writer thus referable. This is an action between molecules only, and at *insensible distances* only, and appears justly referable to a distinct property that might be called *molecular penetrability*. HENRY WURTZ.

Sombrere′te, town of the Mexican confederation, in the state of Zacatecas, was once a very important place on account of its silver-mines, which contained the richest metallic veins ever discovered; but the mines seem now to be nearly exhausted. P. about 14,000.

Som′er, tp., Champaign co., Ill. P. 1120.

Som′erford, tp., Madison co., O. P. 935.

Som′ergem, town of Belgium, province of East Flanders, manufactures cotton, linen, and woollen stuffs and laces. P. 5927.

Som′ers, p.-v. and tp., Tolland co., Conn. P. 1247.

Somers, p.-v. and tp., Westchester co., N. Y. P. 1721.

Somers, tp., Preble co., O. P. 1862.

Somers, p.-v. and tp., Kenosha co., Wis. P. 1359.

Somers (JOHN), BARON SOMERS OF EVESHAM, b. at Worcester, England, Mar. 4, 1651; educated in the cathedral school at Worcester, and at Trinity College, Oxford; studied law at the Middle Temple; called to the bar 1676, but remained at Oxford, engaged in classical, historical, and juridical studies; translated from classic authors and wrote pamphlets in vindication of the exclusion of the duke of York from the succession, and in defence of grand juries (1681); began legal practice at London 1682; soon became a leader of the Whigs; one of the counsel for the seven bishops 1688;

sat as member for Worcester in the "Convention Parliament" Jan., 1689; was chairman of the committee which drew up the Declaration of Right; was made solicitor-general May, 1689; was knighted Oct., 1689; became attorney-general May, 1692, lord keeper of the great seal Mar., 1693, one of the lords justices 1695; was appointed lord chancellor Apr. 22, 1697; was raised to the peerage Dec., 1697; was removed from the chancellorship Apr. 17, 1700; was arraigned for trial before the House of Lords with a view to impeachment on fourteen very miscellaneous charges Apr. 1, 1701, but the prosecution was withdrawn June 17, 1701; recovered his influence at court; was chosen president of the Royal Society 1702; drew up the plan for the union of the crowns of England and Scotland 1706; became president of the council Nov., 1708; resigned that post 1710, and spent his remaining years in comparative retirement. D. in London Apr. 26, 1716. Among the charges preferred against him in the House of Commons on his trial, not the least absurd was that of complicity in the so-called piracies of Capt. Kidd. A valuable collection of state papers, known as the *Somers Tracts*, was edited from originals in his library (16 vols. 4to, 1748–52), and a large number of his MSS. was accidentally destroyed by fire at the chambers of his relative, Charles Yorke, in 1752. A new edition of the *Tracts* was issued by (Sir) Walter Scott (London, 13 vols. 4to, 1809–15). A *Life* of this distinguished jurist was published by R. Cooksey (1791), and his career receives considerable attention from Lord Campbell in his *Lives of the Chancellors* (vol. iv.), but an adequate biography remains to be written.

Som'erset, county of N. W. Maine, adjoining Canada, watered by and containing the sources of Kennebec, Penobscot, and Walloostook (St. John) rivers, includes a part of Moosehead Lake, abounds in smaller lakes and ponds, has a highly-diversified surface, most of the northern part being still a forest, a favorite resort of hunters and fishermen. The S. part is reached by Maine Central and Somerset R. Rs. Lumbering is the chief industry, the other staples being hay, butter, cheese, and wool. Cattle and sheep abound. The abundant water-power is in the southern part utilized by a considerable number of manufactories, especially of carriages and wagons. Cap. Skowhegan. Area, 3800 sq. m. P. 34,611.

Somerset, county of S. E. Maryland, on the E. shore of Tangier Sound, Chesapeake Bay, between Wicomico and Pocomoke rivers, traversed by Eastern Shore R. R., has a generally level surface and fertile soil. Staples, Indian corn, oats, and potatoes. Cap. Princess Anne. Area, 400 sq. m. P. 18,190.

Somerset, county of Central New Jersey, bounded N. E. by Passaic River, intersected by Raritan and Millstone rivers, traversed by Delaware and Raritan Canal, by New Jersey Central R. R. and its branches, and by several ranges of hills, has a fertile soil, and abundant water-power, utilized by numerous tanneries, flour-mills, and distilleries. Staples, Indian corn, oats, wheat, hay, butter, and wool. Cap. Somerville. Area, 275 sq. miles. P. 23,510.

Somerset, county of S. W. Pennsylvania, adjoining Maryland, watered by Conemaugh and Castleman's rivers, and consisting in great part of the valley between the Alleghany Mountains on the E. and Laurel Ridge on the W., has a fertile soil, with numerous glades, is well adapted to pasturage and dairying, has abundant deposits of bituminous and cannel coal, iron ore, and fire-clay, and is traversed by Pittsburg division of Baltimore and Ohio R. R. Staples, butter, maple-sugar, oats, hay, and wool. Tanneries, woollen and saw mills are numerous. Cap. Somerset. Area, 1050 sq. m. P. 28,226.

Somerset, v., Laurel tp., Franklin co., Ind. P. 94.

Somerset, p.-v., Waltz tp., Wabash co., Ind., on Missisinewa River. P. 371.

Somerset, p.-v., cap. of Pulaski co., Ky., in the midst of an iron and coal mining region. P. 587.

Somerset, p.-v. and tp., Bristol co., Mass., on Taunton River, opposite Fall River, and on Dighton and Somerset branch of Old Colony R. R., has some manufactures, and is largely engaged in the coasting-trade and fishery. P. 1776.

Somerset, p.-v. and tp., Hillsdale co., Mich., on Detroit Hillsdale and Indiana R. R. P. 1297.

Somerset, tp., Steele co., Minn. P. 566.

Somerset, tp., Mercer co., Mo. P. 1111.

Somerset, p.-v. and tp., Niagara co., N. Y., on Lake Ontario division of Rome Watertown and Ogdensburg R. R. P. 1862.

Somerset, v., Somerton tp., Belmont co., O. P. 197.

Somerset, v., Knox tp., Jefferson co., O. P. 77.

Somerset, p.-v., Perry co., O., on the Straitsville division of Baltimore and Ohio R. R. and the Zanesville and Maysville turnpike, contains 4 churches, good schools, 1 newspaper, an extensive flouring-mill, 1 woollen-factory, 2 carriage-factories, and 1 bank. Rich deposits of coal, iron ore, and potter's clay abound in close proximity to the town. P. 1153. M. G. Mains, Pub. "Press."

Somerset, p.-b. and tp., cap. of Somerset co., Pa., at N. terminus of Somerset branch of Pittsburg Washington and Baltimore R. R., has 2 weekly newspapers, and is the centre of an active trade in coal, iron, and lumber. P. of b. 945; of tp. 2836.

Somerset, tp., Washington co., Pa. P. 1325.

Somerset, p.-v. and tp., Windham co., Vt. P. 80.

Somerset, p.-v. and tp., St. Croix co., Wis. P. 491.

Somerset (Edward Seymour), Duke of, b. about 1500, was brother of Jane Seymour, third queen of Henry VIII. and mother of Edward VI.; upon his sister becoming queen he was created Viscount Beauchamp and earl of Hertford; distinguished himself in the Scottish and French wars, and was named by Henry in his will as one of the governors of his son during his minority. After the death of Henry, he rose to the head of affairs; was created duke of Somerset and earl-marshal of England, in Feb., 1547, and in March was made lord protector and governor of the realm, and became king in all but name. A powerful party was formed against him, among whom was his own brother, Sir Thomas Seymour, who was apprehended and executed by his orders Mar., 1549. This brought the Protector into great odium, and in Oct., 1549, he was deprived by the young king of his protectorship and thrown into the Tower; but was released with a full pardon in a few months. Among his foremost rivals was the earl of Warwick, afterward duke of Northumberland. Somerset entered into a plot against his life; was again arrested, found guilty of felony and constructive treason, and was beheaded on Tower Hill Jan. 22, 1552.

Somerset (Fitzroy J. H.). See Raglan, Baron.

Somerset (R. Carr). See Overbury, T.

Som'ersetshire, county of South-western England, bordering N. on the Bristol Channel, comprises an area of 1636 sq. m. P. 463,412. The surface is much diversified by ranges of low, rocky hills, the Mendip Hills in the N. and the Quantock Hills in the W., containing iron, lead, zinc, coal, and building-stone; and large tracts of meadow and marshes which afford excellent pasturage. Dairy-farming is one of the principal occupations. Good wheat is raised around Bridgewater. Much cheese and cider is produced; leather, glass, paper, and iron goods are manufactured.

Somer's Point, p.-v., Egg Harbor tp., Atlantic co., N. J., on Great Egg Harbor River.

Somers's Islands. See Bermuda Islands.

Som'ersworth, tp., Strafford co., N. H., on Salmon River, includes v. of Great Falls. P. 4504.

Som'erton, tp., Belmont co., O. P. 2042.

Som'ervile (William), b. at Edston, Yorkshire, in 1677; entered Westminster School in 1690; became a fellow of Oriel College, Oxford, and in 1704 succeeded to his patrimonial estate, where he lived like a jovial country squire, dividing his time between his hounds, his books, and his bottle. His poems are—*The Two Springs, a Fable* (1725), *Occasional Poems, Translations*, etc. (1727), *The Chace*, his best production (1735), *Hobbinol, or the Rural Games*, a burlesque in blank verse (1740), and *Field Sports* (1742). D. July 19, 1742.

Som'erville, county of N. Texas, on Brazos River, formed in 1875 from Hood co., has a rolling surface and a fertile soil. Staples, wheat, Indian corn, and cotton. Cap. Glen Rose. Area, about 300 sq. m.

Somerville, p.-v. and tp., Morgan co., Ala. P. of v. 115; of tp. 1786.

Somerville, tp., Lincoln co., Me. P. 505.

Somerville, city of Middlesex co., Mass., 3 miles from Boston, on Boston and Lowell, Boston and Maine, Eastern, and Fitchburg R. Rs., incorporated as a city 1872, contains 15 churches, excellent schools, several public halls, 1 newspaper, 2 hotels, manufactories of brass tubing, glass bottle-works, a bleaching establishment, a packing house, flour-mills, an art-foundry, a paid fire department and electric fire-alarm, and 2 lines of street railway. P. 14,685. Bourne & Spooner, Eds. "Journal."

Somerville, p.-v., cap. of Somerset co., N. J., on Central Railroad of New Jersey, 37 miles from New York City, has 5 churches, 4 select schools, a public library, and 2 reading-rooms, 3 newspapers, 3 banks, 2 carriage manufactories, and 4 hotels. It is the terminus of the Somerville branch R. R. P. 2236.

Daniel Porter, Ed. "Unionist."

Somerville, p.-v., Rossie tp., St. Lawrence co., N. Y., on Rome Watertown and Ogdensburg R. R. P. 113.

Somerville, p.-v., Milford tp., Butler co., O., on Cincinnati Richmond and Chicago R. R. P. 389.

Somerville, p. v., cap. of Fayette co., Tenn., on Somerville branch of Memphis and Charleston R. R., has 1 newspaper. P. 951.

Somerville (Mary), F. R. A. S., b. at Jedburgh, Scotland, Dec. 26, 1780, daughter of Admiral Sir William Fairfax. She gave no early promise of her wonderful powers except by a thirst for information and indomitable perseverance. Her education was most imperfect; every effort after self-culture was thwarted, and she was not even allowed to read such books as she desired. In 1805 she married Samuel Greig; in 1808 was left a widow with two sons and an independent fortune. For the first time her means and position left her free to follow the natural bent of her mind; she went through a complete mathematical course without aid or sympathy, mastering alone not only pure but applied mathematics. In 1812 she married her cousin, William Somerville, a man of ability and culture, who aided her in her studies, worked with and for her, and introduced her to the highest literary circles of Europe, where her powers were generously acknowledged by its first mathematicians and scientists. She lived to the advanced age of ninety-two, with scarcely waning powers of mind or body, as the dates of her published works attest. In 1830, at the age of fifty, her *Mechanism of the Heavens* was completed and published. The preparation of this work was undertaken by Mrs. Somerville at the earnest solicitation of Lord Brougham, and was published by the Society for the Diffusion of Useful Knowledge. It was an attempt to bring the magnificent *Mécanique céleste* of Laplace within the reach of a larger range of students. Even her clear and simple style failed to bring this work down to anything approaching the popular plane, for Poisson said, four years later, that there were not twenty men in France capable of following its profound mathematical reasoning. In 1834 she published her *Connexion of the Physical Sciences*; in 1849, her *Physical Geography*; in 1869, her *Microscopical and Molecular Science*. She was elected honorary member of the Royal Astronomical Society in 1832, and afterward honorary member, or associate, of the Royal Academy at Dublin, of the Bristol Philosophical Society, of the Société de Physique et d'Histoire naturelle of Geneva, of the College of Resurgenti, of the Imperial and Royal Academy of Science, Literature, and Art at Arezzo, and others. In 1860 she was again left a widow; the later years of her life she passed in Italy, devotedly cared for by her daughters. D. Nov. 29, 1872, at Naples, and rests in the English Campo Santo there.

The wonderful powers of Mrs. Somerville's mind would have placed her abreast of the first mathematicians of Europe if she had received the requisite early training, and had devoted herself exclusively to that branch of study. As it was, she followed with ease and delight the work of others, but was not an original investigator. She recognized too late to remedy it her mistake in abandoning mathematical for physical science. To her great gifts of intellect she united all that is lovely in woman; she had refined and beautiful taste, decided artistic ability both in music and painting, and the executive ability requisite to the management of her home, the education of her children, the fulfilment of her social duties, and her laborious and thorough scientific work. It is her delicate womanliness, her enthusiasm and tenderness which make her chief glory; she was primarily woman, wife, and mother; secondarily, artist, mathematician, and scientist. S. B. Herrick.

Som'ma Lombar'do, town of Italy, province of Milan, in a broad plain partially covered with heath and uncultivable for want of water. This plain is the theatre of extensive military manœuvres during the summer, large detachments of the Italian army being sent here for that purpose. In this town there is a remarkable cypress tree, about eight feet in diameter, and the roots of which are said to have been struck, in digging a well, at a depth of 150 feet. Tradition carries this tree back to Roman times, and a drawing of it, taken more than 300 years ago, represents it much as it now is, except that its lofty crown has since been badly shattered by lightning. The old castle of Somma Lombardo dates from a very early period, is one of the best preserved in the province, and is associated with historic events of interest. P. 5653.

Sommari'va del Bos'co, town of Italy, province of Cuneo, at the foot of a hill which is crowned by one of the finest old castles in Piedmont. P. 5652.

Som'ma Vesuvia'na, town of Italy, province of Naples, on the top of a spur of Mount Vesuvius, about 9 miles N. E. of the city of Naples. This was a favorite retreat of Alphonso I. of Aragon and of Ferdinand I. of Naples, both of whom adorned and strengthened it. In 1794, however, Somma Vesuviana was almost totally destroyed by an eruption of Vesuvius. The fall of ashes and scoriæ, forming a layer to the depth of more than three feet, was followed by torrents of rain, which completed the temporary destruction of the town and adjacent country, and in some places formed a kind of cement so hard as to make further cultivation impracticable, even at the present day. P. 7613.

Somme, department of Northern France, bordering on the English Channel, on both sides of the river Somme, comprises an area of 2343 sq. m., with 557,015 inhabitants. The surface is flat, but the soil very fertile, and large crops of corn, hemp, hops, and fruit are raised. Cattle-breeding is extensively carried on, and the manufactures of velvet, silk, cotton goods, soap, chemicals, beetroot-sugar, paper, and linen are very important. Of 56,402 children of school age, 4593 received no education in 1857.

Somme, a river of France, rises in the department of Aisne, passes by St. Quentin, Ham, Amiens, and Abbeville, and falls into the English Channel after a course of 120 miles. It is navigable to Amiens, and connected with the Seine, Oise, and Scheldt by canals.

Söm'mering, von (Samuel Thomas), b. at Thorn, Prussian province of Posen, Jan. 18, 1755; studied medicine at Göttingen; was appointed professor of anatomy at Cassel in 1778, and at Mentz in 1784; began to practise as a physician in Frankfort in 1790; became physician to the king of Bavaria in 1805; returned to Frankfort in 1820. D. there Mar. 2, 1830. He was a very prolific writer, and his works enjoyed a great reputation, although he held that in man the brain is not absolutely necessary to the maintenance of life—*Abbildung und Beschreibung einiger Missgeburten des ehemaligen anatomischen Theaters zu Kassel* (1791); and also that the soul has its seat in the vapors filling certain cavities of the brain—*Ueber das Organ der Seele* (1796).

Som'mers (Charles G.), D. D., b. in London, England, in 1793, came with his family to the U. S. 1802; became confidential clerk and travelling-agent of John Jacob Astor 1811, and made long journeys to Canada and the North-west in his employer's interest for some years, when, in consequence of religious impressions, he devoted himself to the Baptist ministry in New York; labored at the old almshouse in the Park, where he established the first Sunday-school in America; was pastor of churches at Troy and in Nassau street, New York, for fifty years; was prominent in religious societies, having been twenty-three years secretary of the executive committee of the American Tract Society; wrote a *Life of Dr. John Stanford* (1835); edited a volume of hymns and three volumes of the *Baptist Library*, and was author of several tracts and treatises in polemical theology.

Somnam'bulism [Lat. *somnus*, "sleep," and *ambulare*, to "walk"], a peculiar perversion of the mental functions during sleep, in which the subject becomes an automaton. The organs of sense remain torpid and the intellectual powers are blunted. During this condition some instinctive excitation may take place, and there may be the production of impulses, in consequence, of different kinds. One individual may walk along the ledge of the roof of a house, and another may jump into a river, or a third may commit a homicide. The condition is not as common a one as is supposed, although imperfect examples are seen in persons who walk at night in sleep. A slight stimulation of the organs of sense is sufficient to restore the person. Of late, numerous diseases have been described where hysteria takes this form, and occasionally the public prints are filled with extraordinary stories of sleeping females. These stories generally have no foundation. Nightmares, which are akin to the somnambulistic state, generally come on while the person is lying on his back, when the blood gravitates toward the cerebellum, which is supposed to be the co-ordinating centre.

Allan McLane Hamilton.

Somnauth'- (or **Somnath-**) **Putten,** town of Hindostan, in the Baroda dominions, on the peninsula of Guzerat, in lat. 20° 53′ N., lon. 70° 35′ E., contains a famous temple, now mostly in ruins, but at one time one of the richest and most venerated places of Hindoo worship. Mahmood of Ghuznee sacked the temple in 1024, and carried away its magnificent gates, celebrated as much for their exquisite workmanship as for the costliness of their materials. In 1842 the English carried the gates back from Mahmood's tomb in Afghanistan as trophies, but, fearing to excite jealousy between the two large religious bodies of Hindostan, and not knowing whether the gates were the right ones, the English government did not find it proper to put them in their old place.

Somonauk′, p.-v. and tp., De Kalb co., Ill., on Chicago Burlington and Quincy R. R. P. 3359.

Sona′ta [It.], when first used in the latter part of the sixteenth century, meant any kind of composition for instruments, in contradistinction to vocal compositions, which were called *cantata*. Subsequently, however, especially after the time of Bach, the name was applied principally to compositions for solo instruments and of a certain form, consisting of several movements—first, three, the *allegro*, *adagio*, and *rondo*—to which afterward a fourth was added by Haydn, the *minuetto* or *scherzo*, which differed from each other in time and sentiment, but were held together by the general character pervading them all. This form of composition was greatly developed by Haydn and Mozart, and culminated in Beethoven.

Sonci′no, town of Italy, province of Cremona, on the right bank of the Oglio, was a city of considerable importance, especially as a seat of learning and art, during the mediæval period, and the old castle and other monuments of that time are still standing. The churches contain numerous frescoes of the Campi. P. 7268.

Son′dershausen, town of Germany, capital of the principality of Schwarzburg-Sondershausen, is pleasantly situated on the Wipper, and has 5815 inhabitants.

Son′drio, town of Northern Italy, province of Sondrio (which embraces the valley known as the Valtellina), is at the southern foot of the Rhætian Alps, on the road which crosses the grand pass of the Stelvio. The torrent Mallero, which runs through this town, and had often before threatened it with destruction, rose on the night of Aug. 27, 1834, more than 20 feet above its ordinary bed, carried away all the bridges, and swept off a considerable part of the village. Heavy rains still continuing, the unfortunate inhabitants were obliged to maintain a desperate struggle with the furious flood during the next fifteen days. Similar catastrophes are always liable to occur. P. 6500.

Sone, a river of British India, rises in the Berar highlands, in lat. 22° 41′ N., lon. 82° 7′ E., flows in a northeasterly direction, first through narrow valleys, and then through large alluvial plains, and joins the Ganges, after a course of about 450 miles, 28 miles above Patna. It is 3 miles wide at its junction with the Ganges, but navigable only for a distance of about 60 miles. Above Dandnugur its bed is nearly dry in the hot season. Large works of irrigation are under construction along its banks.

Song [Ang.-Sax. *sang*], a short lyric poem adapted to vocal music, and the music itself to which such words are set. The words in general of the better class of songs are expressive of a single dominant feeling or thought, but too often, both in the more elevated and serious and in comic songs, the words are destitute of all thought and feeling, except some threadbare sentimentalism or some stale platitude. The music should always be simple and melodious.

Song of Birds, the musical notes uttered by many birds, especially by members of the section Oscines and order Insessores. The music of birds not only differs widely in the different species, but individuals of the same species, especially from localities far remote from each other, are sometimes found to differ surprisingly in their song; and nice observation often shows in individuals of the same neighborhood and species very considerable variations in melody. The song of male birds is almost uniformly by far the best, and especially about the pairing-time do the males of most singing birds put forth their best efforts, as if to win the notice and favor of their mates. As a rule, the gayly-plumaged birds of the tropics are not good songsters, but there are exceptions. The Old World greatly excels the New in the number of species of good singing birds. The vocal organs of all singing birds are very remarkable, but the forms are extremely various. The true larynx, the organ of the voice of man, exists also in birds, but the voice is not produced there. At the lower end of the trachea, just at its bifurcation, we find a "lower larynx," which contains a kind of reed or vibratile plate. The pitch appears to be regulated by variations in the length of the windpipe, and there are various *tympana*, or tense membranous patches, in the air-passages, which appear to intensify the vocal notes of some species. Several birds (notably the mocking-bird) have the power of imitating the song of other birds, and even of learning tunes. The vocal notes of all birds are produced in much the same way, except that the tongue of the parrot and other talking birds is employed in uttering articulate sounds, while a very few birds, such as the stork, have neither voice nor inferior larynx.

Song of Solomon. See CANTICLE.

Son′neberg, town of Germany, in Saxe-Meiningen, on the Röthen, forms the centre of a considerable manufacturing industry, comprising articles of wood, papier-mâché, leather, and glass, mostly toys and dolls, which under the name of "Sonneberger ware" are exported to England, France, North and South America, to the value of several million dollars every year. In 1873 the value of the exportations to the U. S. amounted to $938,332, gold. P. 6761.

Son′net [Fr., from Lat. *sonus*, "sound"], a form of verse of Italian origin, which, when legitimate, has fourteen heroic lines, comprising a major part, called the octave, and a minor part of six lines, called the sestette. The octave is commonly made up of two quatrains, and the sestette of two tercets. The rhymes should be perfect; the octave should be restricted to two—one for the first, fourth, fifth, and eighth lines; the other for the second, third, sixth, and seventh. The rhymes of the sestette may be two or three, variously distributed, but the last two should not form a couplet—a rule often broken. In getting material for this article several thousand sonnets were examined, containing more than 700 forms of rhyme-variation. S. S. HALDEMAN.

Sonnini′ de Manoncourt′ (CHARLES NICOLAS SIGISBERT), b. at Lunéville, France, Feb. 1, 1751; studied marine engineering; resided for several years at Cayenne; joined in 1777 the African expedition under De Tott; visited Egypt and Asia Minor; returned to France in 1780; contributed largely to Buffon's *Histoire naturelle*, the division on fishes; edited *Bibliothèque physico-économique* (1801–12), and *Nouveau Dictionnaire d'Histoire naturelle* (24 vols., 1803). D. at Paris May 29, 1812.

Sono′ma, county of N. W. California, between the Coast Range and the Pacific Ocean, watered by Russian, Petaluma, Sonoma, and Santa Rosa rivers, traversed by San Francisco and North Pacific R. R. and by numerous thickly-wooded spurs of mountains, between which are several fertile valleys noted for their orchards, gardens, and vineyards; has some mineral deposits, not hitherto much worked, and contains near its N. E. extremity the celebrated Geysers. Cattle, sheep, and swine are numerous; also saw-mills and manufactures of wooden ware. Staples, wheat, oats, barley, potatoes, wine, butter, cheese, and wool. Cap. Santa Rosa. Area, 1344 sq. m. P. 19,819.

Sonoma, p.-v. and tp., Sonoma co., Cal., on Sonoma Creek. P. 1513.

Sono′ra, a state of the Mexican confederation, bordering W. on the Gulf of California, and bounded N. by the U. S. Territory of Arizona, comprises an area of 123,466 sq. m., with 147,133 inhabitants. The western and northern part of this state is mostly low and level land, in some places consisting of extensive tracts of sandy, unproductive, and arid soil, but in others very fertile, and yielding two crops annually of wheat, maize, tobacco, rice, sugar, cotton, and all kinds of tropical and semi-tropical fruit. The eastern and southern part is covered by branches of the Sierra Madre, which form elevated plateaus interspersed by deep, sometimes broad, always exceedingly fertile valleys, and of whose mineral wealth travellers give almost fabulous reports. But the natural riches of the state are very little developed. About 100,000 of the population are Indians, and of these many tribes live as nomads and hunters and in fierce contest with the Spaniards. The best part of the population consists of those Indian tribes which have been converted to Christianity, and which have settled down as agriculturists. The descendants of the European immigrants are described as indolent, sensuous, and treacherous.

Sonora, p.-v. and tp., cap. of Tuolumne co., Cal., 130 miles E. of San Francisco, equidistant from Yosemite Valley and Calaveras Big Trees, the terminus of the Stockton and Copperopolis R. R., has 4 churches, an academy and schools, Snell Library, 2 weekly newspapers, waterworks, a foundry, and 2 hotels. Sonora is the central point for a large gold-mining area. Principal business, mining, farming, lumbering, and viniculture. P. of v. 1322; of tp. 2489.
CHAS. H. RANDALL, ED. "UNION DEMOCRAT."

Sonora, p.-v. and tp., Hancock co., Ill., on Mississippi River. P. 1485.

Sonora, p.-v., Hardin co., Ky., on Louisville and Nashville and Great Southern R. R. P. 266.

Sonora, v., Tarkio tp., Atchison co., Mo. P. 265.

Sonora, p.-v., Perry tp., Muskingum co., O., on Central Ohio division of Baltimore and Ohio R. R. P. 97.

Sonsona′te, town of Central America, republic of San Salvador, is beautifully situated in a rich district, well built, and carries on a lively trade through Acajutla, its port on the Pacific Ocean. P. about 10,000.

Son′tag (HENRIETTE), b. in Coblentz May 13, 1805; was a singer from childhood; was gifted with fine vocal and

dramatic powers, which were highly cultivated; excelled in German and Italian music, and at the age of twenty-five rivalled Malibran, Pasta, and Catalani; married Count Rossi, an Italian noble, in 1830, and retired to private life. Pecuniary misfortunes compelled her at the age of forty-five to resume her professional career; she sang in Europe; came to the U. S. in 1853, and d. in Mexico June 18, 1854, while on a professional tour. Her reception everywhere was enthusiastic, but at this period her musical art was impaired. O. B. FROTHINGHAM.

Soo-Chow-Foo′, or **Su-Chau,** town of China, province of Kiang-Soo, in a very rich, densely-peopled, and well-cultivated district, is a well-built city, consisting mostly of houses of granite and intersected by a great number of broad canals, on which lives a large floating population. Its manufactures of linen and cotton fabrics, articles of paper, glass, ivory, iron, wood, and horn, and lacquered ware are celebrated and extensively exported. Its trade is very active, and with respect to the gayety and elegance of its life and manners it seems to be a sort of Chinese Paris. Its population is said to exceed that of Nanking, and is estimated at about 2,000,000.

Soodan′, or **Sudan,** also called **Nigritia** (the home of the negro race), is a vast territory in Central Africa, with entirely undefined frontiers, but bounded N. by Sahara, W. by Senegambia, E. by Darfoor, and S. by Upper Guinea. It is still very imperfectly known as a whole; our knowledge of it is mostly confined to some single points which have been visited by travellers, such as DARFOOR, BORNOO, SACCATOO, etc. (which see).

Soofees. See SUFIS.

Sook-el-Shooyookh′, town of Asiatic Turkey, province of Irak-Arabee, on the Euphrates, was terribly devastated by the plague in 1832, at which time it had about 10,000 inhabitants. It has still a very important horse-market, as the horses of this district are considered the best in all the Turkish dominions.

Sooloo′ (or **Suluk**) **Islands,** a group of 150 islands in the Indian Ocean, extending from Borneo to Mindanao, between lat. 4° 44′ and 6° 56′ N., and lon. 119° 30′ and 122° 30′ E. All the islands, most of which are very small, are high, well wooded, and exceedingly fertile, yielding sandal-wood and teak timber, and producing sugar, rice, coffee, and spices in abundance, besides being rich in metals and fish. But the inhabitants, who are Malays and governed by an independent sultan, are addicted to piracy, which seems to be their principal occupation.

Soo′my, or **Sumy,** town of Russia, government of Kharkow, at the confluence of the Psol and the Suma, has an annual market in November, which is attended by a great number of merchants. P. 10,587.

Soonga′ria, or **Songaria,** a vast region in Central Asia belonging to China, extending between lat. 41° and 48° N., and between lon. 75° and 90° E., and bounded W. and N. by Russia, E. by China, and S. by Thibet and Afghanistan. It consists of an elevated plateau surrounded, and in some places intersected, by lofty mountains. The plateau is generally a complete desert, and the numerous streams which rush down from the mountains soon lose themselves in the sand or fall into the large salt lakes which frequently occur. In the valleys or along the lakes and rivers are found good pastures, where the inhabitants, consisting of nomadic tribes, rear their cattle, mostly buffaloes and camels. Originally, the land was inhabited by the Oosuns, a race of blond complexion and blue eyes; these were expelled by the Turks, who in their turn had to give way for the Mongols. In the middle of the eighteenth century the Calmucks, the principal Mongolian tribe, were subdued by the Chinese, and since that time the country has been a Chinese province.

Soor [anc. *Tyros*], town of Asiatic Turkey, province of Syria, on an island in the Mediterranean, which Alexander the Great, when besieging Tyre, connected with the mainland by a broad dam. It has suffered very much from earthquakes, and its harbor has become so silted up as to be accessible for small vessels only. P. about 5000.

Soo′sa, or **Su′sa,** town of Northern Africa, in Tunis, is surrounded with olive-groves, and has an extensive trade in oil and manufactures of woollen fabrics. P. about 8000.

Soo′soo, the *Platanista Gangeticus*, a cetacean of the Ganges, the only living representative of the family Platanistidæ, which is allied to the Iniidæ, or fresh-water dolphins of South America. It is some twelve feet long, and is ordinarily very sluggish, but can move after its prey with much vigor. It has long beaked jaws, 120 teeth, and curious rudimentary eyes.

Soot [Sax. *sot*; Dan. *sod*, *sood*], a carbonaceous deposit from smoke, formed in chimneys. That which forms nearest the fire is often shining and varnish-like, consisting chiefly of dried tarry matters mixed with carbon, and giving a brownish-black powder, sometimes used as a pigment under the name of BISTRE (which see). That which forms farther up the chimney is more of the character of LAMP-BLACK (which see). H. WURTZ.

Soothsayers. See ASTROLOGY, DIVINATION, MAGIC, and ORACLE.

Soothsayers, insects. See MANTIS.

Sophi′a, town of European Turkey, in Bulgaria, has 23 mosques, several Christian churches, celebrated hot mineral springs, and manufactures of leather, arms, earthenware, and woollen cloths. In its general appearance it is a dirty and miserable place. P. 22,000.

Sophi′a Dorothe′a, b. at Celle Sept. 15, 1666, a daughter of Duke George Wilhelm of Brunswick-Lüneburg-Celle, was married Nov. 21, 1682, to George, eldest son of the elector Ernst August of Hanover, and afterward king of England. She bore him two children—George II. and Sophia Dorothea, queen of Prussia and mother to Frederick II.—but the marriage was very unhappy. She asked for a divorce, and when neither her father nor her father-in-law would give their consent, she determined to elope with Count Königsmark to Wolffenbüttel. The intrigue was discovered by the Countess von Platen, whom jealousy made sharp-sighted, and July 2, 1694, when in the night the count came out from the chamber of the princess, he was murdered by four electoral guards. Dec. 28, 1694, the divorce took place, and she lived afterward in retirement till her death, Nov. 13, 1726, at Ahlden, near Celle, whence her popular name, "the princess of Ahlden."

Soph′ist [Gr. σοφιστής, σοφισταί, applied to the seven wise men of Greece; afterward to the teachers at Athens who gave lessons in the arts and sciences for money]. The course of Greek philosophy commences with the establishment of a material first principle—water, air, fire, etc.—and tends toward the recognition of mind as this first principle. Anaxagoras explicitly announced mind (νοῦς) as such first principle. The first and most obvious phase of mind as an activity is its capacity to reflect, and hence to discover grounds and reasons. Each ground or reason in some measure communicates its peculiar character to the fact or opinion which it grounds. Hence, from the stand-point of grounds and arguments all truth seems to be an arbitrary affair, depending upon the selection of grounds and reasons which one makes. Truth is supposed to be many-sided, and the point of view taken is supposed to justify one's difference in opinion. The art of presenting grounds or reasons to justify any view is the art of the Sophists. The fact that these many sides or grounds of truth are mutually interdependent, and therefore that each has truth only as seen in view of the rest,—this is the further and deeper insight which it belonged to Socrates and Plato to discover and unfold. The universal or general is the net result, as well as the active principle, of that dialectic process which appears in the genesis and mutual destruction of different opinions—"different points of view." As a necessary elementary stage of human thinking, the province of the Sophists is of permanent importance in the history of philosophy. The Eleatics, who set up the doctrine of pure being, found it necessary to refute the phases of change, finitude, and negativity that appear in the world. Zeno accordingly discovered the dialectic of self-contradiction involved in those phases. This was adopted by the Sophists, of whom the chief were Protagoras the Individualist (b. 490 B. C.), Gorgias the Nihilist (came to Athens 427 B. C.), Hippias the Polymathist, and Prodicus the Moralist (both younger contemporaries of Protagoras). Everything that existed in the Greek consciousness as opinion, faith, custom, religious tradition, even the evidence of the senses, was sapped and rendered uncertain by the ratiocination of these Sophists. Protagoras asserted: Man is the measure of all things. Just as each thing appears to each man, so is it for him. All truth is relative. The existence of the gods is uncertain. Gorgias expressed his nihilism in three propositions: (*a*) Nothing exists; (*b*) if anything existed, it would be unknowable; (*c*) if anything existed, and were knowable, the knowledge of it could nevertheless not be communicated to others. "Common sense," so called, is the stage of naive faith in one's point of view. The discovery of the equal validity of "many points of view" leads on the one hand to sophistical practices, or on the other to scepticism. Pyrrhonic scepticism in Greece connects through the Megarian school to the dialectic of the Sophists and of Zeno the Eleatic. WILLIAM T. HARRIS.

Soph′ocles, b. in 495 B. C. at Colonus, a village of Attica, near Athens, led the triumphal choir of Athenian youths celebrating the victory of Salamis: Æschylus fought in the ranks of the soldiers, and Euripides was born on the

day of the battle. His father was a man of means, and devoted his whole life to poetry, and the pæan he sang before the Athenians assembled around the trophies of Salamis was his own composition. His teacher in music was Lamprus, a celebrated name, and in 468 B. C. he brought his first tragedy, probably *Triptolemus*, which now is lost, on the stage. The moment was exciting. There was a turning-point in Athenian politics; the age of Pericles was dawning. People expected a similar movement in literature, and the competition between the old poet Æschylus, who had held the supremacy undisputed for a whole generation, and the new poet Sophocles, caused such an agitation that the archon was at a loss where to find judges of sufficient authority. The festival was about to begin, and no judges of the competing tragedies were as yet appointed, when Cimon and his nine colleagues entered the theatre, just returning from the expedition to Scyros, whence they brought back to Athens the ashes of Theseus; and when they approached the altar to offer up their libations, the archon retained them there, took their oaths, and thus the highest authority of the old time was seated as judge over the first steps of the new. But the prize was given to Sophocles, and Æschylus left Athens and went to Sicily. From this moment, and up to the year 441 B. C., Sophocles reigned in the Athenian theatre—that is, he was the modeller of the religious and æsthetical ideas of the Athenian people, the artistic representative of the spirit of the age: and even Æschylus adopted his innovations, the introduction of the third actor, the reduction of the trilogy from a pragmatical to a merely philosophical unity, etc. But about this time a new turning-point was reached in the history of Greek civilization; the age of the Sophists drew near, and Euripides gained the first prize in 441 B. C. Sophocles was never superseded, however. In the very next year (440 B. C.) he brought the *Antigone* on the stage, and this work, which in its ideal conception, as well as in many of its actual details, is a direct vindication of the political principles of Pericles, produced an unbounded enthusiasm; the Athenians chose him *strategos* immediately afterward. His last victory was won after his death by the performance of his posthumous tragedy, *Œdipus at Colonus*. But he had, nevertheless, now a rival, and elements utterly at variance with the ideas he preached were at work in Athenian life. Finally, his enemies attacked him as they had attacked Pericles: unable to cope with his genius, they assaulted his person. In the last year of his life his son, Iophon, accused him of having fallen into dotage and of being incapable of administering his own estate. But Sophocles went to the court, and read to the judges a song from *Œdipus at Colonus*: the case was then dismissed. D. at Athens in 405 B. C. He is said to have composed 130 plays, besides lyrical poems, but only seven tragedies have come down to us entire—namely, *Antigone*, *Electra*, *Trachiniæ*, *Œdipus Rex*, *Ajax*, *Philoctetes*, and *Œdipus Coloneus*. Editions, translations, and historical and critical reviews are numberless. Among the latest editions are those by Wunder (Gotha, 1848 *seq.*, 2d and 3d eds.), Tourneur (Paris, 1873), Schneidewin (Berlin, 1873), Campbell (vol. i., Oxford, 1873), Dindorf (Leipsic, 1866). There are English translations by Dale (1824), Plumptre (1866), Campbell (1874), and others. CLEMENS PETERSEN.

Sophocles (EVANGELINUS APOSTOLIDES), LL.D., b. in Greece Mar. 8, 1807; studied at the convent on Mount Sinai; emigrated to the U. S.; entered Amherst College in 1829; was tutor in Harvard College, with a brief intermission, from 1842 to 1859, and in 1860 became professor of ancient, modern, and Byzantine Greek. He has published a *Greek Grammar* (1838), *First Lessons in Greek* (1839), *Greek Exercises* (1841), *Romaic Grammar* (1842), *Greek Lessons for Beginners* (1843), *Catalogue of Greek Verbs* (1844), *History of the Greek Alphabet*, etc. (1848), *Glossary of Later and Byzantine Greek* (1860), revised as *Greek Lexicon of the Roman and Byzantine Periods* (1870).

Sophonisba. See MASINISSA.

So'phron, flourished at Syracuse in the middle of the fifth century B. C., and was the inventor of the so-called *mime*—that is, he transformed it from a social entertainment into a form of literary composition. The Greeks of Sicily, noted for their broad humor and exuberant talent for merriment, used at the festivals of Dionysus, or perhaps at any kind of social gatherings, to give dramatic representations of events of the life of the wine-god, or of such incidents of every-day life as corresponded in tone to the character of the feast. In these representations gesticulation and musical composition seem to have been the principal elements, but words were also supplied, and by the transition to a form of literary composition they became, of course, of predominating importance. The *mimes*—that is, small comedies—of Sophron enjoyed a great reputation in ancient times; Plato read them again and again, and slept with them under his pillow. But only a few fragments have come down to us, collected by Blomfield in *Museum Criticum* (vol. ii., 1826), and by Ahrens, *De Græc. Dialect.* (vol. ii. p. 464).

So'quel, p.-v. and tp., Santa Cruz co., Cal., on Monterey Bay. P. 1193.

So'ra, town of Italy, province of Caserta, on the Garigliano, in a plain surrounded by hills, lies about 58 miles N. N. W. of Naples, is a walled town, has some good churches and other public buildings, with a few handsome private palaces, and boasts a fine café and inns for travellers. The paper, woollen, and other manufactories here are on a very considerable scale, and are provided with good modern machinery. Much effort is making for improvement in public instruction, especially in the primary schools. The remains of the old Volscian *Sora*, once so important a city, are very insignificant, and the fact that it was taken by the Romans in the year 411 of their city is almost all that is certainly known of its early history. In the sixth century it suffered severely from the northern invasions; in the ninth it fell into the hands of the Saracens, who were, however, soon driven out. For many centuries afterward the possession of Sora was an almost constant subject of dispute between the Normans, Angevins, popes, etc., who gave it no rest. In 1654 it was wellnigh totally overthrown by an earthquake, but was soon rebuilt. Sora is said to have had a bishop as early as 272, and the canons of the collegiate church of Santa Restituta have the odd privilege of wearing the red velvet cape otherwise worn only by the pope himself. P. 12,074.

Sorac'te, the present *Monte di San Oreste*, a mountain of Etruria, an outlying offset of the Apennines, from which it is detached by the valley of the Tiber, rises with its bold and abrupt masses of the peculiar hard Apennine limestone 2420 feet above the surrounding plain, and forms, especially when its top is covered with snow, a conspicuous and very picturesque feature in the views of the Campagna. (Horace, *Carm.*, i. 9.) In ancient times it was dedicated to Apollo, and bore on its top a celebrated temple of this god, to which large and peculiarly solemn processions were made from Rome, situated 26 miles to the S. In 746, Carloman, the brother of Pepin, founded the monastery of San Silvestro on the site of the old pagan temple. Its present name the mountain has received from a village, San Oreste, situated on its slope and notorious for its sour wine.

Sora'gna, town of Italy, province of Parma. The old castle contains some fine frescoes. Under Joseph II. Soragna gave its name to a principality. P. 5492.

Soranjee, the name given in the East Indies to MORINDINE (which see), a yellow crystalline coloring-matter found in the root of *Morinda citrifolia*. Its chemical composition is $C_{28}H_{30}O_{15}$. When heated it is converted into *morindone*, a beautiful crystalline substance containing $C_{14}H_{10}O_5$.

Sora'no, or **Sovana,** town of Italy, province of Grosseto, on a tufa rock about 50 miles E. S. E. of the town of Grosseto. This place, unhealthy like the whole district, was originally a stronghold of the Aldobrandeschi, from whom it passed to the Orsini, who built the upper fortress, then to the city of Siena, and finally to Florence. P. 5589.

So'rau, town of Prussia, province of Brandenburg, on the Goldbach, is an old town, with extensive cloth manufactures, print-works, bleaching fields, etc. P. 11,264.

Sorb'ite [Lat. *sorbum*, "sorb tree"], or **Mountain-ash Sugar.** This saccharine substance is formed in the juice of the berries of *Sorbus aucuparia*, the mountain-ash, a European plant, as well as in the related American plant, *Sorbus americana*. These small trees have bunches of brilliant scarlet berries, and are hence grown in gardens for ornament. The sugar, which has the composition $C_6H_{12}O_6$, or an isomere of glucose, is stated to be incapable of fermentation; and when the juice of the berries is allowed to ferment, so that it afterward settles clear, the unchanged sorbite will crystallize out on evaporation in fine transparent crystals, which are trimetric, have density 1.654, are sweet as cane-sugar, and dextro rotatory to 47°. It is soluble in half its weight of cold water, insoluble in alcohol; forms a cubical compound with NaCl; dissolves lime and baryta like sucrose; and, according to Berthelot, will undergo the lactic and butyric fermentations with cheese, like lactose. H. WURTZ.

Sorbonne', the name generally applied to the theological faculty of the ancient University of Paris, was derived from Robert de Sorbon (b. at Sorbon in the Ardennes in 1201, and afterward chaplain to Louis IX.). In 1252 he founded an institution, connected with the University of Paris, in which a number of secular priests were to teach

theology gratuitously to poor students, and in the following year the institution received its charter from Louis IX., which was confirmed in 1268 by Pope Clement IV. The great care which was taken not to admit among the teachers any but men of the highest talents and attainments soon procured for the school a European fame, and in the fourteenth century the entire theological faculty of the university was merged into it. During the Middle Ages, the period of the Reformation, and even after that time, the Sorbonne was generally considered one of the highest authorities of the Christian Church, and its decisions were appealed to not only in theological controversies, but also in the contests between the popes and the secular powers. It was a staunch champion of the freedom of the Gallican Church, and strongly opposed to Ultramontanism. It condemned Jansen and the Jansenists in matters of doctrine, but it sided with them in their fight with the Jesuits. Its culmination was in the time of Cardinal Richelieu, who, himself a graduate of the school, provided it with a magnificent building and enlarged its library. But in its contest with the philosophy of the eighteenth century it was unsuccessful, and it had outlived its fame when, during the Revolution, it was suppressed and bereft of its endowments. At the reconstruction of the university in 1808 by Napoleon I., the building, still called the Sorbonne, was given to the theological faculty in connection with the faculties of science and belles-lettres. (See Duvernet, *Histoire de la Sorbonne* (2 vols., 1790).)

Sorb Tree, or **Wild Service,** the *Pyrus terminalis*, a small European tree (order Rosaceæ) whose wood is very hard and valuable. Its fruit, the sorb, when over-ripened, is soft and mellow, and very good eating. Hertfordshire is famous for its sorbs, which are largely marketed in London. (See SERVICE TREE and MEDLAR.)

Sorcery. See MAGIC.

Sorel′, a flourishing town, capital of Richelieu co., Quebec, Canada, on the St. Lawrence, just below the mouth of Sorel (or Richelieu) River, 45 miles below Montreal. It has extensive manufactures, and a large lumber-trade with tropical America. The town is finely laid out, has a large public square, good schools, and 4 weekly, 1 tri-weekly, and 1 monthly periodical. It is the seat of a convent, hospital, academy, and college of the Roman Catholics. P. 5636.

Sorel (AGNES). See AGNES SOREL.

Sorel's Cements. These cements owe their name to the inventor, the French chemist Sorel. The principle on which they are founded is the mixing of a concentrated solution of a metallic chloride with the oxide of the same metal to a pasty mass, when, in case of several metals, a solid insoluble oxychloride is rapidly formed, which is sometimes quite crystalline and hard. The most approved compositions of this class are those made with the chlorides of *zinc* and *magnesium*. A solution of MgCl of a density of 20° to 30° of Baumé's hydrometer is mixed with magnesia to a paste, which may be applied and moulded like plaster. It concretes to a very white mass of the hardness of marble. Chloride-of-zinc solution mixed with oxide of zinc, forms a similar cement-composition. H. WURTZ.

Soresi′na, town of Italy, province of Cremona, 15 miles N. W. of Cremona. The churches contain frescoes and other artistic objects worthy of notice, and intarsias of great beauty are still wrought here. This town is remarkable for its domestic industries, and it carries on an active traffic in the products of the vicinity. P. 8919.

Sorex, the shrew. See SORICIDÆ.

Sor′ghum, a genus of grasses of the tribe Andropogoneæ, closely allied to the sugar-cane, presenting many varieties and having various names. The variety usually known as sorghum (*S. vulgare* or *S. saccharatum*) has been cultivated from time immemorial in Africa and China; in Africa it is called *imphee*. The plant was almost unknown in Europe until 1851, when Count de Montigni, the French consul at Shanghai, sent some seeds to Paris, which were planted, but only one is said to have germinated, and from this has sprung nearly all the seed sown in Europe and America. In 1856 some of this seed was obtained by the U. S. patent-office and distributed, but the introduction of the plant here is mainly owing to Mr. Orange Judd of New York, proprietor of the *American Agriculturist*, who imported 25,000 packages of the seed, which he distributed among the subscribers to his paper in all parts of the country. In 1857, Mr. Wray, an Englishman, brought to New York seeds of several varieties of the African imphee, and they were tested by many agriculturists, but the result was upon the whole unsatisfactory, and the Chinese variety is the one chiefly cultivated here. This attains a height of from eight to eighteen feet, and before the seed-cluster makes its appearance bears a close resemblance to Indian corn. It will grow in any place where maize succeeds, but rarely ripens its seed N. of lat. 41°. It is sown in drills or in hills like Indian corn, and the mode of cultivation is essentially the same. The stalks are cut off at the ground just before the hard frosts set in, stripped of their leaves, and stored away for pressing. Well-ripened stalks yield about half their weight of juice, of which from five to ten gallons are required for a gallon of syrup. The saccharine matter is chiefly in the form of glucose, and produces only a very small percentage of crystallized sugar, so that the plant is cultivated chiefly for the molasses or syrup. A fair average yield is about 150 gallons to the acre. This syrup varies greatly in quality, according to the care and skill bestowed upon its manufacture, from a dark greenish-brown fluid with an unpleasant weedy flavor, to an amber-colored saccharine syrup destitute of any characteristic flavor. The finer qualities are by many preferred to the best cane-molasses. The total production of sorghum-molasses in the U. S. in 1860 was about 6,750,000 gallons; in 1870 it was more than 16,000,000 gallons, of which nearly 10,000,000 were in the States of Indiana, Ohio, Illinois, Kentucky, and Missouri. The seeds are chiefly used as food for cattle, swine, and poultry, although bread has sometimes been made from the flour. Coarse wrapping-paper has been manufactured from the refuse of the stalks after pressing. As fodder for cattle it is not regarded as equal to Indian corn.

So′ria, town of Spain, province of the same name, on the right bank of the Duero, is surrounded with thick old walls, has some leather manufactures and dyeing establishments, and carries on trade in wool. P. 5004.

Soric′idæ [from *Sorex*, the Latin name of the typical form], a family of mammals of the order Insectivora, which are often designated as shrews or shrew-mice. Externally, they have much resemblance to mice, but are readily distinguishable by the longer and pointed snout, and of course, belonging to a different order as they do, they have no real affinity. In contrast with the Talpidæ, to which they are most nearly related, they present the following characters: The skull (which has a conoid contour) has well-developed posterior ridges; the foramen magnum subcircular and inclined a little forward below; well-developed post-glenoid processes; the tympanic elements annular, and not forming bullæ; the infra-orbital canals long, subcylindrical tunnels covered by broad osseous walls; and the zygomatic arches not developed; the lower jaw has its ascending rami deflected outward, and each has a cavity at the bottom of the coronoid process; the teeth range in number from 26 to 36 (M. $\frac{3}{3}$, P. M. $\frac{1-3}{1-2}$, C. $\frac{1}{1}$, I. $\frac{2-4}{1-2} \times 2$); the true molars of the upper jaw have four primary (but generally reduced to three by coalescence of the median) external, and two primary and more elevated internal cusps, circumscribing V-shaped areas, and a well-developed secondary posterior lower ledge; the molars of the lower jaw have two primary external cusps (anterior and posterior), and four primary internal ones, the antero-external connected with anterior and intero-median internal by ridges, and thus circumscribing a triangular area; the two median inferior incisors are large and proclivous; the vertebræ are also characteristic, the cervical having well-developed hypapophyses, and the dorsal and lumbar distinct hyperapophyses; the sternum has a broad but not keeled manubrium; the anterior members are more slender than the posterior; the carpus is normal, and has no sickle-shaped bone or os intermedium; the scapula is short and broad. The family thus defined is a very homogeneous one, and although it is by far the largest (as regards number of species) in the order to which it belongs, the differences between its constituents are less than in any other of the related polytypic families. Representatives are found in the entire northern hemisphere, and extend southward into India and Eastern Asia in the Old World and into Mexico in the New. By H. Milne-Edwards eight genera are recognized: of these, three (*Sorex*, *Crocidura*, and *Crossopus*) are represented in Europe, and three (*Sorex*, *Blarina*, and *Hydrogale* or *Neosorex*) in North America, while the remaining three (*Anurosorex*, *Diplomesodon*, and *Nectogale*) are Asiatic. Other genera which were referred to the family by the older authors have no affinity with these, but belong to different families. The species are all of small size, and some of them are among the least of mammals. They have certain glands, near the fore limbs, on the sides, and behind at the base of the tail, in which is secreted a musky fluid. They feed not only on insects, worms, etc., but on such young vertebrates (birds, etc.) as they are able to overcome. THEODORE GILL.

Sorites. See LOGIC, by PROF. W. D. WILSON, LL.D., L. H. D.

Soro′sis [Gr. σώρευσις, "aggregation"], a term in botany applied to a compound fleshy fruit formed by the close

aggregation of many flowers whose floral whorls become succulent, as the pineapple.

In Mar., 1868, the first woman's club of America was organized under the name of *Sorosis*, and has continued to exist under the same style and title; its object being, as stated in its constitution, to bring together representative women in literature, art, science, and kindred pursuits, and by uniting them render them helpful to one another and useful to society. The first annual report of the executive committee of Sorosis, adopted at the annual meeting of the club and published in the *World* of Mar. 23, 1869, states that Mrs. Croly was stimulated to the formation of a woman's club by the refusal of the committee on the Dickens dinner from the Press Club to allow women to participate equally with men on that occasion. She thereupon invited the co-operation of ladies, and a meeting was called at her house in West Fourteenth street to formulate a plan having that object in view. There were present at the first meeting Miss Kate Field, Mad. Botta, Mrs. Henry, Mrs. Field, Mrs. C. B. Wilbour, and Mrs. Croly. A call for a meeting of organization signed by these ladies resulted in the assembling of fourteen well-known women at the same place on the following Monday, twelve of whom organized a woman's club under the name of "Sorosis," which, in the pursuit of a name which should not stand in the way of any object desired, Mrs. Croly found in a botanical dictionary. The officers first elected were—president, Mrs. Fanny Fern Parton; vice-president, Mrs. J. C. Croly; secretary, Miss Kate Field; executive committee, Phebe Cary, Mrs. Ella Clymer, Mad. Demorest, Miss Josephine Pollard, and Mrs. Sara L. Hopper. Subsequently, the officers stood as follows: president, Miss Alice Cary; secretary and treasurer, Mrs. C. B. Wilbour; chairman of executive committee, Mrs. Agnes Noble, Mrs. Parton, Miss Kate Field, and Miss Phebe Cary declining or not being able to serve. At the close of the first year nineteen regular club meetings had been held—fifteen at Delmonico's (the home of the club), four at the houses of members; and the meetings, it is stated, were rendered conspicuously profitable by conversational disquisitions and literary exercises of a high order. The number had increased to 83 members in good and regular standing, 8 of whom were honorary. Among these were 6 artists or workers in art, 22 authors, 6 editors, 1 historian, 11 poets, 9 teachers and lecturers, 8 well-known philanthropists, 2 physicians, 4 writers on science, besides others, contributors to periodicals. At the first January meeting (1869) the committee having in charge the obtaining of an act of incorporation reported that a certificate of incorporation under the general law of the State had been filed in the archives of the secretary of state, a duplicate of which was presented and adopted by the club. The names of the incorporators were Agnes Noble, Jennie C. Croly, Charlotte B. Wilbour, Celia M. Burleigh, E. Louise Demorest, Ella M. Clymer, Josephine Pollard, Sara L. Hopper.

Many women's clubs have since been formed, but Sorosis is the only one whose membership and management consist of and are maintained wholly and solely by women. The scheme of the club is social and educational. It holds two meetings during the month—one on the first, the other on the third Monday—both at Delmonico's, corner Twenty-sixth street and Fifth avenue. The first is social, and to it the members are permitted to bring guests; the second is for business purposes, and is confined to members only. This membership is divided up into ten working committees—literature, art, science, education, music, philanthropy, house and home, drama, journalism, and business-women. Two of these committees have the charge of each social meeting, contributing to the useful entertainment of the club reports of facts interesting to women in their special departments, and suggestive papers to lead discussion upon previously-stated questions—the reports being intended to constitute a summary or record of what is being done by or for women in different fields of activity; the papers to stimulate thought and furnish means for arriving at correct conclusions in regard to mooted questions. Lighter exercises, supplied through the efforts of the music committee and members, vary the graver topics. The initiation fee and golden *S*, the badge of the society, are five dollars each; the annual dues are also five dollars. The presidents of Sorosis have been Alice Cary; Mrs. J. C. Croly; Mrs. C. B. Wilbour, re-elected four times; Mrs. J. C. Croly, elected a second time for 1875, re-elected for 1876. Mrs. Ruth O. Delemater treasurer. J. C. Croly.

Sor'rel, a popular name for several sour-leaved plants, especially for those of the diœcious section of the genus *Rumex* (order Polygonaceæ), to which genus the coarse herbs called dock also belong. Plants of the genus *Oxyria* (of the same order) are called mountain sorrels. The wood-sorrels are of the genus *Oxalis* (order Oxalidaceæ). There are numerous species of the above genera, some of which are occasionally used as salad-herbs and as flavors for sauces. In Europe the sorrels, mountain-sorrels, and wood-sorrels are cultivated for table use in gardens. Of *Oxalis* there are many species, some cultivated for their flowers, and others for their thick starchy roots, used as food in some countries. All the sorrels owe their sourness to the presence of oxalic acid and its salts. (See Oxalis.)

Sorrel, Salts of. See Oxalis.

Sorrel Tree, or **Sour-Wood**, the *Oxydendrum arboreum*, a handsome tree of the U. S., found in Ohio and Pennsylvania and southward to the Gulf. Its leaves resemble those of the peach. They are sour, and from them a cooling drink is made for the sick. The wood is soft and very difficult to dry. It is sometimes planted as an ornamental tree.

Sorren'to, town of Southern Italy, province of Castellamare, on a small rocky peninsula on the S. side of the Bay of Naples. The rocks on which it is built when seen from the sea look like an extensive artificial wall; it is protected from the sirocco by Monte Vico, and from the W. wind by Monte Massa. Sorrento is not a well-built town, but the churches are worthy a visit, especially the Duomo, which contains some fine marbles. The villas, however, are very numerous and extensive, with gardens of almost tropical luxuriance, and the views from the higher points are marvellously beautiful. From the village of Sant' Agata, a mile from the town, the prospect is so enchanting as almost to bewilder the imagination. The high altar of the parish church of Sant' Agata is regarded as one of the finest specimens of intarsia to be seen in Italy; it is of the time of the Medici, and has a curious history. Sorrento was a Greek settlement, was adorned with splendid temples during the Roman period, and after the fall of the Western empire was ruled by its own consuls and dukes. Of the old temples, a few fine marbles, mosaic pavements, etc., alone remain, besides the foundations. The climate of Sorrento, as agreeable as it is salubrious, the luxuriance of the vegetation, and the wonderful variety and beauty of the surrounding scenery, have made Sorrento one of the most frequented resorts in Southern Italy, alike for travellers in search of the picturesque and those in the pursuit of health. There is a small coasting-trade in the rich productions of the vicinity carried on by means of the little harbor. Sorrento has the honor of being the birthplace of Torquato Tasso. P. 7194.

Sor'so, town of Sardinia, province of Sassari, about 8 miles from the town of Sassari, is one of the most prosperous towns of its size in the island, and few even of the larger can boast so much private comfort or so much attention to public instruction. The men are laborious, chiefly in agriculture, and the women make large quantities of linen of very tasteful patterns. In the vicinity may be traced many vestiges of a pre-historic population. P. 5533.

Sortain' (Joseph); graduated at Trinity College, Dublin, and was for many years minister of an Independent church in Brighton, England. He published *Lectures on Romanism and Anglo-Catholicism* (1841), *Memoir of Mrs. George Clayton* (1844), *Life of Lord Bacon* (1851), *Hildebrand and the Excommunicated Emperor* (1851), *Count Arensberg, a Tale of the Days of Luther* (1853), and a sermon on the *Indian Mutiny* (1857). A *Biography* of him by his widow was published soon after his death. D. at Brighton in 1860.

Sorti'no, town of Sicily, province of Syracuse, pleasantly situated on the top of Monte Suzio (*Xuthia*) about 19 miles N. W. of the city of Syracuse. The views from this town are extraordinarily fine, especially toward the S., where the rugged mountains offer points of most picturesque wildness. Below may be seen the ruins of old Sortino (*Xuthia*), which was overthrown by an earthquake in 1693. Not more than a mile from the town there are numerous caverns, originally occupied by the rock-dwellers, and subsequently used as tombs by successive populations. One of these caves is 120 feet in length, 75 in width, and 12 in height. The ruins of the once powerful and flourishing *Erbessa* or *Pantalica* are also very near the town. The inhabitants of Sortino are remarkable for their skill in working gold and silver, and are altogether above the average Sicilian standard. P. 8791.

Sosnit'za, town of Russia, government of Tschernigov, has extensive manufactures of tobacco. P. 5000.

Soteriol'ogy [Gr. σωτηρίας λόγος, "doctrine of salvation"] treats of the redemptive work of Christ. In its wider signification it includes both the atonement which Christ made and its application through faith to individuals. Thus defined, it would comprise not only the doctrine of expiation, but also those of regeneration, justification, and sanctification. It is, however, used in a more re-

stricted signification, to denote only the atonement—the term redemption being applied to the others—and it is in this sense that we shall employ it.

The atonement is the satisfaction of divine justice for the sin of man by the substituted sufferings of the Son of God. Though occupying a large space in revelation, the doctrine received little theoretical investigation in the ancient Church, compared with that bestowed upon the Trinity and original sin. Its first opponents were the Ebionites and Gnostics. From different points of view both alike rejected the two tenets which the Church had derived from Scripture, that the divine justice requires satisfaction for sin, and that this satisfaction was made in behalf of man by Jesus Christ. In combating them, the apostolic Fathers (100–150) confined themselves mostly to the biblical phraseology, and attempted no rationale of the dogma. The evangelical truth was firmly held in the heart and experience, but was not examined in the dry light of the intellect. The relations of the sacrificial death of Christ to the justice of God, on the one hand, and to the conscience of man, upon the other, were left to be investigated by later theologians.

On passing from the apostolic to the primitive Fathers, we find more of the scientific discussion of the doctrine of atonement, though not sufficient to constitute a complete statement. Some of the Fathers, like Irenæus, for example, injure the discussion by attributing to the work of Christ an influence upon Satan, and finding a reference in it to the claims of Satan upon man, his captive. This vitiating element, however, did not enter largely into the patristic soteriology. The principal reference of the death of Christ, according to Irenæus himself, and especially according to Athanasius, the two Gregories, the two Cyrils, and Eusebius of the Greek Church, and Augustine, Leo, and Gregory of the Latin, was to the law and justice of God. The chief defect in the patristic soteriology is, that the distinction between justification and sanctification was not always so carefully drawn as to preserve the doctrine of atonement in its integrity. The holiness of the renewed man is occasionally represented as co-operating with the oblation of Christ in constituting the ground of the remission of sin. This was the beginning of that fatal alteration made in soteriology which finds its completion in the papal theory of justification by sanctification. Augustine himself sometimes employs phraseology which can be construed, and is by papal writers, to mean that man is justified in part by an inherent righteousness. This inward righteousness is indeed regarded as the work of God in the soul, but this fact cannot convert inward holiness or personal excellence into an atonement for past transgression. Because a man has become renewed in his heart and inclination is not a reason why his former sin should be forgiven. Nothing but suffering is expiatory, and holiness is not suffering. The loose use of justification in the sense (favored by the Latin etymology) of making just as well as of pronouncing just, tended to this error.

During the Middle Ages the papal statements had too much influence to allow of an improvement in soteriology. The course of this great doctrine of revelation was downward, in both the theory and the practical experience of the Church. Though holding in a passive and hereditary manner the patristic statements respecting the Trinity and the person of Christ, the Church was holding, more and more, a theory of redemption that was wholly opposed to that form of doctrine which had prevailed during the first four centuries in both the Eastern and the Western Church. The first mind to interrupt this dogmatic decline, and set the Church once more upon the true path of investigation, was Anselm. With him the Protestant theory of the atonement, as distinguished from the papal, may be said to have begun. His tract, *Cur deus homo?* contains the substance of the soteriology of Luther and Calvin. The leading features of his theory are these: (1) Sin is an offence against the divine honor. (2) This offence cannot be waived, but must be satisfied for. (3) Man cannot make this satisfaction except by personal endless suffering. (4) God must therefore make it for him if he is to be saved. (5) God does make it in the incarnation and atonement of the Son of God. Anselm demonstrates, by close reasoning, that the highest form of mercy is the vicarious satisfaction of justice. Whoever puts himself in the criminal's place, and suffers death in his stead, outruns all other forms and degrees of compassion. The soteriology of Anselm exerted but little influence in Roman Catholic Christendom. Anselm's sphere of labor was upon its frontier. The see of Canterbury and the English Church in the eleventh century were too near the Ultima Thule to make themselves felt upon the corrupted Christianity of the Italian popes.

The awakening of the new evangelical life in the sixteenth century was closely connected with the revival of the true doctrine of atonement. Luther's powerful assertion of justification by faith alone, without works, supposed, of course, a biblical theory of expiation. Soteriology now became the centre of dogmatic controversy between Protestant and papist, as anthropology had once been between Augustine and Pelagius, and as Trinitarianism had been between Athanasius and Arius. The consequence was that the symbols of the Reformation, both Lutheran and Calvinistic, exhibit a sharper discrimination than was seen in even the best soteriology of the patristic Church. The principal point of dispute between the Council of Trent and the Protestant theologians related to the place which sanctification occupies. The Roman divine maintained that holiness of heart is necessary to the forgiveness of sin, as a meritorious cause. Pardon, he said, cannot rest solely and wholly upon the atonement of Christ. Man is not justified by faith in Christ's atonement alone, without any works, either internal or external. Though the oblation of Christ is the principal ground of forgiveness, it is not the sole ground. The atonement must be supplemented, to some degree, by charity in the heart and by ecclesiastical penance. The Protestant theologian threw out this subjective and human element altogether. Nothing but Christ's blood is the meritorious cause and ground of forgiveness. Holiness of heart, charity, and all the other Christian graces are indispensably necessary, it is true, but for quite another reason than that assigned by the Tridentine divine. They are no part of the atonement for sin. The Protestant soteriology prevailed in Protestant Christendom, while the papal Church held to the statements now formulated for the first time, with any exactness, in the Tridentine canons.

Within the Protestant Church further discussions were afterward excited, partly by the Socinian opposition, and partly by the Grotian modification. The Socinian denied atonement altogether, taking substantially the position of the ancient Ebionite and Gnostic—namely, that retributive justice is not a real attribute of God, and that benevolence alone regulates the divine method of dealing with sin and sinners. The modification of the doctrine of atonement by Grotius is a much more important chapter in soteriology than its denial by Socinus. Grotius maintained, (1) That the satisfaction of justice is necessary, not intrinsically, but because God so decides. He might decide that it is not necessary should he so please. (2) That the amount and kind of satisfaction required by justice depends upon the will of God. Any sacrifice which God should decide to accept as an equivalent for man's punishment would be an equivalent. This theory is denominated that of *acceptilation*. The substance of it had been held in the Middle Ages by Duns Scotus. The term *acceptilatio* is borrowed from the Roman civil law. As a pecuniary creditor can call a payment of 50 per cent. a full payment if he so pleases, so God can call a satisfaction plenary and complete which in reality is only partial and incomplete. This he has done. The death of Christ in the place of the millions of mankind is not a real and strict equivalent, but it is an accepted equivalent. The object of Christ's death, according to Grotius, is not to make a full satisfaction of all the claims of retributive justice; this would require the death of mankind. But God has the right and power to waive the full demands of justice; he can relax justice if he pleases. This he does when he accepts the sufferings of Christ in the place of those of man. This relaxation of justice could not go to the extent of waiving all the claims of justice without evil consequences to the divine government. A middle course is therefore adopted. There is a partial waiving of claims, and a partial satisfaction of claims. Retributive justice is not satisfied by Christ's vicarious atonement, but public justice, as Grotius denominated it, is. Christ's death exhibits the divine detestation of sin, and thereby counteracts the ill effects of relaxing justice. The public welfare is protected, and in this way public justice is maintained. The Grotian theory finds its refutation in the leading positions taken by Anselm and the Reformers in the construction of their soteriology. The principal arguments against it are—(1) The denial of the Grotian postulate, that justice is of the nature of a positive statute, and may be both made and relaxed by the divine will. Justice is held to be an immanent attribute of God, having a necessary quality, so that its claims cannot be waived or relaxed in the least degree. (2) The satisfaction of justice must be plenary, or none at all. There is no middle ground. Justice must either be fully satisfied or trampled upon. (3) The sufferings of Christ are a true and real equivalent. They are not equivalent because they are accepted, but they are accepted because they are equivalent. The equivalency of Christ's satisfaction to that which mankind would have made by endless suffering is explained by the infinity and deity of his person.

The history of soteriology during the last two centuries presents no elements that may not be found in the preceding history. Churches and theologians have been charac-

terized either by the stricter or the looser theory of satisfaction. Speaking generally, the Calvinist has defended the positions of Anselm and the Reformers, while the Arminian has inclined, though not universally, to those of Grotius.

Among the many treatises may be mentioned Anselm's *Cur Deus Homo?* (translated in *Bibliotheca Sacra*, 1854–55); Calvin's *Institutes*, b. ii. ch. 15–17; b. iii. ch. 1–19; Owen, *On Justification* and *Divine Justice;* Pearson, *On the Creed*, art. iv.; Howe's *Living Temple*, pt. ii. ch. 5–11; Edwards, *On Justification* and *Wisdom in Salvation;* Magee, *On Atonement;* Outram, *On Sacrifice;* Hodge's *Theology*, vol. ii.; Crawford, *On Atonement;* Shedd's *History of Doctrine*, ii. 201–386; Grotius, *De Satisfactione Christi;* Limborch's *Theologia Christiana;* Sykes, *Scripture Doctrine of Redemption;* Socinus, *De Servatore*. W. G. T. SHEDD.

Sotheby (SAMUEL LEIGH), b. in 1805; was a partner with his father in an extensive book and art auction establishment in London; an accomplished bibliographer, antiquarian, and numismatist. Among his bibliographical works are—*Observations upon the Handwriting of Philip Melanchthon*, etc., with 33 plates (1840); *Collection of Fac-Similes of Types, Wood-Cuts, etc. used by Early Printers*, with 42 plates (1840); *Collection of nearly Five Hundred Water-marks used by the Early Paper-Makers* (1840); *The Typography of the Fifteenth Century*, containing fac-similes from the productions of more than 100 early continental printers (1845); *Principia Typographica*, relating to the block-books issued in Holland, Flanders, and Germany during the fifteenth century, considered in connection with the origin of printing, with several hundred plates and wood-cuts (1858); and *Ramblings in Search of the Autograph of Milton* (1861). He left a MS. collection relating to the works of the early poets to the year 1660, which was continued by his widow. D. in 1861, being accidentally drowned in the river Dart.

Sothe'by (WILLIAM), F. R. S., b. in London, England, Nov. 9, 1757; educated at Harrow and in the military academy at Angers, France; travelled in Germany and Austria; was an officer of dragoons in the British army 1777–80; resided on his handsome estate of Bevis Mount, near Southampton, 1780–91; thenceforth divided his time between residences in London and in Epping Forest; possessed an ample fortune; exercised an elegant hospitality, and did much by his pen to naturalize the modern German classics in England. D. at Fair Mead Cottage, Epping Forest, Dec. 30, 1833. Author of several volumes of poems and of correct metrical translations of Wieland's *Oberon* (1798), Virgil's *Georgics*, with Latin text (8vo, 1800), and Homer's *Iliad* (1831) and *Odyssey* (1834). Printed privately the *Georgics* in six languages (folio, 1827), comprising the Latin text of Heyne, the Italian translation of Soave, the Spanish by Guzman, the German by Voss, the French by Delille, and the English by himself.

Soth'ern (EDWARD ASKEW), b. in Liverpool, England, Apr. 1, 1830; made his *début* as an actor in Boston, Mass., Sept., 1852, under the stage name of "Douglas Stewart;" created the character of Lord Dundreary in the play of *Our American Cousin* at Laura Keene's theatre, New York, 1858, and has since represented it many hundreds of times with great popularity in the U. S. and in England.

Sothic or **Sothiac Period**, and **Sothic** or **Sothiac Year** [from *Sothis*, the Egyptian name for *Sirius*, the dog-star]. From a period of fabulous antiquity, said to date from the reign of Osiris, the Egyptians employed a calendar year of 365 days, embracing 10 months of 30 days each, with 5 epagomenal or supplementary days at the end. But the observation of the heliacal rising of the dog-star (that is, of the earliest appearance before sunrise of this star annually) led them to the discovery that their calendar year was about six hours too short. They did not, however, on this account abandon it, though they perceived it to go backward relatively to the true year by an entire day in every quadrennium. Rather, on the other hand, this circumstance seemed to them to be attended with a compensating advantage; for as their religious festivals were regulated by their calendar, the gradual displacement secured to every season in its turn the benefits supposed to flow from their observance. The year of $365\frac{1}{4}$ days was called the *Sothic* year; that of 365 days, the *vague* [Lat. *vagus*, "wandering," "unsettled"] year, of which the beginning, going backward one day in every four years, completes the circuit of the seasons in $365 \times 4 = 1460$ Sothic years, or 1461 vague years; which duration is called the *Sothic* period.

The epoch of a Sothic period is taken at the coincidence of a vague and a Sothic year. Such a coincidence occurred in the year 136 of our era, when the vague year began July 20, which was also the day of the heliacal rising of Sirius. The period which then began is regarded as the third after the establishment of the cyle; which would place the beginning of the second at B. C. 1325, and that of the first at B. C 2785.

The Egyptians were, however, in error in giving to the Sothic year the length of $365\frac{1}{4}$ days exactly, though that length was also given later to the Julian year. By its definition the Sothic year is a sidereal year (see YEAR), and it exceeds its assumed length by 9*m*. 5.95*s*.—a small amount, but sufficient to affect very sensibly the length of the period. If this period be understood to be the interval between two consecutive coincidences of the vague and Sothic years, its length will be found by computation to be almost exactly equal to 1425 vague years, or 1421 Sothic years. The true beginning of the second Sothic period must, on this supposition, be placed in B. C. 1289, and that of the first in B. C. 2713. In the first of these years, the heliacal rising of Sirius which marked at once the beginning of the vague year, the Sothic year, and the Sothic period, took place on the 11th of July by Julian reckoning extended backward; and in the second, this phenomenon occurred on the 2d of July by the same reckoning. These results make it probable that the epochs of the successive periods were not established by direct observation.

F. A. P. BARNARD.

So'this, another name of SIRIUS (which see).

Soto. See DE SOTO.

Sotteville'-les-Rouen', town of France, department of Seine-Inférieure, on the Seine, has cotton spinning and weaving factories, and manufactures of soap, ivory-black, and chemicals. P. 8990.

Sou. See SOLIDUS.

Souari-Nut. See CARYOCAR.

Soubise', the name of an old family of French nobility whose possessions and titles fell to the family of Rohan in 1557 by the marriage of Catharine de Parthenay and René II., Vicomte de Rohan. Their second son, BENJAMIN DE ROHAN, b. at La Rochelle in 1583, bore the title of Seigneur de Soubise, and distinguished himself by his zeal in defending the Protestant cause in France. After the fall of La Rochelle he retired to England. D. in London Oct. 9, 1642. The family became extinct with CHARLES DE ROHAN, Prince de Soubise, who was b. July 16, 1715. He was a favorite of Louis XV., whom he accompanied as aide-de-camp on his campaigns 1744–48. He also gained the favor of Madame de Pompadour, and was appointed commander-in-chief of one of the two French armies which invaded Germany on the breaking out of the Seven Years' war. But he was ignominiously surprised at Gotha by Seydlitz, and soon after completely routed at Rossbach (Nov. 5, 1757). He was recalled and made minister of war, but in 1758 he again took the highest command in the field, this time, however, with the duke de Broglie at his side. A victory was won at Lützelburg, and Soubise was made a marshal. But the jealousy of the two commanders made any further progress impossible. After the peace in 1763 he lived quietly at the court. D. July 4, 1787.

Soul [Gr. ψυχή; Lat. *anima*], a term variously applied to signify either the principle of life in an organic body, or the first and most undeveloped stages of individualized spiritual being, or, finally, all stages of spiritual individuality, incorporeal as well as corporeal. Aristotle, whose treatise *De Anima* (Περὶ ψυχῆς) is the first and still the greatest work on the subject, has himself introduced this confusion by defining the soul in one instance as the self-determining power (ἐντελέχεια) of an organized body, and then afterward attributing to it reason (νοῦς), and making it as reason entirely separable from body. If strictly limited to the phases of relation which the mind has toward its organic conditions, the science of the soul is properly termed anthropology, and treats first of the cosmic, sideric, and telluric influences upon mind—the determining characteristics of race, age, the seasons, the climate, the solar and lunar periods, etc. Next comes the reaction against these determining influences of nature, as manifested in the antithesis of sex, the alternation of waking and sleeping, and in the phenomena of dreams, fœtal life, somnambulism, clairvoyance, catalepsy, St. Vitus's dance, and the various forms of vicarious sense-perception (where seeing, hearing, tasting, etc., are performed by the organ of feeling, the skin, in diseased states of the organism), trance-exaltation, etc. It considers next the questions of arrested development, such as appears in idiocy; the return to the previous stages out of the stage of consciousness, and the mingling of the two (earlier and later) phases in the phenomena of insanity (wherein the Ego is unable to distinguish between the phenomena of sense-perception and those arising from the influence of general external conditions, or those arising from diseased activity of the nervous organism, and is thus confused, now acting upon one set of data and then upon a contrary set of data, and again upon a third set).

Through the stages of feeling and the reduction of external relations to the abstract generalities of habit, and especially in the creation of conventionalities whereby language becomes possible, and with it the formation and expression of general ideas, mind rises into the phase of Consciousness and Reason, knows itself as individual and independent of external natural influences, and accordingly subordinates and eliminates these in manifold ways through institutions—family, civil society, state, church, science, etc.—and learns to recognize conscious immaterial personality as the highest principle of the universe. The much-debated question of the immortality of the soul implies a definition of soul as including not only its phases of corporeal existence, but also the higher ones of thought and will. Hence, if ψυχή (soul) be only the principle of organic life, and νοῦς (reason) be the principle of intelligence elevated above the former and transcending it, the immortality of the former is precluded by definition, for the principle of conscious individuality is placed in the latter. Previous to Aristotle and Plato the theories regarding the soul were mostly crude suggestions. The Pythagoreans taught that the soul is a harmony—that it dwells in the body as in a prison, being confined there for punishment. Many conjectures as to the location of the soul have been made. Alcmæon of Crotona (according to Theophrastus) taught that the soul was located in the brain, "whither all sensations were conducted from the organs of the senses through canals." Like other Pythagoreans he held that the soul was subject to eternal motion, like the stars. Philolaus the Pythagorean held that the soul is united to the body, which is its organ, and at the same time its prison, by number and harmony, all things being known through number as a common principle of the soul and of things—like being known by like. Anaxagoras attributed souls to plants, and affirmed that they sorrow and rejoice. Democritus, who explained everything through the "atom and the void," held soul and fire to possess "round atoms," because they manifested the maximum of mobility. He affirmed that thought arises when the motions of the soul are "symmetrical;" and, further, that "the soul is the noblest part of man; he who loves its goods, loves what is most divine. He who loves the goods of the body, which is the tent of the soul, loves the merely human." Critias the Sophist considered the blood to be the substratum of the soul. Plato (in the *Phædrus*) makes three souls or phases of the soul: (*a*) the appetitive soul, seeking happiness or sensual pleasure, the gratification of desire; (*b*) the irascible or courageous soul, manifesting itself in combative activity, as the former in passive receptivity; (*c*) the rational soul, which alone is immortal. The cognitive or rational soul is the soul in its totality, and the irascible and appetitive souls are merely phases of arrested development occasioned by the confinement of the body. The rational soul dwells in the head (agreeing with Alcmæon), the irascible in the heart, the appetitive in the organs of nourishment and reproduction. Plato defines (*Leg.*, cap. 10) the soul as a self-moving activity (κίνησις ἑαυτὴν κινοῦσα). Transmigration of souls (*Phædo*), a doctrine apparently borrowed from Egypt and the Orient, is consonant with his theory of the pre-existence of the soul, and of the rise of the appetitive and irascible phases of the soul through the descent of the rational soul into a body. Having made the discovery of general and necessary ideas, which could not have originated in sense-perception, he undertook to account for them through reminiscence; the soul had perceived them in a former life. These ideas, *a priori*, were simple and eternal: how could the soul in which they were contemplated be other than simple and eternal? While he condemned the Pythagorean view that the soul was a harmony, Plato employed symbolic expressions quite similar. In the same spirit his successor in the Academy, Speusippus, defined the soul as "extension, shaped harmoniously by number:" hence as, in some higher sense, a unity of the arithmetical and geometrical. So, too, Xenocrates of Chalcedon, the second director of the Academy, taught that the soul is a self-moving number. Aristotle repudiated the use of symbolic language in definitions, to avoid ambiguity. He defined soul (*De An.*, ii. 1) as "the first entelechy [self-actualizing energy] of a physical, potentially living and organic body." The first entelechy is not a fully realized being, and hence it has been inferred that he intended to exclude the reason (νοῦς) from his definition of the soul, especially, too, as he makes the νοῦς to be independent of the body. But in another place he makes the soul to be "that by which we live, feel or perceive, move, and understand." The νοῦς ποιητικός = the *actus purus*, or pure reason, exists before the body, and enters it from without (θύραθεν) as something divine and immortal (*De Gen. et Corr.*, ii. 3). The νοῦς παθητικός = passive reason, including the nutritive (vegetable), sensitive (animal), and so much of the rational soul as included memory, imagination, sense-perception, and discursive intellect, he regarded (*De An.*, ii. 2) as perishable with the body. Exactly what he meant by this was long in dispute. Alexander of Aphrodisias, the great commentator, held that the active reason is the world-soul, and that individuals are mere incarnations of it which perish with the body. Dicæarchus of Messene, pupil of Aristotle, had held this doctrine. The Stoics had held nearly the same doctrine, acknowledging that the soul outlives the body, but is not eternal. Cleanthes the Stoic asserted that all souls would exist until the general conflagration of the world. But Chrysippus limited this to the souls of the wise, while Panætius denied the future life altogether. The statements of Aristotle, taken together, indicate his belief in the existence of the soul independent of the body: and not merely as a general world-soul, but also as individual souls. In the process of education, culture, or self-development the individual gradually eliminates his lower phases of thought; he depends less upon sense-perception, learning to know a great deal from seeing very little (Cuvier could describe the whole animal from one of its bones; Agassiz, a fish from one of its scales); mechanical memory likewise becomes less important as deduction from principles becomes more prominent; discursive intellect gives place to pure intellect. Thus, the lower faculties die out, and give place to more perfect forms; they become useless in the presence of more adequate forms of cognition. Hence, Aristotle was correct in describing them as transient and perishable like the body; and yet he did not at all deny, by this, future conscious identity to the individual. The active reason could energize as nutritive, locomotive, appetitive, and sensitive, organizing a new body; for organization was only a self-limitation of the active reason, a self-arrested development of it. Hence, when Averroës revived the doctrine of Alexander of Aphrodisias, the great scholastic thinkers devoted themselves to this question until they reconciled Aristotle with himself through this theory of the union of the active and passive reasons—the former as independent and substantial, and the latter as eternally produced through its energy. Albertus Magnus held that the active reason bears within itself the vegetative, sensitive, appetitive, and motive faculties. Thomas Aquinas held, similarly, that as the soul is immaterial, it cannot be destroyed through the removal of its substratum. The form-producing principle of the body, the vital force, the appetitive, sensitive, and motive powers, belong to the thinking substance, and do not inhere in the body; hence are immortal. Pure thought acts without organs: the lower functions of the soul act with organs created for temporary manifestation. This view substantially agrees with that of the Neo-Platonists, except as to the origin of the soul. "The soul is immaterial, and whole or entire in every part of the body;" this statement is constantly repeated by thinkers since Aristotle. Plato's doctrine of pre-existence and reminiscence is endorsed by some of the Platonizing Christian thinkers like Origen, Synesius, and Nemesius, but is generally repudiated, as by Arnobius, Justin Martyr, Gregory of Nyssa, St. Augustine, Æneas of Gaza. With Descartes, thinking substance is so sharply distinguished from matter that only divine intervention will account for their interaction. Geulincx, Malebranche, and Leibnitz presented different solutions of this dualism, but Spinoza boldly denied it altogether, making mind and matter two attributes of one substance. La Mettrie, a pupil of Boerhaave, observing the effect of the increased circulation of the blood upon his thoughts during a fever, concluded that psychical functions are all to be explained by the organization of the body. Diderot held that atoms are endowed with sensation, and that when combined in the animal organism they become conscious, thus reviving the doctrine of Democritus and Epicurus, who made the soul material, and perishable upon the separation of its constituent atoms. Carl Vogt in recent times makes the phenomena of the soul to be functions of the brain and nerves. Moleschott and Büchner have promulgated and popularized the same doctrine. Kant endeavored to show that the metaphysical argument which proved the immortality of the soul from its nature as simple substance is a paralogism, because the Ego which thinks is subject only, and does not appear as object in consciousness. Herbart, however, defends the idea of the soul as a simple, spaceless essence; and his disciple, Beneke, expounds the same doctrine. Trendelenburg returns to the Aristotelian definition: "The soul is a self-realizing, teleological idea; not a result, but a principle." At present there is a very great activity on the part of the physiological school of writers, who are engaged in investigating the physical correlates of psychical action.

WILLIAM T. HARRIS.

Soulanges, county of Quebec, Canada, bounded S. by the river St. Lawrence and W. by Glengary co., Ottawa. It is traversed by Grand Trunk Railway. P. 10,808.

Soulé (Mrs. Caroline A.), b. in Albany, N. Y., in 1824; has been connected with periodicals as editor or contributor, and has published *Memoir of Rev. H. B. Soulé* (1852), *Home Life* (1854), *The Pet of the Settlement* (1860), and *Wine or Water* (1862).

Soule (Joshua), D. D., b. at Bristol, Me., Aug. 1, 1781; was licensed as a Methodist preacher 1798; was presiding elder of the Maine district 1804–13; was author of the plan for a delegated general conference of his Church, adopted at Baltimore 1808; was editor of the *Methodist Magazine* 1816–20; preached in New York and Baltimore; declined a bishopric 1820, but was again elected and accepted 1824; resided some years at Lebanon, O.; was a delegate to the British Wesleyan Conference 1842; adhered to the M. E. Church, South, on the division of the Church 1844; settled at Nashville, Tenn.; visited California on an episcopal tour 1853–54, and continued active in the discharge of the duties of his post until his death at Nashville Mar. 6, 1867, being at that time the senior bishop of the M. E. Church, South.

Soulé (Pierre), b. at Castillon, France, in 1801; educated for the Roman Catholic priesthood in the Jesuit college at Toulouse; studied afterward at Bordeaux; there took part in a conspiracy against the government of Louis XVIII., which being discovered he had to flee, and for more than a year followed the occupation of a shepherd; then went to Paris; became a writer for a republican newspaper, *Le Nain*; was imprisoned in Ste. Pélagie for an attack on the ministry; escaped to England; proceeded to Santo Domingo; came thence to the U. S.; resided first a few months at Baltimore; settled at New Orleans 1825; studied law; took a high position at the bar; was U. S. Senator 1847–53, and distinguished for extreme Southern views; was appointed minister to Spain 1853; had a duel with the French ambassador at Madrid; favored the Spanish revolution of Aug., 1854; took part in the Ostend conference of Oct., 1854, intended to facilitate the acquisition of Cuba; returned to the U. S. 1855; visited Mexico soon afterward in the interest of the Tehuantepec canal project; opposed the secession of Louisiana, but ultimately adhered to the movement, and visited Europe as Confederate agent 1861; was imprisoned for disloyalty at Fort Lafayette 1862; was released on condition of proceeding to Europe, where he remained six years; returned to Louisiana 1869. D. at New Orleans Mar. 16, 1870.

Soulé (Richard), b. at Duxbury, Mass., in 1812; graduated at Harvard College in 1832; aided in the preparation of Worcester's *Dictionary of the English Language*, and has published *Memorial of the Sprague Family*, a poem, to which the family genealogy and biographical sketches are appended in notes; in conjunction with William A. Wheeler, *A Manual of English Pronunciation and Spelling* (1861) and *First Lessons in Reading* (1866); and *A Dictionary of English Synonyms or Parallel Expressions* (1870).

Soulié (Melchior Frédéric), b. at Foix, department of Ariège, France, Dec. 23, 1800; studied law; made his début in literature in 1824 with a volume of poems, *Amours français*, which passed by almost unnoticed, and wrote in 1828 *Roméo et Juliette*, and in 1829 *Christine à Fontainebleau*, which had much effect on the stage. Others of his dramas were also successful—*Clotilde* (1831) and *La Closerie des Genêts* (1846). But it was principally as a novel-writer that he became famous. He wrote about 150 volumes of novels, and although their artistic and poetical merits were very small, some of them became very popular, such as *Le Comte de Toulouse* (1835), *Un Été à Meudon* (1836), and *Mémoires du Diable* (1844). D. at Bièvre, near Paris, Sept. 23, 1847.

Soulouque′ (Faustin), b. at Petit Goave, in the southern peninsula of Hayti, about 1785; was by birth a slave, but freed by the French decree of 1790; took part in the insurrections of 1803 and 1820, attaining in the latter year the rank of captain; bore a prominent part in the civil war of 1844–45; became commander of a division 1846; was elected to the presidency Mar. 1, 1847; attached himself to the party of the blacks; inaugurated a period of terror and decimation of prominent citizens; attempted without success to conquer the republic of Santo Domingo; proclaimed himself emperor under the title of Faustin I. Aug. 26, 1849; created a nobility, a military, and a civil order of knighthood, and promulgated a constitution, which, however, he reserved the right to abrogate at any time; had himself crowned 1850, and again with great pomp in imitation of Napoleon I. Apr. 18, 1852; invaded Santo Domingo with 10,000 men, but was completely routed by Santana, losing his treasure and throne, and narrowly escaping capture, 1855; was again unsuccessful in another invasion 1856; was overthrown by Geffrard 1858; took refuge in Jamaica Jan., 1859; returned to Hayti on the fall of Geffrard 1867. D. at Petit Goave Aug. 6, 1867.

Soult (Nicolas Jean de Dieu), duke of Dalmatia, b. Mar. 29, 1769, at St. Amans-la-Bastide, department of Tarn, France, the son of a farmer; entered the ranks of the army in 1785; became a lieutenant in 1792, captain in 1793, brigadier-general in 1794, general of division in 1799, and marshal of France in 1804. He distinguished himself greatly in the battles of Austerlitz and Jena, and was made duke of Dalmatia after the Peace of Tilsit. With the exception of a short period, during which the fatal battle of Vittoria took place, he held the command in Spain from 1808 to 1814. During his first term he baffled all Wellington's exertions, but during the second, when his army had dwindled down to hardly 20,000 men, he was compelled to retreat into France, and was defeated at Orthez and before Toulouse. Made minister of war during the first restoration, he joined Napoleon during the Hundred Days, and lived in exile at Düsseldorf from 1815 to 1819. Allowed to return in the latter year and reinstated in his dignities in the army, he soon won the favor of Charles X., and was made a peer of France in 1827. Under Louis Philippe, between 1834 and 1847, he was several times minister of war, minister of foreign affairs, and president of the cabinet, but in 1847 retired from public life, having been made a marshal-general of France—a dignity which had been conferred previously only on Turenne and Villars. D. Nov. 26, 1851. The first part of his *Mémoires* was published by his son in 1854, in 3 vols.

Sound. See Acoustics, by Prof. O. N. Rood.

Sounding. See Deep-Sea Soundings, by Prof. W. P. Trowbridge, A. M.

Sound, The, or **Oeresund,** is the narrow strait, 40 miles long and 3 miles broad, between Sweden and the Danish island of Seeland, connecting the Cattegat with the Baltic. As Denmark before 1660 possessed the land on both sides of the Sound, she demanded toll of every vessel passing the Sound, and built the splendid fortress, Kronborg, to enforce her demands; and even after she lost her possessions on the eastern side of the Sound, she continued to impose "Sound duties," as the passage is clearest along the Danish coast. The duty was by itself insignificant, but the delay caused by paying it was often very provoking, and might have serious consequences, as the wind is singularly changeable in the Sound. In 1857 this toll was abolished by a friendly agreement between Denmark and the different nations which use the Sound as a road of traffic, but it is worth notice that the maintenance of these "Sound duties," which in their true character were nothing but robbery, has probably cost Denmark ten times more than the revenue ever brought in, for her wars and most of her enmities arose from this source. (See Hanseatic League.)

Sound-Waves. See Acoustics, by Prof. O. N. Rood, and Interference, by Pres. F. A. P. Barnard.

Souris, port of entry of King's co., Prince Edward Island, Canada, on both sides of the mouth of the river Souris, which has a bar with only 8½ feet of water at high tide. A breakwater is in process of construction. There are two villages, E. and W. Souris. The town has a U. S. consular agent and a grammar school. Fishing and shipbuilding are carried on. P. about 500.

Sour′-Sop, the fruit of *Anona muricata*, a beautiful tree of tropical America. The sour sop often weighs two or three pounds. Its taste is sour and pleasant. It is very soft and white, and is much eaten in the West Indies.

Soutane′ [Fr.], or **Cassock** [Lat. *talaris*], the long robe of a Roman Catholic priest. It was formerly, and still is in some places, worn as the every-day garment of priests and clerics of all degrees; and its use is compulsory during public service in all places. The more sacred vestments are worn outside the cassock. Its color for seculars is black; for regulars, such as may be designated in the rules, as white, blue, gray, etc.; for bishops, violet; for cardinals, red; for the pope, white.

South, tp., Siskiyou co., Cal. P. 939.

South, tp., Madison co., Ia. P. 1040.

South, tp., Dade co., Mo. P. 1029.

South (Sir James), F. R. S., b. at Southwark, London, England, in 1785, was son of a druggist; educated for the medical profession; practised some years as a surgeon, but abandoned that profession for the pursuit of astronomical studies; was one of the chief founders of the Royal Astronomical Society 1820; aided Herschel in his laborious researches upon nearly 400 double stars; was associated with Herschel in the award of the gold medal of the Astronomical Society Feb. 10, 1826; received the Copley medal of the Royal Society Nov. 30 of the same year; became president of the Astronomical Society 1829; established a private observatory at Campden Hill, Kensington,

London; was knighted by William IV. shortly after his accession, and received a pension of £300; was concerned for many years in the preparation of the *Nautical Almanac;* published papers *On the Atmosphere of Mars* (1831–32), and was a frequent contributor to the *Annals of Philosophy* and to the *Quarterly Journal of Science.* D. at Kensington Oct. 19, 1867.

South (John F.), M. D., one of the surgeons of St. Thomas's Hospital, London, and some time president of the Royal College of Surgeons; author of several standard surgical works, among which are *Dissector's Manual* (1825), *Compendium of Anatomy* (1831), *Description of the Bones* (1837), *System of Surgery, from the German of J. M. Chelius* (1847), and *Notes on the Surgery of the War in the Crimea* (1858).

South (Robert), D. D., b. at Hackney, near London, England, in 1633; studied as a king's scholar at Westminster School under Dr. Busby; graduated at Christ Church, Oxford, 1655; took orders in the Church of England 1658; was university orator 1660; became chaplain to the earl of Clarendon and tutor to his children; was made prebendary of Westminster 1663, canon of Christ Church 1670; accompanied Lawrence Hyde (afterward earl of Rochester) on an embassy to John Sobieski, king of Poland, 1677; became on his return rector of Islip, Oxfordshire, and soon afterward chaplain to King Charles II.; was a vigorous advocate of passive obedience and of the divine right of kings, and a powerful opponent of dissenters, and was esteemed one of the most eloquent preachers of the time. D. in London July 8, 1716. Author of 11 vols. of *Sermons* (1692 and 1744), and of controversial publications against Dr. Sherlock, whom he accused of tritheism.

South Ab'ington, p.-v., Abington tp., Plymouth co., Mass., on both Plymouth and Bridgewater branches of Old Colony R. R., has important boot and shoe tack and other manufactories.

South Ac'ton, p.-v., Acton tp., Middlesex co., Mass., on main line and on Marlborough branch of Fitchburg R. R., has a woollen-factory, a planing-mill, also pencil and soapstone works.

South Adams. See Adams, Mass.

South Am'boy, p.-v. and tp., Middlesex co., N. J., on Raritan Bay, is the N. terminus of Camden and Amboy R. R., has an academy and some manufactures. P. 4525.

South America. See America.

Southampton, county of England. See Hampshire.

Southamp'ton, a seaport-town of England, at the head of Southampton Water, an inlet communicating with the sea-channel which separates the Isle of Wight from the main. The town is a peninsula between the inner entrances of the Itchen and Test (or Anton) rivers, in which Southampton Water terminates. The situation of the port and the auxiliary dock-accommodations have made Southampton one of the most important steam-packet stations in the world. Steamers sail thence for Australia, America, India, China, Spain, Portugal, Gibraltar, and the Mediterranean, for the Channel Islands and for France, and there is an incessant intercourse with the Isle of Wight. As a government emigration-port it is the port from which Australian emigrants depart. A large export and import trade is carried on, the latter in wines and brandies from France and Portugal, of timber from the Baltic, corn and provisions from America, etc. The site of the ancient Roman *Clausentum,* hard by, is still indicated by rampart and ditch. The present town, attributed to the Anglo-Saxons, was called *Hantstone,* from which the present name is derived. J. G. Barnard.

Southampton (P. O. name Saugeen), a port of entry of Bruce co., Ont., Canada, at the mouth of Saugeen River, on Lake Huron, 60 miles N. by E. of Goderich, is the N. E. terminus of the Wellington Grey and Bruce division of Great Western Railway. Grain and lumber are the chief exports. P. 858.

Southampton, county of S. E. Virginia, adjoining North Carolina, between Blackwater River on the E. and Meherrin on the S. W., intersected by Nottoway River, and traversed by Seaboard and Roanoke and Atlantic Mississippi and Ohio R. Rs., has an undulating surface, variegated by vast forests of pine and cypress. Staples, Indian corn, tar, and turpentine. Cap. Jerusalem. Area, 600 sq. m. P. 12,285.

Southampton, p.-v. and tp., Hampshire co., Mass., on New Haven and Northampton R. R. P. 1159.

Southampton, tp., Burlington co., N. J. P. 2374.

Southampton, p.-v. and tp., Suffolk co., N. Y. (L. I.), on Atlantic Ocean, Shinnecock and Great Peconic bays, and on Sag Harbor branch of Long Island R. R. P. of v. 943; of tp. 6135.

Southampton, tp., Bedford co., Pa. P. 1647.

Southampton, tp., Bucks co., Pa. P. 1393.

Southampton, tp., Cumberland co., Pa. P. 2050.

Southampton, tp., Franklin co., Pa. P. 1963.

Southampton, tp., Somerset co., Pa. P. 673.

Southampton, Earls of. Thomas Wriothesley, first earl, b. about 1490; was educated at Cambridge; called to the bar; was appointed to an office in the common pleas, and in 1538 was made secretary of state by Henry VIII., and after the fall of Thomas Cromwell was virtually first minister, and in 1543 was raised to the peerage under the title of Baron Wriothesley of Titchfield, with a grant of abbey-lands; in 1544 became lord chancellor, taking the prescribed oath of abjuration of papal authority. He, however, joined in the persecutions of the Protestants under Henry VIII., and in at least the case of Anne Askew personally superintended the torture. He was ordered by Henry to arrest and impeach Queen Catharine Parr upon charge of heresy; but when he came to execute the order, the king had changed his mind, and Wriothesley was roughly sent back; but he soon regained the favor of his sovereign, and was made a knight of the Garter. He was one of the executors of the will of Henry, and was created earl of Southampton by Edward VI., but having opposed the ambitious schemes of the protector Somerset, he was deprived of the seals. D. in London July 30, 1550.—Henry Wriothesley, third earl, grandson of the preceding, b. Oct. 6, 1573; was a patron of Shakspeare, who dedicated to him the poems *Venus and Adonis* and *The Rape of Lucrece.* He was a friend of the earl of Essex, whom he accompanied to Cadiz, and in 1599 to Ireland; was accused of complicity in the treasonable designs of Essex; protested his innocence; was convicted, and sentence of death and attainder was pronounced, but Elizabeth remitted the death-penalty, and the attainder was removed by Parliament soon after the accession of James I. He was an assignee of the patents of settlement of Sir Walter Raleigh, and took a prominent part in the early colonization of America, and in the second charter of Virginia his name occupies a leading position, and he became the governor of the Virginia Company. In Parliament he was a firm supporter of liberty; and in 1621 was committed to close custody by the king, but was released through the influence of Buckingham. He soon after went, accompanied by his son, Lord Wriothesley, to the Netherlands, to aid the Dutch in their struggle against Spain, and took command of a regiment. While in winter-quarters he and his son were attacked with fever; the son died, but the father recovered sufficiently to set out to convey the body to England, but died on the way, at Bergen-op-Zoom, Holland, Nov. 10, 1624.—Thomas Wriothesley, fourth earl, son of the preceding, b. about 1600; was at first a supporter of the Commons in resisting the encroachments of Charles I., but with Strafford went over to the royal side, and was made a privy councillor; in 1642 was sent by the king to convey to Parliament his proposals for accommodation, and in 1645 was one of the royal commissioners to discuss terms of peace. He was one of the leaders of the moderate party, and lived unmolested in England during the Commonwealth, and sent large sums for the maintenance of Charles II. during his exile; upon the restoration of Charles, in 1660, he was made lord high treasurer. D. in 1667.

South Ann, p.-v. and tp., Charlevoix co., Mich. P. 400.

South Ann'ville, tp., Lebanon co., Pa. P. 1856.

South'ard (Henry), b. in New York Oct., 1759, his father's name having been Southworth, and connected with the Plymouth family of that name; removed to Baskingridge, N. J., in childhood; received an ordinary common-school education, but was a man of great memory and practical talent; worked on a farm, and earned in that way enough money to buy a farm for himself; served in the Revolutionary war; was for nine years a member of the State legislature; sat in Congress 1801–11 and 1815–21, and in the latter year met as a member of a joint committee of the U. S. Senate his distinguished son, Samuel Lewis, with whom he voted on the Missouri Compromise. D. in New Jersey June 2, 1842.

Southard (Samuel Lewis), LL.D., son of Henry, b. at Baskingridge, N. J., June 9, 1787; graduated at Princeton 1804; taught school in New Jersey, and was a family tutor in Virginia several years, during which time he studied law and was admitted to the bar; settled at Flemington, N. J., 1811; became law-reporter 1814, associate justice of the supreme court 1815; was U. S. Senator from Jan. 22, 1821, to 1823, serving a considerable time as

president *pro tem.* of that body; was appointed by Pres. Monroe secretary of the navy 1823; was acting secretary of the treasury six months 1825, and for a short time acting secretary of war; was chosen attorney-general of New Jersey 1829, governor 1832; and was again U. S. Senator from 1833 to his death, at Fredericksburg, Va., June 26, 1842. He became a trustee of Princeton College 1822, and soon afterward of the Theological Seminary, and was offered, but declined, the Whig nomination for Vice-President along with Harrison, thereby losing also the post of President, to which he would have succeeded by Harrison's death, on which occasion, however, he was for the second time chosen president *pro tem.* of the Senate.

Southard (Samuel Lewis, Jr.), b. at Trenton, N. J., in 1819; graduated at Princeton 1836; took orders in the Protestant Episcopal Church, and is author of *The Mystery of Godliness* (1848) and other theological and miscellaneous publications.

South Ar'lington, p.-v., Clay tp., Montgomery co., O. P. 124.

South Austra'lia, a British colony, founded in 1834 by the South Australian Company, and practically established in 1837, comprises a vast territory estimated at 380,000 sq. m., and extending from lat. 26° S. to the southern coast of the continent, between lon. 132° and 141 E. The climate and physical aspect of so extensive a region vary, of course, considerably, according to locality, but, generally speaking, the interior consists of an elevated plateau, bounded S. and S. E. by ranges of wooded hills, between which fine valleys, running from N. to S., open into large, low plains toward the coast. The interior is only fit for pasturages, but large flocks of sheep and herds of cattle are kept here, and succeed well. In the valleys and on the plains, when sufficiently watered, the soil is very productive; wheat, maize, oats, tobacco, and all the fine fruits of the tropic and temperate zones are raised—oranges, lemons, peaches, grapes, mulberries, etc. But the lack of sufficient water is often severely felt. The whole region, though in many places abounding in small lakes, is deficient in streams. The climate, though healthy, is very hot and dry, and timber and wood are generally scarce. The mineral wealth of the province is very great, but on account of lack of coal the ore must be sent to other places. Gold has been found and mines are worked, though the yield has not been so large that it has attracted any particular attention to the fields. But the copper and lead mines are very rich; the ore of Barra-burra contains 75 per cent. of copper, and in 1868 copper was exported from the colony to the value of £400,691. The principal article of export is wool, which in the same year amounted to £1,346,323. The population of the colony was in 1866, 163,452, and in 1871, 192,387. In 1871 the total value of exports amounted to £3,582,000, and of imports to £2,158,000. Principal town, Adelaide (which see).

South Beaver, tp., Beaver co., Pa. P. 1206.

South Bend, city, cap. of St. Joseph co., Ind., on Lake Shore and Michigan Southern, Michigan Central, and Chicago and Port Huron R. Rs., 85 miles E. of Chicago, contains 12 churches, Notre Dame University, St. Mary's Academy, St. Joseph's Academy, and the Academy of the Assumption, excellent high and ward schools, water and gas works, a fine system of sewerage, 3 banks, 1 daily and 3 weekly newspapers, ample water-power from St. Joseph's River, an extensive wagon and carriage manufactory, South Bend Ironworks, a plough-factory, paper and flouring mills, a sewing-machine establishment, the Indiana Reaper and Iron Co., a fire department, furniture and chair factories, foundries, and the various other industries of a thriving city. P. 7206. A. B. Miller, Ed. "Tribune."

South Bend, p.-v. and tp., Blue Earth co., Minn., on St. Paul and Sioux City R. R. P. of v. 301; of tp. 596.

South Bend, p.-v. and tp., Cass co., Neb. P. 311.

South Bend, tp., Armstrong co., Pa. P. 1127.

South Berne, p.-v., Berne tp., Albany co., N. Y. P. 50.

South Ber'wick, p.-tp., York co., Me., on Boston and Maine and Eastern R. Rs. and Salmon Falls River, has 6 churches, a library and public hall, an academy (1791), 2 banks, 1 newspaper, 1 cotton and 2 woollen mills, a shoe-factory, carriage and ladder factories, and saw and planing mills. P. 2510. Chas. E. Cook, Ed. "Enterprise."

South Beth'lehem, p.-b., Northampton co., Pa., at the foot of Lehigh Mountain. The district in the immediate vicinity is acknowledged to be the richest in needful minerals of any section of the U. S., if not of the world. With 4 railroads to carry raw and manufactured freightage, a canal of good capacity, and a river capable of being converted into the finest, most useful, necessary, and profitable ship-canal in the world, the means of transportation N., S., E., and W. are unsurpassed by any place possessing equal advantages. Surrounding wealth and facilities for manufacturing, and in addition nearness to Atlantic shipping-ports and the markets of New York, Boston, Philadelphia, and Baltimore, make the future of this city most promising. In the immediate vicinity are the richest zinc accumulations in the world. Between here and Mauch Chunk, in Northampton and Lehigh cos., are inexhaustible deposits of iron ore, and near by mountains of coal and slate. There are large quantities of good stone for several purposes, and limestone also. Among the manufacturing establishments are Bethlehem Iron and Steel Rail Works; Lehigh Zinc Works and Mines; Lehigh Shovel Works; Lehigh Brass Works; governor works; iron foundry and machine-works; Northampton Planing mill; a brick-yard; Lehigh Mountain Brewery; Lehigh Valley Chain-works, an organ manufactory, a daily and weekly newspaper, slate and coal dépôts, union R. R. dépôt, 4 bakeries, and a bank. Here are Lehigh University (a large endowed institution), a young ladies' seminary, good schools, a water-cure, springs, boarding-houses, St. Luke's Hospital, 6 churches (one of 3000 members), gas-works, 16 hotels, 2 brass bands and 2 string bands, 2 literary societies, free reading-rooms, dramatic associations, beneficial societies, St. Michael's Hall. P. 3556. Cushing & Jackson, Pubs. "Northampton Conservative."

South Bloom'field, tp., Morrow co., O. P. 1115.

South Bloomfield, p.-v., Harrison tp., Pickaway co., O., on Scioto River. P. 283.

South'borough, p.-tp., Worcester co., Mass., on Boston Clinton and Fitchburg R. R., 28 miles from Boston, including the villages of Centre, Fayville, Cordaville, and Southville, has 4 churches and 6 ecclesiastical societies, a public library, St. Mark's Episcopal school, a seminary, a school for idiots, a handsome town-house, 1 newspaper, 2 shoe, 1 blanket, and 1 mattress manufactory, several mills, a granite-quarry, brickyard, Masonic lodge, and farmers' and reform clubs. P. 2135. Stillman B. Pratt, Ed. "Press."

South Bos'ton, a portion of the city of Boston, Mass., has 18 church edifices; among the public buildings are the house of correction, insane asylum, institution for feeble-minded youth, Massachusetts asylum for the blind, Appleton temporary home for inebriates, branch of the Public Library, excellent schools, 1 savings bank and 1 national bank. Within its limits are many of the largest iron-working establishments in the country, 3 breweries, 3 kerosene-oil refineries, glass-works, several lumber-wharves, 3 sugar-refineries, a chain-factory, American steam safe works, and many factories of other kinds. Its facilities for wharves are very extensive, being a peninsula. The chief historic memory of the place is connected with Dorchester Heights (being formerly a part of Dorchester), by the erection of batteries on which the evacuation of the city by the British was compelled. Three weekly papers are published, and 1 amateur monthly. The streets are laid out with more system and regularity than in the older part of Boston, and when projected improvements are accomplished it will become, doubtless, the business-centre of the metropolis. P. about 45,000. Charles L. Storrs, Ed. "South Boston Inquirer."

South Boston Dépôt, p.-v., Halifax co., Va., on Piedmont Air-line R. R.

South Brain'tree, p.-v., Braintree tp., Norfolk co., Mass., at junction of Taunton and Plymouth branches with main line of Old Colony R. R., has extensive manufactories, especially of boots and shoes.

South Branch, p.-v. and tp., Watonwan co., Minn. P. 146.

South'bridge, p.-v. and tp., Worcester co., Mass., on New York and New England R. R., 70 miles S. W. of Boston, has a public library, 1 newspaper, 2 banks, a fire insurance company, 2 hotels, a woollen-factory, Southbridge printworks, American Optical Company, and manufactories of cotton cloth, knives, shuttles, twine, cassimere, reps, etc. P. 5208. Geo. M. Whitaker, Ed. "Journal."

South Bris'tol, p.-v. and tp., Ontario co., N. Y., on Canandaigua Lake. P. 1218.

South Bruns'wick, tp., Middlesex co., N. J. P. 3779.

South Buf'falo, tp., Armstrong co., Pa. P. 1633.

South Bur'lington, tp., Chittenden co., Vt. P. 791.

South'bury, p.-v. and tp., New Haven co., Conn., on Housatonic River. P. 1318.

South But'ler, p.-v., Butler tp., Wayne co., N. Y., has 5 churches and several manufactories.

South Ca'naan, tp., Wayne co., Pa. P. 1308.

South Caroli'na, one of the Southern Atlantic States, lies between the parallels of 35° 13' and 32° 04' N. lat., and between the parallels of 78° 28' and 83° 18' W. lon. from Greenwich. It is bounded on the N. and N. E. by North Carolina, on the S. E. by the Atlantic Ocean, on the S. W. and W. by Georgia, the Savannah River and its affluents, the Tugaloo and Chattooga, forming the boundary-line between it and Georgia. The State is triangular or wedge-shaped in form, the coast-line forming the thick end of the wedge, and the North Carolina and Georgia lines meeting at the W. of the State. Its coast-line is about 210 miles, and its extreme length from Little River Inlet to the Chattooga River on the W. about 240 miles. Its area is variously stated, the older authorities making it 29,385 sq. m.; Gov. Seabrook stating it in 1850 at 30,213 sq. m.; and the U. S. census-office in 1860 and 1870 at 34,000 sq. m., or 21,760,000 acres. In the absence of an accurate survey, the census estimate may be presumed to be the nearest approximation to the truth.

Seal of South Carolina.

Face of the Country and Topography.—The coast from 80 to 100 miles from the ocean is alluvial, low, and in some sections covered with swamps and marshes, through which sluggish streams flow and discharge their waters into the sounds and landlocked bays along the coast, which are protected, from Winyaw Bay to the Savannah River, from the violence of the ocean by long stretches of alluvial islands. Much of this low, flat country is covered with pitch-pine forests. Beyond it the land rises into a belt of low sandhills, called the "middle country," which is moderately fertile: next to this comes what is known as "the Ridge," where the land rises abruptly in successive terraces, alternating with beautiful valleys and rounded hills, till it reaches its greatest height in the Blue Ridge in the extreme N. W. of the State. This region averages a height of over 2000 feet above the sea, while Table Mountain in Pickens co., the highest peak of the Blue Ridge in the State, is 4000 feet above the sea, and has a perpendicular cliff with a face of 1100 feet. Cæsar's Head in the same vicinity is of less elevation, as is also King's Mountain, an isolated summit in York co. The State is well watered. The Waccamaw, having its source in North Carolina, winds sluggishly through the low lands in the N. E. portion of the State to Winyaw Bay, interlacing in its course through the swamps with the Great and Little Pedee, two important rivers which with their affluents drain a large region in the N. E. and N. part of the State, and discharge also into Winyaw Bay: Black River, with several affluents, finds its way into the same bay; the Santee, the largest river of the State, with its tributaries, the Wateree, called the Catawba in its upper course, Congaree, Broad, and Saluda rivers, drains the central portion of the State, and forms an extensive delta where it enters the ocean; Cooper and Ashley rivers, after washing the sides of the Charleston peninsula, discharge into the bay and harbor of the city; the Edisto, with its N. and S. forks and its numerous tributaries; the Ashepoo, and the Combahee, formed by the union of the Big and Little Salkehatchie, all discharge their waters into St. Helena Sound; the Coosawhatchie, though itself a minor stream, yet falls into the great estuary known as Port Royal Inlet and Port Royal Sound; and finally the Savannah, having its source, under the names of Tugaloo and Chattooga, in the North Carolina and Georgia mountainous district, flows S. E. between Georgia and South Carolina to its broad delta in lat. 32°. The islands along the South Carolina coast are many of them of considerable size and of great fertility. They are the favorite region for the growth of the long stapled or sea-island cotton, rice, etc. The principal islands, several of them largely connected with the incidents of the late civil war, are Hilton Head, Port Royal, St. Helena, Phillips' Hunting, Edisto, John, James, and Folly islands, and above Charleston harbor, Long, Dewees, Caper, Bull's, Cape, Cedar, South, and North islands. There are no lakes except those in the swamp region. The sounds and water-courses along the coast of South Carolina, as far N. as Winyaw Bay, form a continuous, though sometimes a circuitous, navigable route, and may become an important portion of the great landlocked canal projected from New Orleans to Charleston.

Geology and Mineralogy.—The geological formations of South Carolina are very simple. The whole region of swamps, islands, and natural canals for a distance of 25 or 30 miles inland is Quaternary or Alluvial, the soil a light but wonderfully fertile loam, and with proper drainage the most valuable portion of the State; immediately beyond this is a belt of Tertiary from 60 to 80 miles in width, still flat, sandy, and heavily covered for the most part with pitch-pine and some oak, the soil quite fertile, and, when cultivated, yielding good crops; in this belt, along the valleys of the Great and Little Pedee and Lynch Creek, the chalk-beds crop out; the land begins to rise beyond the Tertiary, and in what is called "the Ridge," or perhaps rather the "middle country," though the primitive or Eozoic rocks crop out at intervals, there is a belt of moderate width of Silurian rocks, with a heavy growth of oak and hickory intermingled with some pine and hemlock. Still farther on, and occupying all the remainder of the State, the primitive or Eozoic rocks appear in all their rugged grandeur. Clay takes the place of sand on the surface here, but the land is moderately fertile and the climate delightful. The State is rich in mineral wealth, though much of it is as yet undeveloped. Gold is found in large quantities in the Abbeville and Edgefield districts, and the Dorn mines before the war turned out, in some years, $200,000 per annum. There are large deposits of excellent iron ores in Union, Spartanburg, Greenville, and Pickens cos. Copper, lead, manganese, and bismuth are found in different portions of the State. Granite of excellent quality abounds in the upper counties, and limestone of suitable quality both for burning and building is plentiful. The finest porcelain clays, sometimes in beds 60 feet thick, are found in Aiken co.; this beautiful mineral, so well adapted for the use of the porcelain manufacturer, is unfortunately very convenient for adulterating sugar, soda, cream of tartar, and other articles, and is largely sold for such uses. In the lower districts of the State, and especially in the region extending from the Santee to the Savannah, valuable phosphate-marls of a peculiar character have been found in great abundance. They are said by the geologists to be coprolites, or the excrementitious remains of fossil animals, who seem to have congregated in great numbers in this region. They are treated with sulphuric acid, and are considered as the best of fertilizers. Large quantities are used in the State, and still larger amounts are sent to Europe and to other States and countries.

Soil and Vegetation.—"The soil of the State," said Gov. Seabrook in 1850, "though of every kind, may be said to comprehend six varieties, each the best suited to a certain crop, yet all of them capable of advantageously producing three-fourths of the vegetable products grown in its limits." He proceeds to particularize these different varieties of soil, three of which belong to the low or swamp region and three to the uplands. The swampy soils are —the tide-swamp or rice-lands; the inland swamp, on which rice, cotton, either long or short staple, corn, peas, etc., may be grown; and the salt marsh, like much of the soil of the islands, which is best adapted to the long-staple or sea-island cotton. The upland soils were—the highest on the larger islands and the oak and pine land of the Tertiary formation, which were also adapted moderately well to long-staple cotton, corn, sweet potatoes, etc.; the "middle country," or pine barrens, which were a good region for fruit and vegetables, though much neglected; and the higher lands, where the forests were mainly oak and hickory, but which, especially in the valleys, were well adapted to the growth of short-stapled cotton, corn, and the cereals. The vegetation of the lowlands is sub-tropical. The palmetto, smallest of the American palms, the yucca or bayonet-leaved shrub, the magnolia, the bay laurel, the live-oak, and other evergreens, are abundant, and in the forests streamers of the gray Spanish moss float from pine and cypress trees. In the higher lands pine, oak, hickory, and other trees of the Middle States are the chief forest growths.

Zoology.—Bears and wolves are not often seen, though in the mountainous districts the former are not very rare. The raccoon, opossum, ground-hog, rabbit, and several species of squirrel are abundant. Deer (the Virginian deer) are found throughout the forest portions of the State. Wild-turkeys, grouse, and other game-birds are plentiful,

and the variety of aquatic birds along the coast is very large. There are also many birds of prey: the carrion vulture (turkey-buzzard) and two or three other vultures, one or two species of eagle, five or six species of hawk, gulls, etc., are abundant in the lowlands. The State is also distinguished for the number of its birds of fine plumage. Among the reptiles are found the alligator; lizards, in great variety; tortoises and turtles, from the box and snapping turtles to the large marine turtles; fifteen or twenty kinds of serpents, of which, however, only two or three are venomous; and batrachians of many species. Fish of excellent quality abound along the coast and frequent the rivers.

Climate.—The climate, from the location, should be very hot, being in the latitude of Morocco and the Barbary States, but it is more like that of the S. of France and Northern Spain. On the coast the sea breezes, and in the interior the mountains, greatly modify the heat. In the N. W. portion of the State, Indian corn is not as sure a crop as it is in Minnesota, while in the southern and southeastern districts the orange, the sugar-cane, the pomegranate, the fig, and the banana are largely cultivated. Sudden frosts sometimes cut off these fruits, but in the average of years they do well. The mean annual temperature of Charleston for the past thirty years has been 65.6°—the summer mean about 80°, the winter mean 52°, the spring 66.3°, and the autumn about 65°. The maximum in 1874 was 96°, the minimum 23°, and the annual range 73°. The isothermal line of 64° crosses the State from Little River Inlet (N. E. corner of the State) to Hamburg, opposite Augusta, on the Savannah River. S. of this line, toward the Savannah River and harbor, the mean annual temperature rises to 67°. N. and N. W. of it the annual mean falls to 60°, and in the mountainous district to 56°. The annual rainfall is greatest along the coast; in 1874 it was 67.70 inches at Charleston, but this was exceptional. The range on the lowlands is from 51 to 60 inches; on the middle and ridge lands, 44 to 52 inches; and in the mountainous districts, from 40 to 44 inches.

Agricultural Productions.—In 1870 the U. S. marshal for South Carolina reported 12,105,280 acres of land in farms in the State; of these only 3,010,539 were under cultivation, 6,443,851 acres were in woodland, and 2,650,890 acres in other unimproved farming land. The State census of 1875, which in this respect is said to be more accurate than the census of 1870, states the number of acres under cultivation in that year at 2,090,441, but gives no information in regard to other farming lands. The value of farms, according to the census of 1870, was $44,808,763, and of farming implements and machinery $2,282,946. These values are not reported in the State census, but the comptroller reports for 1875 the assessed value of all farming lands and buildings for purposes of taxation at $59,255,589, while the value of farming and mechanical implements is stated at $1,600,224. The value of all farm productions in 1870 was reported to be $41,909,402; of animals slaughtered or sold for slaughter, $2,507,149; of home manufactures, $312,191; of forest products, $167,253; of market-garden products, $127,459; of orchard products, $47,960; and of wages paid during the year to farm hands, $7,404,297. The only items among these reported by the State census in 1875 were—value of slaughtered animals, $1,794,578; of market-garden productions, $399,151; of orchard productions, $114,933. The pitch-pine forests yielded that year 3,421,262 gallons of turpentine and 343,146 barrels of rosin, worth together about $2,490,000. Of particular farm products there were of wheat in 1870, 783,610 bushels, in 1875, 662,912 bushels; of rye in 1870, 36,165 bushels, in 1875, 13,772 bushels; of Indian corn in 1870, 7,614,207 bushels, in 1875, 9,454,341; of oats in 1870, 613,593 bushels, in 1875, 772,590 bushels; of barley in 1870, 4752 bushels, in 1875, 6401 bushels; of cotton in 1870, 224,500 bales of 400 pounds each, in 1875, 349,848.6 bales of short-staple and 4555 bales of long-staple or sea-island cotton; of wool in 1870, 156,314 pounds, in 1875, 185,486 pounds; no flax reported in 1870, but 2586 pounds in 1875; of hay in 1870, 10,665 tons, in 1875, 6975 tons; of rice in 1870, 32,304,825 pounds, in 1875, 35,884,640 pounds; of tobacco in 1870, 34,805 pounds, in 1875, 18,746 pounds; of cane and sorghum sugar in 1870, 1,055,000 pounds, in 1875, 22,816 pounds; of cane and sorghum molasses in 1870, 620,467 gallons, in 1875, 67,170 gallons; of Irish potatoes in 1870, 83,252 bushels; in 1875, 122,461 bushels; of sweet potatoes in 1870, 1,342,165 bushels, in 1875, 1,568,533 bushels; of peas and beans in 1870, 460,378 bushels, in 1875, 466,450 bushels; of bees-wax in 1870, 11,404 pounds, in 1875, 15,843 pounds; of honey in 1870, 194,253 pounds, in 1875, 221,577 pounds; of domestic wine in 1870, 13,791 gallons, in 1875, 9506 gallons; of butter in 1870, 1,461,980 pounds, in 1875, 2,223,422 pounds; in 1870, 241,815 gallons of milk were sold, in 1875 there was no report. In live-stock the census of 1870 reported, 44,105 horses, the comptroller in 1875, 68,813; the census of 1870, 41,327 mules and asses, the comptroller in 1875, 56,673; the census of 1870, 98,693 milch cows, the census of 1875, 118,337; the census of 1870, of working oxen and other cattle, 150,610, the comptroller in 1875, 195,212; the census of 1870, 124,594 sheep, the comptroller in 1875, 155,673 sheep and goats; the census of 1870, 395,999 swine, the comptroller in 1875, 392,360 swine. The total value of live-stock in 1870 was reported at $12,443,510; the comptroller in 1875 gives $12,608,973 as its assessed valuation. The increase in the aggregate amount of most of the crops on an acreage nearly one third less than that of 1870 is due to the free use of the fossil phosphates of the coast-region, of which 76,023 tons were used in 1875.

Manufactures and Mining Industries. South Carolina is not a manufacturing State. She ranks thirty second in the catalogue of States in this regard, only Arkansas, Florida, Mississippi, Nebraska, and Oregon being below her in 1870, and one if not two of these having since passed her in the race. In 1870 the State had 1584 manufacturing establishments, employing 8141 hands (7099 men, 578 women, 464 children), using a reported capital of $5,400,418, paying wages to the amount of $1,543,715, using $5,855,736 of raw material, and producing $9,858,981 annually. There has been moderate progress since 1870, but it is doubtful if the value of the manufactured products of 1875 would exceed $12,000,000. The most important manufactures of the State were—cotton goods, 12 establishments, employing 1123 hands, having a capital of $1,337,000, and producing goods valued at $1,529,937; lumber, 83 saw-mills, with 859 hands, $400,650 capital, and producing $1,032,194 of lumber; flouring-mill products, 91 mills, 182 hands, $171,150 of capital, and $825,465 of products; tar and turpentine, 54 establishments, 876 hands, $205,425 of capital, and $774,077 of annual products; fertilizers, 2 establishments, 825 hands, $350,000 capital, and $425,000; machinery, 11 establishments, 220 hands, $137,502 capital, $286,550 annual products; printing and publishing, 13 offices, 182 hands, $129,550 capital, $257,155 annual products. The census of 1875 gave no return of manufactures. The mining industry of the State in 1870 was reported as having 5 mines or quarries, employing 148 hands and $137,000 of capital, and yielding an annual product of $19,888. There are no authoritative returns of either manufactures or mines in the State of later date than 1870.

Railroads.—In 1875 there were 1481.45 miles of railroad in operation in the State, and nearly 400 miles more projected, but not completed. The roads in operation cost for road, equipment, etc., $39,018,955. The principal lines are the Charlotte Columbia and Augusta, 195 miles; Greenville and Columbia, 197 miles; North eastern R. R., 102 miles; Savannah and Charleston, 104 miles; South Carolina R. R. and branches, 242 miles; Spartanburg and Union, 68 miles; Cheraw and Darlington, Atlanta and Richmond air line, Port Royal R. R., Blue Ridge R. R., and Wilmington and Columbia. Several of these are aided by the State.

Commerce.—There are three ports of entry and customs districts in South Carolina—viz. Beaufort, Charleston, and Georgetown. The following table gives the commercial statistics of each:

PORTS OR CUSTOMS DISTRICTS.	Imports from foreign countries for year ending June 30, 1875.	Domestic exports for year ending June 30, 1875.	Foreign goods exported for year ending June 30, 1875.	Entrances of American and foreign vessels, including coastwise trade and fisheries.			Clearances of American and foreign vessels, including coastwise trade and fisheries.			Vessels owned in each district.		Vessels registered, licensed, and enrolled in each district	
				American and foreign vessels, number.	Tonnage of American and foreign vessels for year ending June 30 1875.	Crews.	Vessels cleared.	Tonnage of vessels cleared.	Crews.	Vessels.	Tonnage.	Vessels.	Tonnage.
Beaufort	$122,318	$1 047 257	....	124	58,714	1,650	116	59,405	1,598	8	92.53	1	[illegible]
Charleston	680,343	19,655,966	....	745	488 829	14,507	734	451,225	14,021	173	6,938 45	22	[illegible]
Georgetown	....	17,635	....	56	14,530	376	13	3 802	97	18	791.57	11	[illegible]
Totals	$802,661	$20,720,858	....	925	562,073	16,533	863	514,432	16,716	199	7,822.55	34	[illegible]

Finances.—The public funded debt of the State on Nov. 1, 1875, was stated by the State treasurer at $7,674,704.75, principal, mostly bearing 6 per cent. interest. Of this amount, $2,614,670.74 was exchanged during the year 1875 for consolidation bonds and stock maturing July 1, 1893. Besides this, there was a floating debt, composed of unpaid appropriations and deficiencies, of about $1,156,000. The receipts from all sources during the year ending Nov. 1, 1875, were $1,558,146.67; the expenditures for the same year were $1,345,465.17, leaving a balance in the treasury of $212,681.50, which was liable to be much more than absorbed by past-due appropriations. The finances of the State for some years after the war were shamefully mismanaged, but there has been a commendable effort to restore its credit and financial standing; and it is believed that its financial affairs are as justly and as economically managed as is possible in its existing condition.

Banks and Savings Banks.—In 1875 there were 12 national banks in the State, having an aggregate capital of $3,170,000, $2,010,000 bonds on deposit, and $2,167,420 of circulation outstanding. There were also at that time 5 State banks and trust companies in the State, with an aggregate capital of $1,300,000. One of these, the South Carolina Bank and Trust Co. of Columbia, S. C., failed in July, 1875, involving the State, counties, and education funds in heavy losses. The others were on Oct. 1, 1875, reported to be in good condition. There were also 3 savings banks, estimated to have capital and deposits to the amount of about $600,000, and 16 or 18 private banking-houses.

Population.

Census year.*	Total pop.	Males.	Females.	White.	Free colored.	Slaves.	Natives.	Foreigners.	Density.	Ratio of increase.	Dwellings.	Families.	Of school age, 5 to 20.	Of military age, 18 to 45, males.	Of voting age, 21 years and upward, males.	Citizens.
1790	249,073	125,082	123,991	140,178	1,801	107,094	....	......	7.32							
1800	345,591	174,352	171,239	196,255	3,185	146,151	....	......	10.16	38.75						
1810	415,115	207,956	207,159	214,196	4,554	196,365	....	......	12.21	20.12						
1820	502,741	254,702	248,039	237,440	6,826	258,475	....	......	14.90	21.11						
1830	581,185	289,731	291,454	257,863	7,921	315,401	....	......	17.09	15.06						
1840	594,398	293,038	301,360	259,084	8,276	327,038	....	......	17.19	2.27						
1850	668,507	329,634	338,873	274,563	8,960	384,984	659,743	8707	19.66	12.47	52,642	52,937	258,708	121,053	139,573	62,150
1860	703,708	347,320	356,388	291,300	9,914	402,406	693,722	9986	20.70	5.27	58,220	58,642	273,843	128,480	148,327	69,170
1870	705,606	343,902	361,704	289,667	415,814	....	697,532	8074	20.75	0.27	143,485	151,105	264,393	120,151	148,052	146,614
1875	925,145	450,132	475,013	350,754	574,391	....	....	......	27.21	31.11	....	....	305,317	142,193	184,943	179,520

Education.—The school population of the State (between the ages of 6 and 16 years) in 1875 was 239,264, of whom 122,910 were males and 116,354 females: 85,566 were whites and 153,698 colored. There were 428 school districts and 2580 free common schools; the school attendance for the year 1875 was 110,416—57,694 males and 52,722 females; 47,001 whites and 63,415 colored, a little more than $\frac{11}{24}$ths of the whole school population. In 1875 there were 2855 teachers employed in these schools—1773 males and 1082 females; 1876 whites and 979 colored. Only 866 were of the first grade, 1049 of the second grade, and 940 of the third grade. The average monthly wages paid to male teachers throughout the State was $31.64; to female teachers, $29.21. In the city of Charleston the wages of male teachers averaged $121.66 per month, and of female teachers $39.45 per month. The free schools were in session an average of four and a half months during the year; in three counties the average was 7 months in the year, and in one only two months. In the city of Charleston they were in session ten months. Of the whole number of children in the schools, only 2752 were studying anything above the most elementary branches. The number of school houses in the State was 2347, valued at $313,289.79; only 701 of these were owned by the districts, 1646 were owned by other parties; of these 345 were rented. The number erected in 1875 was 118, and their cost $13,486.35. Of these 2347 school-houses, 1347 were log, 981 frame, 18 brick, 1 stone; 320 had the grounds enclosed. The total amount of school revenue for the year ending Oct. 31, 1875, was $489,542.75; of this, the State school appropriation was $240,000: the net proceeds of the poll-tax, $63,143.42; the local or school-district taxes collected, $130,721.17; eight counties raised no local or school-district taxes. The school expenditures for the school year ending June 30, 1875, were $426,462.99, of which $369,685.21 was paid for teachers' salaries. The public schools in the city of Charleston are generally in very good condition; they were attended in 1875 by 6070 children—2852 males, 3218 females; 3008 white, 3062 colored; 87 teachers were employed—5 males, 82 females; 79 of the whole number were whites and 8 colored; 301 of the pupils were in the higher branches. The expenditure for public schools in the city was $59,932.50. The State superintendent thinks that there has been a fair amount of progress in the schools of the State during the year, but admits that, except in the city of Charleston, they are still in a very low state, which he attributes to four main causes: (1) want of qualified and efficient teachers; (2) inefficiency and unfitness of school officers; (3) lack of sufficient interest of the right kind on the part of the people in general; (4) inadequacy of means. To these might be added the gross mismanagement and frauds which in the past few years have made competent teachers and school officers unwilling to have any connection with the schools. There were 6 teachers' institutes held during the year, and they were the means of some benefit to the schools. There is a small but well-conducted normal school at Columbia, having a principal and one assistant and a matron and steward, with about 40 pupils. Claflin University at Orangeburg, a school under the control of the Methodist Episcopal Church, and which has also the land-scrip of the agricultural college fund, has a department intended as a normal school for colored teachers, which is doing an excellent work. There are 10 or 12 academies and seminaries for the advanced instruction of both sexes; some of these are of a high character, and have been in existence for many years. The following table gives the statistics of the colleges and professional and scientific schools of the State:

Institutions.	Location.	Date of organization.	Under what control.	No. of professors.	Students. In preparatory department.	Students. In collegiate or professional department.	Value of buildings, grounds, and apparatus.	Amount of productive funds.	Income from productive funds.	Income from all sources.	Amount of scholarship funds.	Volumes in library.
Colleges and Universities.							$	$	$	$	$	
Claflin University	Orangeburg	1870	Methodist Episcopal	4	156	....	40,000	......	......	......	.. ..	600
Charleston College	Charleston	1795	Non-sectarian	5	....	....	50,000	200,000	12,000	13,000	33,000	10,000
Erskine College	Due West	1839	Asso. Ref. Presb.	5	8	64	30,000	45,000	3,600	......	......	12,500
Furman University	Greenville	1851	Baptist	5	....	50	75,000	150,000	10,000			
Mount Zion College	Winnsboro'	1785	Non-sectarian	1	43	...	15,000					
Newberry College	Walhalla	1858	Evang. Lutheran	6	42	28	....	......	......	370	1,400	5,500
University of South Carolina	Columbia	1805	State	10	117	42	300,000	.....	......	50,000	......	28,342
Wofford College	Spartanburg C.-H.	1853	M. E. South	7	70	103	100,000	50,000	......	6,103	.....	15,000
School of Science.												
S. C. Agricultural and Mech. Institute (Dept. of Claflin College)	Orangeburg	1874	State	2	....	20	.. ...	180,000	12,000			
Schools of Theology.												
Baker Theol. Institute (Claflin Univ.)	Orangeburg	1870	Methodist Episcopal	..	....	9						
Southern Baptist Theological Seminary	Greenville	1858	Baptist	5	....	60	30,000	......	17,000	......	......	5,000
Theol. Sem. Gen. Assembly Presb. Ch.	Columbia	1828	Presbyterian	5	....	57	......	......	......	......	......	18,873
School of Law.												
Law Dept. University of South Carolina	Columbia	1868	University S. C.	4	....	16						
Schools of Medicine.												
Medical College of State of South Carolina	Charleston	1826	Trustees	7	....	53	20,000	......	......	2,500		
University of South Carolina Med. Dept.	Columbia	1868	University S. C.	4	....	8						

* The statistics of population given in the census of 1875, and those of 1870 (U. S. census), are regarded by the State authorities as equally unreliable.

There is an institution for the education of the deaf and dumb and the blind at Cedar Springs, near Spartanburg, founded in 1849, but since 1871 or 1872 instruction has been suspended and the buildings are unoccupied. It is proposed to remove it to Columbia, and reopen it. There is a State orphan asylum, formerly at Charleston, but removed in 1875 to Columbia. It had in Jan., 1876, 84 inmates—35 boys and 49 girls.

Charitable Institutions.—The State lunatic asylum is at Columbia, and seems from the governor's message to be well managed, although the best results cannot be looked for in its present crowded condition (it has about 300 patients), and, like all the public institutions of the State, suffering from the need of funds which were three or four years since recklessly squandered by corrupt officials. Its expenditures for the year 1875 were about $70,000, a sum smaller than it should have been, and only made to answer by the most rigid economy.

Churches.

DENOMINATIONS.	Church organizations, 1870.	Church edifices, 1870.	Church sittings, 1870.	Church property, 1870.	Church organizations, 1875.	Church edifices, 1875.	Ministers, 1875.	Members or communicants, 1875.	Adherent pop., 1875.	Value of church property, 1875.
All denominations	1457	1308	491,425	$3,276,982	1883	1672	1111	193,708	877,850	$4,065,500
Baptists, regular	518	466	190,750	688,882	790	698	451	95,313	400,000	890,000
Baptists (other), Anti-mission, etc	5	5	800	1,600	8	8	12	850	4,200	2,500
Christians, or Disciples	2	2	200	400	2	2	2	150	750	1,000
Congregationalists	1	1	300	10,000	1	1	1	243	1,200	12,000
Episcopalians (Protestant)	83	81	35,350	729,600	60	58	50	4.439	22,000	670,000
Huguenots	1	1	400	10,000	1	1	1	300	1,500	12,000
Jews	3	3	900	91,200	3	3	3	750	1,500	100,000
Lutherans	49	44	17,900	137,450	63	58	37	5,271	25,000	190,000
Methodists	611	532	164,050	652,100	728	641	412	71,480	342,000	876,000
Presbyterians (regular)	148	136	61,450	537,900	190	170	112	12,180	60,000	650,000
Presbyterians (other), Associate, etc.	16	17	5,650	33,500	18	17	13	2,232	11,200	42,000
Reformed (late Dutch)	2	2	300	4,000	2	2	2	250	1,000	10,000
Roman Catholics	12	13	10,775	291,500	14	10	12	....	15,500	300,000
Unitarians	1	1	750	250,000	1	1	1	250	1,000	250,000
Universalists	3	2	850	58,350	2	2	2	....	1,000	60,000

There were also in 1870, 1 Friends' meeting, with one meeting-house, 300 sittings, and $10,000 of society property; and one Union church, with 1 edifice, 700 sittings, and $10,000 of church property.

Penal Institutions.—The State penitentiary is at Columbia, and under a new superintendent its management has been much improved. There were 322 prisoners in confinement on Oct. 31, 1875, of whom 318 were males and 4 females. The receipts of the year were $25,000, and the disbursements $19,812.72. Attempts were made to contract for the labor of a part of the prisoners, while a part were employed in making bricks and in agricultural labor. The jails of the State, except that in Charleston, are generally very badly managed, and need reform. There is no reform school in the State. There are several orphan asylums under private control, and one home for destitute ladies.

Insurance Companies.—There was in Oct., 1875, but 1 insurance company chartered by the State which reported to the comptroller, the Home Insurance Co. of Charleston. There was, in 1874, a small mutual company also in Charleston, reporting assets amounting to $24,445. There are no life insurance companies chartered by the State, but many of the insurance companies of other States do business here.

Newspapers.—In 1870 there were 55 newspapers of all classes, which issued 8,901,400 copies annually, and had an aggregate circulation of 80,900; of these, 5 were dailies, with 16,100 circulation; 4 triweeklies, with 9600 circulation; 42 weeklies, with 44,000 circulation; 3 monthlies, with 10,000 circulation; and 1 quarterly, with 1200 circulation. There have been some changes, but not much increase of circulation, since 1870.

Constitution, Courts, Representation in Congress.—The constitution under which the State is now governed was framed by a convention which sat from Jan. to Mar., 1868, and was ratified by the people in April of the same year. By this constitution every male citizen of the U. S. of the age of 21 years and over, who resided in the State at the time of the adoption of the constitution, or who shall hereafter reside in the State for one year and in the county in which he offered to vote for 60 days next preceding an election, is entitled to vote. The legislature is composed of a senate and house of representatives, the two constituting the general assembly of the State of South Carolina. There are 33 senators, one for each county except Charleston co., which has two. The house has 124 members. Both senators and representatives are chosen by ballot every second year in their respective districts. The governor is elected for two years, and the comptroller-general, treasurer, and secretary of state for four years. The judicial power is vested in a supreme court; in two circuit courts—viz. a court of common pleas, having civil jurisdiction, and a court of general sessions, having criminal jurisdiction only; in probate courts and justices of the peace. The supreme court consists of a chief-justice and two associate justices, any two of whom constitute a quorum. It has appellate jurisdiction only in cases of chancery, and constitutes a court for the correction of errors of law. It holds a session annually at the seat of government and at such other places as the general assembly may direct. The State is entitled to five members of Congress under the apportionment of 1872.

Counties.—There are 32 counties in the State, as follows:

COUNTIES.	Total pop., 1875.	Males, 1875.	Females, 1875	Total pop., 1870.	True valuation, 1870, U. S. census.	Assessed valuation, 1875.
Abbeville	38,968	18,914	20,054	31,129	$7,361,095	$5,549,287
Aiken	30,304	14,779	15,525	......	....	3,667,906
Anderson	29,127	14,192	14,935	24,049	5,968,134	4,652,444
Barnwell	37,523	18,633	18,890	35,724	9,941,090	4,010,600
Beaufort	43,062	21,099	21,963	34,359	11,669,471	3,630,142
Charleston	123,489	57,269	66,220	88,863	60,524,654	33,308,245
Chester	24,227	11,786	12,438	18,805	5,557,272	3,422,824
Chesterfield	13,826	6,645	7,181	10,584	2,500,815	1,494,570
Clarendon	16,243	8,049	8,194	14,038	2,559,560	1,919,456
Colleton	33,883	16,723	17,160	25,410	5,117,454	3,627,813
Darlington	30,461	15,217	15,244	26,243	4,859,282	2,993,909
Edgefield	35,039	17,483	17,596	42,486	8,578,424	3,890,370
Fairfield	22,791	11,266	11,525	19,888	5,142,542	3,750,201
Georgetown	17,646	8,267	9,379	16,161	2,980,338	1,819,499
Greenville	32,706	15,804	16,902	22,262	5,362,358	4,616,[illegible]
Horry	12,012	5,921	6,091	10,721	1,556,500	1,116,969
Kershaw	20,902	10,184	10,718	11,754	3,245,161	2,358,064
Lancaster	14,735	7,186	7,549	12,087	2,012,810	1,711,176
Laurens	26,405	12,854	13,551	22,536	4,504,017	3,854,512
Lexington	16,613	8,073	8,540	12,988	3,517,197	2,180,238
Marion	31,654	15,527	16,127	22,160	4,682,914	3,048,318
Marlboro'	17,683	8,716	8,967	11,814	2,101,298	2,181,475
Newberry	23,326	11,433	11,893	20,775	4,984,344	4,150,320
Oconee	14,075	6,830	7,245	10,536	2,385,649	1,777,120
Orangeburg	34,070	16,998	17,072	16,865	9,039,915	4,176,610
Pickens	11,807	5,793	6,014	10,269	1,411,002	1,476,056
Richland	34,245	16,992	17,253	23,025	8,127,020	6,856,140
Spartanburg	32,184	15,301	16,883	25,784	4,336,910	4,312,560
Sumter	31,480	15,509	15,971	25,268	5,347,100	3,529,925
Union	21,965	10,703	11,262	19,248	4,287,180	3,088,100
Williamsburg	21,055	10,425	10,630	15,489	3,149,638	2,204,585
York	31,639	15,601	16,038	24,286	5,035,815	4,594,744
Total	925,145	450,132	475,013	705,606	$208,146,989	$134,968,224
Add for railroad property assessed						8,357,911
Grand total						$143,326,135

Principal Cities and Towns.—The capital of the State is Columbia, which in 1875 had 14,449 inhabitants; the largest city and commercial capital is Charleston, which in 1875 had 56,540. (See CHARLESTON.) The other considerable towns are Greenville, which had 1547 inhabitants in 1875; Sumter, 2147; Anderson, 1579; Winnsboro', 1398; Georgetown, Newberry, Beaufort, Pickensville, Spartanburg, and Camden, which had between 1000 and 2000 each.

History.—The first attempts at settlement in South Carolina antedate those of all the other Atlantic States except Florida. In May, 1562, John Ribault, the leader of a party of French Huguenots, made a voyage of exploration with two ships to Florida, discovered and named the river St. John in Florida, and after a little delay sailed northward and entered a spacious inlet and harbor, to which he gave the name of Port Royal. On an island in that harbor he built a fort, which he named Carolina in honor of Charles IX. of France. Here he left 26 colonists, and himself returned to France for supplies; but in the course of two or three months the colonists became dissatisfied, mutinied, killed the commandant whom Ribault had placed over them, and, fitting up a clumsy and ill-constructed vessel, sailed for France. They were long at sea and endured great hardships, but were finally picked up by an English vessel and returned to Europe. It was more than 100 years before an attempt was again made to effect a settlement on this coast. In 1670 a party of English colonists settled at

Port Royal, but the same or the following year removed to the W. bank of Ashley River, and in 1680 to the present site of Charleston. There were three shiploads of these immigrants, and they were under the leadership of William Sayle. In 1674, Joseph West was appointed governor of the southern colony, though both North and South Carolina were nominally under one proprietary government. Gov. West remained in office several years. The colonists were made up of several classes and nationalities: there were Cavaliers and the sons of Cavaliers from the English aristocracy and gentry, who had come out to the new country as adventurers or to hold office under the proprietary government; Puritans, who were dissatisfied with the loose morals and the exacting rule of the Stuarts; Irish Presbyterians and Scotch dissenters; French Huguenots of the best blood of France, who fled from the persecution, cruelty, and oppression of Louis XIV.; Hanoverians and other Protestants from Germany; Swiss emigrants from the Protestant cantons; and Moravians and Bohemians from Austria and Bohemia. At first, the Cavaliers were not disposed to grant to these dissenters and refugees the full privileges of citizenship, but eventually they won their way to the complete recognition of their rights. In 1680 there was an Indian war in which the colonists were victorious, and Gov. West having taken a large number of the Indians prisoners, sold them as slaves to the West India planters. This so greatly displeased the proprietors that in 1683 he was removed, and Gov. Morton appointed his successor. Until 1720 both North and South Carolina were nominally governed under the constitution prepared by John Locke, who, with the earl of Shaftesbury and some other associates, had received a grant of the territory. This constitution was very complicated in its provisions, and was never fully enforced. There was a colonial legislature, and its laws were generally observed. The difficulty in enforcing the collection of quit-rents to the proprietors led to frequent *émeutes* and partial insurrections, and in 1687, Gov. Colleton was deposed in consequence of his attempt to compel the payment of these rents. Early in the administration of his successor (probably Gov. Moore) the captain of a Madagascar vessel which entered Charleston harbor sent a bag of seed-rice to the governor, who distributed it among his friends, and thus began the cultivation of that grain. The attempt on the part of Gov. Moore to capture St. Augustine from the Spaniards in 1702, resulted in a defeat and very heavy expenses, which led to the first issue of paper money in the colony. In 1706 a French fleet attacked Charleston, but was promptly repulsed and with heavy loss. The Indians were very troublesome to the colonists, but in 1715 they were expelled after a severe battle, and driven into the swamps of Florida. This Indian war and the previous contests with the French and Spanish had involved the colony in debt, and disturbances grew out of this which led to the expulsion of the governor in 1718 or 1719. The Locke constitution had been practically abrogated since 1693, but after the expulsion of the governor the people of the colony held a convention and proceeded to organize a government independent of the proprietaries. The English Parliament, wiser then than it was afterward, solved the difficulty by purchasing the proprietary rights for about $80,000 (£17,500), and making the colony a direct dependency of the Crown. This was accomplished in 1720. For more than fifty years from this time the career of the colony was prosperous. The colonists were generally loyal, and the colony was a favorite with the British government. Slavery existed, but the proportion of slaves was not so great as it became soon after the Revolution. But when the British government began to pass oppressive laws and lay heavy and unjust taxes, the love of liberty manifested itself in the colonists, and they early took measures to resist the invasion of their rights. A provincial congress was called in 1774, delegates were appointed to the Continental Congress of 1774-75, and when in Sept., 1775, the royal governor fled, the provincial congress assumed all the powers not vested in the Continental Congress. South Carolina suffered much from the invasion of her territory by the enemy during the war of the Revolution. The severe battles of Fort Moultrie, Charleston, Camden, King's Mountain, Cowpens, Eutaw Springs, etc., were fought on her soil. The last-named engagement, fought in Sept., 1781, between Gen. Greene and Col. Stuart, was a drawn battle, but was the last of any considerable moment in the war. On May 28, 1788, the State ratified the Constitution of the U. S. She had previously (July 9, 1787) ceded to the U. S. her claims to the region lying between the Appalachian Mountains and the Mississippi River. On June 3, 1790, her first permanent State constitution was adopted without submission to the people. In 1832 her leading men—and most prominent among them the late John C. Calhoun—attempted to nullify certain acts of Congress imposing a tariff, from the belief that it bore unjustly on the interests of the State. A convention was called by the State legislature, which on Mar. 11, 1833, passed a nullification ordinance. As this was a defiance of the national authority, there seemed a probability of a civil war, but the prompt and decided measures adopted by Pres. Jackson (himself a native of South Carolina) restored order and led to the pacification of the difficulty. From 1820 the number of slaves in South Carolina had exceeded the white population. Her staple agricultural products, sea-island and upland cotton and rice, had led to this great increase of slave-labor, and the State had been for fifty years and more the stoutest advocate of slavery in the Union. The unquestioned intellectual ability of her political leaders and statesmen, and their bold and unflinching advocacy of the slave system in Congress and elsewhere, had given them the foremost position as the leading champions of that system. Whenever, from any cause, the obnoxious and unjust features of slavery came up for discussion or rebuke, for adjustment or appeal, South Carolina, by her legislature and her State and municipal officers, her Senators and Representatives in Congress, was always ready to defend its most odious exactions. This was specially noticeable in their treatment of Hon. Samuel Hoar in 1844, in their advocacy of the Mexican war and of the Kansas and Nebraska bill, and in the violent assault by two of her Representatives in Congress (Messrs. Brooks and Keitt) upon Hon. Charles Sumner in 1856. It is not surprising, then, that deeming the election of a Republican President a menace upon her rights as a slaveholding State, and as threatening the supremacy of the South in the American Congress, South Carolina, as the champion of the South, should have given notice, early in the Presidential campaign of 1860, that if Mr. Lincoln were elected she should secede. On Oct. 25, 1860, a meeting of the prominent political leaders of the State, including its members of Congress, was held at the house of Ex-Gov. Hammond, and it was unanimously resolved that South Carolina should at once secede from the Union in the event of Mr. Lincoln's election. Gov. Gist called the legislature together in extra session by proclamation on Nov. 5, the day of the Presidential election, ostensibly to choose electors, but really, as his message showed, to take measures for immediate secession in case of Mr. Lincoln's election. The legislature ordered an election for a convention on Nov. 22, and appointed Dec. 17, 1860, as the opening day of the convention. It met on that day at Columbia, but adjourned at once to Charleston, and on Dec. 20 passed the ordinance of secession by a unanimous vote of 169 yeas. It also passed a "declaration of causes" by the same vote. Commissioners from South Carolina were sent to the other Southern States to urge their secession and the calling of a convention at Montgomery, Ala., to organize a confederacy. On the night of Dec. 26, 1860, Major Robert Anderson, in command of a battalion of Federal troops in Fort Moultrie, an old and weak fort in Charleston harbor, removed his command, with its munitions of war, provisions, etc., to the new and stronger fort, Sumter, in the same harbor. This act was denounced by the leading South Carolinians, and attempts were made to compel him to return to Fort Moultrie. (See Confederacy, Southern.) The U. S. arsenal and its arms and munitions were soon after seized by South Carolina volunteers, as were also the custom-house, post-office, etc., and after almost four months of excitement and agitation, on Apr. 12, 1861, South Carolina commenced the civil war by the bombardment of Fort Sumter. After the surrender of this fort, it was at once put in order, for a permanent occupation, by the Confederate authorities, and the work of raising troops and preparing for war went on rapidly in the State. During the war which followed, South Carolina suffered severely. On Nov. 7, 1861, the Federal squadron under Com. Du Pont captured Forts Warren and Beauregard, and entered and took possession of Port Royal harbor and the town of Beaufort, S. C. This port and the adjacent islands were held by Federal troops through the war. Charleston harbor was closely blockaded. Several of the islands were seized and retained; in June, 1862, the severe battle of Secessionville was fought, the heaviest losses falling on the Federal side; in October of the same year, the less important action of Pocotaligo occurred, with a preponderance of loss on the Federal side; the naval attack on Fort Sumter under Com. Du Pont, Apr. 6, 1863, though proving a failure, was not attended with heavy losses on either side. But this was followed in the ensuing summer by that deliberate siege of Charleston and demolition of Fort Sumter under Gen. Gillmore which was one of the most famous events of the war. By this siege Fort Wagner and Battery Gregg were captured, the lower part of Charleston rendered uninhabitable, and the whole coast of the State was at the mercy of the blockading squadron and the Army of the South. South Carolina had made large contributions of men to

the Confederate army, and had suffered, like the other Southern States, from the extensive destruction of her staple crops; but her greatest pecuniary losses were experienced when, in Jan., 1865, Gen. W. T. Sherman commenced his march from Savannah through the Carolinas. His previous march from Atlanta to Savannah had broken the power of the Southern portion of the Confederate forces, and when he entered South Carolina, though his troops and their attendants, the "bummers" or camp-followers, occupied a track fully 50 miles in width and swept everything before them, they encountered very little resistance. What was left of Charleston, Columbia, and all the principal towns of the State, fell into the hands of the Federal troops almost without a struggle, and most of their track was left a desert. Soon after the close of the war, reconstruction was attempted, a convention being called in Sept., 1865, which declared the secession ordinance null and void, repudiated the Confederate State debt, and framed a new constitution for the State. Other conditions being required by Congress for complete reconstruction, were after some delay passed, the thirteenth, fourteenth, and fifteenth amendments to the Constitution of the U. S. ratified, and another and more satisfactory constitution for the State adopted by a large majority, composed almost wholly of colored votes. The State was restored to the Union in June, 1868. As emancipation was a necessary result of the war, and the right of suffrage to the people of color a natural consequence of emancipation, the State, having a majority of its population of African descent, fell into the hands of the negroes and those who had the skill and adroitness to manage them. The legislature was largely composed of negroes, and many of the State officers and some of the members of Congress were of the same race. Had these new legislators and rulers been persons of intelligence, culture, integrity, and political ability, the result would have been different; but they were, with a few honorable exceptions, ignorant of their duties, and controlled by artful and designing men, who through their votes found the means of enriching themselves to the detriment of the State. But the colored people are becoming somewhat more intelligent, and are finding out that these adventurers were not their real friends, and the outlook for the future of the State is much more hopeful than it was in 1870–74.

Governors of South Carolina.

Charles Pinckney	1789-92	George McDuffie	1834-36
Arnoldus Vanderhorst	1792-94	Pierce M. Butler	1836-38
William Moultrie	1794-96	Patrick Noble	1838-40
Charles Pinckney	1796-98	B. K. Hennegan (acting)	1840-40
Edward Rutledge	1798-1800	John P. Richardson	1840-42
John Drayton (acting)	1800-02	James H. Hammond	1842-44
James B Richardson	1802-04	William Aiken	1844-46
Paul Hamilton	1804-06	David Johnson	1846-48
Charles Pinckney	1806-08	W. B. Seabrook	1848-50
John Drayton	1808-10	John H. Means	1850-52
Henry Middleton	1810-12	John L. Manning	1852-54
Joseph Alston	1812-14	James H. Adams	1854-56
David R. Williams	1814-16	Robert F. W. Alston	1856-58
Andrew Pickens	1816-18	William H. Gist	1858-60
John Geddes	1818-20	Francis W. Pickens	1860-62
Thomas Bennett	1820-22	M. L. Bonham	1862-64
John L. Wilson	1822-24	A. G. Magrath	1864-65
Richard J. Manning	1824-26	Benj. F. Perry (provis.)	1865-65
John Taylor	1826-28	James L. Orr	1865-68
Stephen D. Miller	1828-30	Robert K. Scott	1868-72
James Hamilton	1830-32	Franklin J. Moses, Jr.	1872-75
Robert Y. Hayne	1832-34	Daniel H. Chamberlain	1875-78

Electoral and Popular Votes for President and Vice-President.—Until 1868, South Carolina had always chosen her Presidential electors in her State legislature, and had never cast a popular vote for President. Under her present constitution the electors are chosen by the people:

Elect. year.	Names of candidates for whom the electoral vote was cast.	Elect. vote.
1788	George Washington P.	7
	John Rutledge V.-P.	6
	John Hancock V.-P.	1
1792	George Washington P.	8
	John Adams V.-P.	7
	Aaron Burr V.-P.	1
1796	Thomas Jefferson P. / Thomas Pinckney V.-P.	8
1800	Thomas Jefferson P. / Aaron Burr V.-P.	8
1804	Thomas Jefferson P. / George Clinton V.-P.	10
1808	James Madison P. / George Clinton V.-P.	10
1812	James Madison P. / Elbridge Gerry V.-P.	11
1816	James Monroe P. / Daniel D. Tompkins V.-P.	11

Elect. year.	Names of candidates for whom the electoral vote was cast.	Elect. vote.
1820	James Monroe P. / Daniel D. Tompkins V.-P.	11
1824	Andrew Jackson P. / John C. Calhoun V.-P.	11
1828	Andrew Jackson P. / John C. Calhoun V.-P.	11
1832	John Floyd P. / Henry Lee V.-P.	11
1836	Willie P. Mangum P. / John Tyler V.-P.	11
1840	Martin Van Buren P. / Littleton W. Tazewell V.-P.	11
1844	James K. Polk P. / George M. Dallas V.-P.	9

Elect. year.	Names of candidates for whom the electoral vote was cast.	Elect. vote.	Pop. vote.
1848	Lewis Cass P. / William O. Butler V.-P.	9	
1852	Franklin Pierce P. / William R. King V.-P.	8	
1856	James Buchanan P. / J. C. Breckenridge V.-P.	8	
1860	John C. Breckenridge P. / Joseph Lane V.-P.	8	
1864	No vote.		
1868	Ulysses S. Grant P. / Schuyler Colfax V.-P.	6	62,301*
1872	Ulysses S. Grant P. / Henry Wilson V.-P.	7	72,290†

(For valuable documents and material for this article the writer is under obligations to His Excellency, Hon. Daniel H. Chamberlain, governor of South Carolina, and Hon. F. L. Cardozo, State treasurer.) L. P. BROCKETT.

South Car'rollton, p.-v., Muhlenburg co., Ky., on Louisville and Nashville and Great Southern R. R. P. 240.

South Charles'ton, p.-v. and tp., Clark co., O., on Pittsburg Cincinnati and St. Louis R. R. P. 818.

South Ches'ter, p.-b., Delaware co., Pa. P. 1212.

South Codo'rus, tp., York co., Pa. P. 2002.

South Cort'land, p.-v., Cortland tp., Cortland co., N. Y., on Utica Ithaca and Elmira R. R. P. 54.

South'cott (JOANNA), b. at Gittisham, Devonshire, England, about 1750; was entirely uneducated, and for many years a domestic servant at Exeter; joined the Methodist Church about 1790, and having become acquainted with a man named Sanderson who laid claim to the gift of prophecy, she in 1792 announced herself as a prophetess, giving forth an extraordinary series of revelations in ungrammatical prose and doggerel verse; challenged the bishop and clergy at Exeter to investigate her claims, and obtained such success that in a few years her believers were numbered by thousands. She established herself at London at the expense of the celebrated engraver, William Sharp, and there published numerous pamphlets setting forth her revelations. She announced herself as the woman spoken of in Rev. xii., sold sealed packets which were warranted to secure the salvation of the purchaser, and at last, when sixty years of age, declared herself pregnant, and that she should give birth to "Shiloh" or "the Prince of Peace" at midnight on Oct. 19, 1814. The event was awaited by large numbers of disciples with eager interest, and a sumptuous cradle provided for the expected infant, but the occasion was marked only by the prophetess falling into a trance. She d. in London Dec. 17, 1814. A *post mortem* examination showed that she had been suffering from dropsy. Four congregations of believers, comprising 198 persons, were reported in England by the census of 1851, and a community was founded at Wenthorp in 1857.

* Popular vote for Seymour and Blair, 45 239.

† Horace Greeley for President and Benjamin Gratz Brown for Vice-President, received 22,903 votes.

Southcottians. See SOUTHCOTT (JOANNA).

South Cov'entry, p.-v., Coventry tp., Tolland co., Conn., on Shetucket River and on New London Northern R. R., has 1 newspaper and several manufactories.

South Coventry, tp., Chester co., Pa. P. 649.

South Creek, p.-v. and tp., Bradford co., Pa., on Northern Central R. R. P. 1070.

South Dart'mouth, p.-v., Dartmouth tp., Bristol co., Mass., at the head of Apponagansett Bay.

South Deer'field, p.-v., Deerfield tp., Franklin co., Mass., on Connecticut River R. R., has important manufactures, and is the locality of the famous Bloody Brook massacre in King Philip's war, at which Capt. Thomas Lothrop and 76 men, called the "flower of Essex," lost their lives Sept. 18, 1675 (O. S.). A marble monument, erected in 1838, commemorates this event, and the bi centennial anniversary was celebrated in 1875.

South Del'phi, v., Deer Creek tp., Carroll co., Ind. P. 160.

South Dix'on, tp., Lee co., Ill. P. 905.

South East, tp., Orange co., Ind. P. 1556.

Southeast, tp., Putnam co., N. Y. P. 2975.

South Eas'ton, b., Williams tp., Northampton co., Pa., on S. bank of Lehigh River, opposite Easton, on Le

high R. R. and Navigation Canal, has several iron furnaces, foundries, and rolling-mills, and a wire factory. P. 3167.

Southeast Pella, v., Lake Prairie tp., Marion co., Ia. P. 147.

South Eg'remont, p.-v., Egremont tp., Berkshire co., Mass.

South Eng'lish, p.-v., Keokuk co., Ia., on Southwestern R. R. (proposed), 13 miles N. of Sigourney, the county seat, has good schools, 1 newspaper, and 2 hotels. It is in one of the richest farming sections of the State. P. about 300. BROWN BROS., EDS. "WESTERN HERALD."

South'ern (THOMAS), b. at Oxmantown, Ireland, about 1660; studied at Trinity College, Dublin, and at the Middle Temple, London, and was called to the bar, but soon abandoned that profession for dramatic literature; served in the army against Monmouth's rebellion, and afterward enjoyed the friendship of Dryden, Pope, and their circle of wits. D. at Westminster May 26, 1746. Author of ten plays, of which the most popular were *Isabella, or The Fatal Marriage*, and *Oronooko*.

Southern Confederacy. See CONFEDERATE STATES.

Southern Continent. See ANTARCTIC RESEARCHES.

Southernwood. See ARTEMISIA.

South'ey (CAROLINE ANNE **Bowles**), second wife of Robert Southey, b. in Hants co., England, Dec. 6, 1787. At an early age she wrote for *Blackwood's Magazine* and other periodicals. In 1820 a collection of her pieces was made, which speedily won for her a place in the world of letters; among those who became her friends were Southey and William Lisle Bowles, who, although bearing the same name, was not her relative. The friendship between her and Southey was of more than twenty years' standing when, two years after the death of his first wife, who had for years been bereft of reason, they were married in 1839. At this time Southey's mental faculties had begun to show signs of decay, and at the moment when she first entered their home as his wife he experienced an attack, which speedily reduced him to a state of absolute dementia, in which the remaining four years of his life were passed. His pension expired with him, and his wife was left absolutely without resources; but a pension of £200 from the civil list was bestowed upon her. Her published works are—*Ellen Fitz-Arthur*, a poem (1820), *The Widow's Tale, and other Poems* (1822), *Solitary Hours*, prose and verse (1826), *Chapters on Churchyards* (1829), *The Birthday*, a poem (1836), *Tales of the Factories*, in verse, and *Robin Hood*, a fragment of a poem commenced jointly by herself and her husband, to which were added other fragments by both of them (1847). D. July 20, 1854.

Southey (ROBERT), b. at Bristol, England, Aug. 12, 1774, the son of a linen-draper; early left an orphan, he was cared for by an uncle; received his early education at Westminster School; in 1793 entered Baliol College, Oxford, with the design of taking holy orders, but becoming unsettled in his religious and political views, left Oxford after two years, and entered upon a career of authorship in verse and prose, his first published works being a small volume of poems (1794) and the tragedy of *Joan of Arc* (1795), for which his friend Cottle paid him fifty guineas. In 1795 he married Edith Fricker, whose sister soon after became the wife of Coleridge; set out with his uncle for Portugal; published an account of his six months' residence (1797); published the poem *Thalaba the Destroyer* (1801); was made secretary to the chancellor of the exchequer for Ireland, a sinecure with a salary of £350; resigned the position, and in 1804 settled for life at Keswick. From this time his life is mainly the history of his numerous writings in almost every department of literature. In early manhood he had imbibed strong radical ideas; proposed, in conjunction with Coleridge and Lovel, to set up a socialistic establishment on the banks of the Susquehanna in Pennsylvania, to be called a "pantisocracy," because there all persons were to be equal; and wrote a drama, *Wat Tyler* (printed in 1793, but first published in 1817, without his consent), which was denounced in the House of Commons as seditious. In the course of years he went over to the opposite extreme of conservatism in Church and State, and came to be considered the exponent of high Tory opinions. Although his literary labors were indefatigable, and he was in 1807 made the recipient of a pension of £160, his circumstances were very moderate. He was named poet laureate in 1813. In 1835 he received from Sir Robert Peel, then prime minister, the offer of a baronetcy, which he declined, mainly for the reason that his income was inadequate; he said that there had never been a time when his earnings were six months in advance of his necessary expenditures. Sir Robert, in acknowledgment of his eminent literary services, at once made an addition of £300 to his pension. His wife, who had for several years been hopelessly insane, died in 1837, and two years afterward he married Caroline Bowles. (See SOUTHEY, C. A. B.) But Southey's own faculties had begun to give way, and on the day when he brought his wife to their home he fell into a state of mental prostration which soon grew into complete imbecility, that continued to his death, which took place Mar. 21, 1843. Southey's principal poems are—*Joan of Arc* (1795), *Thalaba the Destroyer*, an Arabian tale (1801), *Madoc*, founded on legends of early Welsh voyages to America (1805), *The Curse of Kehama*, based upon Hindoo mythology (1810), *Roderick, the Last of the Goths*, founded on Spanish history (1814), *A Vision of Judgment*, an apotheosis of George III. (1821), and *A Tale of Paraguay* (1825). Among his numerous prose works are—*History of Brazil* (1810–19), *Life of Nelson*, one of the best works in English biography (1813), *Life of John Wesley* (1820), *History of the Peninsular War* (1820–32), *Book of the Church* (1824), *Sir Thomas More, or Colloquies on Society* (1829), *Life of John Bunyan* (1830), and *The Doctor* (1834–37). He also contributed largely to the *Quarterly Review* for many years. His poetical works were collected by himself (10 vols., 1837), and have been several times republished in different forms. His *Life and Correspondence*, edited by his son, Rev. C. C. Southey, appeared in 1849, and a selection from his *Commonplace Book*, by his son-in-law, Rev. J. W. Warter, in 1856. A. H. GUERNSEY.

South Fayette', tp., Allegheny co., Pa. P. 1927.

South'field, p.-v. and tp., Oakland co., Mich. P. 1547.

Southfield, tp., Richmond co., N. Y. (Staten Island), includes the v. of Richmond, the county-seat. P. 5082.

Southfield, tp., Elizabeth City co., Va. P. 1766.

South Fork, tp., Clarke co., Ark. P. 898.

South Fork, tp., Fulton co., Ark. P. 518.

South Fork, tp., Montgomery co., Ark. P. 624.

South Fork, tp., Humboldt co., Cal. P. 273.

South Fork, tp., Klamath co., Cal. P. 286.

South Fork, tp., Christian co., Ill. P. 1279.

South Fork, tp., Delaware co., Ia. P. 1610.

South Fork, tp., Jackson co., Ia. P. 1014.

South Fork, tp., Wayne co., Ia. P. 774.

South Fork, tp., Monroe co., Mo. P. 1463.

South Fork, tp., Forsyth co., N. C. P. 1398.

South Fra'mingham, p.-v., Middlesex co., Mass., on Boston and Albany R. R., 21 miles W. of Boston. Five railroads centre here, forming one of the most important junctions in the State. It contains 3 churches, excellent schools, 1 newspaper, 3 straw-goods manufactories, 1 grain-elevator, mills, and manufactories of wheels, shoes, and rubber goods. P. 4968. C. M. VINCENT, ED. "GAZETTE."

South Gard'ner, p.-v., Gardner tp., Worcester co., Mass., at the intersection of Vermont and Massachusetts with Boston Barré and Gardner R. R., is largely engaged in the manufacture of chairs and settees.

South'gate (HORATIO), D. D., b. at Portland, Me., in 1812; graduated at Bowdoin College 1832, and at Andover 1835; took orders in the Protestant Episcopal Church 1836; travelled as a missionary in the East; was chosen missionary bishop of Constantinople 1844; remained there until 1851, in which year he became rector of St. Mark's, Portland, of the church of the Advent, Boston, 1852, and later of Zion church, New York City. Author of *A Tour through Armenia, Kurdistan, Persia, and Mesopotamia* (New York, 2 vols., 1840), *A Visit to the Syrian Church of Mesopotamia* (New York, 1844), *The War in the East* (1855), *Parochial Sermons* (1859), and of printed sermons and pamphlets, and of magazine articles.

South Glas'tonbury, p.-v., Glastonbury tp., Hartford co., Conn., on Connecticut River, has several factories.

South Glen's Falls, p.-v., Moreau tp., Saratoga co., N. Y., on Hudson River, opposite Glen's Falls. P. 1047.

South Grove, p.-v. and tp., De Kalb co., Ill. P. 795.

South Had'ley, p.-v. and tp., Hampshire co., Mass., on Connecticut River, which here makes a fall of 40 feet, around which a canal 2 miles in length has been constructed; has 5 churches, 1 cotton, 2 woollen, 4 paper, and 4 saw mills, a high school, lyceum, and farmers' club, and is celebrated for the Mount Holyoke Female Seminary, the earliest collegiate institution for females in the country. P. 2840.

South Hadley Falls, p.-v., South Hadley tp., Hampshire co., Mass., takes its name from the noted falls of Connecticut River, which supply, by means of a magnificent dam, an unequalled water-power for flourishing manufac-

tures, both at this point and at the thriving new city of Holyoke on the opposite bank of the river. (See HOLYOKE.)

South Ham, p.-v., cap. of Wolfe co., Quebec, Canada, 33 miles N. W. of Sherbrooke, has a court-house. P. about 100.

South Hamp'ton, p.-v. and tp., Rockingham co., N. H. P. 448.

South Han'over, tp., Dauphin co., Pa. P. 1196.

South Ha'ven, p.-v. and tp., Van Buren co., Mich., on Lake Michigan, at the mouth of Black River and at the W. terminus of South Haven division of Michigan Central R. R., has a good harbor, a thriving lake-trade, and 1 weekly newspaper. P. of v. 1576; of tp. 2203.

South He'ro, p.-v. and tp., Grand Isle co., Vt., embraces the southern half of Grand Isle in Lake Champlain. P. 586.

South Hill, p.-v. and tp., Mecklenburg co., Va. P. 2384.

South Ho'mer, tp., Champaign co., Ill. P. 1510.

South Hun'tington, tp., Westmoreland co., Pa. P. 2210.

South'ington, p.-v. and tp., Hartford co., Conn., on New Haven and Northampton R. R., 20 miles N. of New Haven, contains 7 churches, a well-endowed academy, 1 bank, 1 newspaper, a puddling furnace, 1 hotel, manufactories of tinmen's machines and carriage bolts, general and carriage hardware, pocket cutlery, eyelets, and paper bags. P. 4314. STEPHEN WALKLEY, ED. "REPORTER."

Southington, p.-v. and tp., Trumbull co., O. P. 799.

South Kings'ton, tp., Washington co., R. I., includes the villages of Kingston, the county-seat, and Narragansett Pier, a thriving watering-place; also the noted headland, Point Judith, at entrance to Narragansett Bay. P. 4493.

South Lan'caster, p.-v., Lancaster tp., Worcester co., Mass., on Worcester and Nashua R. R.

South Leb'anon, tp., Lebanon co., Pa. P. 1783.

South Lee, p.-v., Lee tp., Berkshire co., Mass., on Housatonic River and R. R., has celebrated marble-quarries.

South Lon'donderry, p.-v., Londonderry tp., Windham co., Vt.

South Ma'con, tp., Macon co., Ill. P. 79.

South Maho'ning, tp., Indiana co., Pa. P. 1131.

South Man'chester, p.-v., Manchester tp., Hartford co., Conn., noted for the extensive silk-factories of the Cheney Brothers, and the comfortable homes provided for the operatives.

South Man'heim, tp., Schuylkill co., Pa. P. 929.

South Man'itou, tp., Manitou co., Mich., consists of an island in Lake Michigan. P. 76.

South Mer'iden, p.-v., Meriden tp., New Haven co., Conn., on New York New Haven and Hartford R. R.

South Mid'dleton, tp., Cumberland co., Pa. P. 3226.

South Mil'ford, tp., Cedar Creek hundred, Sussex co., Del., on Junction and Breakwater R. R. P. 800.

South Mills, p.-v. and tp., Camden co., N. C. P. 2056.

South Mountain, Battle of. See ANTIETAM CREEK.

South Mud'dy, tp., Jasper co., Ill. P. 584.

South Mur'derkill, hundred, Kent co., Del. P. 4382.

South Na'tick, p.-v., Natick tp., Middlesex co., Mass., on Charles River, is noted as the locality of the missionary labors of the "apostle" Eliot, the translator of the Bible into the Indian language, to whose memory a monument has been raised here; has 3 churches, several shoe and other factories, and a society of natural history. There is an Indian burial-place, and a few persons of Indian descent still reside here; none, however, of pure Indian blood, or who speak the language of Eliot's Bible. (See the *History of Natick* (1856), by Oliver N. Bacon.)

South Newmar'ket, p.-v. and tp., Rockingham co., N. H., on Squawscot River and on Boston and Maine R. R. P. 808.

South Nor'ridgewock, p.-v., Norridgewock tp., Somerset co., Me., on Kennebec River.

South Nor'walk, city and seaport, Fairfield co., Conn., on Long Island Sound, 42 miles from New York, on New York New Haven and Hartford and Norwalk and Danbury R. Rs. The principal industries are the manufacturing of hats, shoes, locks, bronzed goods, force-pumps, steam engines, ship and boat building, marine railway, paper boxes, portable gas-machines, and the cultivation and sale of oysters. It contains 2 banks, an insurance company, 1 newspaper, hotels, opera-house, street railroad, planing-mill, 4 churches, excellent schools, waterworks, fire department, gas, markets, etc. Steam freight-boats run to New York the year round—passenger boats during the summer season. Vessels drawing 12 feet come to the docks. Immediately W., and within the city limits, the land rises to an elevation of 160 feet, affording delightful locations for residences, with extensive views of the Sound N., E., and S., and the harbor on which the city is situated. P. 5000. JAMES GOLDEN, ED. "SENTINEL."

South Oil City, p.-v., Venango co., on Allegheny River, opposite Oil City.

South'old, p.-v. and tp., Suffolk co., N. Y., on Long Island R. R., is a neck of land between Long Island Sound on the N. and Great and Little Peconic and Gardner's bays on the S., and includes Plum and Fisher's islands in Long Island Sound. The township embraces the incorporated village of Greenport and the post villages of Southold, Cutchogue, Mattituck, Peconic, East Marion, and Orient. There are 20 churches within the township, and an academy and savings bank at the village. Shipbuilding, manufactures, and commerce are the leading pursuits. Southold was settled in 1640 as a portion of New Haven Colony, became a part of Connecticut Colony 1662, and passed under the jurisdiction of New York 1664. P. of tp. 6715.

South Ononda'ga, p.-v., Onondaga tp., Onondaga co., N. Y., adjoining the reservation of the Onondaga Indians. P. 242.

South Or'ange, p.-v. and tp., Essex co., N. J., on Morris and Essex R. R., 15 miles W. of New York City, has 4 churches, 1 college and 3 schools, manufactories of hats, gelatine, and paper, 1 weekly newspaper, and a street railway. P. 2963. WILDEY & CO., PROPS. "BULLETIN."

South Otse'lic, p.-v., Otselic tp., Chenango co., N. Y.

South Ot'tawa, tp., La Salle co., Ill. P. 597.

South Ottawa, tp., Franklin co., Kan. P. 41.

South Pa'ris, p.-v., Paris tp., Oxford co., Me., on Grand Trunk R. R.

South Pass City, p.-v., Sweetwater co., Wyoming Ter., on Sweetwater River, formerly the county-seat. P. 460.

South Pel'la, v., Lake Prairie tp., Marion co., Ia. P. 191.

South Per'ry, p.-v., Perry tp., Hocking co., O., on Salt Creek. P. 136.

South Pitts'burg, formerly a borough of Lower St. Clair tp., Allegheny co., Pa., has been included since 1872 in city of PITTSBURG (which see). P. 3095.

South Point, p.-v. and tp., Gaston co., N. C. P. 2414.

South'port, town of England, county of Lancaster, at the mouth of the Ribble, on the Irish Sea, contains several large and elegant hotels and beautiful promenades, and is rapidly developing as one of the first sea-bathing places of England. P. 18,085.

Southport, p.-v., seaport of Fairfield co., Conn., on Long Island Sound and New York New Haven and Hartford R. R., 50 miles N. of New York City, contains 3 churches, a seminary, high and parochial school, 1 newspaper, 2 banks, a print-establishment, and paper pail-factory. P. 2000. C. M. GILMAN, ED. "CHRONICLE."

Southport, p.-v. and tp., Lincoln co., Me., is an island in Sheepscot Bay, on the Atlantic coast. P. 684.

Southport, p.-v. and tp., Chemung co., N. Y., on Chemung River, opposite Elmira, and on Erie and Northern Central R. Rs. P. 2185.

South Quebec', p.-v. of Levis co., Quebec, Canada, on the St. Lawrence, opposite Quebec, and adjoining the city of Levis. It is on Grand Trunk Railway, has fine docks and a large trade, being the point of departure of the Liverpool steamers. It has an emigrants' home. P. about 3000.

South River, tp., Marion co., Mo. P. 728.

South River, tp., Augusta co., Va. P. 4181.

South River, tp., Rockbridge co., Va. P. 2573.

South River, tp., Warren co., Va. P. 2110.

South Ron'dout, v., Esopus tp., Ulster co., N. Y., on Rondout Creek, opposite the city of Kingston. P. 105.

South Roy'alston, p.-v., Royalston tp., Worcester co., Mass., on Miller's River, and on Vermont and Massachusetts R. R.

South Royalton, p.-v., Royalton tp., Windsor co., Vt., on White River, opposite Royalton, and on Vermont Central R. R., has 1 weekly newspaper.

South Sag'inaw, p.-v., Spaulding tp., Saginaw co., Mich., on Saginaw River, at the mouth of the Shiawassee. P. 1875.

South St. George, v., St. George hundred, Newcastle co., Del. P. 111.

South St. Louis, city, St. Louis co., Mo. (annexed to St. Louis in Apr., 1870; enjoys all the privileges of the ward school system of the latter city), has 1 newspaper, a marine railway and dry dock, a street railway, an iron shipbuilding yard, a handsome park, Carondelet, water and gas works, the repair shops of Iron Mountain and Southern R. R., 2 banks, the South St. Louis and Missouri furnaces, producing pig and railroad iron of a superior quality, and the Martindale, Missouri, and Carondelet zinc furnaces, ranking among the first of the country. P. 15,000. R. H. ROBBINS, ED. "CARONDELET REVIEW."

South Scit'uate, p.-v. and tp., Plymouth co., Mass., on North River, has 3 churches, 1 hotel, 1 savings bank, 1 shipyard, 7 saw-mills, 5 box and trunk and 2 tack-factories. There are several large swamps which produce valuable live oak for shipbuilding, which was formerly an important industry. P. 1661.

South Sea Bubble, a financial speculation which arose in England about the same time with Law's Mississippi Scheme in France. The South Sea Company was established by Lord Treasurer Harley in 1711. The public debt was made the stock of the company, under an engagement of the government to pay 6 per cent. interest at the end of five years, and the grant of a monopoly of the trade to the South Sea or the coast of Spanish America. Though the South Sea trade yielded no great profit, the company flourished from other sources, and became so well established as to vie with the Bank of England in controlling the finances of the country. In 1719 the government, with a view to reducing the rate of interest on the public debt and getting rid of certain unredeemable annuities, proposed to extend the privileges of the company and allow it to pay off the annuitants with its own stock. The ministers intended to give the South Sea Company a good bargain, but when the plan was proposed in the House of Commons that body voted to open the scheme for competition to the Bank of England also. The company was thus compelled to offer £7,500,000 for its privilege. Notwithstanding this drawback, under the extravagant expectation of profits from the American trade and the prevalent rage for speculation, the stock of the company was in great demand. It was increased by successive subscriptions, the price of shares rapidly rising till £1000 was paid for a single share of £100. Other bubbles were started, such as schemes for a fishery of wrecks, to make salt water fresh, to make oil from sunflowers, to extract silver from lead, all with promises of enormous profits. Madness ruled the hour. For lack of office-room the streets near "'Change alley" were lined with desks and clerks full of business negotiating the worthless stocks. The action of the South Sea Company itself against some of these bubbles first broke the spell. Attention was turned to its own affairs, and distrust arose, under which the stock rapidly declined. The news of the failure of Law's scheme, and its consequences in Paris, opened all eyes to the delusion, and as the year 1720 closed, the bubble burst, bringing ruin to the company and to thousands of families who had embarked their all on this treacherous sea of speculation. A. L. CHAPIN.

South Shenan'go, tp., Crawford co., Pa. P. 1042.

South Shet'land, or **New South Shetland,** a group of islands in the S. Atlantic, between 60° and 70° S. They are destitute of vegetation, and in the interior covered with perpetual snow and ice. They were discovered in 1819, and are visited by whalers, but navigation here is very dangerous on account of the ice.

South Side, tp., Wright co., Minn. P. 143.

Southside, tp., Appomattox co., Va. P. 2551.

South Strabane', p.-v. and tp., Washington co., Pa., includes v. of Washington, the county-seat. P. 1159.

South Tar River, tp., Yancy co., N. C. P. 344.

South Thom'aston, p.-v. and tp., Knox co., Me., on Penobscot Bay. P. 1693.

South Tren'ton, p.-v., Trenton tp., Oneida co., N. Y. P. 206.

South U'nion, p.-v., Shocco tp., Logan co., Ky., on Louisville Nashville and Great Southern R. R. P. 263.

South Union, tp., Fayette co., Pa. P. 860.

South Val'ley, tp., Cattaraugus co., N. Y., on Alleghany River, includes a portion of Alleghany reservation of Seneca Indians, and has numerous saw-mills. P. 743.

South Versailles', tp., Allegheny co., Pa. P. 2194.

South Vine'land, p.-v., Cumberland co., N. J., on West Jersey R. R., 38 miles S. of Philadelphia, has 3 churches, a graded school, 1 newspaper, and a stoneware and plough factory. Principal business, fruit-raising. P. about 1200. N. P. POTTER, ED. "GOOD TEMPLAR."

South Wash'ington, p.-v., cap. of Pender co., N. C., on Wilmington and Weldon R. R.

South'well, or **Sotwell** (NATHANIEL), b. in the county of Norfolk, England, about 1600; was educated in the English Roman Catholic college at Rome; entered the order of Jesuits 1624; resided in England as a missionary priest 1624–27; returned to Rome; was from 1637 to 1668 secretary-general of the order; completed the *Bibliotheca Scriptorum Societatis Jesu* (Rome, folio, 1676), begun by Peter Ribadaneira (to 1609), and continued by Philip Alegambe (to 1643), and published *A Journal of Meditations for Every Day in the Year* (1669). The *Bibliotheca* was continued by Oudin to the year 1745, and a new edition appeared at Rome 1816. Southwell d. at Rome Dec. 2, 1676.

Southwell (ROBERT), b. at Horsham, St. Faith's, Norfolk, England, in 1560; educated in the Roman Catholic seminary at Douay, France; became a Jesuit at Rome 1578; prefect or rector of the English Jesuits' college at Rome 1585; sent as a missionary to England 1586; chaplain to Anne, countess of Arundel, and secretly administered the rites of his Church to the English Roman Catholics; was thrown into the Tower July, 1592, on an accusation of complicity in a plot against Queen Elizabeth; was ten times subjected to torture, but made no confession beyond that of being a Jesuit and having exercised his priest's office; was condemned to death for constructive treason in refusing to take the oath of supremacy Feb. 20, 1595, and on the following day was hanged, drawn, and quartered at Tyburn, meeting his fate with firmness and composure. Author of several pieces of prose and verse published at London immediately after his death, among which were *St. Peter's Complaint, and other Poems, Mæoniæ, or Certaine Excellent Poems and Spiritual Hymns, The Triumph over Death, Epistles of Comfort to those Catholics who Lie under Restraint*, and *Mary Magdalen's Funeral Teares*. A complete edition of the *Poems* appeared in 1856.

South West, tp., Crawford co., Ill. P. 325.

Southwest, tp., Warren co., Pa. P. 677.

Southwest, tp., Doddridge co., West Va. P. 1251.

South Wes'terlo, p.-v., Westerlo tp., Albany co., N. Y. P. 147.

South West Harbor, p.-v., Tremont tp., Hancock co. (Mount Desert Island), Me., on the W. side of Soame's Sound, is the site of a French colony established May, 1613, by De Saussaye and the Jesuit Biard, but shortly afterward captured and broken up by Capt. Samuel Argall. (See Francis Parkman's *Pioneers of France in the New World*.)

South Wey'mouth, p.-v., Weymouth tp., Norfolk co., Mass., on Plymouth branch of Old Colony R. R., 11 miles S. of Boston, has flourishing manufactures, especially of boots and shoes.

South Wheel'ing, v., Ritchie tp., Ohio co., West Va., on Ohio River, adjoining the city of Wheeling. P. 3158.

South White'hall, p.-v. and tp., Lehigh co., Pa., on Lehigh River, Canal, and R. R., includes the v. of Allentown, the county-seat. P. 2748.

South'wick, p.-v. and tp., Hampden co., Mass., on New Haven and Northampton R. R. P. 1100.

South Wil'braham, p.-v., Wilbraham tp., Hampden co., Mass., on Scantic River, which supplies water-power to a paper-mill and to flourishing manufactories, has 3 churches, and a celebrated collegiate institution, the Wesleyan Academy.

South Wil'liamstown, p.-v., Williamstown tp., Berkshire co., Mass.

South Wind'ham, p.-v., Windham tp., Windham co., Conn., on New London Northern R. R.

South Windham, p.-v., Windham tp., Cumberland co., Me., on Portland and Ogdensburg R. R.

South Wind'sor, p.-v. and tp., Hartford co., Conn., on Connecticut River. P. 1688.

South Wood'berry, tp., Bedford co., Pa. P. 1439.

South'worth (CONSTANT), b. at Leyden, Holland, in 1614, son of Edward, a merchant and business-agent of the Leyden Pilgrims (d. 1621); was brought to Plymouth, Mass., in the third vessel that arrived 1621 by his widowed mother, Alice Carpenter Southworth, who became the second wife of Gov. William Bradford, under whose care he was educated; was one of the early colonists of Duxbury; was often a magistrate and representative in the legislature; served as commissioner for the United Colonies; governor of the Kennebec Plantation and assistant governor of Plymouth. D. at Duxbury about 1685. He was supposed to be the author of the *Supplement* to the

New England's Memorial of his cousin, Nathaniel Morton. —His brother THOMAS, b. in Leyden in 1616, was also prominent in public affairs. D. 1690.

Southworth (EMMA D. E. NEVITT), b. in Washington, D. C., Dec. 26, 1818; was married in 1841, and two years later was thrown wholly upon her own exertions for a livelihood; engaged in teaching, and wrote for the Washington *National Era* a novel entitled *Retribution*, which was published in book-form in 1849, since which time she has put forth in rapid succession a long series of novels. A uniform edition of her works has been published, among which are—*The Family Doom, Prince of Darkness, The Bride's Fate, The Changed Brides, How He Won Her, The Widow's Son, The Bride of Llewellyn, The Fortune-Seeker, The Bridal Eve, The Fatal Marriage, The Deserted Wife, The Lost Heiress, The Discarded Daughter, The Three Beauties, Vivia, The Wife's Victory, The Mother-in-Law, The Haunted Homestead, Lady of the Isle, Retribution, India, or the Pearl of Pearl River, The Curse of Clifton, Cruel as the Grave, Tried for Her Life, A Beautiful Fiend*, and *The Spectre Lover.*

Southworth (NATHANIEL), b. at Scituate, Mass., in 1806; early displayed artistic talent; became a celebrated miniature-painter at Boston; visited Europe in 1848, and subsequently practised his profession in New York and Philadelphia. D. at Dorchester, Mass., Apr. 25, 1858.

Southworth (TERTIUS DUNNING), b. at Rome, N. Y., in 1800; spent his childhood at Bridgewater; studied at Whitesboro' Academy; graduated at Hamilton College 1827 and at Andover Seminary 1830; became a Congregational minister at Sauquoit, N. Y.; was afterward settled at Claremont, N. H., 1834; succeeded the celebrated Dr. Nathaniel Emmons as pastor of the church at Franklin, Mass., 1838–49; was for several years without pastoral charge on account of ill-health; was settled at Pleasant Prairie, Wis., 1859–68, after which he returned to Bridgewater, N. Y., to spend his declining years, and d. there Aug. 2, 1874. Author of numerous occasional publications, including many sermons and addresses, among which the sermon preached at the funeral of Rev. Dr. Emmons was especially noted for its eloquence.

South Yar'mouth, p.-v., Yarmouth tp., Barnstable co., Mass., on Bass River, near Cape Cod R. R., is extensively engaged in fishing and salt manufacture.

Souval'ki, town of Russian Poland, cap. of the government of Souvalki, is the seat of several civil and ecclesiastical authorities, and has good educational institutions. P. 16,533.

Souvarof. See SUWAROW.

Souvestre' (ÉMILE), b. at Morlaix, department of Finistère, France, Apr. 15, 1806; after editing for some time a liberal newspaper at Brest, he settled in 1836 at Paris, where he attracted attention first by his sketches of Brittany, and became soon one of the most popular novelists and dramatists. D. at Paris July 5, 1854. The most remarkable of his novels are *Les Derniers Bretons, L'Homme et l'Argent, Confessions d'un Ouvrière, Un Philosophe sous les Toits* (the last-named receiving in 1851 a prize from the French Academy); and of his dramas, *Henri Hamelin, L'Oncle Baptiste, La Mousse*, etc. All his works have a strongly-marked tendency, representing morality and riches as incompatible. He is sometimes sad, and even bitter, but he often gives most delightful pictures of the innocence of simple surroundings and the cheerfulness of humble circumstances.

Souzdal', town of European Russia, government of Vladimir, on the Kamenka, is said to have been founded in 606 B. C. It has 6919 inhabitants, mostly engaged in raising vegetables.

Sov'ereign, the British gold coin representing the pound sterling of 20 shillings. It first appeared in 1817, and now weighs $\frac{1}{35\frac{7}{10}}$th of an ounce troy, and is worth $4.839 in U. S. money. The English coin first called double royal (afterward replaced by the guinea), first struck about 1489, was often called the sovereign. Its value varied from 20 to 30 shillings, but its original value was 22 shillings sterling.

Sov'ereignty [It. *sovranità*; Fr. *souveraineté*, from the Latin prep. *super*, through It. *sovrano*, Fr. *souverain*, "high," "supreme"] denotes the possession of the highest power in any given sphere, as in the state or in the universe. A kindred word from the same origin was *suzeraineté*, from *suzerain*, the feudal lord-paramount. The debates concerning the supreme power, whether it resides by right in the people—*i. e.* the organized people—ultimately, or in some ruler who received it from God, led to the application of the word to the former as the source from which the right of the particular magistrate or line of kings was derived, and to the latter as invested by the former with his power according to the will of God. In the English usage the king or queen is called sovereign, although possessed of an authority limited on every side by law. Yet as in theory all executive power is derived from that of the monarch, the term sovereign contains no absolute misnomer.

Under our Constitution the question whether the several States or the U. S. are invested with the sovereignty has been made a matter of great contention, and the term has been used to justify the most false and dangerous doctrines. We ask our readers' attention for a word or two upon this subject.

(1) In the provisional articles of peace between the U. S. and Great Britain (1782), and in the definitive treaty of 1783, the king acknowledges the thirteen United States "to be free, sovereign, and independent States," "treats with them as such," and "relinquishes all claims to the government, propriety, and territorial rights of the same, and of every part thereof." The meaning of this is, that he and no one else had any claims of sovereignty over the territory of the U. S., and that by relinquishing those claims he left them in the same condition in which other states, independent of all external powers, were by the nature of their situation placed. The thirteen States were at that time confederated together, but of this confederation he takes no notice.

(2) In the new Constitution, framed in 1787, important limitations were put on the power of the thirteen States, all of them tending to throw power into the hands of the general government. Among these were the powers to declare war, to make peace, to send and receive ambassadors, to raise and support armies, to coin money, to emit bills of credit, to provide for calling forth the militia of the States in order to execute the laws of the Union, to decide in all questions, whether questions of interpretation or of other kinds, arising under the Constitution. And it is added that "the Constitution, and the laws of the U. S. which shall be made in pursuance thereof, and all treaties made or which shall be made under the authority of the U. S., shall be the supreme law of the land; and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding." (Art. VI. 2.) This section is immediately followed by one to the effect that the Senators and Representatives of the U. S., and all judicial and executive officers, both of the U. S. and of the several States, shall be bound by oath or affirmation to support the Constitution. The President especially is required to declare on oath or affirmation that he will to the best of his ability preserve, protect, and defend the Constitution of the U. S. So far from being sovereigns, then, the States composing the U. S. have not a single attribute of sovereignty belonging, according to international law, to a sovereign and independent state. They can have no other or higher relations to foreign powers than any municipality, private corporation, or individual. If they differ with the general government on the interpretation of laws or treaties, the difference must be drawn before the courts of the Union, and their interpretation must decide the judgments of all State courts thereafter. The Constitution is thus supreme, and as a supreme instrument it *prohibits* the States (Amendments, Art. X.) from exercising certain powers.

(3) The question whether the States were supreme in the interval between the Declaration of Independence and the formation of the present Constitution, or in any part of that interval, as from the peace with Great Britain onward, is of very minor importance. The question of sovereignty is one of fact. Does a community, called a state, possess or not the status of a treaty-making power on a par with other states of the world? Can it interpret the constitution to which it has given its assent, or must some other body interpret for it? Questions like these determine its condition, no matter what its former condition may have been. If it was once sovereign, it can have renounced its sovereignty; if it was not, it never acquired sovereignty by the Constitution. The preamble of this instrument intentionally begins not "We, the States," but "We, the people of the U. S.," "do ordain and establish this Constitution," etc. But we lay no stress on this form of words, except so far as it seems intended to avoid a seeming inconsistency with which "we, the States," might have been chargeable.

All this is better expressed than we can express it in Gen. Jackson's proclamation of Dec., 1832: "The States severally have *not* retained their entire sovereignty. It has been shown that in becoming parts of a nation, not members of a league, they surrendered many of their essential parts of sovereignty. The right to make treaties, declare war, levy taxes, exercise exclusive judicial and legislative powers, were all of them functions of sovereign power. The States, then, for these important purposes, were no longer sovereign. The allegiance of their citizens

was transferred, in the first instance, to the government of the U. S.: they became American citizens, and owed obedience to the Constitution of the U. S., and to laws made in conformity with the powers it vested in Congress. This last position has not been, and cannot be denied. How, then, can that State be said to be sovereign and independent whose citizens owe obedience to laws not made by it, and whose magistrates are sworn to disregard [its own] laws when they come into conflict with laws passed by another? What shows, conclusively, that the States cannot be said to have reserved an undivided sovereignty is, that they expressly ceded the right to punish treason—not treason against their separate power, but treason against the U. S. Treason is an offence against *sovereignty*, and sovereignty must reside with the power [able] to punish it." (Comp. the articles NULLIFICATION and TREASON.) T. D. WOOLSEY.

Sovicil'le, town of Italy, province of Siena, is beautifully situated at the foot of Monte Maggio, on the Spino. P. 7115.

Sow'er (CHRISTOPHER), b. in Germany toward the close of the seventeenth century; was a bookseller at Hesse-Darmstadt; emigrated to Pennsylvania 1726; settled as a printer and bookseller at Philadelphia; established the first type-foundry and the first manufactory of printer's ink in America; published the first quarterly magazine (1735) and the second Bible (1743), both being in German. D. at Philadelphia Sept., 1758.—His son, CHRISTOPHER, b. at Hesse-Darmstadt Sept. 26, 1721, succeeded to the management of the publishing business 1758; was the introducer of cast-iron stoves into America, and supposed to be their inventor; was noted for philanthropy during the war of the Revolution, when he merited the name of *Das Brod-Vater* ("the bread-father"), but lost his property by confiscation in consequence of his loyalist sentiments. D. at Philadelphia Aug., 1784. A descendant of the family is in the educational-book business in Philadelphia.

Sow'erby, an English family, several members of which have attained eminence in connection with natural history and art: JAMES, b. at Lambeth Mar. 21, 1757; was originally a miniature and portrait painter, and later in life took up botany in connection with his art. He published *Botanical Drawing-Book* (1789); *English Botany*, containing colored figures of all the native plants of Great Britain (36 vols., with descriptions by Sir James Edward Smith, M. D., 1792–1807; supplement by his son, James De C. Sowerby, 4 vols., 1815–49; new ed. by J. T. B. Syme, 10 vols., 1863–70); *The Florist's Delight* (1791); *English Fungi or Mushrooms*, with 440 colored figures (3 vols., 1797–1803); *British Miscellany*, comprising animal subjects (1804–06); *Exotic Botany* (1804–05); *British Mineralogy*, with 550 colored plates (5 vols., 1804–17); *Description of Models to explain Crystallography* (1805); *Gleanings of British Algæ*; *New Elucidation of Colors* (1809); *Exotic Mineralogy*, with 169 colored plates (2 vols., 1811–17); and *Mineral Conchology of Great Britain*, with 600 plates (6 vols.; the last two by his son, J. De C. Sowerby, 1812–30). He was a contributor to the *Annals of Philosophy* and to the *Transactions* of the Linnæan and Geological societies. D. Oct. 25, 1822.—JAMES DE CARLE, eldest son of the preceding, b. at Stoke Newington June 5, 1787; in 1839 was made secretary of the Royal Botanic Society, holding the position until 1870, when he retired with a small pension. He was a skilful artist, made the designs for Loudon's *Encyclopædia of Plants*, and assisted his father in many of his works. D. Aug. 26, 1871.—JOHN EDWARD, son of James, prepared either alone or in conjunction with others *The Ferns of Great Britain* (1855), *Fern Allies* (1856), *British Poisonous Plants* (1856), *The Grasses of Great Britain* (1857), *British Wild Flowers* (1858), *Wild Flowers worth Notice* (1861), *The Useful Plants of Great Britain* (1862), and an *Illustrated Key to British Wild Flowers*.—GEORGE BRETTINGHAM, second son of James, b. at Lambeth Aug. 12, 1788; assisted his father in the entomological portions of his works; purchased for £6000 the collection of shells belonging to the earl of Tankerville, of which he prepared a catalogue, and also purchased several other large collections of shells; was one of the founders of the *Zoological Journal*, and published *Genera of Recent and Fossil Shells*, with 264 colored plates (42 parts, 1822–34); *Species Conchyliorum* (1830; not completed); *Conchological Illustrations* (200 parts, 1832–45); *Thesaurus Conchyliorum*, being figures and descriptions of shells, the later volumes by his son (23 parts, 1842–64). D. July 26, 1854.—GEORGE BRETTINGHAM, JR., son of the preceding, b. Mar. 25, 1812; has published *Manual of Conchology*, with more than 650 figures of shells (1839; 4th revised ed. 1852); *Thesaurus Conchyliorum* (30 parts, 1842–71); *Popular British Conchology* (1854; new ed. 1866); *Popular History of the Aquarium* (1857; new ed. 1865); *Illustrated Companion to Kingsley's Glaucus* (1858); *Illustrated Index of British Shells* (1859); and *Labels for the Recognized Species of British Shells* (1861). He also made the drawings for Reeves's *Elements of Conchology* and *Land and Fresh-Water Mollusks of the British Isles*.—HENRY, a younger brother of the preceding, who subsequently emigrated to Australia, has prepared a *Popular Mineralogy*, comprising a familiar account of minerals and their uses (1850). A. H. GUERNSEY.

Sowerby Bridge, town of England, county of York, has malting-houses, dyeworks, and manufactures of ironware and cotton goods. P. 6000.

Sowing and Sowing-Machines. Sowing, in its widest sense, is the process of depositing seed in the ground for the purpose of producing plants. When the seeds are deposited singly or with only a few in a definite spot, it is usually called *planting*, the term *sowing* being restricted to cases where the seed is thrown broadcast or deposited in rows or "drills." Sowing or planting is usually performed in the spring, but sometimes, and with some kinds of crops, in the autumn, so that the plants may have a fair start when the spring opens. The seeds are usually covered over by harrowing, brushing, or rolling the soil after they have been deposited. As a rule, it may be laid down that when the soil is rather firm and the climate moist, little depth of covering is required; but when the soil is loose and the climate dry, the seeds should be covered to a depth of about twice their thickness. Machines, more or less complex, for performing the operation of sowing or planting in all its forms have been in use from time immemorial. Some scatter the seed broadcast; others dibble it into the ground in rows or drills, and then cover it, the general principle being that the drills should be at such a distance apart that a horse drawing a light plough may pass between the drills without injuring the plants. In the larger machines, often drawn by horse power, the seed is placed in small cups, from which it passes through tubes so arranged as to suffer them to drop regularly into shallow furrows cut by coulters just in front of the escape-orifice of the tubes, the furrows being closed up by a kind of rake or harrow following immediately after and forming a part of the machine. Sowing-machines form an important adjunct to the reaping and mowing machines elsewhere described. (See REAPING AND MOWING MACHINES.)

Sowles (WILLIAM L.), b. in the State of Vermont in 1800, d. at Swanton, Vt., May, 1878; was member of the State legislature 1828–31; State senator 1841–42; and for many years one of the leaders of the Republican party in the State.

Soy Bean, the *Soja hispida*, a bean extensively grown in Japan, China, India, and the Spice Islands, where it is much used as food. The sauce called "soy" is, when genuine, made of boiled soy beans, mixed with wheat-meal and fermented. It is then salted and mixed with water, and after daily stirring for a long time the supernatant liquid is poured off and preserved for use. Good soy is a spirited and excellent sauce, and is believed to improve with age.

Soyer' (ALEXIS), b. in France about 1800; was cook in the Reform Club in London; became noted for his army cookery during the Crimean war. D. Aug. 5, 1858. He published *Culinary Relaxations* (1845), *Gastronomic Regenerator* (1847), *Modern Housewife* (1849), *Culinary Campaign* (1857).

Spa, town of Belgium, province of Liege, in a beautiful valley, is handsomely built, and celebrated for its cold mineral springs, which were resorted to on account of their curing effect even in the fourteenth century. P. 5881.

Spaccafor'no, town of Sicily, province of Syracuse, on the side of a hill which rises above the right bank of the Bufaldone. Within the limits of this town is the curious locality known as the Cava Ipsica, a wooded valley, in the rocky sides of which were cut, in some pre-historic age, dwelling-places for a now forgotten population. These artificial caverns are not uncommon in the island, but most of those found in the Cava Ipsica could only have been reached by ladders. P. 8035.

Space [Lat. *spatium*] is regarded by Aristotle (*Phys.*, iv. 1–5) "as the first and unmoved limit which bounds body" when taken as finite space or *place*; taken as space in general, it is "the unmoved limit of whatever is moved"—*i. e.* of all bodies. Time, on the other hand, should be, according to him, the number and measure of movement. The existence of pure space is evident, he says, from the fact that things change places; yet in spite of its three dimensions it is not to be confounded with body, for in that case two bodies would coincide; it is not cause; there is no place in which space itself exists; nor does space grow with what grows. Matter and form are in-

separable, but extension and limiting surface are separable; hence matter and form do not explain them, as was thought by Plato in the *Timæus*, where he makes space to be the primitive matter of the universe; it is not form, for space remains when the form is removed. In these distinctions Aristotle lays especial stress on the idea of limit, negation, discreteness in relation to body as essential to the definition of space. In philosophy there is scarcely any subject upon which there is more apparent diversity of opinion or more fruitless attempts at definition. The difference, however, is not really so great as it seems. Space has been made identical with pure extension, but this leaves no definition for time, which likewise involves extension. Leibnitz made it "the order of things coexisting, as time is the order of things successive," so that if the totality of things could be moved, space, being their arrangement, would likewise be moved. It has been defined to be pure nothing, thus omitting its specializing attribute. For while "nothing" may be regarded as the potentiality of all (of events and ideas as well as of bodies), space can be regarded only as the potentiality of bodies. It has been made an accident or attribute or relation inhering in bodies; but this would involve the absurdity that annihilation of bodies destroyed space. As the ultimate logical condition for the co-existence of bodies, space is itself a correlate of time as regards motion and actually existing matter—time by itself being the ultimate logical condition of all succession. As ultimate logical condition it has quite frequently been identified with the infinite, or made to be a divine attribute. Sir Isaac Newton suggested that God by existing constitutes time and space. Samuel Clarke expanded this suggestion into a system of theology, and held a long discussion with Leibnitz on the subject. Akin to this view is that which makes space and time to be forms of mind when it thinks nature. Kant laid great stress on this, making space and time subjective forms of intuition and devoid of objective validity as regards "things in themselves." By this, however, he must not be understood to mean that they are subjective to the mere individual mind, and to be refused validity as regards objects in nature and history; for Kant regards all nature and all history as necessarily conditioned in and through space and time. His doctrine, therefore, does not narrow or belittle space and time, but only magnifies and glorifies mind, which is thus shown to transcend the world and to be of an eternal nature.

Much labor has been expended by sensationalists on the problem of accounting for the origin of the idea of space. Locke thought that he could trace it to the senses of touch and sight; most of his followers have adopted the same doctrine, making it a generalization from experience gained in the perception of bodies. Accordingly, they ignore in some manner the attributes of universality and necessity which are the distinctive characteristics of *a priori* ideas, and make unbroken custom or habit to be the explanation of the inability or impotence of the mind which we call inconceivability. That geometry rests upon the *a priori* cognition of space, as arithmetic and algebra rest upon a similar cognition of time, is not conceded by them. But Kant saw and stated with great clearness the grounds for all transcendental or spiritual philosophy as involved in the question, "Are *a priori* synthetical judgments possible?" *i. e.* Can we enounce the universal and necessary conditions of experience? The answer being affirmative, instancing mathematics, the next question is, "How are they possible?" that is, What does this presuppose in regard to mind? Instead of deriving the idea of space from experience in regard to bodies, he saw that by no possibility could the mind conceive a body in the first instance without already having the idea of space. The mind uses the idea of space as an indispensable instrument in thinking the idea of a body. Moreover, space is not a generalized idea ("discursive"), inasmuch as it is not abstracted from spaces, but is thought as the logical condition of all possible spaces or bodies, and therefore as infinite from the first. Much has been written upon the inconceivability of the infinite, especially by Sir William Hamilton and his followers. We know space to be infinite, because it is its nature to be that in which all limits exist; hence, were it supposed to be finite and limited, it must be necessarily thought to be limited by itself; but self limitation is continuation, therefore space can be only continued, and this universally. Hegel unites in his view of space the doctrine of the Christian Mystics with that held by such thinkers as Newton and Clarke; the former, making God's thinking and willing to be identical, hold this self-knowledge to be a creation of the world—his making an object of himself to be the creative act. The self consciousness of God being self externalization, as well as return out of self externalization through the act of recognition, nature and man (in whom nature is perpetually sacrificed and subordinated for spirit) come into being. Accordingly, the lowest, most elementary, abstract, and inadequate form of the divine self-knowing is space; time being at once the needed correlate to correct its imperfection, and reflect God's unity with himself, which is essential to destroy his self-alienation. Space and time as abstractions thus unite in matter and movement, which are therefore relatively concrete. Meister Eckhart, Jacob Böhme, Angelus Silesius, Franz Baader, Schelling, and others have explored this abyss of the creative idea, and with substantially the same results. Indeed, the Oriental mysticism which underlies Gnosticism, Neo-Platonism, and the Jewish Cabbala is not essentially different as regards its logical movement, but only in its construction of the "return," and its assertion of the principle of emanation instead of creation. Spinoza's "thought and extension" as the two attributes of God suggest the view which he held of the relation of space to the divine activity.

WILLIAM T. HARRIS.

Spad'ra, p.-v. and tp., Johnson co., Ark. P. 1905.

Spaf'ford, p.-v. and tp., Onondaga co., N. Y. P. 1595.

Spagnolet'to, whose true name was JOSÉ RIBERA, b. at San Felipe de Jativa, province of Valencia, Spain, Jan. 12, 1588; studied painting, first under Francisco Ribalta, afterward in Italy, especially under Caravaggio, and settled about 1612 at Naples, where he achieved a great fame; was made court painter, and d. probably 1656. His most remarkable pictures are *The Flaying of Saint Bartholomew*, *Ixion on the Wheel*, *Jacob's Dream*, *Adoration of the Shepherds*, etc., besides a great number of portraits. Among his pupils was Salvator Rosa.

Spa'his [Pers. *sipâhî*, "soldier"], a name applied to the former irregular Turkish cavalry, abolished in 1826; at present applied to the Franco-Algerine cavalry. There are at present but three regiments of spahis in the French service. The Turkish government has several regiments of regular spahis, besides an irregular force of that name. Tripoli also employs some 1500 spahis at present in her small army.

Spaight (RICHARD DOBBS), b. in Ireland about the middle of the eighteenth century; educated at the University of Glasgow; came to America shortly before the Revolution; settled in North Carolina; took part in the Southern campaigns 1778–80; sat in the North Carolina legislature 1781, in Congress 1782–86, in the convention which framed the Federal Constitution 1787; was governor of North Carolina 1782–85; again member of Congress 1798–1801, and killed in a duel by John Stanley Sept. 5, 1802.

Spaight (RICHARD DOBBS), JR., b. at Newberne, N. C., in 1796; graduated at the University of North Carolina 1815; studied law; was elected to the State assembly 1819, to the senate 1820–22; was a member of Congress 1823–24; again a State senator 1824–34; member of the State constitutional convention 1835, and governor 1835–37. D. at Newberne in Nov., 1850.

Spain, Kingdom of, occupying the largest part of the Pyrenean peninsula, extends from lat. 36° 0' 40" to 43° 46' 40" N., and from lon. 8° 17' 42" to 20° 59' 56" E., and comprises an area of 507,036 quadrate kilomètres, inclusive of the two European groups of islands—the Balearic Isles, 4817.4 q. k., and the Canaries, 7272.6 q. k. The surface consists principally of a large plateau walled in N., E., and S. by high mountain ranges, but sloping W. down to the Atlantic. On the N. rise the Pyrenees and the Cantabro-Asturian Mountains. The Pyrenees are wild and impracticable, almost destitute of longitudinal valleys, and forming a barrier between Spain and France crossed only by two great lines of communication. The average height of the ridge is 7500 feet, that of several single peaks still greater—Maladetta, 10,722 feet; Pic du Midi, 9000 feet; Canigou, 8646 feet; on the Spanish side the descent is very steep. The Cantabro-Asturian Mountains connect with the Pyrenees at the Bay of Biscay, and run parallel with the coast, rising 8800 feet. To the E. the mountains of Catalonia extend along the coast to Tortosa, where the Ebro breaks through them; they are rich in metals, coal, and salt, and have made Catalonia the only truly manufacturing region of Spain. Divided by numerous rivers into insulated groups, which the Spaniards call *muelas*, and without any common name, the mountains continue southward through Valencia and Murcia. The southern wall of the plateau is formed by the Sierra Morena, which rises 5000 feet and runs from E. to W., ending in Cape S. Vicente. The Sierra Morena is not a coast-range, however; to the S. extends the Andalusian lowland, separated from the Mediterranean by the Sierra Nevada, which rises 11,000 feet. The plateau forming the main bulk of the peninsula is divided into two parts by a range running from the N. E. to the S. W. The northern part is the plateau of Leon and Old Castile, with an average height of 2400 feet; the southern, the plateau of New Castile, with an average

height of 2000 feet. The range, collectively called the Castilian Mountains, is called Samosierra to the N. E., Guadarama and Sierra de Gredos to the S. W. The rivers which traverse the country flow mostly in very deep beds, and are thus less available for irrigation. To the Atlantic run the Duero, Tajo, Guadiana, and Guadalquivir, all rising on the eastern wall of the central plateau; to the Mediterranean, the Ebro, which rises between the Cantabrian Mountains and the north-eastern wall of the plateau of Old Castile. Of the minor rivers, the Minho runs to the Atlantic, the Segara, Xucar, and Guadalaviar to the Mediterranean. All the rivers, with the exception of the Guadalquivir, are navigable only for a short distance from the sea, and are consequently of little importance for communication. The most important canals are the Aragonian, the San Carlos, and the Castilian. Noticeable are the immense establishments for irrigation found throughout the country, and generally founded by the Moriscoes; the most remarkable is the canal of Isabella II., which provides Madrid with water. The coast formation of the peninsula is not very favorable. The southern coast is steep and rent by numberless small gulfs from Cape de Gata to Cape Tarifa; then sandy and covered with salt-marshes, *marismas*, to Faro. Only one important maritime place is found here—namely, Cadiz. From Faro to Cape S. Vicente the coast is one steep wall of rock. The coast of Galicia is also steep, but indented by numerous deep bays, *rias*, and rich in small harbors; the northern coast offers good harbors at Santander and Bilbao. Along the eastern coast Barcelona, Tarragona, Valencia, Alicante, and Cartagena are the most important harbors. In general, the climate of Spain, more than that of any other European country, resembles the climate of the tropical regions, all natural forces manifesting themselves with singular power—sudden changes from heat to cold, hurricanes, earthquakes, long droughts, violent rains; nevertheless, the climate is very different in the different regions. The central plateau is dry, destitute of forests, very hot in the summer, very cold in the winter; the Cantabrian and Pyrenean mountain-regions are milder and moister, on account of the sea-breeze; the coast lands of Valencia and Murcia enjoy a most delicious air, and the lowland of Andalusia has an almost tropical character; it knows only spring and summer. Very unfavorable to the climate and fertility of Spain are the large tracts of waste land and the great lack of forests, both features resulting from false administrative principles and the internal dissensions of the people. A great diversity in the flora and fauna of the country corresponds to the diversity of its climate and surface. In the northern region grow the oak, beech, chestnut, alder, ash, elm, and birch; fruit and nut-bearing trees, wheat, rye, barley, oats, and fodder-plants are cultivated; the wolf, bear, boar, fox, rabbit, stag, roe, etc., are found. The central districts have an alpine flora—heath, thyme, thistle, now and then forests of pine and *Quercus ilex*; in the south-western the olive, orange, fig, almond, vine, laurel, cypress, prickly pear or Indian fig (*Cactus opuntia*), the date and fan-palm, myrtle, etc., abound; in the southern region the plants of Northern Africa, Egypt, and Asia Minor, and sugar, cotton, and sweet potatoes are cultivated; in the south-eastern, oranges, date-palms, melons, and rice are grown; farther to the N., along the Mediterranean, wine and wheat are produced—maize, hemp, flax, vegetables, fruit, especially peaches and apricots, and evergreen oaks abound. A mixture of the European and African fauna inhabits the central, western, and eastern districts. The eagle, falcon, genet, ichneumon, numerous butterflies, the scorpion, etc., are indigenous here, while in the southern districts the African birds and apes and the chameleon are found. The steinbok is frequently met with in the Sierra Nevada.

The population consisted in the oldest times of two entirely different races, the Celts in the W. and the Iberians in the E., much intermixed with each other in the central part of the country. The Basques (*Vascones*) in Navarre, the Cantabrian Mountains, and on both sides of the Western Pyrenees, numbering about 500,000, form a pure and unmixed stock of the Iberians, who probably came from Africa and spread over Southern France as far as the Garonne. To these races many others were added by immigration: first, the Phenician and Greek colonists; next the Carthaginians, after 236 B. C.; then the Romans, who under Augustus occupied the whole peninsula and divided it into three provinces: *Tarraconensis*, the central plateau; *Bætica*, Andalusia; and *Lusitania*, Portugal. In 409 A. D. the Sueves, Alanes, and Vandals invaded the peninsula, and in 711 came the Arabs, who founded a powerful empire. The present race-distribution is the same as was apparent in the political division of the country at the end of the Middle Ages. In Aragon and Catalonia the Limousin dialect is spoken, a branch of the Provençal, down to the frontier of Valencia. The Catalonian is enterprising, courageous, hardy, born a merchant. The Basque is gay and social, patriotic and industrious; his land is carefully cultivated, and good roads are laid out. His language has no relation at all to any other known language. The Castilian, occupying the centre of the country, shows at this very day the same characteristics which formerly the Romans admired. He is proud, grave, valiant, dignified, liable to fall into intolerance and bigotry, and apt to despise everything foreign and new. In Andalusia, Granada, and Murcia the Spaniards are much mixed up with Arabian elements; they are lively, talkative, quick-witted, poetical, and hospitable. But in spite of their many great and good qualities, the Spaniards stand in general civilization far below the other European nations; they are ignorant, and boast most of that which constitutes their very weakness. The reason for this state of affairs lies partly in the soil and climate of the country. The grandeur of all natural phenomena and the violent changes which take place foster superstition and prevent regular labor. But the reason must partly be found in the history of the people, the chief part of which is made up of religious wars; the people have always been under the control of the clergy. According to the census of 1870, the population amounted to 16,835,506, including the Canaries and the Balearic Isles, which together had 573,084 inhabitants. In 1860 the population numbered 15,673,536, and in 1787, when the first census was taken, 10,409,879. The country is divided into the following 47 provinces:

	Quadrate kilomètres.	Population.		Quadrate kilomètres.	Population.
Alava	3,121.7	103,320	Lerida	12,355.9	330,348
Albacete	15,465.9	220,970	Logroño	5,037.5	182,941
Alicante	5,434.3	440,470	Lugo	9,808.4	475,836
Almeria	8,552.9	361,553	Madrid	7,762.4	487,182
Avila	7,722.1	175,219	Malaga	7,312.9	515,010
Badajoz	22,499.8	431,922	Murcia	11,597.1	439,067
Barcelona	7,731.4	762,555	Navarre	10,478.0	318,687
Biscay	2,197.9	187,926	Orense	7,092.8	432,796
Burgos	14,635.1	353,560	Oviedo	10,595.8	610,883
Caceres	20,754.5	302,455	Palencia	8,097.2	184,668
Cadiz	7,275.7	425,490	Pontevedra	4,504.3	480,145
Castellon	6,335.4	295,222	Salamanca	12,793.7	289,870
Ciudad-Real	20,305.0	264,619	Santander	5,471.5	241,581
Cordova	13,441.6	382,652	Saragossa	17,112.0	401,894
Corunna	7,973.2	630,504	Segovia	7,027.7	150,812
Cuença	17,418.9	242,231	Seville	13,714.4	515,011
Gerona	5,883.9	325,110	Soria	9,935.5	158,699
Granada	12,787.5	485,346	Tarragona	6,348.8	350,395
Guadalajara	12,610.8	208,638	Teruel	14,229.0	252,201
Guipuzcoa	1,884.8	180,743	Toledo	14,467.7	342,272
Huelva	10,676.4	196,469	Valencia	11,271.6	665,141
Huesca	15,224.1	274,623	Valladolid	7,880.2	242,384
Jaen	13,426.1	392,100	Zamora	10,710.5	250,968
Leon	15,971.2	350,092			

The old division, however, is much more characteristic both for the land and the people. It comprised (1) the kingdom of New Castile, with the capital, Madrid; pop. 332,024 in 1870; the Escurial palace built by Philip II., and containing the tombs of the kings; Aranjuez on the Tajo, the royal residence during spring; and the towns of Cuença on the Jucar, and Valdepenas and Manzanares on the Andalusian road. (2) The territory of Estremadura, with the fortress of Badajoz and the towns of Merida and Caceres. (3) The kingdom of Leon, the oldest part of the Spanish monarchy, whose inhabitants call themselves *christianos viejos*, with the University of Salamanca, the former fortress of Zamora, and the town of Leon, the capital of Don Pelayo, who began the 700 years' war with the Arabs. (4) The kingdom of Galicia, with the towns of Orense on the Minho, Vigo, La Corunna (pop. 30,132), Ferrol, and the celebrated place of pilgrimage, Santiago de Compostela. (5) The principality of Asturias, the cradle of the Spanish monarchy; here Don Pelayo found refuge in the rock-cave, now an abbey, of Covadonga, and since that time the crown-prince of Spain bears the title of prince of Asturias. Towns, Oviedo and Gijon. (6) The kingdom of Old Castile, with the towns of Santander (pop. 30,202), Reynosa, Palencia; Valladolid (pop. 43,361), built by Philip II., with a university and a harbor on the Castilian Canal; Simancas on the Pisuerga, with the state archives; Avila; Segovia, from the Roman period; San Ildefonso, palace and park; Soria, the centre of the Castilian sheep breeding; Burgos (pop. 26,000), with a great cathedral and very strong fortifications; Logroño. (7) The Basque provinces, Alava, with the town and fortress of Vittoria; Biscay, with the port of Bilbao; Guipuzcoa, with the town of San Sebastian and the former frontier fortress Fuentarabia on the Bidassoa. (8) The kingdom of Navarre, with the fortress of Pamplona and the town of Tudela on the Ebro. (9) The kingdom of Aragon, with Huesca (pop. 40,000), Saragossa (pop. 67,428), a fortress with a university, and the town of Teruel. (10) The principality of Catalonia, with Lerida, Gerona, Figueras, Barcelona (pop. 189,948), a military and commercial place of first rank, with a university; Tarragona, Reus, and Tor-

tosa. (11) The kingdom of Murcia, with Murcia (pop. 87,803), and Cartagena (pop. 54,315). (12) The territory of Andalusia, composed of the four ancient Moorish kingdoms of Jaen, Granada, Cordova, and Seville, with Almera, Granada (pop. 67,326), containing a university and the palace of the Alhambra; Malaga (pop. 94,732), the second port of the country; Cadiz (pop. 71,521); Xerez de la Frontera (pop. 52,158), Cordova (pop. 41,963), and Seville (pop. 118,298), a fortress, with a university and considerable trade.

The sources of wealth which the country contains are very rich, but generally either undeveloped or abandoned. No other country of Europe is so rich as Spain in metals and useful minerals. Among the rocks which compose the crust, the plutonic and primary sedimentary rocks play a conspicuous part; two-thirds of the south-western part of the peninsula consist of granite, gneiss, and other crystalline rocks, clay-slate and graywacke. In the north-eastern part the more recent formations preponderate—the members of the Chalk, Jurassic, and Triassic period. Immense coal-deposits are found, capable not only of supplying the demands of the country, but also of yielding a considerable surplus for exportation if properly worked. Coal-formations are most extensive in Asturias, Leon, and Old Castile, but large coal-seams are also found at Belmez, Fuente-Ovejuna, and Cazalla in the central Sierra Morena, at Villanueva del Rio on the Guadalquivir, and at San Juan de las Abadesas in Catalonia. The Tertiary and Diluvial deposits have an immense extension, covering the largest part of the central plateau and the wide basins of the Ebro, the Guadalquivir, the middle course of the Guadiana, and the lower Tajo. They are rich in salt. Various kinds of porphyry and trachyte are very frequent, especially in the south-western part. From this composition of the crust the wealth of the ground in metals, ores, etc., may be surmised. The cinnabar-veins of Almaden and Almadenejos, which formerly produced the larger part of all the quicksilver consumed, are celebrated. Veins and whole masses of lead and iron ore are numerous, found partly in the granite, partly in the crystalline and Silurian slates. The copper-mines of Rio Tinto and the silver-veins of the Sierra Almagrera and Hienlelaencina are famous. Tin, zinc, antimony, nickel, cobalt, and graphite abound; salt is inexhaustible; natron, saltpetre, alum, sulphur, asphaltum, and petroleum occur; at Logrosan in Estremadura is an entire mountain of phosphorite. Gold is found in many rivers; precious stones, such as diamonds, rubies, garnets, turquoises, topazes, amethysts, etc., occur in several places; splendid marbles of various colors, jasper, and alabaster; excellent building-stone and chalk abound. The working of the mines and the production of metals are mostly in the hands of foreigners, especially Englishmen, and carried on with foreign capital. In 1874 metals were exported to the value of 252,000,000 reals, and other useful minerals to the value of 165,360,000 reals; and the consumption seems to be increasing of late years.

The fertility of the soil is generally very great, and agriculture is the principal occupation. Nevertheless, in 1875 only 60.6 per cent. of the soil was arable; the rest lay waste; 26–27 per cent. was under tillage, 2–3 in vineyards, 14 in pasturage, and 16.3 in forest. The annual average production of grain in Spain is 90,000,000 hectolitres. Of the cereals, wheat is most generally cultivated; rye principally in the N., rice in Valencia, barley and maize in most parts of the country. The grain production of Spain has increased very much in this century; in 1805 it was insufficient to supply the home demand, while in 1874 grain and flour were exported to the value of 128,344,000 reals. Among the leguminous and fodder-plants, the *Cicer arietinum* and beans are most important, and exported in considerable quantities. Vegetables and other garden-plants are more largely cultivated here than in any other country of Europe. Orchards are numerous and extensive. The olive, orange, fig, and other fruit trees are cultivated with great success. In 1874 the value of the exportation of oil amounted to 74,320,000 reals, of dried fruit to 132,912,000, of fresh fruit to 35,200,000. In the same year the value of the exportation of wine amounted to 561,204,000 reals. Cattle-breeding is an occupation of great importance. In 1865, Spain possessed 680,473 horses, among which were some excellent breeds; horse breeding, however, is declining, giving room for the breeding of mules and asses, which is highly developed. In the same year the country possessed 2,967,303 horned cattle, 22,468,969 sheep, and 4,531,228 goats. The various breeds of sheep are celebrated, and in goats Spain is richer than any other country of Europe, the herds roaming over immense tracts of land which could be cultivated, but which have lain waste since the expulsion of the Moors. Arboriculture is neglected, and the forests are much impaired; the country is nevertheless still very rich in timber. A peculiar item of exportation is cork, the value of which amounted to 43,023,000 reals in 1874. In general, however, the last Carlist war has injured the productiveness of the country very much, which is evident from a comparison between the exportation of 1874 and that of 1873. In the latter year the value of the exportation of oil amounted to 208,512,000 reals, of cork to 132,800,000, of fruits to 209,260,000, of grain and flour to 386,650,000, and of wine to 736,332,000.

Manufacturing industry is by no means so important as it ought to be in order to correspond to the immense natural resources of the country; in general, however, it is increasing, although in this respect, too, the late Carlist war has done great harm. Paper manufacturing, the spinning and weaving of cotton, the manufacture of leather and metal ware, especially iron goods, are the most prominent branches of Spanish industry, and are principally carried on in the provinces of Gerona, Barcelona, Tarragona, Guipuzcoa, and Vizcaya. The cigar and tobacco manufacture is a government monopoly; other trade limitations were abolished long ago. On account of its geographical position, Spain ought to have an immense commerce, and in the sixteenth and seventeenth centuries she was, indeed, the queen of the sea; but in the eighteenth century her commerce dwindled into insignificance, and a revival was not noticeable until after the end of the first Carlist war, in 1839. The following table shows the commercial movements between 1850 and 1865, computed in reals:

	Importation.	Exportation.
1850	671,993,110	488,664,682
1855	1,020,331,984	1,247,370,908
1860	1,183,313,498	1,098,213,115
1865	1,362,000,000	1,142,000,000

From 1866–70 the average annual value of exportations amounted to 309,700,000 pesetas (a peseta being equal to four reals), and that of importations to 153,200,000 pesetas; in 1871 it arose respectively to 142,400,000 and 569,000,000 pesetas, divided among the various countries in the following manner, reckoned in millions of pesetas:

	Importations from	Exportations to—
England	206.5	177.4
France	129.2	78.3
Portugal	15.1	20.9
Belgium	10.5	2.8
Sweden and Norway	17.2	2.2
Italy	8.2	2.2
Turkey	7.9	1.4
Russia	4.3	3.8
Germany	2.4	6.7
Denmark	1.4	2.0
Rest of Europe	6.8	3.7
Cuba and Porto Rico	43.5	73.5
United States	66.1	23.5
Argentine Republic	3.2	12.4
Brazil	8.5	5.2
Venezuela	8.4	1.3
Uruguay	.6	5.8
British colonies	4.8	1.7
Other countries	12.4	3.8

The relation between the various items of importation and exportation, reckoned in millions of pesetas, may be seen from the following table: the figures given for 1873 and 1874 do not comprise the territories occupied by the Carlists:

	Importation			Exportation		
	1871.	1873.	1874.	1871.	1873.	1874.
Cereals	19.6	.4	6.4	27.0	102.4	38.7
Fermented liquors	6.8	8.9	11.5	141.2	192.3	141.4
Colonial produce	41.6	45.0	41.4	7.6	8.4	4.9
Tobacco	16.8	?	?			
Seeds and fruits	...	...	...	51.4	55.9	45.8
Animal products and living animals	20.3	18.7	21.3	18.4	9.3	6.4
Coal	17.6	14.6	17.6			
Minerals	...	...	...	30.6	34.3	43.7
Raw metal	3.4	3.4	5.5	53.5	46.0	62.8
Hides and leather	13.8	14.5	21.6	4.0	?	?
Textile fibres	90.2	75.2	104.5	14.3	8.9	5.6
Hemp	...	...	...	7.9	6.1	10.6
Wool	11.4	14.9	23.5	.5	.8	.8
Glass	1.4	1.2	1.3			
Metal ware	12.0	12.1	18.2	1.4	.5	.2
Machines	36.2	30.8	18.7			
Shoes	...	...	...	5.0	?	?
Thread and network	37.2	24.7	29.3			
Woven fabrics and cordage	38.4	19.3	23.0	.9		
Furniture	1.8	1.4	1.4			
Cork	...	..	..	15.0	32.1	8.2
Paper and playing-cards	1.8	1.8	3.6	3.6	2.9	2.4
Drugs, dyestuffs, and chemicals	9.5	16.2	17.7			
Salt	...	...	...	8.2	8.6	9.9
Oils, fats, gums	11.0	10.8	15.5	16.6	55.6	21.5
Various	175.6	"	"	34.9	"	"
Total	569.0	313.8	382.0	412.2	554.2	403.0

A reform of the tariff, consisting principally in the abolishment of prohibitory or protective duties, was introduced by a law of July 12, 1869, and has proved very beneficial to commerce. The importations amounted in the period from 1865–68 to 8032 millions of reals, and in the period, 1870–73, to 8032 millions, showing an increase of 1198

millions. The exportations amounted in the first period to 4815 millions, in the second to 7493 millions, showing an increase of 2678 millions. The importation of coal comprised in the first period 1,342,333 metrical tons, in the second 1,876,145, showing an increase of 533,812 tons. The increase in the exportation of raw materials during the same period amounted—in steel to 50 per cent., in pig iron to 18 per cent., in cotton to 53 per cent. of the former consumption. The commercial fleet which during the first period consisted of 4362 sailing vessels and 152 steamers, with an aggregate tonnage of 390,700, increased during the period from 1870–74 in tonnage to 551,412; the number of steamers increased to 296, while that of sailing vessels decreased to 3540. The river navigation is much neglected. The Ebro is the only river which can be called navigable; it is accessible to flat-bottomed vessels as far as Saragossa. The Guadalquivir, Guadiana, and Minho can be navigated only near their mouths. Of the navigable canals, the Imperial Canal of Aragon, commenced by Charles V., and the Castilian Canal, are the most remarkable; the Manzanares and San Carlos canals are very little used: 5414 kilomètres of railway were in operation on Jan. 1, 1875. In 1871 the number of post-offices was 2347, of letters, 78,174,400; the length of telegraph lines was 11,754 kilomètres; the number of stations 193, of despatches, 9,916,912, of which 73,357 were received from foreign countries.

The general standard of mental culture is lower in Spain than in any other European country. Although there exist old and celebrated universities and schools, and although a systematic organization of public education and instruction, after the model of foreign countries, was adopted in the eighteenth century, the influence of the clergy has proved stronger than the instinct of progress. The system of public education consists of the *enseñanza superior*, comprising the universities of Barcelona, Granada, Madrid, Oviedo, Salamanca, Santiago, Seville, Valencia, Valladolid, and Saragossa; and the *segunda enseñanza*, comprising the so-called *institutos*, partly *locales*, partly *provinciales*, which latter fall into ten groups, corresponding to the ten universities, and containing each group from three to five schools. In these *institutos* geography, history, mathematics, natural science, and foreign languages are taught, and scientific collections are founded. The *primera enseñanza* was established by law of Sept. 9, 1857, but soon abolished: it was re-established by the revolution of Oct. 14, 1868, but much modified by decree of July 29, 1874. The revolution introduced liberty of teaching, both with respect to method and matter of instruction, but the decree of Feb. 28, 1875, revoked this liberty with respect to the universities and all schools supported by the state, and it hinted at a revocation also with respect to private schools. The primary education is not obligatory. The special schools of agriculture, commerce, art, etc., stand low, and the libraries founded at the universities and the episcopal sees, although in some respects rich and interesting, consist mostly of theological works, and contain very little serviceable to progress and development. The revolution of 1868 made literature and the press free, but many restraining and prohibitory ordinances afterward appeared, and they are applied with great arbitrariness. Some good works on geography and natural science have, however, lately been published, but any great influence from literature and the press cannot be expected, as seven eighths of the Spanish people are unable to read. Sanitary affairs are not so well regulated as in other European countries. Each province has a sanitary board which is under the sanitary council in Madrid. The large ports have their special sanitary boards. The benevolent institutions are truly grand, as might be expected from the generosity and nobleness of the Spanish character; they have, however, one great drawback: they encourage beggary and idleness. The Spanish beggar is not ashamed to ply his trade; on the contrary, he expects that the rich will compensate with their gifts for the inequality of fortune. About 500,000 paupers are taken care of in the public almshouses, and yet the streets and roads swarm with beggars. There are 7 general, 350 provincial, and about 700 municipal hospitals. The houses of punishment and correction consist of *presidios* for male and *casas de correccion* for female criminals. The treatment in these houses is more humane than in other European countries; the galleys have ceased to exist.

The government is a constitutional monarchy. The constitution dates from June 6, 1869, and places the legislative power in the hands of the Cortes, consisting of a congress elected for three years, and a senate elected for twelve. The principal points of the constitution are—responsibility of the ministers, consent of the Cortes to the budget, foreign alliances and treaties, personal freedom, universal suffrage, the liberty of the press, right of assembly, association, and petition, freedom of exercise of worship for all denominations, etc. But the people understand very imperfectly how to make use of their constitution, and since 1869 the government has cut off some of the most important parts of the constitution without making any great impression on the people. The municipal constitution dates from 1845: each community numbering at least 30 members has its own municipal council, presided over by an alcalde. The administration is carried on by the king and a responsible cabinet comprising the departments of war, foreign affairs, justice, navy, finances, interior, agriculture and commerce, and the colonies. Public instruction and the institute of geography and statistics belong to the ministry of agriculture and commerce.

Finances.—The debt of Spain amounted to 40,481,110,882 reals, with an interest of 1,023,122,804, on June 30, 1874, to which on Oct. 1, 1875, a floating debt of 519,000,000 pesetas was added. But on Dec. 31, 1871, the debt amounted only to 29,734,586,152 reals, with an interest of 810,211,213. The budget of the financial year 1874–75 showed the following figures, reckoning in pesetas: *Receipts*—(1) Direct taxes, 151,184,565, among which was the land-tax, 100,768,781. (2) Indirect taxes, 110,826,986, among which were customs duties, 66,892,821; excise, 29,871,685. (3) Stamp-tax and monopolies, 132,710,872, among which tobacco paid 62,865,571, lotteries, 41,145,107. (4) Domains, 57,912,771. (5) Surplus from the Philippines, 2,962,902. (6) War indemnity from Morocco, 1,756,275. (7) Arrears, 23,819,580. (8) Liberation from military service, 63,620,800. (9) Funds from 1873–74, 64,746,390. Total, 609,541,141 pesetas. *Expenses.*—Royal appanage (five months), 2,996,667; presidency of the executive (seven months), 327,592; legislation, 796,704; public debt, 48,898,851; justice, 1,032,920; pensions, 31,503,049; presidency of the cabinet council, 818,318; ministry of state, 3,066,518; ministry of justice and civil administration, 8,059,496; church administration, 14,188,775; ministry of war, 245,731,957; of the navy, 32,811,776; of the interior, 19,291,575; of agriculture and commerce, 36,267,343; of finances, 64,744,401; arrears from 1873–74, 94,589,626. Total, 605,125,569.

The army has undergone numerous changes with respect to its organization during late years. A law of Sept. 27, 1872, made military service a universal duty, and fixed the term to three years in the army and four in the reserve, but on Feb. 17, 1873, this law was abolished, and it was determined to form the army of volunteers. In 1875 the army consisted of 40 regiments of infantry, 20 regiments of cavalry, 4 regiments of foot artillery, 5 regiments of field artillery (mounted), 3 regiments of mountain artillery, and 3 regiments of engineers. The number of soldiers was 91,400 in peace and 216,000 in war. In Cuba were stationed 23 battalions of infantry and 2 regiments of militia (colored), 3 regiments of mounted chasseurs, 1 foot, 1 field, and 1 mountain artillery regiment, and 4 regiments of militia cavalry; in Porto Rico, 4 regiments of infantry, 7 regiments of militia, and 2 squadrons of cavalry; in the Philippines, 7 regiments of infantry. The fleet contained—vessels of the first class, 6 iron-clads, with 105 guns and 3900 horse-power; 10 screw frigates, with 413 guns and 5380 horse-power; 2 wheel-steamers, with 32 guns and 1000 horse-power; of vessels of the second class, 10 wheel-steamers, with 48 guns and 3130 horse-power; 10 screw-steamers, with 47 guns and 1920 horse-power; 2 transport-vessels of 600 horse-power; of vessels of the third class, 16 screw-steamers, with 39 guns and 1660 horse-power; 35 gunboats, with 35 guns and 1400 horse-power; 7 wheel-steamers, with 13 guns and 867 horse-power; 4 screw-steamers, with 530 horse-power; besides 2 steamers, with 4 guns and 310 horse-power, and 19 *fuerzas sutiles*, with 19 guns and 464 horse-power; total, 113 steamers, with 755 guns and 21,161 horse-power; 20 admirals, 378 officers, 25 cadets, 14,000 marines, and 550 marine infantry.

The colonies of Spain formed in the fifteenth and sixteenth centuries a vast possession, the greater part of which, however, has been lost by bad policy. All European states have endeavored to hold their colonies not through interest, but by force, and have sought to make them as profitable as possible. But Spain has sinned worst in this respect; only under Charles III. were the colonies properly treated. It still holds Cuba, area 118,833 q. k., pop. 1,400,000; Porto Rico, area 9334 q. k., pop. 625,000; the Philippines, area 170,600 q. k., pop. about 6,000,000; the Carolines, area 1384 q. k., pop. 18,800; the Palaos, area 897 q. k., pop. about 10,000; the Marianes, area, 1079 q. k., pop. 5610; Guinea, area 2204 q. k., pop. 35,000; total area 304,311 q. k., pop. 8,094,410. The most important colony is Cuba. In 1873 it exported 714,960 tons of sugar and 189,333 tons of molasses; in 1874, 644,109 tons of sugar and 175,228 tons of molasses. In 1873, Havana exported 1412 tierces (80 gallons each) of honey, 19,574 barrels (125 gallons) of rum, 11,554 arrobas (25 pounds) of wax, 13,387,652 pounds of tobacco, and 224,765,000 cigars; 2104 vessels, of 921,632

tons burden, visited its harbor—944 North American, 731 Spanish, 306 English.

History.—The peninsula, so favorably situated for commerce, was inhabited by Celtic and Iberian tribes when in olden times the shrewd and versatile Phenicians reached it and founded colonies along its coasts. They were followed by the Greeks, and then by the Carthaginians. The latter made the country the principal support of their empire and the basis of their wars with Rome. But the Romans attacked Carthage in Hispania; Hannibal and Publius Cornelius Scipio became the leading names of an important historical epoch; and finally the Romans succeeded in driving their adversaries out of the country in the second century before Christ. At the beginning of our era the peninsula was a Roman province, and one of the most flourishing of the whole empire. The emperors Trajan, Hadrian, Antoninus, Marcus Aurelius, and Theodosius, and the authors Seneca, Lucanus, Martial, Flavius, and Quintilian were born here. Christianity was early introduced. The northern races which finally overthrew the decaying Roman empire invaded also the Peninsula, and caused a thorough revolution in its affairs. First, the Vandals and Sueves conquered the country in the beginning of the fifth century, and confined the Roman dominion to the eastern part. Then, toward the end of the century, the Visigoths, who originally were allies of the Romans, expelled both the Romans and the Germanic tribes, and made themselves masters of the whole country; Toledo was the residence of their kings. The Visigoths, like the Sueves, were Arians, and their religious confession involved them in a war with the orthodox Franks, who considered them heretics. The war for the independence of the state was also a religious war, and this circumstance laid the first foundation of the subsequent power of the clergy. The Visigothic king, Recared, was converted to the Latin orthodox creed in 588, and his successors continued true to their orthodoxy, but the prestige which the Arian clergy had enjoyed was now simply conferred on the orthodox clergy, and in the seventh century the ecclesiastical synods became parliaments, the bishops the chief judicial authorities. In 711 the Arabs invaded the Peninsula from Africa, defeated the Visigoths under King Roderick at Xeres de la Frontera, and conquered the country in three years, with the exception of the northern mountain-regions. In this impracticable terrain, where in recent times the Carlist army formed its strongholds, the Visigoths took a stand, and from hence they commenced the reconquest of the lost country: Don Pelayo was their hero. The Arabs made Spain a province of the caliphate of Bagdad, and crossed the Pyrenees in order to conquer France; but here they were defeated at Poitiers in 732 by Charles Martel. In Spain the Christians still held Asturias, Biscay, Aragon, Navarre, and Galicia, but the rest of the country became a Mohammedan dominion, and Cordova was made the capital of a separate caliphate, founded in 756 by Abderrahman, the last of the Ommyiade dynasty. The war between the Spanish Christians and the Arab Mohammedans lasted for 800 years. It was a war at once for fatherland and for religion. The Arabs founded a flourishing empire, which became the starting-point for all Europe of the arts and sciences. Their schools were frequented by Christians, and they treated the Jews and Christians who lived under their dominion with generosity. On the other hand, the Christians, led by their priests, shut up among wild and arid mountains, deprived of all the luxuries of civilization, poor and ignorant, waged the war with an ineradicable fanaticism. In the middle of the ninth century they reached the line of the Duero; toward the end of the eleventh century, that of the Tajo; in 1085 they reconquered their old capital, Toledo; the Cid was the hero of that century. At the beginning of the twelfth century the Christians occupied one-half of the country—Leon, Castile, Aragon, and Navarre, each of which formed an independent kingdom. Soon, however, Castile and Aragon assumed a prominent position, increasing both by uniting other Christian countries and by conquering Mohammedan territories. Castile acquired Leon in the beginning of the thirteenth century, and conquered Murcia, Estremadura, Cordova, Seville, and Cadiz. Aragon acquired Catalonia and Valencia, and conquered the Balearic Isles, Sardinia, Sicily, and even Naples. At last a union of the two kingdoms took place in 1469 by the marriage between Ferdinand V. the Catholic, king of Aragon (1479-1516), and Isabella, queen of Castile, though each of them continued to rule independently in their respective kingdoms. Meanwhile, the war was carried on with success against the Arabs. After their defeat at Tolosa, in the Sierra Morena, in 1212, they had only Cordova and Granada left, and in 1492 they lost their last possession, Granada, to Ferdinand and Isabella, and became a subjugated race, whose complete extirpation was effected by degrees. The government of Ferdinand and Isabella corresponded with the traditions of their respective houses. Led by their shrewd minister, Cardinal Ximenes, they thought to strengthen the royal power by making the Church the foundation of the throne. They supported the Hermandad and the Inquisition, and they endeavored to curb the nobility. They became grand masters of the three knightly orders instituted at the end of the eleventh century—Alcantara, Santiago de Compostela, and Calatrava—and centralized the judicial authority in the crown. That they, nevertheless, were only tools in the hands of the clergy is apparent from the exclusively religious tendency of their policy; immediately after the conquest of Granada, they began to convert and expel the Moors and the Jews. This policy, which was pursued also by the great successors of Ferdinand and Isabella, made Spain mighty, but only for a moment: then it ruined her. A marked invigoration of the state was the first and immediate consequence of the intimate coalition between kingdom and priesthood. The whole people clung with reverence and enthusiasm to these leaders of its destinies, and in their hands religion became a powerful instrument for the subjugation of other peoples and the propagation of the Roman Catholic Church. But as all scientific research was cut off and all independence of character weighed down, the sources of vitality soon became dried up in the people, and it succumbed the moment weak kings happened to be placed at its head. Even the discovery of America, which added so great a splendor to the name of Spain, so vast an extension to her dominion, such immense treasures of precious metals to her wealth, contributed finally to enfeeble the country through the same false policy. It is true that a similar policy, subservient to the purposes of the Church, was followed generally throughout Europe at that time, and Cardinal Richelieu was really the first statesman who entered on another course; but the theological tendency was much more strongly marked and retained for a much longer time in Spain than in any other country. All the children of Ferdinand and Isabella died early, with the exception of one daughter, Joanna, who married the archduke Philip, a son of Maximilian I., emperor of Germany, and succeeded her mother on the throne of Castile in 1504. Philip died young, and Joanna became insane. The states of Castile then appointed King Ferdinand, Joanna's father, guardian of his grandson Charles, who was declared heir of Aragon and Castile; and he governed both kingdoms till 1516; at his death he appointed his minister, Cardinal Ximenes, regent during the minority of King Charles. The young king, who was born in 1500, assumed the reins himself in 1517, and united to Spain the Netherlands and Franche-Comté, which he had inherited from his father, Philip. At the death of his grandfather Maximilian in 1519, he was also elected emperor of Germany. During his long reign of forty years Spain reached the culmination of its prosperity. Vast conquests were made in America, and in Europe the Spanish armies defeated France, the Protestant princes of Germany, and the Turks. But liberty of any description was not tolerated. An insurrection in Castile, headed by Juan de Padilla, was suppressed with great bloodshed; the Spanish cities were stripped of their old rights; heretics were vehemently persecuted; in the Netherlands alone 100,000 persons lost their lives on account of their creed. In 1556, Philip II. succeeded his father as king of Spain, but the decline of the mighty empire had already begun. Philip wished to rule over all Europe in order to propagate the true faith everywhere; and it was a saying of his that it was better not to rule at all than to rule over heretics. On this point he possessed the full sympathy of the Spanish people, and he actually succeeded in extirpating heresy in Spain, though outside of Spain he suffered several severe defeats. He united Portugal to Spain, but only for a short time; in 1581 he lost the Netherlands, and his contest with England and the Barbary states was unfortunate. From the Spanish possessions in America, which under Philip II. comprised Mexico, Central America, Venezuela, New Granada, Peru, Chili, and the islands of Cuba, Santo Domingo, Jamaica, and others, immense riches flowed into the country. But they were no blessing; they seduced the people into neglect of productive labor. To the ambitious no other career was open than the ecclesiastical or the military. All the great Spanish poets and authors—Cervantes, Calderon, Lope de Vega, Moreto, Montalvan, Sandoval, Argote de Molino, Acuña, Boscan, Hurtado de Mendoza, Pulgar, Solis, Tarrega, Miñana, and others—were either priests or soldiers, often both. The literature of that time is pervaded by a glowing enthusiasm for religion and an unconditional reverence for the king. In 1599, Philip II. died, and this sombre, despotic, but energetic man was succeeded by Philip III., a weak and unsettled character. Under him the decline of the kingdom became singularly rapid. The minister, Count Lerma, was the actual ruler, and he en

tered into a close alliance with the Church in order to secure his own position. The greatest error committed by his government was the cruel expulsion of the Moriscoes in 1609. The measure originated with the clergy. The archbishop of Valencia, Juan de Ribera, the archbishop of Toledo, Bernardo de Rojas y Sandoval, and the Dominican monk, Bleda, demanded that all the Moriscoes should be killed. The government contented itself with their expulsion, by which, however, several hundred thousand lost their lives. More than 1,000,000 of the most industrious inhabitants were thus lost to the country, and the sad consequences soon became apparent. The cultivation of rice, cotton, and sugar, the manufacture of silk and paper, were almost entirely in the hands of the Moriscoes, and these branches of industry were thus almost completely destroyed. Large tracts of land became waste, and have remained so since, the lurking places of gangs of robbers. All scientific research became, of course, stifled in such an atmosphere of fanaticism. But the clergy grew luxuriantly; they actually suppressed the other estates. When Philip III. died, there were 9000 monasteries in Spain, besides nunneries; the Dominican and Franciscan orders alone numbered more than 30,000 members; in the diocese of Seville there were 14,000 chaplains, 18,000 in that of Calahorra; and so all the country through. Laymen were daily plundered in order to enrich clergymen. In 1621, Philip IV. ascended the throne, but he too was incapable. He was entirely under the control of the clergy and his minister, the duke of Olivarez, and the country sank deeper and deeper. Insurrection broke out in Catalonia, Andalusia, and Naples, and long civil wars ensued. Portugal separated from Spain in 1640; by the Peace of Münster (1648) Philip was compelled to acknowledge the independence of the Netherlands, and by the Peace of the Pyrenees (1659) to cede Spanish territory to France; buccaneers deprived Spain of some of her American colonies, Dutchmen and Englishmen of others. His son, Charles II. (1668-1700), was still more miserable, ruined both bodily and mentally. He lost Franche-Comté to France and brought the finances into utter confusion. The decay of the country was nearly complete. From 1668 to 1700 its population decreased from 11,000,000 to 8,000,000; in many cities two-thirds of the houses lay in ruins and whole villages stood deserted. The population of Madrid decreased from 400,000 to 200,000 during this century, and under the reign of Charles II. it was exposed to a severe famine. The army, once so celebrated, was now worth nothing; it had neither able leaders nor reliable soldiers; the arsenals and magazines were empty; the fleets rotted in the docks; the art of building ships was forgotten; of sea-charts there were none, and the Spanish pilots were notorious for their ignorance. The poverty was so great that even the royal servants could not be paid, and sometimes they had nothing to eat. In 1693 the payment of all pensions was suspended, and one-third was deducted from the salaries of all officials, even from those of the ministers of the crown. A change for the better took place when at the death of Charles II., the last king of the house of Hapsburg, the Bourbon dynasty ascended the throne of Spain and opened the way into the country for French intelligence. Charles, who was childless, appointed Philip of Anjou, the grandson of Louis XIV., his successor, and he succeeded him as Philip IV. Louis XIV. said to him, when he left Versailles, that he was never to forget that he was a Frenchman; and, indeed, he remembered it so well that he gave all state affairs into the hands of Frenchmen, disregarded any advice which came from the Spanish side, and received his policy drawn up for him at Versailles. Foreigners now decided all the most important affairs of the country, and although this was certainly very humiliating to Spain, it was nevertheless to her advantage. A few months after the accession of Philip (Apr. 14, 1701), the French financier Orry was called to Spain to bring order out of the confusion of her finances; he also took charge of the ministry of war, and the leadership of the Spanish army was confided to foreigners throughout the whole Succession war, which broke out at the same time. This war was waged by Austria, England, and Holland for the purpose of placing the Austrian archduke Charles on the Spanish throne instead of Philip; the real aim, however, was to check the power of France, and Louis XIV. was compelled to take up the contest. The allied French-Spanish army was repeatedly defeated in 1701 and 1702. In the latter year the king himself took the command in Italy, with the duke de Vendôme as chief of his staff, and at Vittoria (July 26) and Luzzara (Aug. 15, 1702) he fought with success, but at the same time Spain was humiliated at sea. The allied Dutch-English fleet attacked the French-Spanish fleet in the Bay of Vigo, defeated and destroyed it, and captured an immense booty of gold and silver. The war lasted till 1713, and was partly carried on in Spain, as Portugal joined the enemy and Catalonia rose in revolt against Philip. The English and Portuguese conquered Barcelona and Valencia, and even entered Madrid, and the English admiral Rook took Gibraltar. At Almansa the Spanish army, led by the duke of Berwick, an Englishman, defeated the invaders Apr. 25, 1707, and the party of Charles succumbed for a time; but the victories of Marlborough and Eugene over the French again opened the way to Madrid for the enemy. Then the duke of Vendôme was appointed commander-in-chief of the Spanish army, and he succeeded in replacing Philip on the Spanish throne, though by the Peace of Utrecht (1713) Spain was compelled to cede Naples, Sardinia, Milan, and its possessions in the Netherlands to Austria, Sicily to Savoy, and Gibraltar to England; thus the Spanish crown could not even keep its native soil intact. Aided by the Italian Alberoni and the Dutch Ripperda, Philip introduced many reforms after the termination of the war, and encouraged commerce, industry, and art; but he deprived the provinces of their old liberties, and only Biscay and Navarre retained theirs. In 1714 he married a second time, and the new queen, Elizabeth of Parma, was a spirited lady who exercised a good influence on the government. Philip d. in 1746. His son and successor, Ferdinand VI., was a weak-minded person, and could not carry out the reforms begun; on the contrary, many old abuses were revived. He d. in 1759, and was succeeded by his brother, Charles III. With him began an era of progress. The most important men of his government were—Wall, an Irishman, born in France; Grimaldi, a Genoese; and Esquilache, a Sicilian. It was the aim of these truly enlightened men to check the influence of the Church, and especially of the Inquisition; and during the whole reign of Charles III. the Inquisition succeeded in burning only three persons. In 1767 the Jesuits were expelled. Much was done to encourage agriculture, commerce, and industry; foreigners were invited to Spain, and whole colonies were planted in the Sierra Morena; peace was concluded with the African robber-states, and thus a perpetual waste of money and men was stopped, while the Spanish commerce on the Mediterranean rose immensely. However beneficial were the reforms of Charles III., they were, nevertheless, disapproved by the people, and after his death everything retrograded. He had raised Spain from a power of the third to a power of the first rank, but under his son and successor it sank down and became a vassal of France; the reforms did not endure, for they had not sprung from the people. When Charles IV. ascended the throne in 1788, he dismissed his father's councillors, among whom were Aranda and Florida Blanca, and gave himself up to the influence of his favorite, Godoy, duke of Alcudia. He took part in the wars against the French republic, but was compelled to cede to France the colony of Hayti by the Peace of Bâle (July 22, 1795). Godoy, who from the negotiations of this treaty received the title of the "Prince of Peace," now concluded at San Ildefonso (Aug. 19, 1796) an offensive and defensive alliance with France, the principal effect of which was that Napoleon became able to use Spanish soldiers and vessels in his wars. By the Peace of Amiens (1802) Spain lost Trinidad, which was ceded to England; in 1805 her fleet was entirely destroyed by the English at Trafalgar; her troops were sent by Napoleon to Tuscany and Denmark. Spanish Louisiana was ceded to France, and large sums of money were delivered over to the French treasury as tribute. At last the division of Portugal was agreed upon by the convention of Fontainebleau (Oct. 27, 1807), and French troops entered Spain. This called forth the crisis. On Mar. 18, 1808, a revolution broke out which placed on the throne, instead of Charles IV., the prince of Asturias, the leader of the opposition to Godoy, under the name of Ferdinand VII. Both he and Charles asked for help from Napoleon, and the two kings were invited to meet the emperor at Bayonne in April. The result of this meeting was that they both abdicated; Charles was ordered to take up his residence at Compiègne, Ferdinand at Valençay, and on June 5, 1808, Napoleon appointed his brother, Joseph Bonaparte, king of Spain. An assembly of Spanish and American deputies was convoked at Madrid, and opened June 15. On July 7 the new constitution, cut after the French fashion, was ready and published, and on July 20, King Joseph entered Madrid. Provoked by these outrages, the Spanish people rose; *juntas* were formed which declared themselves for Ferdinand VII., and organized an armed resistance to the French and their partisans, first in Asturias, and then in all the other provinces. Gen. Dupont with 6000 men was surrounded at Baylen July 20, and compelled to capitulate; Saragossa was successfully defended; and King Joseph fled in haste from Madrid. Then Napoleon himself went to Spain with a strong army, defeated the Spaniards at Medina del Rio Secco, Gamoral, Espinosa, and Tudela, and carried Joseph back to Madrid (Dec. 1,

1808). But the war did not terminate thus; the Spaniards showed an unexpected stubbornness and valor, and the protracted contest with them proved an important agency in the final overthrow of the Napoleonic power. In regular battles, such as those at Corunna (Jan. 16) and at Medellin (May 28, 1809), the French were victorious; but a perpetual guerilla warfare was going on, and in the mean time the English established an army in Portugal under Wellington, and came to the aid of the Spaniards. The war lasted four years. In 1809, Napoleon went away to take the command in the campaign against Austria, and left it to his marshals to carry on the war in Spain. Wellington conquered at Talavera (July 27 and 28, 1809), but was nevertheless compelled to retreat into Portugal; the French subdued Andalusia, and (Feb. 1, 1810) King Joseph entered Seville, the seat of the central *junta*, which now removed to Cadiz. The siege of Cadiz and Marshal Massena's campaign against Wellington remained without effect; but the French took Valencia. Meanwhile, the central junta deposited its authority in the hands of a regency, which convoked the Cortes to Cadiz for the purpose of forming a new constitution. This constitution was finished Mar. 18, 1812. Soon after (July 22), Wellington defeated Marshal Marmont at Salamanca, and King Joseph fled from Madrid Aug. 11. Once more, however, the French were victorious, and drove Wellington back into Portugal, but the disaster of Napoleon in Russia completely changed the situation. One part of the French army, under Marshal Soult, was recalled, and the rest, under King Joseph, was defeated at Vittoria by Wellington June 11, 1813, and returned to France, across the Pyrenees. Marshal Soult was again sent to Spain, and the contest was continued for several months in the Pyrenees, but the advantage was on the side of the Spaniards and Englishmen, and in Nov., 1813, the French were completely expelled from Spain, while Wellington invaded France. Napoleon now gave up Spain by the Treaty of Valençay (Dec. 11, 1813); Ferdinand VII. was restored to liberty, and invited by the Cortes to take possession of the Spanish throne. He came, but he began his government by overthrowing the liberal constitution of 1812 and persecuting the men who had helped him to the throne; but this infamous conduct was approved by the large mass of the people, who still lived in the darkness of the Middle Ages, and by no means shared the liberal views of their former leaders. Thousands of the best men were driven into exile; the Inquisition was restored, and the most miserable priestcraft, in connection with court intrigues, ruled the country. By the treaty of Feb. 22, 1819, the two Floridas were sold to the U.S. for $5,000,000, while, on the other hand, very expensive but utterly ineffective armaments were sent against the revolting colonies. This last measure called forth a military insurrection. On Jan. 1, 1820, four battalions under Lieut.-Col. Riego proclaimed the constitution of 1812; very soon an insurrectionary army of 10,000 men was formed, and the movement grew so rapidly that Ferdinand became frightened, conceded all demands, and made oath on the constitution Mar. 9, 1820. On July 9 the first general Cortes assembled. But the liberal innovations which Ferdinand now introduced, though against his will—amnesty, the abolition of the Inquisition, the taxation of the clergy, etc.—roused that part of the people which was wholly under the influence of the priests, and an "apostolic junta" was formed with the purpose of re-establishing the absolute monarchy with all its monkish institutions. The nation was split into two parties—the one liberal, which conducted the government and controlled the king; and the other clerical, which intended to liberate the king. The clergy numbered at that time 150,000 men, besides nuns, and possessed property to the value of about 180,750 million reals. In the beginning of 1821 civil war broke out, but in Nov., 1822, the troops of the government gained a decisive victory over the army of the "faithful." Averse to any extension of liberal ideas, France, Austria, Prussia, and Russia then determined to make an armed intervention, and in Apr., 1823, 100,000 Frenchmen, under the command of the duke of Angoulême, invaded Spain, united with the 30,000 soldiers of the faithful, and pushed forward against the army of the government. The generals Ballesteros, Mina, O'Donnell, and Morillo were defeated and compelled to retreat, and on May 24 the French entered Madrid, while the Cortes with the king removed to Seville and attempted to organize a guerilla war. The people, however, were against the government on account of its liberal measures; no guerilla war took place except in Catalonia under Mina, and on June 18 the Cortes was compelled to flee to Cadiz, carrying the king along with them. Cadiz was surrounded by the absolutists and compelled to capitulate; all troops in the field were defeated and dispersed; the king was liberated; the Cortes was dissolved, and when the French occupied Cadiz (Oct. 4, 1823) the king issued a proclamation by which he abolished all laws enacted between Mar. 7, 1820, and Oct. 1, 1823. A horrible reaction set in; the Inquisition was restored; the Jesuits obtained the greatest influence; and the liberals were persecuted in every possible manner. French troops remained in the country for the maintenance of peace and order. But in spite of this terrorism, which even went so far that men were put to death because they were Freemasons, the apostolic junta found the proceedings of the government too lenient, and began intriguing in order to place Don Carlos on the throne, the brother of Ferdinand, whom they considered thoroughly clerical. Thus originated a protracted civil war. Between 1825 and 1828 several scattered risings took place, especially in Catalonia and Aragon, but they were suppressed. Meanwhile, the state of the finances grew worse and worse. In 1828 the public debt amounted to 6000 million reals, and the country was in so miserable a state that the bey of Tunis unpunished plundered its coasts because the tribute due to him was not paid. In 1827 the French left the country. In 1830 the Carlist movement received a new impulse from the alteration of the law of succession. Dec. 10, 1829, Ferdinand VII. married the princess Maria Christina of Naples, and she persuaded him to abolish (Mar. 29, 1830) the Salic law, valid in the house of Bourbon, according to which females were excluded from succession. Sept. 29, 1833, Ferdinand died, and Maria Christina now grasped the reins of the government in the name of her daughter, Queen Isabella (b. Oct. 10, 1830). Don Carlos immediately protested, and laid claims to the throne in accordance with the Salic law, which he declared had been illegally abrogated by Ferdinand. Thus the country became once more divided, this time between Carlists and Christinos, and as the Carlists inscribed absolutism and religion on their colors, Maria Christina was compelled to espouse liberalism. Under able leaders, such as Zumalacarreguy, Javala, and Merino, the Carlist insurrection in the northern provinces soon assumed a dangerous aspect; and in order to gain the support of the liberals the queen was compelled to give the country a new constitution (Apr. 15, 1834). Apr. 22 she formed an alliance with England, France, and Portugal for the defence of constitutionalism against the Carlists. The Inquisition was abolished, the Jesuits were expelled, and when in 1835 the Carlists gained some military success over the Christinos, English, French, and Portuguese troops came to the aid of the queen. Meanwhile, it became more and more apparent that the ideas of the French revolution had penetrated into Spain and spread rapidly. The peasants lived still with the ideas of the Middle Ages, but the educated classes wanted progress, and as soon as Maria Christina was compelled to lean upon the liberals the dam which stemmed the flood of progress was broken through, and many of the larger cities came forward with reform demands far beyond that which the queen was willing to give. At first she resisted, but by degrees she yielded. The cabinet of Mendizabal (Sept., 1835) was a great concession, Mendizabal being an *exaltado*; and when he was replaced by Isturiz, a *moderado* (May, 1836), insurrections broke out in Cadiz, Seville, Xeres, Cordova, and Saragossa, the constitution of 1812 was proclaimed, the troops of San Ildefonso revolted, Sergeant Garcia penetrated into the sleeping room of the queen (Aug. 12, 1836) and compelled her to issue an order that the army should make oath on the constitution of 1812. The next day Calatrava was placed at the head of the government, and on June 18, 1837, the queen made oath on a new, improved liberal constitution. Meanwhile, the Carlists advanced victoriously, defeated Gen. Cordova, and crossed the Ebro in the spring of 1837. This advance, however, proved fatal. Dissensions broke out in the camp of Don Carlos, and Espartero, commander-in-chief of the army of the Christinos, understood how to avail himself of these dissensions; Aug. 31, 1839, he concluded a convention with Maroto, the Carlist commander-in-chief, according to which most of the Carlists laid down their arms and went home. Don Carlos gave up his cause and fled; and in the summer of 1840 the war was completely ended. Freed from her enemy, the queen regent now believed that she could give up her liberal policy. The constitution was not abolished, but it existed only on paper, and the reaction gained more and more ground. New insurrections broke out, and the country presented the picture of a perpetual party struggle, without any results. The cabinets changed rapidly, and the Cortes was several times dissolved. In Oct., 1840, the queen regent abdicated, and the Cortes elected Espartero regent May 8, 1841. His policy was principally directed to the material weal of the country—the building of roads, the improvement of mining, the development of commerce, etc. but he too found vehement adversaries, and he had to struggle against various military conspiracies formed by the queen-regent, who lived in France. To such a revolt, headed by Concha, he was compelled to yield July 26, 1842;

he went to England. After bloody contests between the *exaltados* and republicans on the one side, and the Christinos on the other, the Cortes declared the young queen, Isabella, of age Nov. 8, 1843. First Olozaga, then Bravo, was placed at the head of the government. The latter recalled Maria Christina, with whom a new epoch of reaction set in, but was afterward replaced by Gen. Narvaez, who introduced a severe military rule. Oct. 10, 1846, the two daughters of Maria Christina were married—Queen Isabella to the infant Francis of Assisi, and her younger sister, Louisa, to the duke of Montpensier. Queen Isabella began immediately after her marriage to emancipate herself from her mother's influence: with her husband she lived in open hostility; her whims and her favorites ruled her policy. One cabinet followed the other—Serrano, Narvaez, Bravo, Murillo, etc. —in rapid succession, each professing an entirely different policy from the others, and the whole political life of the country seemed to dissolve into a struggle between merely personal interests. In 1850 a difficult question arose with respect to Cuba. Several expeditions whose object was to wrest the island from Spain went out from the U. S. in spite of the prohibitory measures of the government. Their commander, Lopez, was garroted at Havana Sept. 1, 1851, but the relations between Spain and the U. S. remained cold for a long time. In June, 1854, the prevailing unsteadiness of the internal affairs of the country developed into open revolt. Gen. O'Donnell, at the head of a number of insurrectionary troops, made a *pronunciamiento*, and demanded the expulsion of Maria Christina and the introduction of the constitution of 1837. The movement assumed great dimensions; Isabella recalled Espartero, and he sent Maria Christina across the frontier with an escort. But the country found no rest—Narvaez, O'Donnell, Serrano, Miraflores, Arrazola, Mon, etc., cabinet after cabinet, *pronunciamiento* after *pronunciamiento*, everybody on the verge of revolt. On July 7, 1868, the duke of Montpensier, Serrano, and other influential men were either banished or imprisoned; Prim had been previously exiled on account of revolt. This led to the overthrow of the royal government. The parties of the liberal union, the progressists and the democrats, united; Admiral Topete received Prim on board his ship in the harbor of Cadiz Sept. 17, 1868, and the colors of revolution were unfurled. The banished generals returned to Spain, advanced with an army upon Madrid, and defeated Gen. Novaliches at Alcolea Sept. 28. On Sept. 30, Isabella left Spain and went to France. In Madrid a provisional government was instituted under Serrano, and the policy of the country was suddenly turned in the direction of the most advanced progress. The order of the Jesuits was dissolved and its property confiscated; the liberty of the press was established, and on Mar. 30, 1869, a draft of a new constitution was laid before the Cortes. It was accepted, and the new constitution, a monarchy with responsible ministers, etc., was proclaimed June 6, 1869; on June 18, Serrano, duke de la Torre, was elected regent. This change was of course received with great discontent by the clergy and its party, and a Carlist insurrection took place, which, however, at first seemed rather feeble; a grandson of Don Carlos, who after the resignation of his father, John, called himself King Carlos, appeared as a pretender to the throne. At the same time the Cuban question arose once more, and in a dangerous manner. The barbarous treatment to which the Spanish government had subjected the island occasioned an insurrection in the autumn of 1868; and as this insurrection found sympathy both in the U. S. and in the South American republics, it developed into a war which demanded a large military force to be sent to the island, and gnawed at the vital power of Spain like a gangrene. At home the most important problem to the leaders of the people seemed to be the election of a king. Finally, on Nov. 16, 1870, after many fruitless negotiations, Prince Amadeus of Savoy was elected king by the Cortes; and on Dec. 30 he arrived in Spain. The same day Gen. Prim, who had prepared the way to the throne for him, died from the wound an assassin had given him three days before. The reign of Amadeus was not successful, and on Feb. 11, 1873, he abdicated and left the country. By his withdrawal all bands of social order were loosened, and the Carlist insurrection, which still raged in the northern mountains, spread to the S. On July 15, 1873, Don Carlos himself arrived and took the command. To suppress this insurrection, which was supported by the deposed Italian princes and by the clerical party in France, Germany, and Austria, was the principal task of Serrano's government, but fortune seemed to declare in favor of the Carlists. At the end of 1874 a change took place, however. On Dec. 29, Gen. Martinez Campos proclaimed Prince Alfonso, son of Isabella, king. On Jan. 9, 1875, he landed at Barcelona and took command of the army. His first movements against the Carlists were not successful; he was defeated at Lacar Mar. 9, 1875. Nevertheless, he gradually succeeded in consolidating his position, in winning over to his side the various parties, and harmonizing the different interests. In the spring of 1876 he was able to attack Don Carlos with a superior force, and the insurrection was finally quelled. AUGUST NIEMANN.

Spain, Language and Literature of. See SPANISH LANGUAGE AND LITERATURE, by PROF. SCHELE DE VERE.

Spain's, tp., Lauderdale co., Ala. P. 296.

Spain, Wines of. See WINE.

Spalacopod'idæ [from *Spalacopus*—Gr. σπάλαξ, "mole," and πούς, "foot"—one of the genera], a family of mammals (order Rodentia, sub-order Simplicidentati) including rat-like and porcupine-like forms, many of which have spiny hairs. They have large anteorbital foramina, through each of which a portion of the masseter muscle, as well as infraorbital nerve, passes: there are four (or three) molar teeth in each jaw on each side, and their crowns have re-entering folds of enamel of varying extent; the alveolar portions of the maxillary lines are normally developed (having no connection with the squamosals); the clavicles are fully developed; the fibula and tibia separate from each other; the claws of the feet curved and moderately acute; the hairs are generally more or less rigid, and in some developed as true spines. This family is distinguished from the Hystricidæ especially by the complete development of the clavicles. It is manifested under a number of generic types, which have been grouped into four sub-families, diagnoscible by the presence or absence of roots to the molar teeth and osteological peculiarities. These are (1) Spalacopodinæ or Octodontinæ, (2) Echimyinæ, (3) Cercolabinæ, and (4) Ctenodactylinæ. Of the 21 recognized generic forms, 17 are peculiar to South America and 4 (Ctenodactylinæ, Petrodromus, and Aulacodes) to Africa. The typical porcupines of America (*Erethizon*, *Cercolabes*, and *Chætomys*) constitute the sub-family Cercolabinæ. THEODORE GILL.

Spala'to, or **Spala'tro,** town of Austria, province of Dalmatia, on a peninsula jutting out into the Adriatic, has a good harbor, is defended by a citadel, and carries on an active trade in grain, cattle, horses, swine, fruits, wine, and rosoglio, besides an extensive transit-trade between Italy and Turkey. It is situated near the ancient *Salonæ*, on the site of the famous palace of Diocletian, called *Salonæ Palatium*, or, in an abbreviated form, *S. Palatium*; hence the name of the modern town. Of the magnificent palace, which covered 8 acres of ground and which it took twelve years to build, many interesting and impressive remains are still extant. P. 15,784.

Spalax. See MOLE-RAT.

Spald'ing, town of England, in Lincolnshire, on the Welland, which is navigable here for vessels of 100 tons burden. It has an active trade in corn, flax, hemp, and wool. P. 9664.

Spalding, county of W. Georgia, bounded W. by Flint River, and traversed by Macon and Western and Savannah Griffin and Northern Alabama R. Rs. The surface is undulating, the soil fertile. Staples, cotton, Indian corn, wheat, oats, cattle, and swine. Cap. Griffin. Area, 190 sq. m. P. 10,205.

Spalding (BENEDICT JOSEPH), D. D., b. in Marion co., Ky., in 1810; studied at St. Mary's College and at Bardstown, and graduated at the Propaganda in Rome in 1837; was ordained priest; in 1844 became pastor of St. Joseph's church at Bardstown; in 1849 of the cathedral church in Louisville, and vicar-general of the diocese. D. at Louisville Aug. 4, 1868.

Spalding (HENRY H.), b. near Prattsburg, N. Y., in 1804; educated at Western Reserve College and Lane Theological Seminary; went in 1836 as a missionary of the American Board to the Nez Percé Indians of Oregon (now Idaho); was there associated with Dr. Whitman, who in Nov., 1847, was murdered with his family at Walla-Walla by the Indians; translated portions of the Bible into the Nez Percé language; and was successful in the conversion of many hundreds of Indians. His later years were employed under the auspices of the Presbyterian Board of Missions. D. at Lapwai, Id., Aug. 3, 1874.

Spalding (JOHN FRANKLIN), D. D., b. Aug. 25, 1828, in Belgrade, Kennebec co., Me.; graduated at the North Yarmouth Classical Academy, Me., in 1849, at Bowdoin College, Me., in 1853, and at the General Theological Seminary of the Protestant Episcopal Church, New York, in 1857; minister of St. James's church, Oldtown, Me., 1857–59; was rector of St. George's church, Lee, Mass., till 1860, when he became assistant minister of Grace church, Providence, R. I., for one year; rector of St. Paul's church, Erie, Pa., 1862–74; member of the general board of missions from 1865; dean of the Erie convocation Jan., 1866; member of

the general convention 1868 and 1871; elected Oct. 24, 1873, by the House of Bishops missionary bishop of Colorado, with jurisdiction in Wyoming and New Mexico; consecrated bishop Dec. 31, 1873, and removed to Denver, Col., in Feb., 1874. Published in 1864 *The Threefold Ministry*, and in 1872 *Manual of Prayers*, etc., and author of various articles, sermons, pamphlets, etc. Bishop Spalding has been for many years prominently connected with the movement to promote lay co-operation and women's work in the Church, deaconesses' institutions, and sisterhoods. Residence, Denver, Col.

Spalding (LYMAN), M. D., b. at Cornish, N. H., June 5, 1775; graduated at Dartmouth College in 1798; studied medicine, and aided in the establishment of the medical school of Dartmouth, where he delivered the first course of lectures on chemistry; began the practice of his profession at Portsmouth in 1799; in 1812 became president of the College of Physicians and Surgeons in Western New York; removed to New York City in 1813; planned the *U. S. Pharmacopœia*, and in 1820 was one of the committee for its publication; was a skilful anatomist, and member of many learned societies in Europe and America. D. at Portsmouth, N. H., Oct. 31, 1821.

Spalding (MARTIN JOHN), D. D., b. in Marion co., Ky., May 23, 1810; graduated at St. Mary's College in 1826, and in 1830 went to Rome to enter the college of the Propaganda; returning to Kentucky, was ordained priest in 1834; appointed pastor of the cathedral church at Bardstown, and established *The Catholic Guardian*, with which he retained his connection until 1858; lectured in favor of Roman Catholicism in the U. S. and Canada, his lectures being published under the title *Evidences of Catholicity* (1847; 4th ed. 1866); in 1848 appointed coadjutor of the Roman Catholic diocese of Louisville; in 1850 became bishop of Louisville, where he erected a cathedral; advocated the establishment of Roman Catholic schools in all parishes; set up a colony of Trappist monks and an institution for the deaf and dumb, and engaged in newspaper controversies. In the Roman Catholic provincial councils held at Cincinnati in 1855, 1858, and 1861 he bore a prominent part. In 1864 he succeeded Dr. Kenrick as archbishop of Baltimore; in 1866, as apostolic delegate, convened the second national council at Baltimore, and drew up the acts of the council (*Concilii Plenarii Baltimorensis II. Acta et Decreta*), which form the manual of American Roman Catholic canon law. He took a prominent part in the Vatican Council of 1870–71, where he urged an immediate decision on the subject of papal infallibility, but wished it to be indirect and implied, rather than positive and affirmative; but he, with the other Roman Catholic bishops from America, yielded in favor of a positive declaration. His principal works are—*Early Catholic Missions of Kentucky* (1844), *History of the Protestant Reformation in Germany and Switzerland*, written in opposition to Merle d'Aubigné (1860), and a translation, with notes and an introduction, of Darras's *General History of the Catholic Church* (1866). D. in Baltimore Feb. 7, 1872.

Spalding (SOLOMON), b. at Ashford, Conn., in 1761; was a soldier in the war of the Revolution; graduated at Dartmouth College 1785; became a Congregational minister in Connecticut 1787; settled in Ohio some years later, and while residing at Salem in that State about 1812 wrote a novel entitled *The Manuscript Found*, suggested by the opening of an Indian mound. It is claimed that this fiction became known to Sidney Rigdon at Pittsburg in 1814, and that it was the origin of the *Book of Mormon*. D. at Amity, Pa., in 1816.

Spalding (WILLIAM), b. at Aberdeen, Scotland, in 1809; educated at Marischal College in that city; was called to the bar at Edinburgh 1833; was professor of rhetoric in the University of Edinburgh 1834–45, and of logic at the University of St. Andrew's from 1845 until his death, Nov. 16, 1859. Author of *Italy and the Italian Islands* (3 vols., 1841); *A History of English Literature* (1852), an admirable work, now (1876) in its 10th edition; and *An Introduction to Logical Science* (1857), being a reprint of the article "Logic" contributed by him to the 8th ed. of the *Encyclopædia Britannica*, for which work he wrote, among others, the important articles on Addison, Bacon, Demosthenes, Tasso, Sir Walter Scott, Rhetoric, and Slavery. He was also a frequent contributor to the *Edinburgh Review*, *Blackwood's Magazine*, and the *Penny Cyclopædia*, and wrote the lives of poets, novelists, and men of letters in Elihu Rich's *Cyclopædia of Biography* (London, 1854).

Spallanza'ni (LAZARO), b. at Scandiano, duchy of Modena, Jan. 12, 1729; studied at Reggio and Bologna, and was appointed professor of logic, metaphysics, and Greek at Reggio in 1754, and at Modena in 1761. At the re-establishment of the University of Pavia in 1768 he became professor of natural science; made extensive scientific travels in Italy and Sicily, Switzerland and Germany, Turkey, Asia Minor, Corfu, and Cyprus, and lectured to very large audiences. D. at Pavia Feb. 12, 1799. His numerous writings on geology and zoology, obtained a wide reputation, and were translated into several foreign languages. His polemics against Needham, whose theory of spontaneous generation among the Infusoria he contested, attracted special attention, showing by a series of ingenious experiments that these animals originated from germs existing in the atmosphere. His *Viaggi alle Due Sicilie e in alcune parti degli Apennini* (6 vols., Pavia, 1792) was also much appreciated.

Span'dau, town of Prussia, province of Brandenburg, at the confluence of the Havel and the Spree, is fortified, surrounded by walls, and defended by a citadel. The citadel stands on an island in the Havel, and is used by the Prussian government as a prison for military and political criminals. The city, which is very old, but well built, has manufactures of stockings, hosiery, woollen fabrics, gunpowder, and arms, and carries on a large transit trade between Berlin and Hamburg. P. 19,013.

Spang'enberg (AUGUST GOTTLIEB), PH. D., b. at Klettenberg, Germany, July 15, 1704; graduated at Jena 1726; became a professor at the University of Halle 1731, and assistant superintendent of Francke's orphan-house; was dismissed for too liberal views on church fellowship 1733; joined the Moravians; became assistant to Count Zinzendorf at Herrnhut; visited England 1734; obtained lands from the trustees of Georgia for a Moravian settlement in that colony; landed at Savannah with nine Moravian settlers, the first who located in America, 1735; labored as a missionary among his German countrymen in Georgia and Pennsylvania 1735–39, after which he visited Europe; was instrumental in procuring the establishment of the settlement at Bethlehem, Pa.; founded at London 1741 the first regular Moravian society in England; became "general deacon," and in 1744 bishop, of his church; proceeded to Pennsylvania the same year; repeatedly visited the Oneida Indians; made another visit to Europe 1749–51; organized a Moravian community in Western North Carolina 1752; was elected successor of Count Zinzendorf in the supreme council; returned finally to Europe 1762, and for thirty years was the leading spiritual guide of the Moravians, becoming in 1789 president of the general directory. D. at Berthelsdorf, Saxony, Sept. 18, 1792. Author of a *Life of Zinzendorf* (3 vols., 1772–75) and of *Idea Fidei Fratrum* (1779), the authoritative manual of Moravian theology.

Span'heim (EZECHIEL), b. at Geneva Dec. 7, 1629; was educated at Leyden under Salmasius and Heinsius, and was appointed professor of belles-lettres at Geneva in 1651, and elected a member of the grand council in the following year. Having been appointed tutor to the son of the elector palatine, whom he accompanied on a tour through Italy, he entered the diplomatic career; represented the elector of Brandenburg for many years at the court of Paris; assisted at the negotiation of the Peace of Ryswick, and was sent in 1702 as Prussian ambassador to London, where he d. Nov. 7, 1710. His *Dissertationes de Usu et Præstantia Numismatum Antiquorum* (Rome, 1664) and *Orbis Romanus* (1704) acquired a great reputation. His editions of *Julianus* and *Callimachus* are still considered valuable.

Spaniard's Bay, a large fishing-town on the N. side of Conception Bay, Harbor Grace district, Newfoundland, is surrounded by high hills and has some fine views. The inhabitants are mostly engaged in the Labrador cod fishery. P. 1182.

Spanish Armada. See ARMADA, THE SPANISH.

Spanish Fly. See CANTHARIS.

Spanish Grass. See ESPARTO.

Span'ish Language and Literature. The prevailing opinion as to the oldest known inhabitants of Spain is that they were Iberians, now known as Basques, a race of Ugro-Tartarian origin, and coming from the northern parts of Asia and Europe. They have left few distinct traces of their language in modern Spanish. After a long and bloody war, these Iberians were conquered by invading Celts, who, united with their new subjects, became known as Celt Iberians, when Spain first appears in the annals of history. The Phœnicians, who came by sea from their powerful colony of Carthage in Africa in search of the mineral resources of Spain, which made it the Eldorado of the ancient world, founded Carthagena, and probably Cadiz, near the Straits of Gibraltar. Before they could obtain, however, possession of the whole country, the Romans, moved by jealousy, interfered with their progress, and by the victories gained in the Second Punic war drove them for ever from Europe. The traces left by the Phœni-

cians in the population and language of Spain are few and of slight importance. The enlightened policy of the new conquerors soon established peace and produced a hearty union between the two races, and the S. of Spain became another Italy. Thus, Latin became the language of the favored province, and the first Roman consul, as well as the first emperor of foreign origin, was a Spaniard by birth. Latin writers of eminence claimed Spain as their native land, and Lucan and Martial, Columella and the two Senecas, with a host of others, bore evidence of the far-famed culture of Spain. The influence and popularity of Latin derived new strength from the use of it by Christianity, which became in the days of Constantine the acknowledged religion of large parts of the country. This Latin was, however, not classic Latin, but the *sermo rusticus*, the speech of the people, sadly corrupted by ignorance and admixture of foreign elements. For in the mean time a new race of northern barbarians had begun to invade Spain after having overrun every part and province of the Roman empire. The first tribes of this German race that rushed over the Pyrenees, the Franks, Vandals, Alani, and Suevi, passed swiftly into Africa, leaving bloody traces behind them. The Goths, who succeeded them, had fortunately been not only converted to Christianity, but more or less civilized in Italy, before they reached Spain, and as Visigoths established a beneficent reign in their new conquest. Their noble code of laws survived their memory, but their language, a barbarous idiom, readily succumbed to the greater power and higher culture of the Latin as far as words were concerned. They played, however, sad havoc with the beautiful though complicated system of Latin inflections, and thoroughly changed the general structure of that language. Of comparatively trifling effect, as far as the language was concerned, was the otherwise formidable invasion of the Arabs, who made their first descent from Africa in 711, and, with their usual marvellous celerity, in three years conquered the whole of Spain, save only the mountainous N. W., where a large body of Christians found a safe asylum. During their long occupancy of Spain they maintained numerous schools and libraries, which were frequented by Spaniards and Arabs, by Mohammedans and Christians, alike. Arabic became the language of the majority of Spaniards; even the Scriptures had to be translated into it, and records and literary works were written in Arabic. Thus, when, after a fierce struggle of nearly eight centuries, the Christian Spaniards recovered possession of their native land, and the Gothicised and corrupted Latin became once more the national language, a considerable infusion of Arabic remained and gave to modern Spanish those Oriental peculiarities which distinguish it most pointedly from the other Romance languages.

As the province of Castile was not only one of the oldest but also the most powerful portion of the newly-restored kingdom, to which it gave its rulers, the new language became generally known as the *Castilian*. The oldest document written in this language which still exists is a confirmation of privileges by Alfonso III. in the year 1155, and from that date Spanish begins its existence as an independent national language. The bulk of words is Latin, to which Arabic, German, and Basque make small contributions, while Gothic constructions abound largely. By order of Alfonso X. (d. 1282) the Bible was translated into it from the Vulgate, and at the same time Spanish was made the language of all law proceedings and legal contracts.

Spanish is spoken now not only in Spain, but also in certain portions of Africa, in Central America, Mexico, and the West Indies, in South America, except Brazil and Guiana, and in the Philippine Islands. It shares with Italian its melodiousness and richness of vowels, but surpasses it in vigor and dignity: as clear and precise as French, it possesses greater elasticity and superior fitness for poetry, and avoids the sibilants and nasal sounds of the Portuguese, without losing its soft and liquid notes. Of former dialects only the Galician (closely related to Portuguese) and the Catalan survive. Lebrija (1492) was the first to treat Spanish grammatically; the dictionary and the grammar of the Spanish Academy are standard works, which Salva's *Gramática Castellana* (Paris and Mexico, 1851) adapts to modern spelling. An historical grammar has not yet been written: the material for such a work is found in Diez (*Romanische Sprachen*). Cabrera wrote (1837) an etymological dictionary, and Hernan Caballero in his *Nomenclatura geografica de España* furnished valuable contributions to Spanish etymology.

The *literature* of Spain, as a national literature, begins only with the twelfth century, when the Limousin and Aragonese dialects had become extinct, and Castilian rose to the dignity of a national language. As in the history of all nations, here also, poetry and, of all its branches, epic poetry, produced first permanent fruit. Amid storm and strife the Christian Spaniards gave utterance to the fierce energy and the matchless heroism which animated them in their long-continued struggle against their national enemies, the Moors. The people of Roman and of Gothic blood alike made common cause against the invader, and in their common language loved to sing the praise and glory of their heroes and heroic deeds. Naturally fond of song, they learned from the Arabs to form riddles and romances, largely tinctured with rich Oriental imagery and passionate eloquence. From their neighbors, the Provençals, they acquired poetic skill through trovadores and yoglares, and thus playful songs and national romances became the representatives of the true national literature of Spain. Adventures of love and achievements in war being the great topics of the day, and most of the poets being warriors themselves, these romances naturally sing mostly of love and war. The form varied, although they were generally written in *redondillas*, consisting of stanzas or couplets, each line containing four trochees. Rhymes occurred only in songs fashioned after Arabic models, and were then employed quite irregularly. Other romances, known as *versos de arte mayor*, consisted of dactylic stanzas of eleven to fourteen syllables. Alexandrine verses and sonnets were mainly used by monks in their poems, and never became popular because they could not so easily be sung. (Authorities: L. I. Velasquez, *Origines de la poesia Castellana* (Malaga, 1754); M. Sarmiento, *Memoria para la historia de la poesia y poetas Españoles*; Martinez de la Rosa, *Sobre la poesia epica Española*; E. de Ochoa, *Tesoro de los poemas Españoles* (Paris, 1840).) The first and by far the most important of these works is *The Poem of the Cid*, composed about the year 1200. Its subject is the life of a great Christian knight, Don Rodrigo Diaz, who bore the Arabic name of *Cid* (*Seid* — "Lord"), bestowed upon him by five Moorish kings whom he had conquered, and was generally known as *El Cid Campeador*, "the lord champion of Spain." His personal adventures form part of the great struggle between the Christian Spaniards and the Mohammedan Moors, and the poem hence has a national character throughout. Although the great hero died as early as 1099 in Valencia, no portion of the poem is older than the twelfth century. It has existed only since 1207, when Per Abbat copied it in its present form. Inartistic in many respects, it is invaluable as a contemporary exhibition of Spanish character; at times it rises to Homeric simplicity, and is always full of life and interest. Every line breathes the true Castilian spirit of loyalty to king and country, as well as to the God of the Christian, and for centuries the poem has held its own as unsurpassed in originality and intrinsic beauty. (Authorities: Sanchez, *Poesias Castellanas* (Madrid, 1729); Southey, *Chronicle of the Cid*.)

For a time the poems of the people remained anonymous, but already in the thirteenth century we meet with a well-known author, Gonzalo de Bercea (1220–60), who has left us a number of rhymed legends. A royal author, Alfonso X., surnamed THE WISE (1221–84), was a true poet and a profound scholar, although a poor king. Of his poems but few survive, but his fame rests mainly on the great code of laws to which his labors gave the general character and finish. He himself called it *El Setenario*, but history records it as *Las Siete Partidas*, from the seven parts of which it consists. This code, the greatest legislative work of its age, has been uniformly respected as the common law of Spain and the basis of all Spanish jurisprudence. Being thus the law of the colonies also, it has not been without influence on American law since the acquisition of Louisiana and Florida. (*Las Siete Partidas*, Academia Española (Madrid, 1807)—*The Laws of the Siete Partidas*, which are still in force in the State of Louisiana (New Orleans, 1820), by M. Lislet and H. Carleton.) Of subsequent poets few rose to distinction. Juan Lorenzo Segura wrote toward the end of the twelfth century a long poem on Alexander the Great, and Juan Ruiz, known as the archpriest of Hita (d. 1351), has left us poems in the style of Petronius, rather free in tone, but full of life and humor. His language is far superior to that of his predecessors, and this and his poetic genius and satirical temper have procured him the name of the Spanish Chaucer.

In the mean time, lyric poetry had brought forth its first fruits under the protection of King John II. of Castile. A courtly school of poets, following the example of the troubadours in the adjoining provinces of France, sprang up under that chivalric monarch and produced a large number of lyric poems. Divided into stanzas (*canciones*), they bore, like every product of the Spanish Muse, the impress of a strongly-marked nationality in form and treatment. Hence, the almost painful uniformity of these poems and the narrow circle of ideas which they display. A collection of such canciones was made by Baena, secretary to John

II., but the *Cancionero General* by Ferrando de Castilla (Valencia, 1511) is far more complete, and an invaluable storehouse of such songs. Cultivated almost exclusively by courtiers and knights, the *canciones* appealed only to certain classes of society; hence the popularity of the far more national ballads and songs, which kept the memory of the ancient glory of Spain alive among the people at large. These romances, written by unknown authors, sang of the great deeds of chivalry performed by the paladins of Charlemagne or the Cid and his followers. Among the older poems a few treat of early myths, while the later compositions are gradually verging into purely lyrical songs. (*Tesoro de los Romanceros y Cancioneros Españoles*, por E. de Ochoa (1818, Paris).) These romances are by far the most attractive works produced by the genius of the Spanish people; they are extremely popular at home and greatly admired abroad.

Unfortunately, Spanish poetry was not allowed long to remain independent of foreign influence. While Spain became under Charles V. the most powerful empire of the world, and its literature kept pace with its political progress, the conquest of Naples (1504) brought it in contact with Italian literature, at that time the most advanced in Europe; and this influence changed the whole aspect of its culture. Italian authors like Dante and Petrarch became the models which Spanish poets tried to imitate, and Italian forms and measures were closely copied. Juan Boscan de Almogaver (d. 1543), who accompanied the duke of Alba to Italy, had there learnt to admire Italian poetry, and after having in his youth written *Coplas Españolas*, now tried his hand at the first sonnets in Castilian. His success, great as it was, was surpassed by that of his friend, Garcilaso de la Vega (d. 1536), whose genius excelled especially in pastoral poems. Their gentleness and winning melancholy are peculiarly striking when contrasted with the life led by the author, a brave but ruthless soldier. The most brilliant among these successful imitators of Italian masters was, however, Diego Hurtado de Mendoza (d. 1595), whose eminent services as a soldier and a statesman left him still leisure to write sonnets and epistles after foreign models, and *redondillas* and *quintillas* in the ancient form of old Castilian verse. His *Cartas*, the first epistles in Spanish, prove him a worthy imitator of Horace. The admiration with which these works were received by the whole nation led to still greater efforts in the same direction, resulting finally in a happy combination of the high art of Italian poets with the attractive peculiarities of Spanish genius. This explains the brilliant success of the two greatest lyric poets that Spain has produced—Fernando de Herrera (d. 1575) and Luis Ponce de Leon (d. 1591). The former earned by his canciones, and especially by his odes—the first classic odes of modern Europe—the title of "the divine;" the latter, as famous in prose as in poetry, gave himself up almost exclusively to mystic meditation, and is hence better known at home than abroad. He deserves special praise, however, for the rare vigor and classical purity with which he uses the old Castilian measures in contrast with the prevailing partiality for Italian forms. So great was the success of this Italian school that even in Portugal, then already an independent kingdom, distinguished poets like Saa de Miranda (d. 1558) and Jorge de Montemayor (d. 1506) wrote idyls and pastoral novels, not in Portuguese, but in Castilian. Nor were imitators and followers wanting in Spain, though their success was but moderate. An Acuña (especially known as a translator) and a Gil Polo became more generally popular among the host of minor poets, while an attempt was made to counteract foreign influence and to bring back the old Spanish simplicity and national feelings. The leader of this party was Castillejo (d. 1580?), whose love-songs are masterpieces. The two brothers Argensola (Bernardo, d. 1565; Bartolomeo, d. 1566) endeavored to imitate Horace directly, without following the example set by Italian writers; while Vicente de Espinel (d. 1634) excelled in canciones and elegies. To assist in restoring the ancient classics to their full authority, Villegas composed his *Eróticas* after the model of Anacreon, and Jaureguy (d. 1640) translated Lucan's *Pharsalia*.

The gradual decline of poetry in the next century was aided by the division of poets into two schools—the Conceptistas, who resorted to metaphors and puns after the manner of Italian *concetti*, and the Cultos or Cultoristos, whose endeavor to show a peculiarly high culture in form and thought led them into exaggeration and pedantry. The illustrious dramatist Lope de Vega wrote some of the best romances and sonnets that were produced during the reign of these two schools, but he also abandoned the good old classic models, and his easy versification led him to commit numerous mistakes. The extreme affectation of Luis Góngora de Argote (d. 1627) makes him the representative poet of the Cultoristos; his style is artificial, full of hyperbole, and affected beyond endurance. The most efficient resistance to this false taste was made by Francisco de Quevedo y Villegas, whose burlesque sonnets and satires fairly entitle him to be called the Spanish Voltaire. In all his works—his *sueños*, clever visions, his *bayles*, songs to accompany dances, and his *jácaras*, gypsy songs—he shows a decided improvement on his predecessors.

The popular desire to preserve the treasures of olden times led to numerous efforts in the sixteenth and seventeenth centuries to collect, complete, and publish the earlier romances. The writers of those days endeavored either to imitate the ancient poems, or, when such efforts proved futile, to regenerate poetry by imitating the works of the classic French writers, who were now in the ascendant. The new dynasty of the Bourbons (1701) favored this tendency, and the brilliant talents of Ignacio de Luzan (1737) succeeded in applying the rules of French critics to Spanish literature. The fact that his own poems, though extremely brilliant, lacked all poetic fire, assisted his opponents, the advocates of a national literature, in counteracting his influence. Their leader, Garcia de la Huerta (d. 1787), received immense applause for his poems written in the old Spanish form, but a number of men who in Salamanca formed a school characterized by moderation, and by endeavoring to unite the merits of older works with the demands of more recent days, soon obtained the supremacy. Although the French and the national party continued to contend for supremacy, the new school obtained great triumphs through men like Moratin (d. 1780), Cadalso (d. 1782), and Iriarte (d. 1791), whose *Fables* are a classic work in Spain; while Melendez Valdez (d. 1807) surpassed all recent poets, and still enjoys universal admiration. A highly-gifted man of genius, he revived the national enthusiasm, and proved that poets might remain true patriots in sentiment and yet profit by the example of the classic models of other nations. For some years Spanish writers followed in his footsteps, trying to learn from the great poets of France, Italy, and England, and their efforts became even more zealous when Spain succeeded in shaking off the yoke of the foreign usurper and once more could think and write as an independent nation. The liberal and patriotic movements of the years following Napoleon's downfall served to revive the national spirit and to give to literature a more patriotic character. These influences infused new life into Spanish poetry, and the number of modern poets is very great, although but few of them have risen to eminence. This comparative failure is especially due to the cruel political persecutions to which almost every man of genius was subjected. Thus, Martinez de la Rosa, Angel de Rivas, Galiano, and Torreno, all men of undoubted genius, were either banished or driven in early youth from literary pursuits. The greater their attachment to their native land, the surer, it seems, was their martyrdom. The younger Moratin (d. 1828), whose ballads were national in tone, though highly finished in form, died an exile in want and poverty (*Obras de L. F. Moratin*, 1830, Madrid); Gallego, Mora, Mauri, Xerica, and Japia, all suffered persecution. Among recent poets of this class, Santos Lopez Pelegrin, known as "Abenamar" (*Poesias*, Madrid, 1841), Campoanor (*Poesias*, Madrid, 1840), and a lady, Gertrudis Gomez de Avellaneda (*Poesias*, Madrid, 1842), may be mentioned as worthy of praise.

Epic poetry, as distinguished from the early romances, can hardly be said to have begun in Spain before the days of Charles V. A nation possessed of such a vast treasure of popular ballads was not likely to encourage individual efforts, and the republication of the old national songs in the romancero made the competition still more difficult. Hence, the small success obtained by poets like Balbuena (d. 1627), whose residence in Mexico and Jamaica led him to publish his *Siglo de Oro* (1608, Madrid), and Cueva (d. 1608) in his *Bética* gives us little more than versified history. The *Cristiada* of Father Hojeda (d. 1611) shows some progress, but the first epic poem of real merit is undoubtedly the *Araucana* by Alonzo de Ercilla y Zuniga (d. 1596). This remarkable work contains a graphic account of a military expedition sent out against the Araucans, a tribe of South American Indians, in which the author took part. Its beautiful descriptions of natural scenery and the eloquent speeches which are plentifully inserted command admiration, and elicited praise even from Voltaire, who first called attention to the strange work. The American continent produced two epic poems of some merit: one on Cortés by Antonio de Saavedra Guzman (Madrid, 1599), and the other on the conquest of Peru by the Pizarros, by Barnuevo (Lima, 1732). The elder Moratin published in 1765 an *Epic Canto* on the destruction of his ships by Cortés, the noblest poem of its class produced in Spain during that century. The *Conquest of Minorca*, by Meras (Madrid, 1797), is a feeble imitation of Moratin's work, and a poem by Melendez, *The Fall of Lucifer* (Mad-

rid, 1785), is a complete failure to copy Milton. The historian Muñoz was equally unsuccessful in his *Méjico Conquistada* (Madrid, 1798), although the work is not without merit: and since that time no effort has been made to revive this branch of poetry in Spain.

Didactic poetry has occasionally been a special favorite with the Spaniards, from the time when Pedro Lopez de Ayala (d. 1407) wrote his famous *Rimado de Palacio* ("Court Rhymes")—a work containing much statesmanship and profound learning—to our own day. The Rabbi Santob (d. 1350) addressed to King Peter the Cruel many wise counsels in a curious poem written in excellent *redondillas*, and breathing a true poetical spirit. Of unknown date and authorship is the *Danza General*, or "Dance of Death," a striking and picturesque poem on the well-known subject of the dance to which all men of all conditions are finally summoned. The age of Charles V. produced, in this branch also, works of considerable merit—Boscan's poem on his own conversion, another by Castilla on *The Virtues*, and one by Mendoza on *A Happy Life* are among the best. They were, however, surpassed by Francisco de Guzman's (d. 1580) larger poems, and especially by Juan de la Cueva (d. 1608) in his *Ejemplar Poetico*, the oldest original effort at an art of poetry written in Spanish. Religious and descriptive poems of this kind abound, but on the whole didactic poetry has not been successfully cultivated by the Spaniards.

Far more brilliant are the annals of the Spanish drama, which seems to have very promptly appeared to take the place of the ancient classical drama, banished by the Arabs. But, although Alfonso X. had already issued edicts against certain abuses connected with farces performed in public, no trace of dramatic writing is found till the latter part of the fifteenth century. At that time the drama appears already under its double aspect—religious, as patronized by the Church and addressing itself to the fervent religious zeal of the people; and humorous, as introduced by the *juglares*, from France, and overflowing with more or less coarse buffoonery. A number of anonymous dramatic works, such as *Mingo Revulgo* (1472) and the *Celestina* (1480), in prose, were followed at last by the first Spanish dramas that were published. They were written by Juan de la Encina (d. 1534), and, although religious in their general character, were acted by secular persons. Thus, in the same year in which America was discovered the foundation was laid of the Spanish secular drama. Gil Vicente (d. 1536) followed Encina's example in Portugal, and endowed that country with the best dramatic works produced in Portuguese literature, though they were written in Spanish. The first *comedias*, so called, bore strongly the marks of Italian influence, having been produced by Naharro (d. 1517), who had long lived in Rome at the court of Leo X. He divided them not into acts, but into *jornadas* ("days"), as is still done in Spain, and he introduced also the *gracioso* ("fool"), who has ever since remained a prominent personage in Spanish comedies. Naharro's verse shows not rarely high artistic finish; the humor of his plays is often broad, but always original, and the interest is well kept up. Hence, his plays were acted both in Italy and in Spain, and soon became highly popular.

The true national drama of Spain begins, however, only with the age of Charles V., after an interval during which the representation of dramas was forbidden by the Inquisition. Only strictly religious plays (*mysteries*) were allowed. Strangely enough, it was a mechanic of Seville, Lope de Rueda (d. 1567), who as a dramatic writer and an actor re-established the popular drama. His plays were performed in a rude structure on public squares, whenever an audience could be collected, but they proved extremely attractive, and evidently had struck the popular vein. His example was promptly followed by others. Thus, Juan de la Cueva (d. 1608), wrote a number of plays, many of which are on national subjects and of great interest. Cristóval de Virues (d. 1609), a friend of the great Lope de Vega, attempted to imitate the ancient Greek masters in form and in spirit, and obtained a fair success. Three tragedies by Lupercio de Argensola (d. 1603) produced a great sensation, but failed to make a permanent impression. By these authors, however, the way was opened to a dramatic literature founded on the national character and manners. Cervantes, unsurpassed in another department of literature, wrote several dramatic works, which, however, were eclipsed by the greater achievements of the two great masters of the Spanish drama—Lope de Vega Carpio (d. 1635) and Calderon de la Barca (d. 1687). The former excelled in fertility, originality of conception, and promptness of execution, 100 dramas having been conceived and written in twenty-four hours. His works comprise all the favorite branches of the Spanish drama—*comedias divinas*, including *vidas de santos* and *autos sacramentales* (lives of saints and glorifications of the sacraments), and *comedias humanas*, which were called *heróicas* when they related to history, and *de capa y espada* ("sword and cloak") when the subject was intrigue. Moreover, almost all his plays (over 2000) have *loas* (prologues), *entremeses* (interludes), or *saynetes* (ballets), interspersed. His rival, Calderon, was fully his equal in the number and value of his works, and his *autos* especially exhibit the imposing grandeur of Spanish religious zeal. These brilliant examples were followed by numerous imitators, and even after the decline of Spanish poetry dramatic writers flourished down to our day. Cándamo (d. 1709), Cañizares (d. 1750), and Zamora (d. 1722) are still favorites, the latter especially, through his *Don Juan*, for which Mozart wrote the music.

Spanish prose began early, Juan Manuel, duke of Peñafiel (d. 1362), having written in his *El Conde Lucanor* the first moral tales. Romantic novels abounded from the beginning, among which the *Amadis de Gaula*, perhaps by a Portuguese, Vasco Lobeira (d. 1403), was most popular, being frequently republished down to the time of Charles V. (*Los 4 libros del muy esforzado Cab. Amadis de Gaula*, Salamanca, 1519). This was followed by a host of imitations, which grew weaker and weaker till works of this kind became a laughing-stock and a grievance. This led Miguel Cervantes de Saavedra (d. 1626), of all Spanish authors best known abroad, to write his immortal *Don Quijote*, a parody, and at the same time the best model of Spanish prose. His *Novelas Ejemplares* ("model novels") showed the remedy, and gave new vigor and great popularity to this branch of literature. Montalvan and Caravajal wrote similar novels (Paris, 1646); Montemayor (1554) added the pastoral novel; and Hurtado de Mendoza (d. 1575), a soldier and a diplomat, invented the *gusto picaresco*, comic novels with heroes taken from low life. His *Lazarillo de Tormes*, the standard work of this kind, was followed by a number of graphic sketches of the lower classes, among which Mateo Aleman's (d. 1609) *Guzman de Alfarache* stands prominent. Quevedo's *Gran Tacaño* and Espinel's *Marcos Obregon* are masterpieces of the kind; the *Limping Devil* of Velez de Guevara (d. 1646) furnished the material for Le Sage's *Diable Boiteux*.

It was much later when historical writings were developed, the Spaniards preferring their romances and ballads to prose-writings. In 1590, however, Perez de Hita published his famous *History of the Civil Wars of Granada*, which still holds its place by the side of Mendoza's *War of Granada*, and by Garcilaso de la Vega's (d. 1620) *History of the Incas of Peru*. In more recent times this branch of literature has become the most fertile, thanks to the tendency of Spaniards to turn from the sadness of their present condition to the glory of former days. Among modern writers, Martinez de la Rosa (1839), Escosura, Serafin Calderon, and a lady, Gertrudis de Avellaneda, stand prominent. Even the social novel gives more or less attention to historical descriptions, and the German lady who writes under the name of "Fernan Caballero" has excelled here, as the German author Hartzenbush excels in the modern drama. The same popular taste has led to the valuable collections of older works published by E. de Ochoa in Paris, and the far superior *Biblioteca de Autores Españoles*, by B. C. Aribau, which was begun in 1846 in Madrid.

The student of Spanish literature will find ample information, among foreign writers, in Bouterwek's German and in Sismondi's French work on the subject, to which Wolf's *History of Spanish National Literature* and Schack's *History of Spanish Dramatic Literature* (both in German) must be added. The most recent work in Spanish is Orihuela's *Spanish and American Poets of the Nineteenth Century* (Paris, 1851), and for reference Ferrer del Rio's *Gallery of Spanish Literature* (Madrid, 1845) is useful. The best work of all is, however, George Ticknor's *History of Spanish Literature* (New York, 1854), which is admitted, even by Spanish authorities, to be still unsurpassed in thoroughness, completeness, and accuracy.

SCHELE DE VERE.

Spanish Mackerel, a name given to different kinds of fishes. (1) Along the eastern coast of North America it is applied to the *Cybium maculatum*, a very slender, compressed, fusiform fish, with many-rayed dorsal and anal fins (D. xvii.–xviii. 2.15 + 8–9 finlets; A. ii. 15 + 8–9 finlets), the lateral line slightly deflected under the second dorsal, and thence continued straight to the caudal fin, and the color bluish-green above, satin-like white below, with yellowish spots on the back and sides, and with the first dorsal fin blackish before and along its margin. It attains a length of nearly two feet, and sometimes more. It is a native of the tropical seas, but ranges from Southern Brazil to Cape Cod. It is now frequently caught in spring and summer along the Eastern as well as the Southern coasts. It is one of the most esteemed of salt-water fishes,

and commands a comparatively high price in the markets. (2) In England, along the Cornish coast, the name is conferred on the *Scomber colias*, a species nearly allied to the common mackerel (*Scomber scombrus*), and having, like it, a stout fusiform shape, comparatively few-rayed dorsal and anal fins; the spinous dorsal has seven spines, and there are five or six finlets above and as many below; the lateral line is slightly decurved and then straight, and the color dark-blue on the back, with irregular dark broad lines and grayish spots on the sides. It often reaches fourteen inches or more in length. According to Couch, it is scarce, but some are taken every year, most frequently in drift-nets and in single specimens. (3) The name is employed by Dekay and Storer for the *Scomber colias* or *Dekayi* in their works on the fishes of Massachusetts and New York, and consequently their species must not be confounded with the one now generally so called. At one time the *Scomber colias* was abundant along the American coast.

THEODORE GILL.

Spanish Main, a name formerly applied to the southern part of the Caribbean Sea, through which the Spanish treasure-ships passed from Mexico and Central America to Europe.

Spanish Town, town of Jamaica, West Indies, on the right bank of the Cobre, is the seat of the English government. It contains some fine public buildings, but is in general ill-built, unhealthy, and of no commercial importance. P. about 7000.

Spanish War of Succession. See SUCCESSION WARS.

Spano (GIOVANNI), b. at Ploaghe, Sardinia; began his education in his native island; later went to Rome to study the Oriental languages with Sarti and Lanci; afterward to Turin, where he profited by the lessons of Peyron. The following works of Spano are very valuable: *Vocabolario Sardo-Italiano e Italiano-Sardo* (Cagliari, 1851, 2 vols.), *Ortografia Sarda* (Cagliari, 1840, 2 vols.), *Bullettino Archeologico Sardo*, which was continued for eight years, *Canzoni popolari Sarde*, besides numerous learned archæological and linguistic monographs.

Span-Worm, another name for the CANKER-WORM (which see).

Spar. See BARYTA, CALCAREOUS SPAR, FELDSPAR, FLUOR-SPAR, and ICELAND SPAR.

Spar'idæ [from *Sparus*, the ancient Latin name of the typical genus], a family of fishes of the order Teleocephali and sub-order Acanthopteri, comprising the porgy and sheepshead of the U. S. and related forms. The body is compressed and oblong; the scales have obsoletely pectinated margins and striæ diagonally crossing the surfaces, and meeting the sides at acute angles; lateral line continuous to the caudal fin; head compressed; opercular bones unarmed; nostrils double; mouth terminal, with an oblique lateral cleft; upper jaw moderately protractile, and with the supramaxillaries partly sliding under the preorbital bones; teeth in the jaws either developed on the sides as molars, or in front as more or less defined incisors, or of both kinds; palate unarmed; branchial apertures continuous below; branchiostegal rays five to seven; dorsal fin elongated, with its spinous portion rather longer than the soft, and folding in a dorsal groove; anal with three spines; caudal fin with pointed lobes; pectoral fins pointed and with the rays branched; ventrals thoracic, each with a spine and five branched rays, and with pointed axillary scales. The skeleton has about the normal number of vertebræ (*i. e.* D. 10-11 + A. 11-13); pyloric cæca are developed in small number (*e. g.* 5). The family is quite rich in species, and is well represented in all warm and temperate seas. There is a considerable range of variation in dentition and squamation, as well as in osteological characters. Those exhibiting the characters above enumerated have been distributed by Dr. Günther among three sub-families—viz. (1) *Cantharina*, with more or less broad, trenchant teeth in front of the jaws, no molars or vomerine teeth, including mostly vegetable feeders; (2) *Sargina*, with trenchant teeth in front and molar teeth on the sides, mostly carnivorous; and (3) *Pagrina*, with conical teeth in front and molars on the sides, mostly carnivorous. Dr. Günther also confounds in the same family the Haplodactylina, which are at least more nearly related to Cirrhitidæ, and the Pimelepterina, which typify a peculiar family. Considerably over 100 species are known. Four are inhabitants of the Atlantic coast-waters of the U. S.—viz. (1) A small species named *Lagodon rhomboides*; (2) the celebrated sheepshead, *Archosargus probatocephalus*; (3) the common porgy, *Stenotomus* or *gyrops*; and (4) the doubtful *Sparus aculeatus*. No typical sparoids have yet been detected along the Pacific coast of the U. S. (See also PORGY and SHEEPSHEAD.)

THEODORE GILL.

Spark, Electric and Galvanic. See ELECTRICITY, by PRES. HENRY MORTON, PH. D.

Spark'ill, p.-v., Orangetown tp., Rockland co., N. Y., on Northern New Jersey R. R.

Sparks (JARED), LL.D., b. at Willington, Conn., May 10, 1789; graduated at Harvard 1815; was mathematical tutor there 1817-19, studying theology meanwhile; became pastor of a Unitarian church at Baltimore, Md., May, 1819; was chosen chaplain to the U. S. House of Representatives 1821; published two controversial works on the Trinitarian questions then agitated; conducted at Baltimore a periodical, *The Unitarian Miscellany*, 1821-23; retired from the ministry on account of ill-health, and removed to Boston 1823; purchased the *North American Review*, of which he was sole editor until 1830; published a *Collection of Essays and Tracts in Theology from various Authors, with Biographical and Critical Notices* (6 vols., 1823-26); issued a *Life of John Ledyard* (1828); visited Europe 1828; spent considerable time in examining the English and French archives for materials of American history; founded in 1830 *The American Almanac*; edited for the U. S. government *The Diplomatic Correspondence of the American Revolution* (12 vols., 1829-30); published *The Writings of George Washington, with a Life of the Author* (12 vols., 1834-37); *The Life of Gouverneur Morris* (3 vols., 1832); conducted two series of a valuable *Library of American Biography* (1st Series, 10 vols., 1834-38; 2d Series, 15 vols., 1844-48), for which he wrote several of the lives; edited *The Works of Benjamin Franklin, with Notes and a Life of the Author* (10 vols., 1836-40), and *The Correspondence of the American Revolution* (4 vols., 1854); published two or three controversial pamphlets in defence of his editorial conduct in correcting Washington's orthography and grammar, and upon other similar topics. Dr. Sparks was McLean professor of history at Harvard 1839-49, and president of that institution 1849-53. D. at Cambridge Mar. 14, 1866. A *Memoir* by Rev. George E. Ellis, D. D., was published in 1869.

Spar'land, p.-v., Whitefield tp., Marshall co., Ill., on Illinois River and on Chicago Rock Island and Pacific R. R., has coal-mines, distilleries, and 1 weekly newspaper. P. 558.

Spar'row [Ang.-Sax. *spearwa*], a name applied in English-speaking countries to numerous small birds, chiefly belonging to the family Fringillidæ. (1) The common sparrow of Britain is the *Pyrgita domestica* or *Passer domesticus*. This is a rather strikingly colored bird. The sexes are differently colored: in the male the head is bluish-gray above, with a black band from the base of the bill to the eye, and a longitudinal black streak behind; whitish on the cheeks, and rich rufous brown over the ear and nape of the neck; the back is rufous; the wings also rufous, with the centre of each feather nearly black and with a rather broad transverse whitish band; the chin and throat are black; the breast grayish-brown spotted with white; the belly grayish-white; the length rather exceeds six inches. It is one of the most common and familiarly known of European birds, and is found all through Europe, as well as in Northern Africa and corresponding climatic regions in Asia. It is a sociable, fearless, and rather aggressive species, and seeks the haunts of men, being the most common bird of the cities. The sexes pair early in spring, and are very prolific, having several broods in the course of a year, and five to seven in each brood. They are very careful of their young. The species has been acclimatized in the U. S., and is now common in a number of cities. According to Dr. Brewer, it was introduced into Portland, Me., in 1858, by Mr. Deblois; into New York in 1860 and following years by Mr. E. Schieffelin and (in 1864) the Central Park commissioners; into Boston in 1868 by the city government; into Philadelphia in 1869 by the municipal authorities; and into Washington in 1871 by the Smithsonian Institution. It is now common in all those cities, and has spread into the surrounding country. It is also abundant in St. Louis, Salt Lake City, Havana, etc. (2) Nearly allied to the common sparrow is the tree or mountain sparrow (*Pyrgita montana*). In this the sexes are little differentiated; the head and neck are chestnut, white on each side of the neck, and under the eye and over the ear is a narrow black streak; on the cheeks and sides of the neck a triangular black spot; the back and wings are reddish brown, streaked with black, and crossed by two narrow transverse whitish bands; the chin and throat are black; the breast and belly brownish-white; the length is about five inches and a half, the male somewhat exceeding, and the female rather less than the mean. The species has not quite as extensive a range as the common sparrow, and is comparatively rare in at least many parts of Britain. It is, on the whole, similar in its habits to its congener, but not so prone to settle in cities. Its popular name, "tree sparrow," is due to the belief that it lives and nests

more in trees than the common species, but it also often builds in company with the latter. It has been introduced into the U. S. to a small extent with the common sparrow, and specimens have been obtained at St. Louis. Both these species belong to a group characterized by a robust swollen bill, the lower mandible of which is narrower than the upper.

All the indigenous American "sparrows" have a more slender bill, whose lower mandible is as wide as the upper. The species to which the name is applied are numerous. The recent ornithologists (*e.g.* Baird, Brewer, and Ridgway) use the name in connection with 3 species of *Passerculus*, 1 of *Zonotrichia*, 3 of *Poospiza*, 5 of *Spizella*, 3 of *Melospiza*, 3 of *Peucæa*, 1 of *Embernagra*, and 2 of *Passerella*. The most familiar of these, at least in the Eastern States, is the *Spizella socialis*, called "chipping sparrow" or "chippy."

A prolonged discussion was carried on recently in several journals as to the relations of the common sparrow (*Pyrgita domestica*) to other birds, some contending that it drove the native species away, while others urged that it did not materially interfere with them. It is claimed that the species has proved of service by destroying the measure-worms which formerly infested shade trees in the parks of the several cities. THEODORE GILL.

Sparrow-Hawk, a name given to several forms of the genus *Falco* and sub-genus *Tinnunculus*. They are comparatively small species, whose wings have each two primaries emarginated along their inner webs, the second to third longest, and the first shorter than the fourth; the tarsus longer than the middle claw; and the basal joints of the toes provided with transverse scutellæ; the color of the sexes is very different at all ages, but the old and young of each sex are alike. The common American species is *Falco* (*Tinnunculus*) *sparverius*. Its diagnostic characteristics are the bluish crown (with or without a patch of rufous), whitish front and auriculars, conspicuous "moustache" across the cheeks, the rufous back, the white or whitish abdomen, and the barring of the inner webs of the primaries with white and dusky: in the male the upper part of the head, as well as wings, is ashy-blue or slate-colored, the scapulars, back, rump, and tail rufous; the primaries, secondaries at their basal halves, and broad subterminal band of tail, black; in the female the head is bluish above, but the bluish on other parts is replaced by rufous, which is barred with blackish. Its length is about a foot. The species is an inhabitant of North as well as South America, but is divided by Ridgway into five sub-species or races, limited to various countries; the only U. S. form is the typical *Sparverius*, and this is found from the sub-polar regions to the Isthmus of Panama. It preys upon small birds as well as mice and reptiles. It may be frequently seen perched on the top of a tree nearly erect and motionless, surveying the country around. It breeds in the Northern U. S. as well as farther N., and selects for its nest a hollow tree, in which it lays five to seven dark cream-colored, nearly spherical eggs. It often makes incursions upon poultry-yards for chickens. THEODORE GILL.

Spar'ta. The Greek name of the city signifies "sown land" (σπαρτή, sc. γῆ), and in truth it is characteristic of the city that it did not stand upon rocky heights, as was the case with nearly all Hellenic towns, but upon a group of knolls, which are seen on the right bank of the Eurotas, an hour's journey E. of Mistra, at the spot where now stands a new Sparta. The first glance at the surroundings makes it clear that the springing up of a city in this place was only accidental; it was the camp of the Dorians, who, coming from the N., gained a firm foothold first on this spot, while the Achaians still held possession of the strongholds and cities of the land. The place was marked by an island which at this point divides the Eurotas into two arms, and thus forms a natural crossing. Four cantons were situated here in the pre-Dorian times—Limnai, Kynosura, Mesoa, Pitane. Limnai and Pitane lay in the low lands by the river, and a very ancient bloody Artemis worship united these districts. The centre of the Dorian city was upon the hill, whose southern slope still shows to view the imposing ruins of a marble theatre. Of all the hills, this alone has a considerable level space at the summit, on which lay the sanctuary of the goddess of the acropolis, Athena Chalkioikos, so called because the walls, according to the oldest style of building, were covered with bronze plates, the work of the architect, sculptor, and poet Gitiadas. The large space of low ground E. of the acropolis was occupied by the market-place, in which centred the traffic of all Laconia. A portion of this space, bearing the name Choros, was designed for the representation of festival dances, and this part must be conceived of as within sight of the theatre. The most beautiful side of the market-place was formed by the Persian porch, the entablature of which was supported by figures of barbarians, among them portrait-statues of Mardonius and Artemisia. The market-place was also the seat of government, where the gerontes had their council-house, and the ephors their place of assemblage and archives. The market-place had three outlets. From the first led the street Aphetais (*i. e.* "race-course," *corso*) toward the southern plain. By the second outlet was the Skias, a large pavilion-shaped rotunda, the work of Theodoros of Samos: this building was arranged for assemblies, and lay near the Karneion, the seat of the worship of Apollo Karneios. A third street led from the market-place past the theatre to the tombs of the Agiadæ. While the principal streets led from the market-place toward the plain which stretched out in the direction of the Taygetos range, a hollow way passed through the group of hills to the Eurotas, where, not far from the acropolis, theatre, and market-place, but at the same time in the rural freedom of the river-bank, extended the quarter of the Pitanatæ, esteemed the most beautiful and desirable portion of the city. Down-stream, where the river-bank widened, stretched the dromos, an enclosed space near the gymnasium and stadium, and constituting the training-school of the young Spartans. Next to it, where the bank became still broader, was the so-called Platanistas, low land overgrown with plane trees and intersected by canals, where the young men, divided into two hostile bodies, executed their unarmed but not bloodless mock fights. To the left of the Eurotas extended the Menelaion, which towers above river and plain in the same manner as does the Janiculum above the Tiber. An ancient bridge, the foundations of which still exist, led from Pitane to the hill-top, where the temple of Menelaos and Helena was seen from far crowning a cliff 700 feet in height. Thither thronged the men and women through the festive street, the former praying to Menelaos for success in war, the latter to Helena for the gift of beauty. (*Herodot.*, vi. 61.) A large number of leaden votive figures have been found in the ruins. The Menelaion was situated in Therapne: Therapne was the acropolis long before in the Achaian times: in its recesses lay the Dioscuri at rest, "changing day and day." (*Pind. Nem.*, x. 55.)

The appearance of Sparta was different from all other Grecian cities. The situation had nothing imposing in it. The small hilly undulations by the Eurotas vanish in face of the enormous rocky walls of Taygetos, which rise steeply from the plain to a height of 7500 feet. No monuments exist which characterize the mistress of Hellas. The whole locality gives only the impression of rural grace, and the prophetic words of Thukydides (i. 10) have been literally fulfilled, that in contrast to Athens, Sparta's ruins would give no sign of the former greatness of the city. And yet the historic character of Sparta is to be plainly seen in all the surroundings. The old city never confined itself within narrow walls; the citizens dwelt beside each other, as it were, in the open country. The canals, whose ditches are seen extending diagonally over the site of the old city, watered the gardens and plantations; there was no distinction between town and country. The laws of Lycurgus forbade the luxury of municipal architecture, even the dwellings of the kings preserved a patriarchal simplicity. The city, as she became powerful, was filled with votive offerings to the gods, especially with tripods, but the sacred centre of the land was not Sparta, but the Amyklaion. In Sparta also, after the Persian wars, a more imposing style of architecture was introduced, as is shown by the Persian porch; but the more Athens took the lead in the arts, so much the more remained Sparta behind, and even Lysander's victories brought the city no new adornments. It only lost more and more its old Doric character; the dwindling numbers of the citizens drew closer together; they themselves were no longer a sufficient protection; ditches and entrenchments were constructed against Demetrius (296), and against Pyrrhus (279), and at last the city was enclosed with a wall whose extent Polybios gives as 48 stadia (ix. 21). As Polybios says that Sparta within this circuit was much larger than Megalopolis within its wall of 50 stadia, we must conclude that the wall had a circular form and the city a dense population. The wall was a symptom of degeneration and loss of freedom (*Livius*, 39, 37); even under the tyrant Nabis it did not enclose the town completely, but only protected the open sides. It was restored after the capture of the city under Philopoimen, and remained under the Romans, under whose sway Sparta was one of the most populous and prosperous cities of the peninsula.

As Sparta was never destroyed in antiquity, and was uninhabited in the Middle Ages, it is reasonable to suppose that many antiquities will be found in the deep soil. Very remarkable reliefs of the old style have come to light in the last few years; especially worthy of mention is the four-sided pedestal with the reliefs, published in the *Annali del*

Instituto (1861, tav. d'agg. C), and the relief with Dionysos and Ariadne (1870, p. 272). Since the foundation of the kingdom of Greece the capital city of the Eurotas Valley is no longer Mistra, situated near Taygetos, but has been removed again to the Eurotas, and New Sparta spreads itself out on the hills of the old city. ERNST CURTIUS.

Sparta, p.-v. and tp., Conecuh co., Ala., on Mobile and Montgomery R. R. P. 913.

Sparta, p.-v., cap. of Hancock co., Ga., on Macon and Augusta R. R., contains 7 churches (3 colored), an academy, a weekly newspaper, 1 cotton-factory, a steam saw-mill, and 1 hotel. P. about 1500.

ELAM CHRISTIAN, ED. "TIMES AND PLANTER."

Sparta, tp., Knox co., Ill. P. 1950.

Sparta, city, Randolph co., Ill., on Cairo and St. Louis R. R., 50 miles S. of St. Louis, Mo., was first settled in 1829 under the name of Columbus, but changed to Sparta in 1840; contains 6 churches, a public library, a high school, 1 bank, 1 newspaper, 3 flouring and 2 woollen mills, 2 large plough-factories, and 4 wagon and carriage factories. P. 1335. S. LOVEJOY TAYLOR, ED. "PLAINDEALER."

Sparta, p.-v. and tp., Dearborn co., Ind., on Ohio and Mississippi R. R. P. 1939.

Sparta, tp., Noble co., Ind. P. 1381.

Sparta, p.-v., cap. of Bienville parish, La., has 1 newspaper and a thriving trade.

Sparta, v. and tp., Kent co., Mich., on Grand Rapids Newaygo and Lake Shore R. R. P. 1666.

Sparta, tp., Chippewa co., Minn. P. 275.

Sparta, p.-v., Chickasaw co., Miss. P. 99.

Sparta, p.-v. and tp., Sussex co., N. J., on Sussex R. R. P. 2032.

Sparta, v. and tp., Livingston co., N. Y., on Canaseraga Creek. Daniel Shays, the leader of "Shays's rebellion" in Massachusetts, was an early settler, and d. here Sept. 29, 1825. P. 1182.

Sparta, p.-v. and tp., Edgecombe co., N. C. P. 1522.

Sparta, p.-v., Bloomfield tp., Morrow co., O. P. 197.

Sparta, tp., Crawford co., Pa. P. 1131.

Sparta, p.-v., cap. of White co., Tenn., has 1 weekly newspaper. P. 414.

Sparta, p.-v. and tp., cap. of Monroe co., Wis., in the heart of La Crosse Valley, at the junction of Chicago Milwaukee and St. Paul and Chicago and North-western R. Rs., has 6 churches, excellent schools, 2 banks, 2 newspapers, a public library and reading-room, paper, woollen, and flouring mills, carriage-works, machine-shops, a large pork-packing establishment, several hotels, and medicinal springs. P. of v. 2314; of tp. 3461.

D. W. C. WILSON, ED. "MONROE CO. REPUBLICAN."

Spar'tacus, b. in Thrace, and educated as a shepherd; became afterward chief of a gang of robbers, but was captured by the Romans, sold as a slave, and trained as a gladiator in a school at Capua. By showing how much better it would be to die in an attempt at freedom than to be butchered for a Roman holiday in the arena, he succeeded in forming a conspiracy among the pupils of the schools, numbering 200, mostly Gauls and Thracians. But the conspiracy was discovered, and only 70 of the members, among whom were Spartacus and some of the other leaders, escaped. From a cook's shop they snatched some spits and cleavers, fought their way through the streets and gates of Capua, pillaged a train of wagons laden with arms which they met on the road, and took refuge in the crater of Vesuvius. Here they were soon joined by numbers of runaway slaves; an organization was accomplished, Spartacus was chosen leader, Crixus and Œnomaus, two Gauls, his lieutenants, and formidable predatory expeditions were undertaken against the neighboring towns. C. Claudius Pulcher was then sent against them, and blockaded them in the crater with an army of 3000 men. But on ladders twisted of wild vines Spartacus led his troops down through one of the most impracticable, hence the least guarded, fissures of the crater, attacked C. Claudius Pulcher unexpectedly in the rear, and annihilated his army. After this success the insignificant mutiny of a few slaves rapidly grew into a formidable war. The peculiar state of affairs in Southern Italy contributed much to this result. The numerous villages, with their free agricultural population, which formerly flourished in these regions, had entirely disappeared during the wars by which Rome finally subjugated and annexed the country. The bad policy of the Roman statesmen, the insatiable greed of the Roman nobility, and a thirst after vengeance in the Roman people had caused this widespread devastation. The soil was now almost exclusively owned or leased in large allotments by the Roman nobles, who raised immense flocks here or cultivated extensive olive-plantations and vineyards by means of a numerous slave population, which lived in the most abject condition. Spartacus proclaimed the abolition of slavery, and before long he was at the head of an army of 70,000 men. Cities were conquered, armies were routed, and Rome seemed to be on the very verge of ruin. Spartacus, however, had a just idea of the enormous resources which the city could command in an emergency. He never dreamed of conquering it. His plan was simply to force the passes of the Alps, lead his army out of Italy, and then send every man to his home. With a victorious army of about 100,000 men he passed by Rome, and penetrated into the regions of the Po, where he was met by two consular armies. He defeated and routed them both, and at the funeral games which he celebrated in honor of Crixus he compelled the Roman knights among his prisoners to fight as gladiators in the arena, while their former slaves sat in the amphitheatre as spectators and applauded them. These victories, however, which prove that he must have been possessed of considerable military talent, made it difficult for him to command his own army. His soldiers were allured by the prospect of booty, and refused to leave Italy. He returned to Southern Italy, and went into winter quarters in Thurii. Meanwhile, dissensions arose in his camp. The Gauls separated and formed an independent army, which was speedily annihilated by the Roman generals. The discipline in the main army became weakened, and the situation soon became difficult. Spartacus knew very well that by force he could never compel Rome, but he hoped to come to terms with her by carrying the war over to Sicily, the cornfield of Rome, where a recent and very dangerous slave insurrection was not yet wholly extinguished. He hired the fleet of the Cilician pirates to carry him across the strait, but they betrayed him, and delivered up a part of his army to the prætor, Licinius Crassus, who blockaded him at the extreme point of Bruttium. An attempt to cross on rafts and wicker boats failed, and he was nearly lost, when by a violent assault he broke through the intrenchments of Crassus, and once more made Rome tremble. Lucullus was now recalled from the East, Pompey from the West. After new victories, Spartacus turned toward Brundisium with the purpose of seizing the shipping in the harbor and crossing over to Thrace. But Lucullus had just landed here from Epirus. Turning back, he fell in with the army of Crassus, near the source of the river Silarus, and, well aware that the final moment approached, he killed his war-horse in front of his army and plunged himself into the midst of the desperate struggle, in which he was killed. His army was cut to pieces and dispersed. One remnant of it was destroyed a few days afterward by Pompey; 6000 fugitives were crucified along the Via Appia; and thus ended the Servile War, which had lasted only two years (73-71 B. C.), but which was not so soon forgotten. Later Roman authors, among whom are Cicero, Horace, etc., never become tired of vilifying the slave-leader; but their invectives appear inappropriate and time-serving to modern eyes; for his cause was just, his talents admirable, and his character by no means destitute of grandeur and elevation. CLEMENS PETERSEN.

Spar'tanburg, county of N. W. South Carolina, bordering on North Carolina, watered by affluents of Broad River, and traversed by Spartanburg and Union and Atlanta and Richmond Air line R. Rs., has a hilly surface, but productive soil. Cattle, horses, sheep, and swine are numerous, and it has several cotton and flour mills. Staples, Indian corn, wheat, oats, sweet potatoes, cotton, a little tobacco, butter, and wool. Cap. Spartanburg. Area, about 900 sq. m. Pop. 25,784.

Spartanburg, p.-v., Green's Fork tp., Randolph co., Ind. P. 192.

Spartanburg, p.-v. and tp., cap. of Spartanburg co., S. C., on Piedmont Air-line, Spartanburg and Union, and Spartanburg and Ashville R. Rs., contains Wofford College, a female seminary, orphans' home, 3 newspapers, 2 banks, 2 large hotels, 2 carriage and wagon factories, and excellent water-power. P. of v. 1080; of tp. 2669.

F. M. BROWNE, ED. "SEMI-WEEKLY SENTINEL."

Spartansburg, p.-v., Sparta tp., Crawford co., Pa., on Pittsburg Titusville and Buffalo R. R. P. 457.

Spartianus (ÆLIUS). See LAMPRIDIUS.

Spasm [Gr. σπασμός, from σπᾶν, to "draw or stretch"], sudden and involuntary muscular contraction. The relaxation and tension of muscular tissue are dependent on nerve-force. Spasm of muscle may result from disturbance of the nerve-centres, from peripheral irritation of the affected part, or from irritation of other organs or surfaces, reflected from the nerve centres. When spasmodic rigidity is persistent for any length of time, it is termed *tonic* spasm. Such is the period of rigidity at the beginning of the epileptic attack and the prolonged rigidity of tetanus and cerebro-spinal meningitis. When spasm is brief and re-

curs rapidly, it is termed *clonic* spasm. Such are the intermitting and repeated muscular contractions following the inception of the true epileptic attack, and constituting the more ordinary epileptiform attacks or "fits" of children, the contractions of chorea and of hysterical seizures. The graver spasmodic diseases are true epilepsy, epileptiform attacks from many causes, as indigestion and worms in children, renal disease in adults, and in the course of severe acute diseases, narcotic poisoning, etc., chorea or "St. Vitus's dance," tetanus, hydrophobia. Many lesser and local states of spasm frequently occur. Sneezing and coughing are spasmodic contractions of the respiratory tracts excited by irritation of the nasal or bronchial mucous membrane. Spasm of the larynx in nervous temperaments causes aphonia. Asthma is spasmodic constriction of many bronchial tubes, producing dyspnœa. Whooping-cough unites extreme hyperæsthesia and spasm of the bronchi with spasmodic constriction at the larynx—a succession of violent expiratory spasms or coughs, followed by a sonorous or whooping inspiratory sound. Spasm of the heart, evidenced by dyspnœa, præcardial distress, and disturbed circulation, by intermitting and irregular heart-beats, has many causes—excess of food, indigestion, narcotic depression. Angina pectoris, or spasm of the heart, with associated spasm of the thoracic walls, is frequently due to disease of the coronary arteries, the nutrient vessels of the heart-wall. Spasm of the diaphragm may be due to indigestion, to taking cold, or to gouty or rheumatic vice. Intestinal colic and cholera morbus are conditions of painful spasmodic constriction of the intestines, due to cold or bad diet. In invalids and persons of sensitive nervous system painful spasms of various internal and external parts may develop suddenly from unknown or trivial exciting causes. The immediate relief of spasm is secured by so-called antispasmodics or nervines, as valerian, musk, camphor; by anæsthetics, narcotics, and sedatives, as bromide of potash, hyoscyamus, belladonna, opium. The permanent cure, when admissible, demands the correction of known causes, as debility, indigestion, and the rheumatic, gouty, and other blood-taints.

E. Darwin Hudson, Jr. Revised by Willard Parker.

Spathe [Gr. σπάθη, a word allied to our *spade*], the single sheathing bract which encloses a cluster of one or more flowers in many species of endogenous plants. Sometimes the enclosed flowers are arranged on a spike of the form called *spadix* (σπάδιξ), and in numerous palms the spadix is branching, and besides the principal spathe there are numerous secondary ones on the spadix.

Spathic Iron Ore. See Iron, Ores of, by John B. Pearse.

Spauld'ing, tp., Prince George's co., Md., on Potomac River, adjoining the District of Columbia. P. 1687.

Spaulding, tp., Saginaw co., Mich., includes p.-v. of South Saginaw. P. 2117.

Spaulding (Elbridge Gerry), b. at Summer Hill, Cayuga co., N. Y., Feb. 24, 1809; educated at Auburn Academy; taught school; studied law; was admitted to the bar in Genesee co.; removed to Buffalo 1834; became solicitor and councillor in chancery, city clerk, and alderman; was chosen mayor 1847; member of the State assembly 1848; member of Congress 1849–51, and again 1859–63; State treasurer 1854–55; was member of the canal board two years, and for several years president of the Farmers' and Mechanics' Bank of Genesee at Buffalo. He served in Congress on the committees on foreign affairs and on ways and means, and has published a number of speeches and pamphlets on finance and general politics.

Spaulding (Levi), b. at Jaffrey, N. H., Aug. 22, 1791; graduated at Dartmouth College 1815 and at Andover 1818; went to Jaffna, Ceylon, as a missionary of the American Board; remained on that island fifty-three years, during which time he made but one visit to the U. S. (1844); superintended a female boarding-school at Oodooville; prepared tracts, hymns, and schoolbooks in the Tamil language, into which he translated several religious works; prepared (with Rev. J. Knight) a *Tamil Dictionary* (Madras, 1844), and issued a revised translation of the Bible. D. in Ceylon June 18, 1873, being then the oldest missionary of the American Board.

Spav'in [It. *sparenio*], certain swellings upon the hock-joint of the horse. In the parlance of the stable the name "spavin" is applied to two entirely dissimilar diseases. In "bog spavin" and "blood spavin" the swellings and lameness, if there be lameness, are due to undue secretion of *synovia* (the lubricating fluid of joints and parts subjected to friction) in the hock-joint or in the sacs (*bursæ mucosæ*) which are located upon or near the hock. "Thorough-pin" is identical in character and similarly located, and is distinguished by the fluid occupying two connected cavities, into either of which it may be forced by gentle pressure, and so back and forth. These swellings amount to a deformity, but are seldom, if let alone, a serious inconvenience to the animal, although it may be otherwise in the worst forms of the disease. They are, however, unsightly and difficult of reduction. The lameness which sometimes accompanies them, observable when the horse is first taken out of the stable, is due to the inflammation of the synovial membrane of the joint, which is indeed the cause of the excessive secretion of the fluid. The most successful treatment is entire rest, with frequent bathing of the parts with cold water, and bandaging, accompanied by firm pressure upon the swelling, secured by means of compresses or spring trusses. Blistering is of little or no avail. Bone spavin, or spavin proper, is bony enlargement (exostosis) of the hock-joint, usually commencing at the lower part of the joint on the inside, and involving the heads of the splint and cannon bones, and of the small bones with which they articulate. It causes lameness, observable even in the early stages, and an imperfect action of the joint, gradually growing worse until finally the various bones become to a great extent united and solidified by the mass of fibrous bone which grows over them. The disease is caused by strains, to which the hock is particularly subject in work-horses drawing heavy loads, especially when starting them, and in race-horses and saddle-horses accustomed to leaping. The lameness caused by spavin in its incipiency is most observable when the horse is first taken out from the stable. Even before this is much noticeable, a slight swelling may be detected upon the inside of the hock in front of the middle of the joint. To see this distinctly, both hocks should be examined and compared with care, for the shape of this joint—and of all joints—in different horses varies considerably, but the corresponding processes upon different legs of the same horse will be alike if both are sound. When taken early, rest and counter-irritants will effect a cure; but when a considerable growth of bone has taken place, no absorption sufficient to cause a permanent cure can be expected, although setons, iodine blisters, or firing may cause an absorption of the bony excrescence, or even of the contiguous bone to some extent. The wisest course in an attempt to cure a spavined horse, when the disease is taken early, is to turn the animal out to grass, or otherwise regulate his diet so that his food shall be nutritious yet cooling, and moderately loosening to the bowels. At the same time, the "spavin-place" may be bathed for a week daily with salt and vinegar, and then a blistering salve of biniodide of mercury rubbed in upon the spavin. The salve may be applied once in three or four days, and both the strength and frequency of the application should be graduated according to the amount of excitement produced in the skin, avoiding any considerable blistering, but maintaining irritation upon the surface. After several applications, the spavin may be let alone until all heat and evidence of excitement in the skin have gone down, and the treatment then renewed. When not taken at its earliest stage, entire rest in the stall will promote a solid union (ankylosis) of the bones affected, and cooling lotions, salt and vinegar and iodide of potassium in solution in water, with attention to diet, will reduce the swelling of the contiguous parts, which is often considerable. Thus, after a while the horse will be able to labor with little or no pain, but with more or less stiffness of the joint. Severe blistering and the use of the firing-iron are, as a rule, not advisable, and should never be resorted to except as applied by a veterinary surgeon of education and responsibility—never by a farrier. Though caused by strains and overwork, spavin is peculiarly hereditary, and a spavined horse or mare should never be used as a breeder. M. C. Weld.

Speak'er, p.-v. and tp., Sanilac co., Mich. P. 1118.

Speaker of the House, the presiding officer of the British Houses of Parliament, of the House of Representatives of the Congress of the U. S., of the lower houses of State legislatures, etc. In the parliamentary bodies of many of the British colonies the name and office of Speaker are also retained. In England the title was first applied to Sir Thomas Hungerford in 1376 (*temp.* Edward III.), Speaker of the Commons, but the office is much more ancient. The lord chancellor is usually the Speaker of the House of Lords. As the representative of the House, the Speaker communicates its resolutions to others and conveys its thanks or censures. He is thus the mouthpiece of the House, whence his title seems to be derived. In the U. S. House of Representatives the Speaker presides over the deliberations of that body, appoints its committees, supervises its journal, certifies to the amount of compensation due its members, signs its bills, resolutions, writs, warrants, subpœnas, etc., and appoints three regents of the Smithsonian Institution. He votes in cases of ballot, and has a casting vote in some other cases. He is chosen

by the House from its own number, and can be removed from office by the House.

Speak'ing-trumpet, an instrument usually in the form of a hollow truncated cone, the mouth-piece at the smaller end, and the larger end with a reflected lip. It is used for intensifying the sound of human speech and causing its further propagation in one direction. Its chief uses are on shipboard and in giving commands to firemen during conflagrations. The trumpet is of wood or metal. Its invention is ascribed to Kircher and to Sir Samuel Moreland, but the instrument was well known long before their time; and Alexander the Great, we are told, made use of it in his wars. The theory of the action of this instrument has never been thoroughly explained.

Spear (Samuel P.), b. at Boston, Mass., in 1815; entered the U. S. army 1833; served in the 2d Dragoons through the Florida war, and in all the battles of the Mexican war under Gen. Scott, being wounded at Cerro Gordo; was stationed on the frontier 1848–61, taking part in the Utah expedition under Gen. A. S. Johnston; raised and commanded during the civil war the 11th Pennsylvania Cavalry, which did good service in scouting; was wounded twice at Five Forks; was made brigadier-general and brevet major-general; suffered during his last years from a slow disease contracted in the service, and after long illness d. in St. Luke's Hospital, New York City, May 5, 1875.

Spear (Samuel Thayer), D. D., b. at Ballston Spa, N. Y., Mar. 14, 1812; graduated as a doctor of medicine Apr. 15, 1833, at the College of Physicians and Surgeons in the city of New York; studied theology under Rev. Dr. Beman of Troy, N. Y.; was ordained and installed over the Second Presbyterian church of Lansingburg, N. Y., 1835; in 1848 accepted a call from the South Presbyterian church in Brooklyn, N. Y., and in 1870 became one of the editors of the *Independent*, which position he now (1876) holds. His publications are *The Family Power*, *Eighteen Sermons on the Rebellion*, preached during the war, ten essays in various quarterly periodicals, *The Legal-Tender Acts considered in Relation to their Constitutionality and Political Economy*. He has in press a work to be entitled *Religion and the State, or the Bible and the Public Schools*. R. D. Hitchcock.

Spearman's, tp., Shelby co., Ala. P. 500.

Spear'mint (*M. viridis*), a species of plant of the genus *Mentha* and order Labiatæ, found abundantly in Europe and the U. S., generally upon moist soil; is frequently cultivated for the sake of its leaves, which are used as the chief ingredient in a popular sauce for roast meats and for imparting a flavor to alcoholic beverages. An oil is also distilled from spearmint, and from this an essence is prepared, both possessing valuable medicinal uses. The common spearmint is a handsome plant, with deep-green, lanceolate, acutely serrate, and nearly sessile leaves, and pale purple flower springing from an erect stem, usually two feet in height.

Spe'cies [Lat.], in logic, denotes a group of individuals agreeing in common attributes and designated by a common name, this group of individuals being one of several groups agreeing with it in some of the common attributes, and included with those groups under a common name called the *genus*. Thus, genus and species are relative terms, and the same concept may be a genus when considered in relation to subordinate concepts, which are its species, or a species when considered as subordinate to a more general concept. Thus, *man* is a genus with reference to *negro, Indian, European*, etc., and a species with reference to *animal, biped*, etc. While the *summum genus* can never in turn be species, the *infima species* is the species which can never become *genus*, but can contain only individuals. There can be only one *summum genus*, but there is practically no limit to the number of species, and hence it is next to impossible to ascertain the *infima species*. The species has greater comprehension (*i. e.* more attributes belong to it) and less extension (includes fewer individuals) than the genus.

Species, in perception, is a term used formerly in explaining the process of external perception. It was maintained that external objects send forth *species* or images of themselves, which make impressions on the bodily organs and imprint themselves on the mind. A *sensible species* was the resulting impression upon the senses; an *intelligible species* the concept of the understanding. William of Occam and his followers vigorously combated this theory of vicarious species, as indeed Reid and the Scotch school have done recently. Apart from this theory, however, the question of the reality corresponding to the species was discussed by the Nominalists and Realists (which see), and forms one of the most interesting themes in the history of philosophy. William T. Harris.

Specification. See Patents, Laws relating to, by George Gifford.

Specific Gravity. See Gravity, Specific, by Pres. F. A. P. Barnard.

Specific Heats. See Heat, by Prof. W. P. Trowbridge, A. M.

Specif'ic Perform'ance. This term belongs to the equitable jurisprudence of the U. S. and of England, and denotes the species of remedy conferred by courts of equity, in which a party is compelled to perform the very thing which he has undertaken to perform in behalf of the person to whom the undertaking is given. In its broadest sense the phrase would properly describe all the varieties of equitable relief, which consist in procuring a defendant upon whom an obligation rests to do the very specific acts which such obligation requires him to do; but in its technical and more restricted signification it is confined to cases in which the obligation arises out of a contract entered into by the defendant. The common law knows but one form of remedy for the breach of any and all contracts—a recovery of money either as debt or damages. Whatever be the nature of the agreement, whatever be its subject-matter, whatever acts or omissions it calls for, a pecuniary compensation for its non-performance is the only judgment that can ever be obtained against the defaulting party by means of the common-law courts. It is very plain that in the innumerable variety of relations incident to modern society contracts will necessarily be made for whose breach this mere pecuniary payment would be an utterly inadequate, and often impracticable, relief; and a system of municipal law which provided no other kind would fail in maintaining and dispensing the justice which is the final object of all enlightened jurisprudence. To supply this defect in the common-law methods the courts of equity began long since to decree the specific performance of contracts in certain cases; and the general principles which determine the classes of agreements to which this remedy may be applied are now ascertained and well settled, and constitute a distinct department of equity. The doctrine as thus established will be shown in the simplest and clearest manner by enumerating the instances in which a specific performance will not be decreed, and which are therefore left within the exclusive jurisdiction of the common-law tribunals and to the application of the common-law remedies: (1) The fundamental and most important rule is, that a specific performance will not be ordered when the complaining party can obtain adequate relief by means of a purely legal judgment. If, therefore, the contract vests the plaintiff with property in a chattel, so that he can recover its possession through an action at law, or if by the money recovered he can restore himself to the same position, in contemplation of law, which he would have occupied if the defendant had fulfilled his agreement, he will be left to his legal remedy alone, and courts of equity will not interfere in his behalf. As an illustration: If the contract relates to ordinary goods and chattels, or to any kind of personal property having a marketable value, and contemplates a delivery thereof in any manner or a transfer of title, since a sufficient sum of money paid to the injured party will always enable him to purchase or procure other articles of a like nature, amount, and value to those stipulated for, such a pecuniary compensation is deemed an adequate remedy, and a specific performance will be refused. The example here given, and the fundamental rule which it illustrates, have a very wide application, and they remove at one blow all ordinary agreements concerning personal property, especially those which are mercantile in their character, from the operation of this equitable mode of enforcement. The mere fact, however, that an agreement deals with or relates to personal property does not necessarily withdraw it from the jurisdiction of a court of equity. The subject-matter may be a chattel of some peculiar, intrinsic, but not marketable value, which cannot be elsewhere purchased or reproduced, so that pecuniary damages will not compensate for its loss; and in such cases, although they are exceedingly rare, the specific relief may be obtained. A certain class of covenants, also, wherein the parties promise to execute some further and more formal agreements—as, for example, to execute a marriage or family settlement on wife and children—may be specifically enforced by compelling an execution of the contemplated instrument, although it relates to personal property and not to real estate. These instances, however, are comparatively few, and in the vast majority of contracts concerning personal property or personal services the money-recovery granted by the law-courts is regarded as an adequate relief, and the extraordinary remedy administered by the equity tribunals is denied. In all the subsequent rules it is of course assumed that the agreement, if judged by the principle alone

which has [illegible], is one to which the equitable method [illegible] be applied. (2) In order that a [illegible] may be decreed, such a performance [illegible] possible by the contracting part[illegible] the original terms of the contract he [illegible] to fulfil, or if from circumstances [illegible] the power has been lost, even [illegible] produced by his own voluntary act, a [illegible] go through the empty form of or[illegible] to be accomplished, and the plain[illegible] with an award of pecuniary damages, [illegible] may be enhanced by reason of the defend[illegible]. For example, if the owner of a farm should, [illegible] agreement of sale, bind himself to convey it to [illegible] on a future day named, but before that time [illegible] should actually convey it to another *bonâ-fide* [illegible], a specific performance of the contract would not be decreed at the suit of the original vendee, because a transfer of the title to him by the vender would then be impossible, and he would be left to his action for damages. As a corollary of this rule, it is requisite that the terms of the contract should be so plain and unambiguous that there can be no reasonable doubt as to the intention of the parties, and that this design may be directly carried into effect by the judgment. (3) Not only must the performance be possible by the party upon whom the obligation rests, but the subject matter of the agreement, and its stipulations in regard thereto, must be of such a nature that the court, by means of its ordinary administrative instruments and machinery, can compel the specific performance which it decrees. Cases may arise, and are not infrequent, in which the court, after directing a performance according to the provisions of the contract, would have no power to directly enforce its decision without departing from its customary functions or incurring an amount of trouble, care, and responsibility incompatible with the discharge of its regular duties; a specific performance will then be refused, however inadequate might be a mere recovery of damages. Under the operation of this principle the agreement of an actor, a singer, a painter, or other artist to employ his talents in a specified manner cannot be specifically enforced; and the rule applies in general to all stipulations for personal services, notwithstanding the fact that these services may be of such exceptional value that they cannot be procured from any other person but the defendant. For the same reason, it has been decided that the specific performance of a contract to construct a railroad will not be decreed, since such an undertaking is too extensive and burdensome to be carried on under the direction of a court of equity. (4) Finally, in addition to the foregoing requisites, the agreement and the relations of the parties must be such that a decree of specific performance will be reasonable, just, and equitable. It is sometimes said that this remedy is never a claim of right, but is always a matter of discretion. The doctrine as thus stated simply means that in determining whether the relief shall be granted in a given case certain equitable considerations are to be taken into account, and not the mere fact that the agreement is valid in law. The beneficent principle is applied that he who seeks equity must do equity. If, therefore, the contract was procured by overreaching or artifice, although not so tainted with fraud as to be invalid, if it is unfair or oppressive in its terms, if the consideration is grossly inadequate, if its specific enforcement would be unreasonably burdensome to the defendant without any corresponding benefit to the plaintiff, if the plaintiff has been guilty of unnecessary delay in prosecuting the action whereby his opponent has been prejudiced,—in these and in similar cases showing a want of good faith or diligence on one side or serious injury on the other, the equitable considerations become controlling, and lead to a denial of the specific remedy. As the practical result of the foregoing rules, the usual contracts which are enforced by a decree for a specific performance are those directly relating to land as their subject-matter. It is a settled doctrine of the equity courts that money-damages are not an adequate relief for the breach of such agreements. This conclusion is partly based upon the fact that a special value may be attributed to the very premises bargained [illegible] not susceptible of pecuniary estimate and compensation, but chiefly upon the pre-eminence which the English law has always given to the ownership of land in comparison with every other species of property. A contract for the [illegible] of land, or for the creation of an estate therein, [illegible] by the statute of frauds, and if complying with the [illegible] above described, will in general be enforced [illegible] of specific performance compelling the execution of the proper instruments and the creation or transfer of [illegible] interests. What contracts are thus valid under the [illegible], and how far courts of equity have grafted exceptions upon this enactment, substituting certain acts of the parties—such as the vendee's possession, making improvements, and payment of the price—in place of the written evidence required by the legislature, are questions of the highest importance, but do not legitimately belong to the subject-matter of this article. (See FRAUDS, STATUTE OF.)

JOHN NORTON POMEROY.

Spec'tacles [Lat. *spectaculum*], a device for the improvement of defective sight, the invention of which is variously ascribed to Alexander da Spina of Florence, or to his contemporary and fellow-townsman, Salvinus Armatus (d. 1317); also to Roger Bacon (d. about 1292). But it is more probable that the knowledge of them in Europe came through the Saracen Alhazen (d. 1038). The Chinese, we are told, have for ages employed spectacles for the relief of defective eyesight. Spectacles are of various kinds. For long-sighted (presbyopic) persons, whose imperfect vision is due to too great flatness of the lens and cornea, either plano-convex lenses or menisci are employed (the latter, called periscopic glasses, were recommended by Wollaston). Both of these magnify objects and render near objects more distinct. Near-sighted spectacles (for the use of myopic persons, those whose cornea and crystalline lens are too convex) are either plano-concave, concavo-concave, or, in the case of the so-called periscopic glasses, the front is slightly convex and the inside deeply concave. Plane glasses, colored blue, green, or smoky, are used by persons with eyes too sensitive to the light. Cataract-glasses have powerful convex lenses, and are employed by persons whose eyes have been operated upon for cataract. Of late, considerable attention has been given to the examination of each eye, and the careful adaptation of each lens to the needs of the eye it is to serve; since it is very common, especially in myopic or near-sighted persons, to find different degrees of abnormality in the two eyes. Periscopic glasses permit the wearer to examine objects with less turning of the head than others. Many spectacles are sold which, as dealers pretend, have their surfaces ground to a parabolic curve, but the construction of such lenses is difficult and expensive, although it is certain that if properly made there would be somewhat less spherical aberration with such lenses. The best optical glass should be used for spectacles. Brazilian pebble (rock-crystal), first recommended by Brewster, has a very low dispersive effect, and if of perfectly uniform refractive power would consequently be better than glass; but it is stated that in practice it is found defective, and that nearly all the so-called pebble spectacles are of a common grade of glass. (See also OPHTHALMOLOGY.)

Spectator. See ADDISON (JOSEPH).

Spectral Illusions, Delusions, and Hallucinations. See INSANITY, by W. A. HAMMOND, M. D.

Spectre, applied to animals. See LEMUR.

Spec'troscope [Lat. *spectrum*, "image," and Gr. σκοπεῖν, to "see"]. An instrument, as its name implies, designed for the formation and examination of spectra. Although as yet (1876) the invention is barely sixteen years old, we already owe to it many of the most remarkable discoveries of modern science. By its means the light from a body, at whatever distance, can be made to tell more or less completely the story of its chemical composition, physical conditions, and motion.

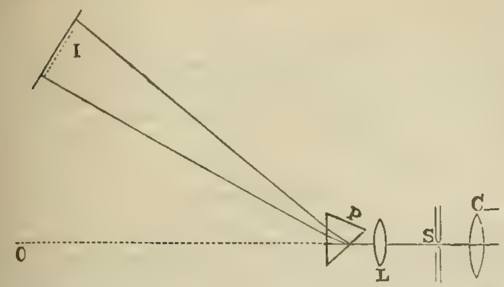
Newton's Experiment.—If a beam of sunlight entering a darkened room be made to pass through a triangular prism of glass at the proper angle, the rays will be *refracted* out of their course, the different colors taking slightly divergent paths; if a white screen be now placed so as to receive the refracted beam, there will be formed upon it an elongated band of colored light, red at one extremity and violet at the other, with the remaining hues of the rainbow—orange, yellow, green, blue, and indigo—arranged in order between them. This colored band is called the *solar spectrum*, and the experiment described we owe to Newton, who thus discovered the composition of white light.

Projection of the Spectrum.—The spectrum formed in this way is impure, since the different colors overlap each other. But if the light be admitted only through a very narrow slit placed parallel to the edge of the prism, and then, before reaching the prism, be passed through a convex lens so adjusted that if the prism were absent it would form a distinct image of the slit upon the screen, we shall get a pure spectrum, with each tint completely isolated from every other. If sunlight be employed, the spectrum will be marked by numerous faint *dark* lines; if the electric light, it will show *bright* bands and lines. This is the method ordinarily used in exhibiting the phenomena to an audience. The accompanying diagram (Fig. 1) will make the arrangement clear.

Wollaston's Experiment.—Another method is simply to look through the prism at a narrow slit from a distance of 20 or 30 feet. It was in this way that, in 1802, Wollaston

first observed a few of the dark lines in the solar spectrum. Some years later, in 1814–15, Fraunhofer, the celebrated op-

FIG. 1.



C, condensing lens, important but not essential; S, slit; L, lens forming image of slit; P, prism; I, spectrum; O, place where image of slit would fall if the prism were removed.

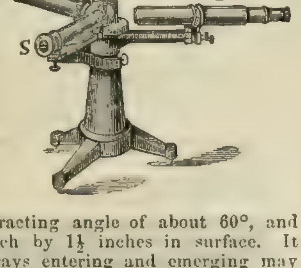
tician of Munich, independently made the same observation, and by substituting for the naked eye a small telescope, greatly increased the power of the apparatus. He made a very careful and accurate map of the spectrum, and to this day its dark lines are known by his name. He also made some observations of a similar nature upon the light of the moon and the stars. He satisfied himself, moreover, that the cause of the lines was not in our atmosphere nor in anything connected with the apparatus.

The Collimator.—Either of the arrangements thus far described requires a considerable distance—15 or 20 feet at least—between the slit and the spectrum. Zantedeschi of Milan appears to have been the first to overcome the difficulty in 1846 by the invention of what is called the *collimator* (from the fact that a very similar piece of apparatus is used to determine the collimation of an astronomical instrument). Swan of Edinburgh was an independent inventor of the same contrivance a year later. The collimator is simply a tube closed at one end by a plate of metal perforated with a narrow slit, and at the other by a convex lens whose focal length equals its distance from the slit. The effect is, that rays proceeding from the slit are rendered parallel by passing through the lens, and then behave in all respects as if they came from an infinite distance. *Optically*, the slit is thus transferred to the sky, while mechanically it remains within easy reach of the manipulator.

As ordinarily constructed, the spectroscope consists essentially of three parts—a collimator as above described, a prism or train of prisms, and a small telescope to which the eye is applied in observation: usually, a scale of some kind or a graduated arc is provided for the purpose of determining with accuracy the position of any lines or bands observed in the spectrum.

The Chemical Spectroscope.—The annexed figure (Fig. 2) represents the common chemical spectroscope as invented by Kirchhoff in 1859. C is the collimator, carrying at its left-hand extremity the slit, which is usually about $\frac{1}{8}$th of an inch long, and adjustable in width from $\frac{1}{50}$th to $\frac{1}{5000}$th of an inch. The diameter of the collimator is about an inch, and its length from 6 to 8 inches. The prism, generally of flint glass,

FIG. 2.



is at P. It has a refracting angle of about 60°, and plane faces about 1 inch by $1\frac{1}{2}$ inches in surface. It is so placed that the rays entering and emerging may make equal angles with the two surfaces. The telescope T receives the rays after they have passed through the prism. S is a collimator in all respects similar to C, except that instead of a slit it carries at its extremity a small scale photographed on glass. This scale-collimator is so placed that the light coming through it from a candle or gas flame suitably placed is reflected (partially only, of course, but still in sufficient amount) from the anterior face of the prism into the telescope. Thus, the observer sees at the same time the spectrum and immediately above it the scale.

Formation of the Spectrum—a Congeries of Images of the Slit.—If the light by which the slit is illuminated be *homogeneous*, the observer looking through the telescope will see simply a single image of the slit, which will widen or narrow to a mere line as the width of the slit is altered by its appropriate adjusting screw. The interposition of the prism between the collimator and telescope in this case merely changes the *direction* in which this image of the slit is seen, making no other difference whatever. If the illumination, instead of being *homogeneous*, contain two or three sorts of light differing in their color, then, instead of one, we shall get two or three separate slit-images or bright lines, the different colored rays being differently bent by the prism, and thus separated. If the light be white—*i. e.* contain rays of all possible colors in the same proportions as in sunlight—we shall then get a ribbon-like spectrum, formed by an infinity of slit-images placed side by side in contact, thus producing a continuous band. If the light be not white, but either redundant or deficient in any of its component hues, the spectrum will of course be marked by abnormal brightness or darkness in the corresponding region; it will show bands bright or dark.

Integrating Spectroscope.—In some cases, and usually in chemical work at least, we wish merely to examine the spectrum of the whole mass of light proceeding from the luminous object, without any special distinction of parts. For this purpose it is only necessary so to direct the collimator that the rays from the central portions of the object shall pass through the slit along the axis of the tube, the object being at such a distance that its angular dimensions as seen from the slit shall not exceed those of the collimator-lens. In this case every portion of the slit, and consequently of the spectrum, receives rays from every portion of the object. An instrument used in this way is called an *integrating spectroscope*.

Analyzing Spectroscope.—In many cases it is, on the other hand, important to obtain separately the spectra of the different portions of the luminous body, especially in astronomical investigation. To accomplish this, it is only necessary to place in front of the slit a lens at such a distance as to form upon the plate containing the slit a distinct image of the object. Then each point in the slit is illuminated by rays proceeding from only a single point in the object, and we can get separately the spectra of the top or bottom or centre of the body observed. Used thus, we call the instrument an *analyzing spectroscope*.

Plücker's Prism of Comparison.—It is often desirable to compare directly the spectra of two different lights. This is readily done by placing, so as to cover one-half the length of the slit, a small reflecting-prism, which will bring into it light from an object placed on one side. In this case the observer sees before him the two spectra, one immediately above the other.

Spectroscopes of High Dispersion.—The form of the instrument of course varies according to the purpose for which it is designed. For many investigations it is necessary to obtain a much higher dispersion than one prism would give. We then use between the collimator and telescope a train of several prisms, sometimes as many as nine. The size of the instrument is also greatly varied. In an enormous spectroscope built by Ladd of London for Lord Lindsay the six prisms had each surfaces 4 inches square, and the collimator and telescope were each 4 inches in diameter and 5 feet long. Browning has also constructed one of fully equal dimensions for Mr. Gassiot, to be presented to the University of Oxford.

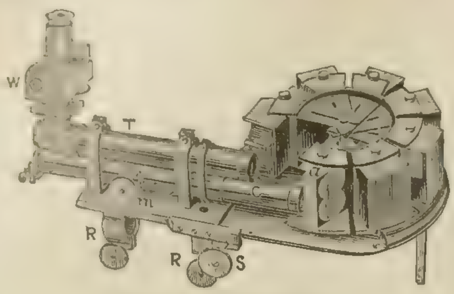
Adjustment of Prisms for Minimum Deviation.—To obtain the best definition, it is necessary that the rays in passing through each prism should make equal angles with its surfaces on entering and emerging, and it is therefore important that the prisms should be so adjusted as to fulfil this condition for whatever color of the spectrum may be under examination. In the first large instruments each prism had to be adjusted tentatively and separately, and it was the work of several hours to alter the adjustment from the red end of the spectrum to the violet. In 1863, Littrow of Vienna, and in 1865, Rutherfurd of New York and Cooke of Cambridge, devised different contrivances by which all the prisms are adjusted simultaneously.

Automatic Spectroscope.—In 1870, Browning of London, making use of Rutherfurd's plan (of which, however, he seems to have been an independent inventor), contrived a so-called *automatic spectroscope*, in which the adjustment for any portion of the spectrum is completely effected by simply pointing the observing telescope to it by the appropriate tangent screw. Lockyer of London and the writer in this country, as well as Grubb of Dublin, have also devised instruments fulfilling the same condition and admitting the use of still greater dispersive powers. The instruments of the two former, though independently invented, are essentially similar. We give a figure of our own, with which many of our American observatories are supplied. It was designed especially for astronomical work, and in its construction compactness, lightness, and facility of manipulation have been chiefly kept in view.

The light after leaving the collimator C falls perpendicularly upon the face of a *half*-prism *a*, passes around through the train of seven prisms near their bases; at the end of

the train is twice totally reflected by a rectangular prism attached to the last prism of the train (which like the first

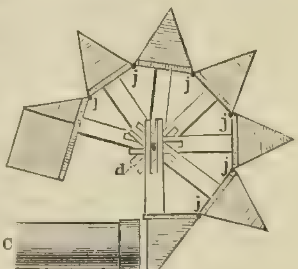
Fig. 3.



Astronomical Spectroscope.

is also a half-prism), is by the double reflection transferred to the upper story of the prism-train, so to speak, and returns to the view-telescope T, which with its diagonal eyepiece is firmly attached to the same mounting as the collimator, and directly above it; both are immovable. The focal length of collimator and telescope is 10 inches, their diameter $\frac{7}{10}$ths of an inch. The different portions of the spectrum are brought to the centre of the field of view by the screw S, which acts upon the last prism of the train. The first prism of the train being firmly fastened, the others are all movable, each being jointed to the preceding, as in the annexed figure, at *j*, *j*:

Fig. 4.



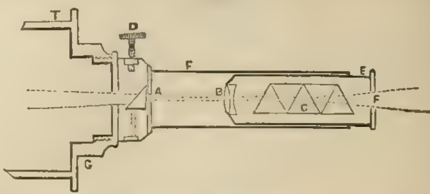
Automatic Arrangement.

To the back of each prism-holder is attached a rigid bar forked at the extremity, and all the forks engage with a movable steel pin or pillar, *d*. It follows, therefore, that whatever motion may be given to the last prism, it and all the others will continue to keep their bases tangent to a common circle whose centre is at *d*, which circle always remains tangent to the axis of the collimator. This is the automatic arrangement, due to Mr. Rutherfurd. The adjustment for focus is by the milled head *m* (Fig. 3 again) upon the tube of the collimator, which carries the object-glasses of both collimator and telescope in and out together. The rings R R furnish the means of attaching the instrument to the eye-end of a large equatorial, and adjusting its distance from the object-glass. The dispersive power of the instrument is that of twelve prisms, but can easily be reduced whenever desired by merely taking out any prism of the train and substituting for it the terminal half-prism with its reflector—an operation not requiring more than a single minute. By adding another tier of prisms, and sending the light back and forth through a third and fourth story, the dispersion could again be doubled with very little expense, except for the additional prisms. The instrument is provided with a comparison-prism at the slit, and the position of any unknown line in the spectrum of a celestial body is referred to the nearest lines in the spectrum of some known gas compared with it by means of a micrometer W in the eyepiece.

Direct-vision Instruments.—In the so-called *direct-vision* spectroscopes the ordinary prism or prism-train is replaced by a compound prism made up of from five to eleven prisms of two different kinds of glass, so put together that the *refractions* for the mean rays of the spectrum balance each other, while of course the *dispersions* do not. The advantage gained is, that the awkward angle between the collimator and telescope is avoided, and the instrument becomes in appearance merely a straight tube.

Pocket Spectroscope.—The *pocket spectroscope* and *micro-spectroscope* are instruments of this kind. The former consists merely of a small tube some 3 inches long, carrying the slit at one end and a magnifying lens of proper focus at the other, with a direct-vision prism combination in the tube between them. Since, however, the rays from the slit are not rendered parallel before they strike the prisms, the instrument does not give very accurate definition of spectrum lines, though for many purposes it answers pretty well. The annexed figure (Fig. 5) shows the construction of the *micro-spectroscope*, which is designed for use in connection with the microscope, and has proved itself a most valuable auxiliary. The tubular extremity T slips into the end of the microscope-tube in place of the ordinary eye-

Fig. 5.



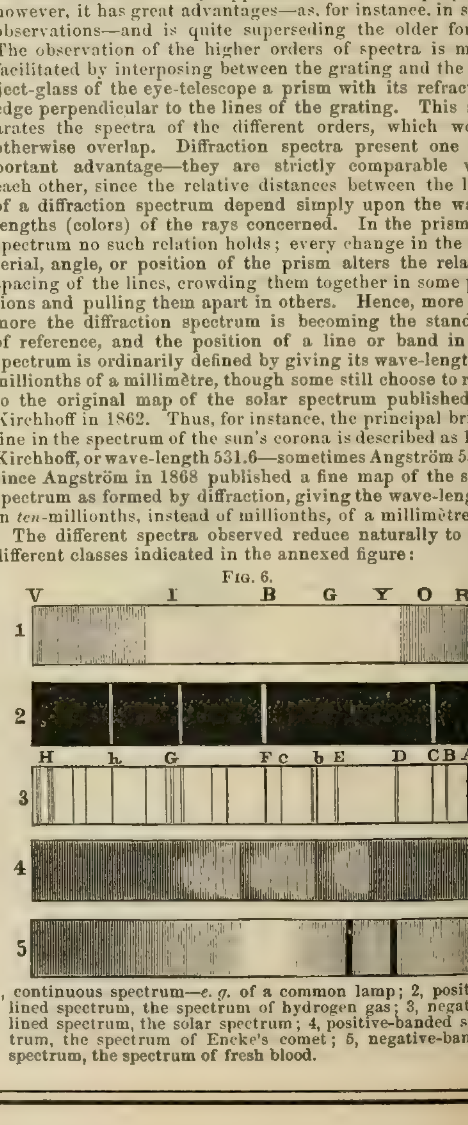
Micro-Spectroscope.

piece. The slit and comparison-prism are at A, the collimating lens (achromatic) at B, the direct-vision combination of prisms at C, and the eye is applied directly at F, the view-telescope being usually dispensed with, though some of the more elaborate instruments retain it, and add numberless accessories—of condensers, illuminating mirrors, object-holders, micrometers, etc.

Diffraction Spectroscope.—In the *diffraction spectroscope* the prism is exchanged for a plate of glass or speculum-metal ruled with fine equidistant lines, from 2000 to 20,000 in the inch. The light after passing through the collimator is received upon this grating, as it is called, and thence is transmitted or reflected, as the case may be, to the telescope. With instruments of this sort, furnished with the exquisite gratings which Mr. Rutherfurd has lately been ruling on silvered glass, a dispersive power is easily obtained in the spectra of the higher orders far greater than by any of the spectroscopes described above—equal to what would be furnished by a train of thirty prisms or more. The spectra obtained in this way are less brilliant than those of the prismatic apparatus, so that for some purposes this form of instrument is hardly applicable; for other purposes, however, it has great advantages—as, for instance, in solar observations—and is quite superseding the older forms. The observation of the higher orders of spectra is much facilitated by interposing between the grating and the object-glass of the eye-telescope a prism with its refracting edge perpendicular to the lines of the grating. This separates the spectra of the different orders, which would otherwise overlap. Diffraction spectra present one important advantage—they are strictly comparable with each other, since the relative distances between the lines of a diffraction spectrum depend simply upon the wave-lengths (colors) of the rays concerned. In the prismatic spectrum no such relation holds; every change in the material, angle, or position of the prism alters the relative spacing of the lines, crowding them together in some portions and pulling them apart in others. Hence, more and more the diffraction spectrum is becoming the standard of reference, and the position of a line or band in the spectrum is ordinarily defined by giving its wave-length in millionths of a millimètre, though some still choose to refer to the original map of the solar spectrum published by Kirchhoff in 1862. Thus, for instance, the principal bright line in the spectrum of the sun's corona is described as 1474 Kirchhoff, or wave-length 531.6—sometimes Angström 5316, since Angström in 1868 published a fine map of the solar spectrum as formed by diffraction, giving the wave-lengths in *ten*-millionths, instead of millionths, of a millimètre.

The different spectra observed reduce naturally to five different classes indicated in the annexed figure:

Fig. 6.



1, continuous spectrum—*e. g.* of a common lamp; 2, positive-lined spectrum, the spectrum of hydrogen gas; 3, negative-lined spectrum, the solar spectrum; 4, positive-banded spectrum, the spectrum of Encke's comet; 5, negative-banded spectrum, the spectrum of fresh blood.

We have (1) the *continuous* spectrum; (2) the *positive-lined* spectrum, marked by *bright* lines upon a black or dark background; (3) the *negative-lined* spectrum, characterized by *dark* or *black* lines upon a bright background; (4) the *positive-banded* spectrum, consisting of *bright* bands separated from each other; (5) the *negative-banded* spectrum, consisting of *dark* bands upon a bright background. Not very unfrequently, however, a spectrum presents the characteristics of two or more of these classes combined.

Continuous Spectrum.—The continuous spectrum is the least interesting and instructive of all. It simply indicates that the luminous material is comparatively *dense*. An incandescent solid or liquid produces it, and so also does an incandescent gas if sufficiently compressed. From a spectrum of this kind we learn nothing as to the chemical nature of the luminous body, and very little as to its physical condition. It is to be noted, however, that a predominance of the red portion of the spectrum usually indicates a much lower temperature than that which corresponds to a normal development of the blue and violet; in other words, a *red*-hot body is cooler than a *white*-hot one. This, with many other facts of capital importance, seems first to have been brought out clearly by Dr. J. W. Draper, whose early investigations on the chemical and thermal rays of the spectrum, as well as the constant association between spectral lines and certain chemical elements, were very extensive and important, and deserve far more attention and recognition than they ever received. In fact, many of the more recent investigators seem to have been substantially anticipated by him in some of their most important results. There are, however, many cases of brilliant luminosity accompanied by a very trifling evolution of heat. We then usually find the yellow and green portions of the spectrum (which are most energetic in their action upon the organs of vision) quite bright, while the extreme red and violet are alike deficient. This is true of the light of fireflies, glowworms, and the luminous organisms of the sea. But while the continuous spectrum is thus comparatively uninteresting, the other four classes of spectra are full of information.

Class 2—Positive-lined Spectrum.—The spectrum of the second class, consisting of a greater or smaller number of sharply-defined bright lines, is produced only by matter in the gaseous condition, of comparatively low density, and, as a general rule, certainly, though possibly not without exception, in an elementary state—*i. e.* not chemically combined with other substances. It is the spectrum of elementary vapor. Every simple substance when sufficiently heated gives its own characteristic spectrum of this sort, as legible to one familiar with the subject as its written name would be. Furthermore, every change in the density, pressure, or temperature alters, so to speak, the style of character in which the name is written; it so affects the relative brilliance of the different lines, their width, distinctness, and general appearance, that from an examination of the spectrum we are not only able to recognize the chemical nature of the material under examination, but also to draw most important conclusions as to the physical conditions to which it is subjected.

Effects of Temperature and Pressure.—Speaking generally, when the gas is very greatly rarefied, and not too intensely heated, the lines in its spectrum are comparatively few—not very brilliant, but very thin and fine. As the pressure increases or the temperature rises, new lines make their appearance, and the old ones brighten, but also grow wider and hazy at the edges; at the same time a faint continuous spectrum appears as a background. Pressure and temperature still increasing, the background grows brighter and brighter, while the lines become more numerous, but less sharply defined and relatively less conspicuous, until at last we have a mere continuous spectrum without noticeable markings, precisely like that of a liquid or a solid heated to whiteness. As yet it is not found possible to discriminate with certainty between the effects of temperature and pressure, which in many respects are very similar. Theory, indeed, would lead us to expect this, for, according to the generally-received ideas of the constitution of gaseous matter, simplicity of the spectrum would imply noninterference of the atoms with each other in the vibratory motions which originate the light. But whenever the atoms do come to interfere with each other much and often —which may happen either from crowding them together or increasing the velocity and range of their motions (raising the temperature)—confused and irregular vibrations must result, producing in the spectrum the very effects observed.

Personal Identity of a Spectrum.—It is now generally believed that the spectrum of any given element retains its specific identity through all changes of temperature and pressure—*i. e.* that the changes observed are merely in the number, brightness, and sharpness of the lines, and not at all in the *position* they hold in the spectrum: or, to express it differently, after the analogy of sound, the *luminous notes* which characterize the spectrum of a given substance are believed never to change their *pitch* (wave length). This, however, is not yet perfectly established, and some physicists of high authority still hold, not without apparent reason, that the same chemical element may give under varying circumstances two or more distinct spectra, differing from each other as much as do the spectra of different elements.

Plücker's Spectra of the First and Second Order.—Thus, Plücker distinguished a first- and second-order spectrum for nitrogen gas. Some of the latest investigations, however, seem to show that his spectrum of the first order (a banded spectrum) is merely the spectrum of one of the *oxides* of nitrogen, and not of nitrogen itself. Still, the subject imperatively demands further and most careful research.

Coincidence of Lines in different Spectra.—In many cases lines in the spectrum of one substance are found to coincide with lines in the spectrum of another. In some instances this coincidence is merely apparent, and a sufficient dispersive power in the instrument employed brings out a slight but real difference in the wave-lengths of the rays concerned. In other cases, the lines probably belong to the spectrum of only one of the substances, and appear in the spectrum of the other simply on account of the impossibility of freeing it entirely from all traces of the first. Thus, iron and titanium and iron and calcium show numerous such coincidences.

Spectra of the Third Class—Negative-lined Spectra.—The spectra of the third class (negative-lined spectra) are no less instructive and important than those of the preceding, to which they are complementary, or, to use a common expression, of which they are *reversals*. The two classes differ from each other simply in the interchange of light and darkness, the bright lines and dark background of the one being reversed to black lines and bright background in the other, while in the relative intensity of the lines and their position there is no change. To this class belongs the solar spectrum, and the spectra of most of the stars are similar. Spectra of this kind occur when the light under examination has passed through a vapor or gas which would itself give a bright-line spectrum. Under these circumstances *the gas absorbs out of the transmitted light precisely those rays it would itself emit if luminous*, and thus causes the spectrum to show dark bands and lines at the very points when the spectrum of the gas alone would exhibit bright ones. For example, the spectrum of sodium vapor is characterized by two bright orange-colored lines very near each other. But if we cause the light of an oxyhydrogen lamp to pass through a tube filled with sodium vapor, it will show in its spectrum a pair of dark lines at precisely the same place. It is difficult to say who first discovered this principle. Stokes in England, Angström in Sweden, and Kirchhoff in Germany seem all to have reached it independently. Angström was the first to give it formal publication in 1853, but in the Swedish language, so that it attracted little attention; on the other hand, it was undoubtedly Kirchhoff who in 1859 first appreciated and insisted upon its full significance, and by its application in investigating the chemical composition of the sun, and his other researches in connection with Bunsen, first brought out clearly the enormous power of the spectroscope as an instrument of discovery.

Changes in appearance of Dark-line Spectrum due to Changes of Pressure, Temperature, and Intensity of Transmitted Light.—Spectra of this class of course indicate as clearly as those of the first the chemical nature of the absorbing vapor to which the dark lines are due; and changes in the density or temperature of this vapor produce upon the lines effects analogous to those described in connection with the preceding class. Furthermore, when the absorbing vapor is at a temperature high enough to render it self-luminous, then changes in the intensity of the transmitted light will also greatly alter the appearance of the spectrum. If it be brilliant enough, all the lines will be intensely black, provided the absorbing layer is sufficiently thick. As the intensity of the transmitted light decreases, those lines which are brightest in the spectrum of the vapor taken by itself will lose their blackness, vanish, and reappear as bright lines, until at last, when the background light is reduced to zero, we have of course simply a spectrum of the second class, with all its lines bright. Thus, it very frequently happens that in spectra of this sort we find bright as well as dark lines. It is evident, also, that changes in the thickness of the absorbing stratum will greatly modify the spectrum.

Spectra of the Fourth Class.—The spectra of the fourth class consist of bright bands of considerable width, sometimes undefined at both edges, and sometimes pretty distinct at one of them, which is usually, but by no means

universally, the lower or less refrangible. They seem to be derived from bodies in which the molecules have less freedom of movement than in elementary vapors, and yet more than in incandescent solids and liquids. Gaseous compounds and fluorescent bodies especially show them; the spectra of comets belong to this class also. They do not admit of such accuracy of measurement as the two preceding classes, nor do they often furnish any such amount of definite and certain information as to the nature and condition of the source of light: still, they are important.

Spectra of the Fifth Class.—The fifth and last class of spectra is characterized by broad dark bands crossing a bright background: spectra of this sort are produced by the action of colored absorbing media, usually solid or liquid (though some highly-colored dense vapors act in a similar manner), upon transmitted light. The spectra of blood, chlorophyl, iodine vapor, and many dyestuffs are instances in point. The worker with the micro-spectroscope deals almost exclusively with this class of spectra, and finds in them a mine of most valuable information as to the nature and constitution of the organisms which he studies.

Chemical Application.—The applications of the spectroscope are extremely numerous and important. Its earliest use was in chemical analysis; by its means already five new elements have been discovered—the metals thallium, cæsium, rubidium, indium, and gallium. The substance to be examined is introduced into the flame of a so-called Bunsen burner, or used as one of the electrodes, between which a stream of electric sparks is made to pass, or placed between the carbon poles of an electric lamp under the action of a powerful continuous current, or finally, if gaseous, enclosed in a glass tube and illuminated by means of an induction coil. The more volatile metals yield their spectra without difficulty in the gas-flame, but most other substances require the use of electricity.

Delicacy of the Reaction.—For some substances this method of analysis is extremely delicate; for instance, $\frac{1}{8000000}$th of a milligramme of thallium is distinctly detectible in the spectrum of the electric spark. At the lower temperature of a Bunsen burner its sensibility is about $\frac{1}{50000}$th of a milligramme. The reaction of strontium is even more delicate, and that of sodium defies estimation. (We give the results of Cappel, as quoted by Schellen.) Indeed, for these and many other substances the method is at present *too* delicate. It is found also, unfortunately, that in a mixture of several substances it frequently happens that only a few of them show their spectra, the others being in some way masked by those which appear. Hence, in examining an unknown material *it is not safe to conclude the absence of any element from its non-appearance in the spectrum.* But for details upon this subject it is necessary to refer to works where it is treated fully.

Quantitative Analysis.—In passing, it may be remarked that recently Vierordt has attempted to make the spectroscope give quantitative results, in addition to its merely qualitative indications. He uses an instrument with two slits, one immediately above the other; the one having a fixed and constant width, while the width of the other is adjustable and can be accurately measured by a micrometer screw. The slit of constant width is illuminated by the flame of a substance containing a known percentage of the element tested for; the adjustable slit is illuminated by the flame of the material investigated; and by widening or narrowing this slit it is sought to make the lines of the element in question appear of the same brightness in the two spectra which are seen side by side in the instrument. From the width of the adjustable slit which produces this result a conclusion of more or less accuracy can then be drawn. As yet, however, nothing more than a partial success can be claimed. In a somewhat similar manner, though fundamentally distinct, Mr. Lockyer has utilized the spectroscope in assaying. If by means of a convex lens we form upon the slit of the instrument an image of a metal point from which a stream of electric sparks is flowing, the bright lines characteristic of the metal will of course appear. But under these circumstances they will differ not only in width and brightness, but in *length.* While some reach across the whole width of the spectrum, others will be very short, and some mere points of light on the tip of the electrode. If now a metallic alloy be used for the electrode, the *long* lines of both metals will generally appear: but if one of the metals be present in only minute quantity, even its longest lines will be very short compared with those of the principal metal. Of course two alloys precisely alike will furnish similar spectra; and thus, by comparing the spectrum of a piece of bullion alloyed with a small unknown percentage of silver, with the spectra of a series of test specimens in which the percentage of silver alloy is known, we can determine the composition of the first; and, as experience shows, with great accuracy.

Physical Applications.—In other physical sciences the instrument has also important applications, furnishing as it does the means of isolating, for purposes of optical experiment, light of any particular wave-length, and giving valuable indications of the temperature and pressure of gases in many cases otherwise quite unmanageable. In photometry especially it is likely to prove of great value. So long as two lights to be compared are similar in tint, there is no great difficulty in determining the ratio of their brightness within reasonable limits of accuracy by many long-known methods; but when the lights differ in color, these methods fail. Now, by means of a spectroscopic apparatus similar to that of Vierordt, described above, or a more recent and delicate apparatus by Trannin, by means of which two spectra crossed with dark interference-bands are superposed in such a manner that when of equal brightness the bands will disappear, it is possible to compare the lights *in detail,* so to speak; *i. e.* the intensity of the *red* light furnished by the first source can be measured against that of the same color emanating from the second; and in the same way the relative intensity of green and blue in the spectrum of each can be compared. If the lights are such as to furnish discontinuous or bright-lined spectra, the difficulty of the comparison is considerably increased, but can be overcome by an addition to the apparatus which does not complicate it very seriously, though its description would take up too much space to be given here.

Medical and Forensic Applications.—The instrument, especially in the form of the micro-spectroscope, has its important medical and forensic applications. It furnishes, according to the investigations of Sorby, a most reliable and delicate method of detecting blood even in the minutest quantity, and distinguishing it from any other coloring-matter of similar tint. Unfortunately, it does not discriminate between blood from different animals, nor does it determine the period which has elapsed since it was drawn from the body. A spectroscopic examination of the contents of the stomach would undoubtedly, in cases of metallic poisoning, show unmistakably the nature of the metal used: arsenic, antimony, thallium, etc., could not escape detection, though as yet we are not aware of any case in which the spectroscope has been thus applied. In the case of poisoning by strychnine, prussic acid, or any similar compound substance, nothing could be expected from the instrument. It is hoped that spectroscopic examination of the urine and other dejecta, and of the liquid contents of cysts and tumors as drawn off by the operation of tapping, may prove of great value in the diagnosis of disease, but as yet the subject has not been thoroughly worked out.

Technical Applications.—In several of the arts the instrument has also found important applications. In the Bessemer process of making steel, air is forced by a powerful blast through a vessel (called the converter) containing molten iron, and in its course burns out most of the impurities, and especially the carbon of the crude pig. But it is important to stop the operation at precisely the right moment, when the carbon is all gone; otherwise the air-blast will attack and oxidize the iron itself, spoiling the whole charge. During the process a powerful flame issues from the mouth of the converter, and the spectroscopic examination of this flame gives precisely and sharply the indication needed. At the moment when the blast should be turned off the lines of carbon, which before were bright and clear in the spectrum of the flame, suddenly disappear. It is fair to add, however, that this disappearance of the carbon from the flame produces an alteration in its color sufficiently marked to enable an expert, even without the spectroscope, to determine the critical moment, but the instrument greatly facilitates the operation, and is in constant use for the purpose. The instrument is also very valuable as a detector of adulterations in dyestuffs and liquors. By its help an expert will give the age of port wine within a year or two (up to a dozen years or so), thanks to the investigations of Sorby, and can infallibly detect the "doctoring" to which it and other wines are so liable.

Application to Astronomy.—But it is in the domain of astronomical science that the spectroscope has achieved its greatest triumphs, which we can hardly more than enumerate in this connection.

Chemical Constitution of the Sun.—Its very first application by its inventor, Kirchhoff, was to the chemical analysis of the sun. In the dark lines of the solar spectrum he read clearly the names of many elements with which we are familiar upon the earth. Iron, titanium, calcium, manganese, nickel, cobalt, chromium, barium, sodium, magnesium, copper, hydrogen, and zinc are plainly indicated, and sulphur, cerium, strontium, aluminium, and iridium are pretty certain. These were the first-fruits.

Constitution of Stars.—Applied by Huggins, Secchi, and others to the stars, it has to a certain extent revealed also the chemical constitution of many of them, and has shown

that they resemble the sun, with, however, specific differences, each star presenting its own peculiar spectrum.

Sun-Spots.—Applied to the study of the solar spots, it has confirmed the belief that they are cavities, and revealed the nature of the dense clouds of absorbing vapors which fill them, besides throwing clear light upon many curious facts before obscure.

Nature of the Solar Prominences.—By its means in 1868 the strange "red protuberances," which had been observed around the disk of the moon during a total eclipse of the sun, were shown to be immense clouds or flames thrown out from the sun and floating in its upper atmosphere—masses composed in the main of hydrogen gas, but also, especially in the lower portions, containing many other vapors carried up from the inferior atmosphere which immediately overlies the incandescent surface.

Daily Observation of the Chromosphere and Prominences.—Nor is this all: up to the date we have mentioned these strange phenomena could be observed only during the few moments when the solar disk was hidden in eclipse; but then Janssen and Lockyer independently and simultaneously contrived that beautiful application of our instrument by which the so-called chromosphere of the sun is brought within the range of daily observation, thus opening to astronomy a new, most beautiful and interesting field of research. The reason why we cannot see these prominences at any time with the simple telescope is merely this: The air in the neighborhood of the sun is so intensely illuminated as to mask them, just as the stars are hidden. If we could only devise some means to weaken this air-illumination without much affecting their own luminosity, we could see them well enough: and this is precisely what the spectroscope does. The air-light, being simply reflected sunlight, is dispersed into a long and comparatively faint spectrum by passing through the prisms, while, on the other hand, the light from the gaseous prominences gives a spectrum of a few bright lines, whose brilliance is not affected by the dispersion, which merely separates the lines without making them faint. Hence, with an instrument of sufficient power the continuous spectrum due to the aërial illumination becomes so weak that upon it, as a background, a prominence will form a spectrum of conspicuous bright lines; and on opening the slit, its image in all the detail of form and movement can be clearly made out.

Nature of the Solar Corona.—In 1869 the spectroscope gave the first decisive evidence as to the nature of that most wonderfully beautiful of all appearances, the sun's corona, by showing that its spectrum is characterized by a vivid line in the green, at 1474 of Kirchhoff's scale: thus proving it to be constituted, in part at least, of some glowing gas, and therefore of solar and not lunar or terrestrial origin. What this gas is, is yet unknown.

Nature of the Nebulæ.—Applied to the study of the nebulæ by Mr. Huggins in 1864, it immediately settled the old dispute as to their nature, showing that some of them, at least, are gaseous masses, and not far-off groups of closely-crowded stars, as the opponents of Laplace's nebular hypothesis had taught.

Self-luminosity of Comets.—A little later, in the same skilful hands, it was directed upon the comets, and proved that they shine not merely by reflected sunlight, but with a brightness of their own. Their spectrum is one of bright bands, and seems to indicate that they are constituted either of some slightly-heated, non-elementary gas (Mr. Huggins suggests one of the hydrocarbon compounds, whose spectrum certainly presents a remarkable coincidence), or else some fluorescing dust.

Atmosphere of Planets.—Applied to the planets, it reveals to us in the atmospheres of our nearest neighbors, Mars and Venus, the vapor of water, and suggests phenomena and habitudes not unlike those of our own aërial ocean—shows that they may be habitable worlds like ours. On the other hand, it shows certain strange markings in the atmospheric spectra of Jupiter, Saturn, and Uranus, which we cannot yet explain, but which indicate an extremely different air from ours.

Motions of the Stars.—Last, and in some respects most wonderful of all, it reveals and measures certain movements of the solar atmosphere and of the stars which would otherwise be wholly beyond our cognizance—motions of approach or recession with reference to the earth. If the source from which the light subjected to the examination of the spectroscope proceeds has a motion either toward or from the instrument, then for any given ray the number of pulsations per second which reach the slit will be altered, and the position of the corresponding line in the spectrum will be changed; if the body be approaching us, all the lines in its spectrum will be displaced toward the blue end of the spectrum, and *vice versâ*. With our present instruments the lowest velocity which can be *perceived* is between 1 and 2 miles per second; a velocity as great as 5 miles can be *measured* with some precision. In studying the spectra of the solar prominences, velocities of from 50 to 150 miles per second are frequently observed, and the observations of Huggins and others upon some thirty or forty of the brightest stars have shown that they are moving, some toward and some from us, with velocities varying from 5 to 60 miles per second.

The best works upon spectroscopy are Roscoe's *Lectures upon Spectrum Analysis* and Schellen's *Spectrum Analysis*, the latter translated from the German by the Misses Lassell, and edited by Mr. Huggins. Mr. Lockyer has also just published a small volume on the same subject. Schellen's work contains in an appendix a very full list of all books and scientific papers in any way bearing upon the subject, complete up to the date of publication (1871–72), and to this we must refer readers desirous of further information. C. A. Young.

Spec'trum [Lat.], in optics, a colored image arising from the dissociation of a ray of light into its constituent tints. There are two modes of obtaining such images: (1) by dispersion, the prismatic spectrum; (2) by diffraction, the grating spectrum.

The Prismatic or Dispersion Spectrum.—In a dark room let the temperature of a platinum wire be gradually raised, and the wire be inspected through a prism. When the heat has risen to about 977° F., it will be found that a dim monochromatic red light is emitted. As the temperature increases, the red radiation becomes more intense, and on one side of it there emerges a tint that is orange. The heat still rising, there is added on the side of the orange, yellow, and in like manner successively green, blue, indigo, violet. The appearance of the wire as seen through the prism is now no longer that of a straight line, as at the beginning of the experiment; it is spread out into a ribbon-like colored form, the tints gradually blending into each other. Not only are new colors thus added as the temperature rises, but the brilliancy of the original ones, and indeed of all, steadily increases. It is to be particularly remarked that the colored spaces thus observed are not of equal breadth. Examining them from the violet to the red, they successively become more and more compressed; they are narrower and narrower. This is a necessary effect in the prismatic spectrum.

If instead of examining the wire through the prism, it is directly looked at, the rays that it emits will be found to be of a dazzling whiteness, the brilliancy of which increases until the wire melts. To the parti-colored rectangular figure into which the image of the wire is thus dilated the designation of *the spectrum* is given. A critical examination will prove that this spectrum is continuous—that is to say, it is not crossed by interruptions, dark spaces, or dark lines. It is therefore spoken of as a continuous spectrum. To see it in the most accurate manner the prism should be placed at its angle of minimum deviation.

If instead of an ignited wire a beam of sunlight coming through a narrow slit be in like manner examined with a prism placed as above indicated, it will be found to display the aspect offered by the platinum at its utmost temperature, so far as colors are concerned, and even more brilliantly. Crossing it, however, there will be perceived many black lines. This, the solar spectrum, is spoken of, therefore, as an interrupted or discontinuous spectrum—a spectrum having fixed lines. If an electric spark passing between two pieces of the same metal be inspected, it will be found to be an interrupted one. The lines, however, are not dark, but bright and shining, and of the color of the spaces in which they occur. If the metallic surfaces are of different metals or of alloys, all the lines that belong to each of the metals present will be seen.

Newton was the first to examine the solar spectrum, and to point out the precautions to be taken in order to produce it in a state of purity. He used a slit parallel to the edge of the prism, and also intromitting apertures of triangular, circular, and other forms, employing not only the sun itself, but also these various intromitting apertures as the luminous source, arranging things so as to employ their images. To avoid the optical imperfections of the glass of the prism, its striæ, air-bubbles, etc., he constructed hollow prisms and filled them with a solution of acetate of lead. Under these circumstances it is somewhat surprising that he did not detect the fixed lines. They, however, escaped him. The deductions he made from what he did observe were, however, of the highest importance. He proved the composite nature of white light, and substantiated the theory of the different refrangibilities of its constituent rays by his celebrated experiment of the dark chamber. He considered that the spectrum is divisible into seven differently-colored regions or spaces, which, enumerated in the order of their departure from the direction of the intromitted light, are red, orange,

yellow, green, blue, indigo, violet. Of these, then, the red is the least and the violet the most refrangible ray.

The spectrum thus formed by a prism offers three points for consideration: (1) the distribution of luminous intensity in it; (2) the distribution of heat; (3) the distribution of chemical force.

(1) With regard to the luminous intensity, or the determination of the order of brightness of the rays, various series of experiment have led to the conclusion that the yellow region of the prismatic spectrum, though it is among the less refrangible, is the most brilliant. From it the effect lessens rapidly toward the red extremity, more gradually toward the violet. Among the methods resorted to for such a determination of the luminous intensity is that of placing a piece of finely-printed paper so as to receive the spectrum, and finding at what distance the letters in the several colored spaces can be distinguished. Other more exact photometric methods have also been employed. All, however, are liable to this criticism—that they merely indicate the relations of the organ of vision, the eye, to the luminiferous radiations, and have nothing whatever to do with their intrinsic force. From other considerations it may be shown that the mechanical intensity of all the radiations is the same.

(2) As regards the distribution of heat in the prismatic spectrum, there has been from time to time much change of opinion. At first it was supposed that the yellow region, being the brightest, must necessarily be the hottest space. This opinion was, however, abandoned on the publication of Sir William Herschel's observations. He had been led to suspect, while using glass screens in telescopic observations on the sun, that a dark red glass is more permeable to heat than one paler and of a different color. He therefore placed a series of small thermometers in the different colored spaces, and found that, commencing with the violet and passing toward the red, they in succession stood higher and higher. Nay, more, in a space altogether beyond the red, and where there was no light, the heat was greatest. Subsequently, it was found by other experimenters that the maximum point varies with the material of which the prism is composed, prisms of water, of alcohol, of crown glass, and of flint glass making it in succession in less refrangible spaces. These experiments were repeated in a more perfect manner by Melloni on the invention of the thermo-multiplier. He showed that when a prism of rock-salt is used, the maximum of heat fell in a much less refrangible space than had ever before been observed. In fact, it was as far below the fixed line B as B is below F. These results have since been repeatedly verified, especially by Tyndall. The observations of such skillful experimenters must of course be correct, but, as will be seen from the description of the diffraction spectrum presently to be given, the conclusions drawn from them must be modified.

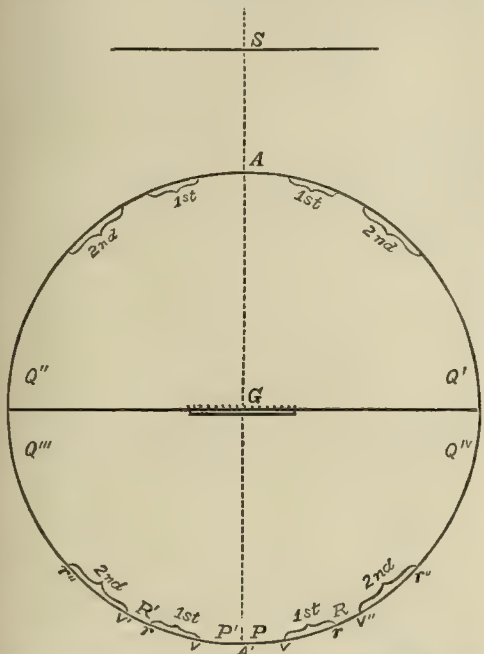
(3) Leaving that topic for the present, we pass in the next place to the consideration of the distribution of chemical force in the prismatic spectrum. The earliest experiments on this point are those of the Swedish chemist Scheele, who received the solar spectrum on a surface painted with white argentic chloride. He found that this substance was not darkened indiscriminately in all the colored spaces, but that the effect took place chiefly in the violet, and not at all in the green, yellow, orange, and red. He also observed that beyond the violet, and in a region where the light had ceased to be perceptible, the darkening continued. Many other experimenters verified these results, and on a comparison of them with the above-mentioned ones in relation to heat, the conclusion seemed to be established that there are three essentially distinct principles in the solar ray: (1) light, (2) heat, (3) chemical force. The last passed successively under various designations, such as chemical rays, deoxidizing rays. Eventually, Sir J. Herschel imposed the inexpressive designation, *actinism*. The view thus held was, therefore, that there are three spectra—one of each of the three essential constituents of light—partially overlapping each other and of different refrangibilities; the heat spectrum being the least refrangible, the light spectrum intermediate, the actinic spectrum most refrangible. Curve-diagrams were drawn, showing the intensity of these principles at different points. This view has been the origin of very many errors—errors that even now have scarcely been eradicated. They have been a serious obstacle to the progress of the science of radiations. They arose from the fact that no account was taken of the physiological peculiarities of the eye. It does not follow, because there are invisible radiations below the red, that what we term heat and light are essentially distinct principles; it is only an illustration that the eye is incapable of perceiving ether waves that are of slower vibration than the red; and a similar remark applies to what are termed the invisible actinic rays beyond the violet, the vibrations of which are too rapid for the eye.

But there were not wanting those who saw that all these effects could be explained on the principle of one agency—ethereal undulations—giving rise to effects that differed as the surfaces on which they were received were different. On dark ones they produced heat; on the retina, the sensation of light; on others, molecular, and again on others chemical, changes. Among those who advocated this view was Becquerel. Of the results which overthrew actinism as a special principle of high refrangibility there was perhaps none more decisive than that brought forward by Draper—the decomposition of carbonic acid. When we recollect that the whole vegetable world obtains its essential element, carbon, by the decomposition of carbonic acid through the agency of sunlight, we shall perhaps not hesitate to rank this as one of the most imposing natural phenomena, and in the world of organization the most important. It is the starting-point of vegetable and animal life. That it is the sunlight which decomposes carbonic acid, setting free its oxygen and fixing its carbon in plants, had been determined by Priestley and other chemists of the last century. And since this is essentially an effect of deoxidation, it was assumed that it was brought about by the deoxidizing or so-called actinic rays. But Draper, on causing the decomposition to be accomplished in the solar spectrum itself, found that so far from the violet being the active ray, or the actinic space the most energetic, they were altogether without appreciable influence. The effect was at a maximum in the yellow, extending thence on one side into the orange, on the other into the green, and rapidly declining to each end of the spectrum. In the extreme violet and extreme red there was no action whatever. This important observation was soon followed by many others. Thus, it was shown that bitumen, when presented in a thin layer, was acted upon by every ray in the spectrum, from the extreme red to the extreme violet. Argentic iodide, which it had been supposed was influenced by the blue, indigo, and violet rays only, if properly placed was affected by rays far beyond the red. Indeed, it was by this substance that the great cold bands α, β, γ were first discovered. Herschel also, in his investigations respecting the coloring principles of flowers, had proved that different colors are affected by different rays, and long previously Grotthus had established the condition under which these actions take place: "The rays effective in the destruction of a given vegetable color are those which by their union produce a tint complementary to that color." In an exhaustive investigation of this subject, Draper proved that "for the production of any molecular or chemical change in any substance it is necessary that some specific radiation should be absorbed," and that "the ray effective in producing chemical or molecular changes in any substance is determined by the absorptive property of that substance." In general terms, it was thus established that all the rays in the spectrum, even the invisible ones at each extremity, are active, and can produce appropriate chemical effects.

Among the mechanical effects accomplished by radiation there is one that can never be witnessed without admiration. It is a matter of common observation that plants tend to grow toward the light. Dr. Gardner was the first to examine the details of this phenomenon in the spectrum. When seeds are made to germinate and grow for a few days in darkness, they develop vertical stems, very slender and some inches in length. These, on being placed so as to receive the spectrum, soon exhibit a bending motion. The stems in other parts of the spectrum turn toward the indigo; those in the indigo bend to salute the approaching ray. Removed into darkness, they recover their upright position. These movements are the most striking of all actinic phenomena. Dr. Gardner's experiments were repeated and confirmed by M. Dutrochet, one of the commissioners appointed by the French Academy to investigate and verify the facts. He, in his report (*Comptes rendus*, No. 26, June, 1844), added a number of other facts respecting the bending of roots *from* the light. This he found to be occasioned by all the colored rays of the spectrum.

The general conclusion which may be arrived at from the foregoing statements, and many confirmatory ones that might be added, is *not* that there exist three or more different principles in the spectrum, but that it is an assemblage of radiations consisting of ether-waves of different lengths and of different times of vibration, the less refrangible being the slower, the more refrangible the quicker. These, when they impinge on surfaces of various kinds, produce varied effects—in some calorific, in others colorific, and still again in others chemical. But this conclusion we shall perhaps see more distinctly when we have considered the diffraction spectrum, to the description of which we now pass.

The Diffraction Spectrum.—For the production of this spectrum it is necessary to be provided with a grating, which consists of a thin flat glass on one of the surfaces of which there has been ruled with a diamond a series of straight lines, very close and exactly parallel to each other. Mr. Rutherfurd, by his machine (see RULING-MACHINE), has produced the most perfect gratings that have yet been made. Fraunhofer was the discoverer of the diffraction spectrum, and to him our knowledge of its peculi-



arities is mainly due. Let a beam of light S A pass through a narrow slit, and fall perpendicularly on the ruled grating G, the lines of which are parallel to the sides of the slit. Concentric with the middle line of the grating let there be placed a circular zone or screen Q′ Q″ Q‴ Q⁗ of white paper, through which there is an opening at A to admit the intromitted light. A beam of parallel rays passing along S G will give a bright image of the slit S when it impinges on the screen at A′. This is the image by transmission. It would also give another similar image at A were it not for the opening arranged there. This is the image by reflection. Also from G, as from a central axis, there fall upon the cylindrical paper zone, covering its surface all over, an infinite number of radiations. These effects are seen with much more precision if there be placed behind the grating a double convex lens, and still better if the lens be the object-glass of a small telescope. Now, the eye can only be impressed by special radiations consisting of waves of determinate length. Its vision is limited by those that impart to it a sensation of red on one hand and of violet on the other. To all others it is blind. Then, though the whole paper zone is receiving and reflecting radiations of every kind, the eye selects those only that it can appreciate, and as a result it sees in the four quadrants Q′ Q″ Q‴ Q⁗ those only for which it is fitted. It follows, therefore, that at A′ there is a white image of the slit S, and to the right and left of this there are equal spaces P P′ completely dark. Beyond and symmetrically on each there is a series of spectra r r, r″ r″, r‴ r‴, etc., of which the violet ends are nearest A′ and the red ends most distant. These spectra are designated respectively as being of the first, second, third, etc., order. On each side the first spectrum is separated from the second by an obscure space R R′, which is narrower than the first dark space P P′; and the red end of each second spectrum is overlapped by the violet of the third. In like manner, the third is overlapped by the fourth, etc. If the intromitted ray be of sunlight, and a convex lens or small telescope be used, the dark Fraunhofer lines are seen in these spectra.

Such are the results seen in the quadrants Q‴ Q⁗ from the light transmitted through the grating. In the quadrants Q′ Q″ exactly the same train of phenomena will be discovered—dark spaces and spectra, the latter having their violet ends nearest to A, and the overlapping taking place in the manner above described.

Since the results are thus symmetrical in all the four quadrants, it is sufficient to select one of them for detailed examination. Let it be the quadrant Q⁗. Selecting one of the fixed lines, D, for example, in its successive spectra it will be found that the distances that separate it from the middle of the white image A is in the second double, in the third triple, etc., the distance in the first. These angular distances are designated as the deviations of the ray under examination. Fraunhofer has shown that (*a*) The deviation of the same ray—*e. g.* D—depends on the sum of the width of a groove in the grating and of a transparent interval, being in the inverse ratio of the sum. (*b*) The deviation of one of the colors of the spectrum of the first order, multiplied by the sum of a transparent interval and a groove, gives the length of an undulation of that color. (*c*) The deviations of the same color in the successive spectra increase as the whole numbers 1, 2, 3, 4, etc. (*d*) The deviation of two colors in the same spectra are to each other as the lengths of their undulations. Hence, in all the violet is nearest to A′, and the red most distant.

The undulatory theory gives a rigorous explanation of all these phenomena. It shows that λ being the wave-length of any particular light, ς the distance between the rulings from centre to centre, and θ the angle of deviation in the spectrum of the first order, we should have $\lambda = \varsigma \sin\theta$. In the spectrum of the second order, which corresponds to values of θ nearly twice as great, $2\lambda = \sin\theta$. In the spectrum of the third order the equation is $3\lambda = \sin\theta$, etc., etc. In practice for the determination of θ it is customary to measure the angle included between the same ray of the same order of spectrum on each side of A′. This gives, of course, double the angle sought.

We may now examine more closely the spectrum that is nearest to A′, the spectrum of the first order. Being separated completely from all the others, it presents the special facts most distinctly. At the point where the light first becomes visible—the violet or inner end of this spectrum—the wave-length of the incident radiation is, as Ångström has proved, about 3930, and the wave-length of the last visible radiation at the outer or red end is about 7600, of the 10^{10} of a mètre. Now, it is very important to remark that the distribution of the colored spaces in this spectrum is not the same as in the prismatic. Here the yellow space, which is the most luminous radiation, is in the middle of the spectrum, and is not crowded down or compressed toward the red end as in the prismatic. So the maximum intensity on illuminating power is, as Mosotti first observed, in the centre, the intensity of the light declining symmetrically on each side to the ends.

Recalling, now, the principle that the wave-length of an incident radiation is proportional to its deviation, let us next select on the zone a point where that length will be 7860. It is of course twice as far from A′ as was the violet end of the first spectrum, for the selected deviation is double. If we inquire what interpretation the mind will give of a radiation having such a wave-length, an inspection of the zone shows that not only is it visible, but that it is regarded as being a violet color. This is an important fact. We find that a radiation consisting of waves of a given length which is visible will also be visible when the constituent waves are twice that length. And in like manner it might be shown that the same will hold good when they are three, four, etc., times that length. Moreover, in all these cases the color-impression imparted to the mind will be the same.

Again, let us select upon the paper zone another point where the wave-length is 15,200. It will have double the deviation of the red end of the first spectrum. Now, agreeably to the foregoing remarks, this point should be visible to the eye, and, for anything that has thus far been said, it should be interpreted by the mind as red light, its wave-length being twice that of the red of the first spectrum. But it is obvious that here a new consideration must enter into account. If this radiation has double the wave-length of the first red, it has triple the wave-length of the first yellow. On the principle just laid down the mind may interpret it as red light or as yellow. Which will it do? Examination of the cylindric screen—or, better still, through a telescope—shows that the mind adopts both these interpretations; and, the same principle applying to other wave-lengths, this constitutes what we have spoken of as the overlapping of the second spectrum by the third. At the point here specially considered both red and yellow light are seen.

From what has here been presented it follows that the principle considered as established in optics, that to every color there belongs a determinate wave-length, must be modified, since the same color-impression will be given to the mind by waves that have twice, thrice, etc., that determinate wave-length. But should the wave-lengths under consideration answer to whole multiples of that of some other color, the mind will interpret them as being of that color too.

Moreover, these observations lead us to extend the range of perception of the eye. The prism would lead us to infer that it can only be affected by waves the length of which is between [illegible] and 7600. Comparisons have hence been drawn between the organ of vision and the organ of hearing, to the disparagement of the former. The ear, it is said, can embrace a range of several octaves, but the eye is in [illegible] less than one. The grating, however, leads us to remove this restriction, and to place the eye more nearly on an equality with the ear. The principles here indicated must not be restricted to the luminous radiations: they apply to all others too. Thus, if a photographic sensitive surface be made to receive the first spectrum, it will be impressed by certain of its radiations, chiefly by those above the line G. If it be exposed in the second, third, etc., spectra, it will again be impressed by the corresponding undulations having two, three, etc., times the former length. From this it may therefore be inferred, that a chemical decomposition of a given substance, brought about by undulations of a certain length, will also be accomplished by radiations that are octaves of the first.

We may next consider the dark space intervening between the first spectrum and A′. In 1843, Draper published photographs of the diffraction spectrum. They were copies of the impressions made upon silver daguerreotype tablets in use at that time. These carried the spectrum impressions as far as the wave-length .3800, and therefore encroached considerably on the dark space toward A′. But collodion, introduced since, is a much more sensitive preparation. It has enabled Henry Draper, who has produced superb photographs of the ultra violet rays, to carry the impressions as far as .3400. According to M. Mascart, waves are emitted by incandescent cadmium having a length not exceeding .2200. These stand still further in the dark space P. In these excursions into the dark space the experiments of Prof. Stokes on the long spectrum of electric light become not only interesting, but very important; for as we gradually approach A′ the wave-length of the incident radiation is continually diminishing, and at A′ becomes zero. That point is the supreme limit beyond which no radiant manifestation of any kind is possible. The goal toward which experimental investigation is tending is therefore obvious. We are gradually groping the way across the dark space, and expect one day to reach the bright streak that lies at its terminus. At every step of advance the ether-waves are becoming shorter and shorter, and the vibrations more and more rapid. When the journey is accomplished, a region will have been gained in which the waves are infinitely short and the vibrations infinitely rapid.

At the red or more distant end of the first spectrum there is another dark space, separating the first from the second. In this, though perhaps of less interest than the one we have been considering, some explorations have been made. Draper in 1843, using the sunlight and a prism, discovered three large and very broad bands. They have subsequently been re-detected by M. Lamanski by the aid of a thermo-electric multiplier.

We may now briefly resume the consideration of the distribution of heat in the spectrum, postponed in a preceding paragraph. The diffraction spectrum, as we have seen, differs strikingly from the prismatic in the arrangement of its colored spaces. In the latter the less refrangible parts are compressed more and more in proportion as their refrangibility is less. Now, there is reason to believe that in the former the colored spaces are equally warm, though so feeble is the calorific effect that all attempts at the direct measurement of the heat have proved unsatisfactory. Admitting, however, that equality, it follows that in the prismatic the heat should appear to increase steadily from the more to the less refrangible end, because the compression of the colored spaces is becoming greater and greater. Draper, who first recognized this fact, and also first tried to measure the heat of the diffraction spectrum, attempted to give probability to this view by considering the sodium line D as the optical centre of the spectrum, and collecting all the visible rays below it into one focus, and all the visible rays above it into another focus. The heat of these foci being measured, proved to be equal.

We have now given a description of the two spectra, the prismatic or dispersion, the grating or diffraction, and have considered the distribution of light, heat, and chemical force in them respectively. Under the article SPECTROSCOPE will be found an account of the Fraunhofer or fixed lines, dark and bright, the various forms of spectroscopes, and the uses to which they are applied. We may therefore close with some historical statements in relation to that subject. In 1860, Kirchhoff and Bunsen announced the discovery of two new metals by the use of the prism. Public attention was instantly drawn to what was at once termed "spectrum analysis." The older publications, which really lay at the basis of the subject, were forgotten, and to M. Kirchhoff was awarded the entire honor for what was regarded as a new discovery. The history of science does not offer an instance of grosser injustice. Thirteen years previously, Draper had shown that all solid substances, and probably all liquids, emit light or become incandescent at the same temperature, that temperature being 977° F. The first ray they give forth is red, and other colors in the order of their refrangibility are added as the temperature rises, the spectrum being continuous and containing neither dark nor bright lines. These results, which formed the bases of M. Kirchhoff's fundamental memoir on *The Relation between the Coefficients of Emission and Absorption of Bodies for Light and Heat*, were appropriated without any adequate acknowledgment by M. Kirchhoff under the guise of mathematical deductions, and in a subsequent memoir on the history of this subject he passed them without notice. It may therefore be proper to recall some of the discoveries that had been made previously to 1860. Newton in his treatise on optics laid the foundation of the subject. He showed, as we have already mentioned, the manner in which a pure spectrum is to be prepared, proved the composite nature of white light, and presented the theory of different refrangibilities. He used a slit parallel to the edge of the prism, as well as triangular and circular openings, employing the image not of the sun, but of these slits. Euler, in his theory of light and heat, stated the principle that every substance absorbs light of such a wave-length as coincides with the vibrations of its smallest particles. Wollaston in 1802 discovered the dark lines in the sun's spectrum, but gave little attention to the subject. Fraunhofer invented the spectroscope in 1814; he used it without a collimator—a form by which results of exquisite perfection may be obtained. He mapped 576 of the fixed lines, gave to the more conspicuous ones the names they still bear, and determined that the cause of the lines is outside of the earth's atmosphere. He examined the light of the moon, Venus, and Mars, and saw in it the solar fixed lines. In the rays of the fixed stars Sirius, Procyon, Capella, Pollux, Betelgeux, though the position of the other fixed lines was different, he recognized the double line D. He inferred that the cause of these lines is the absorptive action of the atmosphere of the stars and the sun. He was thus the originator of astronomical spectroscopy. He connected these facts with chemical ones, by showing that the two dark lines D of the solar spectrum are coincident with the two bright lines given by a sodium flame. He found the lines D, E, b, F in Mars, and *b* in Capella. He also studied the bright lines of the electric spark and of colored flames. Brewster in 1822 utilized the yellow sodium flame in his monochromatic lamp. He examined the lines given by the absorption of nitrous acid gas, showing that they were more numerous as the temperature was higher. He also detected that some of the Fraunhofer lines of the sun's spectrum are due to the absorptive action of the earth's atmosphere. J. W. Herschel examined colored flames, and proposed them as a means of detecting the presence of substances. He published many facts in relation to the photographic and thermal properties of the spectra. In some of his investigations in thermal distribution he used paper blackened on one side and moistened with alcohol. Talbot in 1826 again examined the spectra of colored flames, and proposed the prism as a means of qualitative analysis. He used it practically to distinguish lithia from strontia, designating the operation optical analysis. He subsequently studied the bright lines given by various metals, gold, copper, etc., when volatilized by a voltaic current. Draper in 1843 published colored and other engravings of the fixed lines in the prismatic and diffraction spectra. Simultaneously with Becquerel he discovered the ultra-violet fixed lines. He ascertained that the spectra of ignited solids is continuous, showed that the point of ignition is the same for all solids and liquids (977° F.), and that as the temperature rises rays of increasing refrangibility are given off. He made the prismatic analysis of several different gas-flames, using in these experiments a sunlight comparison spectrum. He employed the method of designating the lines by their wave-lengths. This was subsequently used by Ditscheiner, Van der Willigen, Mascart, Gibbs, and Angström. Wheatstone in 1836 examined the spectra of electric sparks, and proposed this as a means of distinguishing one metal from another. Miller in 1845 published drawings of the spectra of several colored flames. Zantedeschi modified Fraunhofer's spectroscope by introducing a collimator. This made the instrument more compact, and indeed gave it its modern form. Stokes about 1850, from a consideration of the coincidence of the two dark D lines in the solar spectrum with the two bright lines of the sodium flame, inferred that sodium must exist in the sun. Stewart, from the law of the exchanges of heat, led the way to an explanation of the reversal of the spectrum lines. Angström, in an investigation of the

electric spark, proved that it yields two spectra—one derived from the metals of the poles, the other from the gas or air through which the spark passes. In 1856 he announced the general law, that a gas when luminous emits rays of light of the same refrangibility as those which it has the power to absorb; or, that the rays which a substance absorbs are precisely those which it emits when self-luminous. The reversal of the fixed lines was thus completely explained. Subsequently he published charts of the fixed lines, arranged according to their wave-lengths, the normal spectrum. Swan in 1857 proved that the two D lines are due exclusively to sodium, and are always a test of great delicacy of its presence.

The foregoing is offered not as a complete history of spectroscopic science previously to 1860, but for the purpose of showing that the generally-received impression of its originating about that time is altogether a misconception. It was the announcement of the fortunate discovery of two new metals, rubidium and cæsium, that instantly and forcibly drew attention to it; its foundations, as this imperfect statement shows, had, however, not only been long previously laid, but the structure carried very far toward completion. Subsequently, the literature of the subject has become immense, the drift of scientific research taking this special direction, and in the hands of the ablest physicists discovery crowding upon discovery to such an extent that it is impossible in the compass of this article to do it justice. What we have endeavored to do is to draw attention to the labors of those earlier experimenters, who in reality established this beautiful and important branch of science. J. W. Draper.

Spectrum Analysis. See Spectroscope and Spectrum.

Speculative Philosophy. See Philosophy, by W. T. Harris, A. M., LL.D.

Spec'ulum [Lat., "mirror"], **Speculum Metal,** or **Specula of Silvered Glass.** Speculum in optics and astronomy signifies a reflecting surface, usually of metal, though the term has also been frequently applied to unsilvered glass since the introduction of silvered-glass telescopes by Foucault and Steinheil in 1857. As the image formed by a concave speculum is on the same side of the mirror as the object, some arrangement is necessary to prevent the observer's head obstructing the passage of light to the speculum, and hence we have four different forms of reflecting telescope: (1) the Herschelian or Le Mairean, in which the speculum is so tilted as to bring the image to one side of the telescope tube; (2) the Gregorian, in which a secondary concave speculum returns the rays through an aperture in the primary speculum to the eye of the observer; (3) the Cassegrain, in which a convex secondary speculum is used for the same purpose as the concave of the Gregorian; and (4) the Newtonian, in which a plane speculum or right-angled reflecting prism turns the beam of light out to the side of the tube. Each of these forms has its merits and defects. The Herschelian, while it has the brightest image of all with a given aperture, cannot produce the finest definition, because the surface ought to be a paraboloid, with the vertex on the margin of the speculum, and this is almost unrealizable; the Herschels avoided this difficulty in large measure by using nearly spherical surfaces of long focus, their telescopes of 18 inches aperture being 20 feet long, while the Cassegrain of the writer of 28 inches aperture requires a tube less than 10 feet long. The convenience and facility of using a telescope turn almost altogether on its focal length, and in this comparison the advantage of the Cassegrain, allowing for the difference of apertures, is as 3 to 1. The Gregorian form is advantageous where a non-inverted image is desired, and it has been much used for small instruments intended for terrestrial as well as celestial observation. In larger telescopes the increase of length as compared with the Cassegrain, which is equal to twice the focal length of the secondary speculum, is a serious disadvantage. Not only does it require a larger dome to cover a Gregorian of the same aperture, but the flexure of the tube, and the consequent difficulty of preserving the adjustments, are much increased. Moreover, it is commonly stated that the curvature of the secondary speculum being concave, it has a tendency to exaggerate the defects of the primary. But with the modern methods of local correction, to be described further on, this counts for but little.

A defect which is alleged against both the Gregorian and Cassegrain is that the images they give as compared with the Newtonian are too much magnified, and that low powers cannot be used. Under certain circumstances this consideration has some weight, but it is as frequently an advantage. It must always be remembered that with a telescope of large aperture a very low power cannot be employed if the whole objective is to be utilized; for example, with a 28-inch aperture the lowest power should not be less than 140. The pencil emerging from the eyepiece must not be larger than the pupil of the eye at its maximum dilation.

The Newtonian construction may be arranged in two ways—one that used by Newton, to interpose a plane speculum or right-angled reflecting prism in the cone of rays proceeding from the primary speculum at such a distance from the focus as to bring that focus to the side of the telescope, or else as constructed by Foucault, to put a small reflecting prism just inside the focus of the speculum, and adjacent to it the objective of a microscope, the eyepiece of which should be placed on the margin of the telescope tube. This latter construction avoids the serious difficulty of making a large plane surface. The great advantage of the Newtonian is the convenient position the observer may assume; its most serious disadvantage, the necessity of being elevated 40, 50, or even 60 feet from the ground in the case of such instruments as the 4-foot of Mr. Lassell and the 6-foot of Lord Rosse. For the small sizes, like those now so extensively constructed by Messrs. Browning & With of London, this form leaves little to be desired. I have found it convenient to combine both the Newtonian and Cassegrain in my 28-inch.

The relative merits of reflectors and refractors have given rise to much discussion. In truth, each has its separate function: to the reflector belong absolute achromaticity and the maximum of size; to the achromatic, stability of adjustment. The achromatic is therefore suited to measurements of precision—the reflector to physical observation, and especially to certain applications of physics and chemistry to astronomy. The great achromatics of recent years, such as the 26-inch Alvan Clark telescope at Washington, in many respects rival the great reflectors, but they also lose some of the advantages of small refractors. Each is tending to intrude on the special domain of the other, for while Messrs. Lassell, Browning, and Grubb are giving stability to reflectors, Mr. Rutherfurd has made large lenses (13 inches) of great excellence especially suited to astronomical photography.

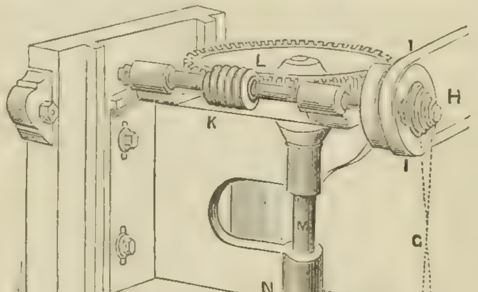
The specula used in reflecting telescopes are of two kinds: (1) Those made of an alloy of copper and tin; (2) those of glass covered with a film of silver, about $\frac{1}{200000}$th of an inch thick on the side turned toward the object. These latter must not be confounded with looking-glass mirrors, which are coated with tin-amalgam on the posterior side. All the great reflectors of Herschel, Rosse, Lassell, De la Rue, and others made previously to 1857, were on the first plan. Silvered-glass telescopes were invented by Steinheil, and reinvented in the same year by Foucault, whose admirable paper in the *Annales de l'Observatoire de Paris* (1859) is a model of what such memoirs should be. It is proper here also to allude to my paper on this subject in the *Smithsonian Contributions to Science* (1864). Ever since the introduction of silvered glass, there has been an animated controversy as to its utility compared with speculum metal, but it seems as if the balance had inclined finally to the former. A silvered speculum is permanent; for even though the silver coating be tarnished, it may readily be repolished, or, if injured by dampness, be replaced without affecting the figure of the glass; it is many times lighter, and therefore demands less weight in the mounting, and is correspondingly more manageable; it is more reflecting, in the proportion of about 92 to 65, and in consequence a smaller aperture will give an equal brilliancy to objects, this being a great advantage in an unsteady atmosphere. Of course, under favorable atmospheric conditions the larger aperture will give greater penetrating power, but nothing prevents the construction of a glass mirror of as large dimensions as any speculum. For these reasons it is not expedient to describe at length the processes for casting speculum metal. It is sufficient to say that it is composed of copper and tin in the proportion of 32 to 14.911; that it must be cast on a chill—that is, a slightly warmed iron surface; and that it must be annealed with the greatest care and for a long time.

Grinding and Polishing.—These operations do not differ much in the cases of metal and glass, except that the latter, being more rigid, will not take a permanent set if raised from its bearings, and being lighter can be more easily manipulated. The grinding and polishing of specula may be accomplished either by machinery or by hand. In former times, when Hadley, Mudge, Edwards, Molyneux, Short, and others were making reflecting telescopes, the work was done altogether by hand, the tools being fixed on an optician's post, which allowed free motion all round the surface to be worked. But when the elder Herschel had advanced to the larger telescopes which he constructed, he found it desirable to use machinery. For many years the arrangement of this machinery was kept a profound secret until finally revealed by Sir John Herschel a short time

previous to his death. A full description may be found in vol. xxi. of the 9th ed. of the *Encyclopædia Britannica.* The late earl of Rosse probably, however, did more to bring methods of working reflecting telescopes to perfection than any one else, particularly when we remember that he had an almost unknown field to work in, and that he attained a diameter of speculum never produced before nor since. Only a person who has devoted many years to exploring the difficulties of this pursuit can appreciate what Lord Rosse overcame. At the same time, it should be mentioned that Mr. Lassell has polished unquestionably the finest reflecting surfaces of 2 and 4 feet diameter that have ever been made, and this after many years of persevering and costly endeavor. His polishing-machine is elegant in design and smooth in action. Dr. De la Rue has produced fine results on specula of 13 inches, though he is better known for his extensive photographic use of this instrument on the sun, moon, planets, and stars. Mr. Grubb has also made the 4-foot equatorial now at Melbourne.

As to hand-working of reflectors, that has been confined to glass specula, and science owes the first publication of the processes to the late M. Foucault, who was the independent discoverer not only of this use of silvered glass, but also of the system of "local corrections." Though this method had long before Foucault's time been practised in America by Alvan Clark in the correction of achromatics for spherical aberration, yet the process had not been published. Any one who reads Foucault's memoir, previously referred to, will see good reason for regretting his untimely death. The methods of examining surfaces that he used enable one to detect every defect that a surface has—in the workshop even better than in the telescope—and give the means of obtaining absolute optical perfection.

Without entering into greater detail than is desirable, we may illustrate the subject of machine-polishing by a woodcut of Mr. Lassell's apparatus. After an experience derived from the construction of different kinds of polishing-machine, and extending over eighteen years, I may say that his contrivance with De la Rue's apparatus for controlling the rotation of the polisher will do all that can be accomplished by any machine, though in a recent memoir (*Phil. Trans. Royal Society*, 1874) Lassell states that a new one he there describes of a stronger model is required for 4-foot surfaces. The pitch coating which serves to carry the pol-



ishing rouge adheres very tightly toward the end of the process, and a machine is severely strained.

Lassell's idea was to cause the polisher to describe circular strokes upon the surface to be acted on, and to secure an equable and smooth motion. The machine has two vertical shafts, each driven by a screw, the axes of the worms being connected by a band passing over cone pulleys. The lower shaft carries the mirror and its equilibrated bearings. The upper shaft, passing through a fixed gear, carries at its lower extremity a crank which in revolving causes the secondary shaft at the side to rotate, and this in turn forces the lowest pinion to turn. By means of the two graduated dovetails the extent of the hypocycloids thus produced can be varied, and indeed other curves be originated. Subsequently, Lassell and De la Rue introduced improvements into this mechanism for the purpose of avoiding the irregular rotation of the polisher, and the tendency to the occurrence of rings of unequal action on the speculum.

As, however, it is evident that silvered-glass telescopes will eventually displace speculum metal, the methods by which they are polished claim our notice. An essential difference in the two cases depends on the fact that the glass surface, being once corrected to the paraboloid of revolution, is permanent, being protected by its silver coating. One is therefore prompted to spare no pains to remove even the most trifling defect, and in the case of my 28-inch a good deal of time, extending over two years, was spent in minute retouching. Eventually, a surface was attained that has exhibited the division in the outer ring of Saturn and other similarly difficult objects. The value of the system of local correction depends to a considerable extent on the fact that the disturbances arising from heat produced during polishing are avoided. But a small part of the surface is acted on at once, and the rest being freely exposed to radiation and evaporation, a harmful degree of expansion does not take place. An indispensable part of the process is frequent examination of an illuminated pinhole by a high-power eyepiece, both eyepiece and pinhole being placed near the centre of curvature of the speculum. The unsilvered glass reflects light enough not only to enable one to use this system of investigation, but also to apply the test by screening, in which the image of a pinhole before a flame is gradually cut off by an opaque straight edge. If there are any aberrating rays, they pass by the screen, and entering the eye disclose to it the parts of the reflecting surface that are in error. These can be attacked by a polisher of suitable size and quickly removed. One effect of the local retouching system is, it does not demand that the whole surface should be remade if a small part is in error, but in most cases that part alone is operated on. There is no difficulty about preserving a surface of revolution, and the minute portion constituting the difference between the sphere and parabola is readily rubbed away. In the case of a 4-foot mirror of 40-feet focus the actual depth of the cut on the edge is only $\frac{1}{21533}$d of an inch to produce parabolicity in a spherical mirror.

Support.—But no matter how perfect the optical surface may be, unless it is properly supported it will not officiate even passably. It is almost incredible what a small pressure will totally destroy the goodness of a large reflector. The statement Herschel makes is literally true, that if you lay a speculum on its back on a flat surface, and find it to define well, and then lift it up and put a thread underneath it, it will be so distorted as only to give a pair of images joined by a fuzz of light. When my 28-inch was supported on an air-bag behind, with three fixed points in front just out of contact, by blowing an ounce volume of air into the bag a star could be made triple. Fortunately, in glass as soon as the pressure is removed the fine figure is regained. Foucault suggested for the back support an india-rubber air-bag, and for certain uses this cannot be excelled. But the arrangement is not sufficiently stable for photographic or spectroscopic work, and it is best to employ the equilibrated lever system invented by Grubb and perfected by Rosse and Lassell. This does well as long as the speculum is on its back and the telescope points nearly vertically. But when the tube is depressed toward the horizon, the edge-support assumes more and more importance, and unless a good system is used the image becomes very much confused, either taking the form of a cross or else becoming doubled and fuzzy. In working with a great many glass specula I was for a long time puzzled by the fact that sometimes a surface showed this defect much more than at others, until eventually it turned out that these glass disks have an axis of maximum rigidity, on either end of which they may rest with a minimum of distortion. It seems likely, from reading the difficulties of others, that speculum metal is affected similarly. In surfaces of even quite large size it suffices, having placed the speculum in its best position, to swing it in a flexible hoop, taking care to have some device to keep the proper diameter in a vertical plane, either by revolving the telescope-tube in its cradle or else by turning the

speculum-box on a finely-fitting collar, so as not to disturb the centring. For the very largest specula the best results are undoubtedly attained by Lassell's scheme of a system of levers distributed over the back of the reflector, and taking into holes in it in such a way that the whole weight does not press on the lower edge. The last degree of nicety will be attained by a combination of this latter set of levers with those intended for the support of the speculum when the tube is vertical.

It has been remarked that it is important to avoid heating during grinding and polishing. It is almost certain that the ordinary kinds of glass used for silvered-glass reflectors not only yield to different degrees in different directions by pressure, but also by heat. Hence, by injudicious working or by undue haste a permanent figure may be communicated to glass, which will give only double images in the line of the optical axis. By allowing the beam of light to fall at a small obliquity on the surface, a good image may be produced at one side of the optical axis; and I have in this way made a 15½-inch mirror that was suited to the Herschelian form, the obliquity being about 2½°. There is reason to suppose that speculum metal shows a similar tendency.

Silvering of Glass.—A large number of processes have been invented for coating glass with a thin and uniform film of silver. They all depend on reducing metallic silver from a solution of nitrate of silver and ammonia, with perhaps the addition of potash. The reducing agent may be Rochelle salt, milk-sugar, inverted sugar, oil of cloves, aldehyde, etc. The best process is described in the *Monthly Notices* of the Royal Astronomical Society (Dec., 1875) by Martin, who has just completed a 4-foot silvered-glass telescope for the Paris Observatory. The glass must be carefully cleaned with nitric acid, and afterward with potash and alcohol, and then placed face downward on a mixture of equal parts of the following four liquids: (1) a solution of 40 grammes of crystallized nitrate of silver in a litre of distilled water; (2) a solution of 6 grammes of pure nitrate of ammonia in 100 grammes of water; (3) a solution of 10 grammes of caustic potash (quite free from carbonate and chloride) in 100 grammes of water. (4) We dissolve 25 grammes of sugar in 250 grammes of water; we add 3 grammes of tartaric acid, and heat to boiling, which is maintained for about 10 minutes, to produce the inversion of the sugar, and the solution is then allowed to cool. We then add 50 cubic centimètres of alcohol, to hinder any subsequent fermentation, and we dilute with water to make the volume half a litre if the silvering is to be done in winter, or dilute still more if it is to be done in summer. The film of silver, if the potash is pure, may not need any polishing, and should in any case require only a few strokes of a buckskin pad slightly tinged with fine rouge.

References.—*Philosophical Transactions of the Royal Society; Memoirs of the Royal Astronomical Society*, and *Monthly Notices of the Royal Ast. Soc.*, under the headings "Newton," "Herschel," "Rosse," "Lassell," "De la Rue," "Nasmyth," "Robinson," "Grubb;" Smith's *Optics*, vol. ii. p. 301; *Proceedings British Association*, 1850; *Smithsonian Contributions*, 1864; *Annals de l'Observatoire de Paris*, 1859; Holtzapfel's *Mechanical Manipulations*, p. 1292; *Encyclopædia Britannica*, vol. xxi., 8th ed., art. "Telescope." HENRY DRAPER.

Speech. See LANGUAGE, by PROF. W. D. WHITNEY, PH. D., LL.D.

Speed (JAMES), b. in Jefferson co., Ky., Mar. 11, 1812; graduated at St. Joseph's College; studied law at Transylvania University; began its practice at Louisville 1833; was a member of the legislature in 1847, State senator 1861, U. S. attorney-general Nov., 1864–July, 1866, and in the same year was chosen president of the Philadelphia Loyalists' convention.

Speed (JOHN), b. at Farringdon, Cheshire, in 1552 (according to others in 1542); pursued the business of a tailor in London until late in life, but at the same time was amassing an extensive knowledge of English antiquities, and ultimately was enabled by Sir Fulk Greville to publish a costly and valuable series of works. He was also much indebted to the friendship of Sir Henry Spelman for his success as an author. He published anonymously about 1590 a treatise on the *Genealogies of the Scriptures*, afterward prefixed to the 1st ed. of King James's Bible (1611), but his first appearance as an author was in 1608, when he printed a collection of 54 maps of various counties and cities, and engravings of antiquities of England and Wales, which were incorporated into *The Theatre of the Empire of Great Britain* (folio, 1611), with descriptive letter-press —a work in which he was aided by Camden, Christopher Saxton, and John Norden. In the same year he published his *History of Great Britain under the Conquests of the Romans, Saxons, Danes, and Normans.* D. at London July 28, 1629.

Speed's Mill, tp., Pickens co., Ala. P. 198.

Speedsville, p.-v., Caroline tp., Tompkins co., N. Y. P. 153.

Speedwell, tp., St. Clair co., Mo. P. 606.

Speedwell, p.-v. and tp., Wythe co., Va. P. 4088.

Speight's Bridge, p.-v. and tp., Greene co., N. C. P. 1820.

Speke (JOHN HANNING), b. at Jordans, Somerset, England, May 4, 1827; entered the British army 1844; served in India and in the Crimean war; accompanied Capt. Richard F. Burton in the expedition which resulted in the discovery of the great lakes of Central Africa, and afterward was at the head of another expedition (with Capt. Grant), which discovered the connection of the Nile with those lakes. Capt. Speke published a *Journal of the Discovery of the Source of the Nile* (1863), *What Led to the Discovery of the Source of the Nile* (1864); received gold medals from the geographical societies of France (1860) and England (1861), and from the king of Italy, and was engaged after his second expedition in a bitter controversy with Capt. Burton as to the merits of their respective discoveries. He was to have been welcomed by the British Association at Bath, but accidentally shot himself the day previous, Sept. 15, 1864, while engaged in field-sports.

Spel'man (Sir HENRY), b. at Congham, Norfolk, England, in 1562; educated at Walsingham School; graduated at Trinity College, Cambridge, about 1580; studied law at Lincoln's Inn, but devoted himself chiefly to archæology; was in 1604 high sheriff of Norfolk; was employed by James I. upon important commissions, especially in determining land-titles in Ireland; was knighted about 1612, in which year he withdrew from public business and settled in London; published his treatise *De Non Temerandis Ecclesiis; of the Rights and Respects due to Churches* (1613), and devoted many years to the study of the Anglo-Saxon language and to the compilation of his chief works, a valuable glossary of terms which occur in records and other ancient writings, and a collection of the councils of the English Church, but published during his life only the first volume of each. D. in London in 1641, and, by special order of Charles I., was buried in Westminster Abbey, near the monument of Camden. Vol. i. of his *Glossarium Archaiologicum*, extending to the letter L, was published 1626; vol. ii., completed by his son, Sir John, and by William Dugdale, appeared in 1664; and the whole work was issued in a single folio volume in 1687. Vol. i. of the *Concilia* was issued in 1639; vol. ii., chiefly by Dugdale, in 1664. Several miscellaneous treatises by Spelman on the laws and antiquities of England were posthumously edited, both separately and in a single volume, entitled *Reliquiæ Spelmannianæ* (Oxford, folio, 1698), with a *Life*, by Bishop Edmund Gibson. They were also included in his *English Works*, republished at London in folio in 1723.—His son, SIR JOHN, was knighted 1641, "in consideration of his father's good services both to Church and State," and was made master of Sutton's Hospital. He edited the *Saxon Psalter* (1641) and a *Life of Alfred the Great*, of which a Latin translation was published in 1678, though the original English was first edited by Thomas Hearne in 1709. D. at Oxford July 25, 1643.—EDWARD SPELMAN, a great-grandson of Sir Henry, published an elegant translation of Xenophon's *Anabasis* (1742) and of the *Roman Antiquities* of Dionysius Halicarnassus (4 vols. 4to, 1758). D. in Norfolk in 1767.

Spelt, the *Triticum spelta*, probably the *far* of the ancient Romans and the *zea* of the Greeks, is a grain somewhat resembling wheat, but quite distinct from it. It can be grown on poorer soils than those which are required for wheat. It is much raised in parts of Europe, and crops of it are occasionally seen in the U. S., as in Virginia. In quality it is much inferior to wheat. Spelt is believed to be specifically identical with *Ægilops caudata*, a wild grass of Europe. A sort of spelt, called *Triticum bengalense*, is raised in India. Lesser spelt, or St. Peter's corn (*Triticum monococcum*), called also "one-grained wheat," is raised to some extent on poor soils in Europe.

Spel'ter, the commercial name for zinc in pigs or blocks. (See ZINC.)

Spence (JOHN), M. D., a well-known practitioner of medicine at Dumfries, Va., and collaborator of the *American Journal of the Medical Sciences* of Philadelphia. He was a native of Scotland; spent five years in the University of Edinburgh in the days of Cullen, Black, and Monro. He took a lively interest in introducing vaccination, being fully satisfied of its protection from variola. Threatened by consumption, a sea-voyage across the Atlantic is sup-

posed to have cured him, and having acquired distinction in his new home, the faculty of the University of Pennsylvania unanimously conferred on him the honorary degree of M. D. D. May 18, 1829, aged sixty three.

PAUL F. EVE.

Spence (JOSEPH), b. Apr. 25, 1699; educated at Oxford, where he became fellow in 1722; entered into holy orders, was chosen professor of poetry in his college, and presented to the rectory of Birchanger in Essex. He subsequently travelled on the Continent, and afterward held the living of Great Horwood, and was made a prebend of Durham cathedral and professor of modern history at Oxford. He wrote an essay on Pope's translation of the *Odyssey*, and some minor works. His principal production is *Polymetis*, an attempt to illustrate the agreement between the ancient Roman artists and poets by comparing their works one with the other. He also made a collection of *Anecdotes of Books and Men*, which possesses considerable value. He was accidentally drowned by falling into a fish pond, Aug. 20, 1768.

Spence (WILLIAM), b. 1783; entered upon mercantile business in Hull, where he acquired a taste for natural history; in 1805 presented some specimens of insects to Rev. William Kirby, the famous entomologist, which led to a warm friendship between the two men, who together wrote the *Introduction to Entomology, or Elements of the Natural History of Insects* (1815–26; 7th ed., with considerable modifications and additions, 1858). Before the publication of this work he had written several valuable papers on entomology; was returned to Parliament about 1815, where he earnestly maintained that England might become independent of foreign produce; in 1826 took up his residence in London, and became an active member of several learned associations and president of the Entomological Society. D. in London Jan. 6, 1860.

Spen'cer, county of S. W. Indiana, bordering on Ohio River. Surface hilly in the W. and level in the S. part; soil productive, abounding in bituminous coal. Cattle, horses, sheep, and swine are numerous. There are flour and saw mills, and manufactures of carriages and furniture. Staples, tobacco in large quantities, Indian corn, wheat, oats, potatoes, hay, wool, and sorghum-molasses. Cap. Rockport. Area, 390 sq. m. P. 17,998.

Spencer, county of N. Kentucky, intersected by Salt River; hilly but fertile. There are many cattle, horses, swine, and sheep. Staples, Indian corn, wheat, rye, oats, and distilled liquors, and a little tobacco. Cap. Taylorsville. Area, 280 sq. m. P. 5956.

Spencer, tp., Harrison co., Ind. P. 1310.

Spencer, tp., Jennings co., Ind. P. 1927.

Spencer, p.-v., cap. of Owen co., Ind., on White River and Indianapolis and Vincennes R. R., 52 miles S. W. of the former city, has 5 churches, 1 bank, excellent graded school employing 6 teachers, 2 weekly newspapers, a woollen and planing mill, 1 stove-factory, a pork-packing establishment, machine shops, saw and flouring mills, stone-quarries, 4 hotels, and block and cannel coal. P. 971.

JOHN WAYLAND, ED. "OWEN CO. JOURNAL."

Spencer, p.-v. and tp., cap. of Clay co., Ia., on Little Sioux River, has 2 churches, a public school, 2 hotels, and 1 newspaper. Principal business, farming and stock-raising. P. 594. SAMUEL GILLESPIE, ED. "CLAY CO. NEWS."

Spencer, p.-v. and tp., Worcester co., Mass., on Boston and Albany R. R., 11 miles S. W. of Worcester, has 4 churches, 18 public schools, a town-house, public library and lyceum, 1 bank, Masonic lodge, post of the Grand Army of the Republic, and 1 newspaper. P. 3952.

CHAS. F. MINOR, ED. "SUN."

Spencer, tp., Kent co., Mich. P. 580.

Spencer, tp., Pike co., Mo. P. 1654.

Spencer, tp., Ralls co., Mo. P. 2119.

Spencer, p.-v. and tp., Tioga co., N. Y., on Geneva Ithaca and Athens R. R. P. 1863.

Spencer, tp., Allen co., O. P. 1153.

Spencer, tp., Guernsey co., O. P. 1359.

Spencer, tp., Hamilton co., O. P. 2543.

Spencer, tp., Lucas co., O. P. 653.

Spencer, p.-v. and tp., Medina co., O. P. 929.

Spencer, p.-v., cap. of Van Buren co., Tenn. P. 147.

Spencer, tp., Powhatan co., Va. P. 2395.

Spencer, p.-v. and tp., cap. of Roane co., West Va. P. of v. 143; of tp. 1366.

Spencer (AMAN CURTIUS), M. D., b. in Charlotte co., Va., in 1790; graduated in medicine at the University of Pennsylvania; settled in Nottoway co., Va., whence, after practising his profession fifteen years, he went to Europe, prosecuting his studies for some time; on his return settled in Petersburg and devoted himself chiefly to surgery; claimed to have first performed lithotrity in America, May, 1832; was also a successful lithotomist. D. in Petersburg Feb., 1861.

PAUL F. EVE.

Spencer (AMBROSE), LL.D., b. at Salisbury, Conn., Dec. 13, 1765; graduated at Harvard University in 1783; studied law, and began practice at Hudson, N. Y.; represented Columbia co. in the State legislature 1793; was appointed assistant attorney-general 1796; attorney-general 1802–04; became a justice of the supreme court in 1804, and chief-justice 1819–23; member of the State constitutional convention 1821; was elected member of Congress 1829–31; held the office of mayor of Albany; presided at the Whig national convention at Baltimore in 1844, and was author of a bill mitigating the criminal code and authorizing the erection of a State prison near New York City. D. at Lyons, N. Y., Mar. 13, 1848.

Spencer (GEORGE E.), b. in Jefferson co., N. Y., Nov. 1, 1835; educated at the college of Montreal, Canada; was admitted to the bar in Iowa 1856; was secretary of the Iowa senate 1858; entered the Union army as captain 1862; became adjutant general of volunteers; recruited the 1st Alabama Cavalry 1863; commanded a cavalry brigade under Sherman 1864, and was brevetted brigadier-general for gallantry in the field; became register in bankruptcy in Alabama 1867; was chosen U. S. Senator as a Republican 1868, and re-elected for the term expiring in 1879.—His wife, Mrs. BELLA Z. SPENCER, b. in London, England, about 1840, to whom he was married in 1862, was the authoress of *Ora, the Lost Wife* (1864), *Tried and True, a Story of the Rebellion* (1866), and *Surface and Depth* (1867), the latter published after her death, which occurred at Tuscaloosa, Ala., Aug. 1, 1867.

Spencer (GEORGE JOHN), D. C. L., SECOND EARL SPENCER, b. at Wimbledon, England, Sept. 1, 1758; graduated at Cambridge about 1776; entered Parliament under the courtesy title of Lord Althorp 1780; was commissioner of the treasury 1782; succeeded his father in the earldom Oct. 31, 1782; became ambassador to Vienna, lord privy seal, and first lord of the admiralty 1794; resigned the latter office 1802; accepted the secretaryship of state for the home department for a few months in 1806; was the first president of the Roxburghe Club, formed for the reprinting of rare English books 1812, and accumulated one of the rarest and most costly private libraries in Europe. D. at Althorp Park Nov. 10, 1834. Dr. T. F. Dibdin, the celebrated bibliographer, devoted some years to a description of Earl Spencer's library, publishing the *Bibliotheca Spenceriana* (4 vols. super-royal 8vo, 1814–15) and the *Ædes Althorpianæ* (2 vols., 1822).—GEORGE SPENCER, his youngest son, b. in London Dec. 21, 1799, graduated at Cambridge 1819, and took orders in the Church of England, but seceded to the Roman Catholic Church 1830; was ordained priest 1832; took charge of the missions of West Bromley and Dudley; entered the order of Passionists 1846; known as "Father Ignatius." D. at Carstairs, Scotland, Oct. 1, 1864. His *Life* was published in 1866.

Spencer (HERBERT), b. in Derby Apr. 27, 1820, and was an only surviving child. His father and grandfather were teachers. Having slender health in boyhood, he was not kept at school, and his father, a gentleman of enlarged views, attended to his studies, but left him much to himself. At thirteen he was sent to study with an uncle, the Rev. Thomas Spencer, rector of Hinton, a liberal clergyman and a cultivated scholar, with whom he remained three years. He had been early attracted to natural history, and under his father's encouragement made collections, practised drawing from objects, made physical and chemical experiments, and indulged a marked taste for manipulation and invention. While at Hinton he devoted himself chiefly to mathematics, and developed a taste and capacity for working out original problems. He was familiar with physical and chemical operations, and the bent of his mind was strongly toward experimental inquiry. Returning to Derby, he was busied for a short time with inventions and miscellaneous study, and in 1837 entered the office of Sir Charles Fox and began work as a civil engineer. After this he was engaged for several years on railroads, but gave his spare time to inventions, scientific experiments, mathematical studies, and to writing for the *Civil Engineer's and Architect's Journal*; in 1842 contributed a series of letters to the *Nonconformist* on *The Proper Sphere of Government*; and in 1848 became sub-editor of the *Economist*. In 1850 he published his first book, *Social Statics*, which was a development in a more scientific form of the ethical ideas contained in his earlier letters on government. The work was a treatise on social science based upon the conception of the evolution of society through the operation of natural laws. He now took up the occupation of a writer, con-

tributing elaborate articles upon various subjects to the leading English reviews. But, although dealing with various themes, his course of thought was systematic, and the masterly series of essays that he published from 1850 to 1860 are mainly devoted to the elaboration and application to various important subjects of the principle of evolution. These papers reappeared in this country in the volumes entitled *Illustrations of Universal Progress; Essays, Moral, Political, and Æsthetic; Education, Intellectual, Moral, and Physical;* and *Recent Discussions.* In 1855, Mr. Spencer published a very able and original work entitled *The Principles of Psychology*, pronounced by Mr. J. S. Mill to be "the finest example we possess of the psychological method in its full power." In this work the doctrine of evolution was applied to the science of mind, and the ground was taken that mental faculties in the whole scale of animal life have been developed by experience, through the intercourse of living organisms with their surroundings, through the principle of heredity and variation, producing slow modifications in vast periods of time. This work was so profound in exposition, and so greatly in advance of the time, that it produced but little public impression. Mr. Spencer had now grasped the conception of evolution in its broad relations, and in 1858 he reached the conclusion that it is a universal process dependent upon the laws of matter and force conformed to by all orders of phenomena and capable of being resolved and formulated. Being a great principle or law of the successive changes of phenomena involving the unfolding and dissolution of things, it seemed to offer the basis of a philosophy of nature from the genetic point of view—understanding by the term "philosophy" the completest unification of positive knowledge by universal principles. Believing that the time had come to attempt a comprehensive scheme of thought from the point of view of modern scientific results, and that although imperfectly executed it might still be valuable, Mr. Spencer resolved to undertake it. Master of logical methods, widely and accurately acquainted with the modern sciences of nature, with rare powers both of analysis and synthesis, peculiarly free from the bias of former systems, and a writer of unrivalled clearness, Mr. Spencer was endowed with unusual qualifications for so difficult an enterprise. To those who think his attempt presumptuous, it may be stated that letters written in 1859, designed to facilitate the execution of Mr. Spencer's project, by Mill, Grote, Huxley, Fraser, Hooker, Tyndall, and Latham, recognized that he was eminently the man to do a great and original work for the advancement of knowledge in this age. This judgment has been abundantly vindicated, high European authorities having subsequently declared that in mental grasp and organizing power Spencer is the strongest man that England has produced since Newton. He began his work by drawing up the prospectus of a *System of Philosophy* involving the full working out of the law of evolution and its application to the phenomena of life, mind, society, and ethics. In this prospectus the logical connection and detailed order of treatment are presented in a scheme designed to embrace eleven volumes, and to require twenty years for its completion. This remarkable analysis of his system was written the same year (1859) that Mr. Darwin made his great contribution to the development-theory in one of its aspects by the publication of the *Origin of Species.* The *Philosophy* was divided into two parts: (1) *The Unknowable;* (2) *The Laws of the Knowable.* The first part was introductory, occupying little more than 100 pages, and was designed to determine the limits of legitimate knowledge, and of any philosophy that is based upon it. It is there argued that in its knowing the human mind cannot transcend phenomena, but that it cannot escape the consciousness of an Unknowable Power, of which all phenomena are the manifestations, and which human thought, from the very nature of intelligence, can never grasp or understand. In this part of his work Mr. Spencer has been much misapprehended. His aim was to clear the field of inquiry of what he held as doubtful and fruitless speculation, so that his proper work might be coextensive with the sphere of science and strictly conform to its methods. Yet for affirming an Unknowable beyond the scope of true philosophy, in a brief preliminary essay, he has been strangely charged with being the author of an "unknowable philosophy." How rigorously his undertaking is confined to the sphere of knowable realities will at once appear. The initial treatise, *First Principles*, was published 1862 in one volume, and aside from its introductory part it is occupied with the foundations of his scheme, in which the law of evolution is broadly worked out and formulated in terms of matter, motion, and force—legitimate conceptions of science. In 1867 he completed the *Principles of Biology* in two volumes, the second division of the system, and devoted to the data and inductions of biological science from the point of view of evolution as expounded in *First Principles.* In 1872 appeared the *Principles of Psychology*, also in two volumes, the third instalment of the *Philosophy*, and based upon the treatise of 1855, with such modifications and extensions as he had been led to by his subsequent studies. It is an exposition of mental science grounded in biology and in accordance with the theory of evolution. The fourth division of his system is the *Principles of Sociology*, outlined to occupy three volumes. But before entering upon it Mr. Spencer issued in 1872 the *Study of Sociology*, a small book, not a part of the regular system, but partially designed as introductory to the sociological division. The *Principles of Sociology* is a very important part of his great work, and is now in progress. Its first volume will be ready this year (1876), and several portions of it have been already printed in numbers. The same plan is here pursued as in the previous divisions, the data of the subject being first treated, to be followed by the inductions or general principles of social science derived from them, and elucidating the conditions and course of social evolution. The closing division of his undertaking will work out the *Principles of Morality*, in two volumes, on the basis of the preceding expositions, and deduce the rules of human conduct from the laws of life, of mind, and of man's social relations. Independent of his "system" proper, but ancillary to the *Principles of Sociology*, he several years ago drew up the plan of a series of publications under the title *Descriptive Sociology.* This is designed to be a comprehensive repertory of facts representing the characters of human societies of all types and grades, existing and historical, savage, barbarous, and civilized. The facts are tabulated upon an original plan, on which the social elements are classified, and the form of presentation is admirably suited for convenient reference, ready comparison, and instructive inference. The civil, military, domestic, industrial, commercial, moral, religious, æsthetic, and intellectual factors which constitute the structure and functions of society are given, so that each table or set of tables maps out, as it were, for inspection, the traits of the communities described. The work involved enormous labor; and having determined its plan and scope, Mr. Spencer employed three cultivated scholars to assist him in carrying it out, assigning to each a separate field of research. In 1873 he published No. I. of this work, the *Descriptive Sociology of English Civilization*, compiled and abstracted by Mr. James Collyer. It is a social history of England in compendious form, giving the classified facts which represent its condition at any epoch, the progress in each element of social activity, the rise of institutions, the differentiation of professions, the growth of industries and arts, and the general *consensus* of English social advancement. Appended to the tables are copious classified extracts sustaining the tabular summaries, and given without comment. This was followed by No. II., devoted to the decayed American civilizations, and was elaborated by Dr. Scheppig. No. III. takes up the Nigretto and Malayo-Polynesian races, and No. IV. delineates the African races. Both were worked up by Prof. Duncan. No. V., devoted to the social history of the Hebrews, and No. VI., to French descriptive sociology, will appear this year. These works are in folio form, as necessitated by the tables. They were at first designed to embrace eighteen issues, so as to form a cyclopædia of the social condition of many representative communities of the world; but the enormous expensiveness of the undertaking, and the very restricted demand for the publication, have compelled Mr. Spencer to limit the printing to nine numbers. His extensive unpublished materials will, however, prove valuable for his own use in dealing with the principles of sociology, the object for which the whole was undertaken. The *Descriptive Sociology* is to be translated and published in Russia, where steps have been taken to reduce Russian social history to the same form of statement. The general works of this author have been translated into nearly all the languages of Europe, and are exerting a powerful influence upon the mind of the age. They are all reprinted in this country.

Mr. Spencer is in imperfect health, which was so broken when he began his great undertaking in 1860 that few believed he would be able to go on with it. But he is a skilful master of the art of taking care of himself, and is in better condition now than when he started. He dictates to an amanuensis about three hours a day, his "copy" as written requiring but little revision for the press. He has followed this practice since 1859, and ascribes his power of going on to the economy of force it allows. Mr. Spencer is full medium in stature, slimly built, long-legged, and a great walker. He is a bachelor, living in a quiet boarding-house in the West End of London. Holding a philosophy that bears closely upon human conduct, and applying it with as much decision and repose as if it had been

accepted by the world for a thousand years, he naturally falls into a critical attitude toward many of the opinions and practices that prevail around him. This leads to controversy, which is serious work with Spencer, as he talks with the same force and perspicuity as he writes. It therefore becomes necessary for him to abstain much from discussion in order to save his strength, and especially in the evening, as it aggravates the sleeplessness that has greatly troubled him for years. His recreations are billiards, concerts, and theatres, with frequent country rambles, which are often prolonged when overdoing has put him "out of sorts." He is a regular frequenter of the Athenæum Club, where he looks over the periodicals, takes notes in the library, chats with friends, plays billiards, takes his tea in the smoking room, and sometimes a cigarette. He has been often besought to join scientific societies, and has been offered university honors, but declines, caring only to get along with his work, and setting himself resolutely against everything that would hinder it by diverting his attention, increasing his responsibilities, or wasting his time. His correspondence having accumulated to a burdensome degree, as a measure of self-protection he has recently issued the form of a lithograph letter explaining his inability to answer all who write to him. E. L. YOUMANS.

Spencer (ICHABOD SMITH), D. D., b. at Rupert, Vt., Feb. 23, 1798; graduated at Union College 1822; taught school at Schenectady, and afterward at Canandaigua, N. Y.; was settled at Northampton, Mass., Sept. 11, 1828, as colleague with Mr. Williams; pastor of the Second church, Brooklyn, N. Y., from 1832 until his death, which occurred at the latter place Nov. 23, 1854. He published *Sermons, with a Memoir* (1855), *Sacramental Discourses* (1861), and *Evidences of Divine Revelation* (1865).

Spencer (JESSE AMES), D. D., b. at Hyde Park, N. Y., June 17, 1816; graduated at Columbia College 1837; studied theology at the General Seminary of the Protestant Episcopal Church; was ordained 1840; was rector of St. James's church, Goshen, N. Y., 1840–42; travelled in Europe 1842–43, and again 1848–49, at which time he visited Egypt and Palestine; was professor of Latin and of Oriental languages at Burlington College, N. J., 1849–50; editor and secretary of the Episcopal S. S. Union and Church Book Society 1851–57; declined the vice presidency of Troy University 1858; was rector of St. Paul's, Flatbush, L. I., 1863–65, and has been professor of Greek in the College of the City of New York since Oct., 1869. Author of a volume of religious *Discourses* (1843), *History of the English Reformation* (1846), *The East, Sketches of Travel in Egypt and the Holy Land* (1850), and of a widely-circulated *History of the United States* (4 vols., 1856–69), first published (in English and German) in semi-monthly parts as a subscription-book, *Greek Praxis* (1870), and *A Course of English Reading* (1873). Dr. Spencer was editor of *The Young Churchman's Miscellany* (1846–68), of 6 vols. of the "Classical Series" of T. K. Arnold (1846–50), of a *New Testament in Greek* (1847), with notes, *Cæsar's Commentaries* (1848), with notes and a lexicon, of Pycroft's *Course of Reading* (1844), of Archbishop Trench's *Poems* (1856), and brought out a new edition of the late Prof. Alpheus Crosby's *Anabasis* (1875). He has been a large contributor to the biographical department of Appletons' *American Cyclopædia*.

Spencer (JOHN), D. D., b. at Bocton, Kent, England, in 1630; educated at the King's School, Canterbury; graduated at Corpus Christi College, Cambridge, about 1650; obtained a fellowship there 1652; took orders in the Church of England; became rector of Landbeach, master of Corpus, and archdeacon of Sudbury 1667; prebendary of Ely 1672, and dean of Ely 1677. D. May 27, 1695. Author of *A Discourse concerning Prodigies* (1663; 2d ed. 1665), *Dissertatio de Urim et Thummim* (1669), and *De Legibus Hebræorum Ritualibus et earum Rationibus* (Cambridge, 1685), a work of great learning which excited much controversy. It maintained that the Hebrew ritual was almost entirely borrowed from the Egyptian—a view previously upheld by Maimonides in his *Moreh Nevochim*, and by Sir John Marsham in his *Canon Chronicus Ægyptiacus*, defended by Bishop Warburton and combated by Witsius, Shuckford, Dr. Woodward, and William Jones of Nayland. Editions of Spencer were published at the Hague 1686, and at Leipsic (1705). A new edition, brought out by Dr. Leonard Chappelow (Cambridge, 2 vols., 1727), contained a supplementary book (the fourth, left in MS. by the author), and the whole work, with a memoir and a commentary by Pfaff, was published at Tubingen (2 vols., 1732).

Spencer (JOHN CANFIELD), LL.D., son of Chief-Justice Ambrose, b. at Hudson, N. Y., Jan. 8, 1788; graduated at Union College 1806; was private secretary to Gov. D. D. Tompkins 1807–08; admitted to the bar at Canandaigua 1809; became master in chancery 1811, judge advocate-general on the northern frontier 1813, postmaster at Canandaigua 1814, assistant attorney-general for Western New York 1815, member of Congress 1817–19, of the State assembly 1819–20, being Speaker the latter year; State senator 1824–28; commissioner to revise the statutes of New York 1829; special attorney-general to prosecute the murderers of William Morgan; was secretary of state and superintendent of common schools 1839–41; secretary of war under Pres. Tyler from Oct., 1841, to Mar., 1843, when he was transferred to the treasury department; resigned the latter post 1844 in consequence of his opposition to the annexation of Texas, and thenceforth devoted himself to the practice of his profession, in which he occupied an eminent position. The organization of the State asylum for idiots and the improvement of the common-school system were largely due to him, and he served on many important State commissions. In 1838 he edited, with a preface and notes, De Tocqueville's *Democracy in America*. D. at Albany May 18, 1855.

Spencer (JOHN CHARLES), THIRD EARL SPENCER, better known as LORD ALTHORP, eldest son of George John, second Earl Spencer, b. May 30, 1782; educated at Harrow and at Trinity College, Cambridge; was elected to Parliament 1804; held office under Fox as junior lord of the treasury from Feb. 11, 1806, to Mar., 1807; sat in Parliament for the county of Northampton from Dec., 1806, till the passage of the Reform bill 1832, during which long period he was one of the leading members of the opposition; was especially prominent in the attacks upon the financial policy of the Tory administrations; was chancellor of the exchequer in the cabinet of Earl Grey Nov., 1830, to Nov., 1834; was ministerial leader of the House of Commons during the memorable debates on the successive Reform bills; succeeded his father as Earl Spencer Nov. 10, 1834, after which he withdrew from active political life; devoted himself to scientific agriculture; was many years president of the Smithfield Cattle Club; was one of the founders and the first president of the Royal Agricultural Society 1838; was an active member of the Roxburghe Club for reprinting rare books; vice-chairman of the Society for the Diffusion of Useful Knowledge, and a liberal promoter of the *Biographical Dictionary* undertaken by that society. D. at Wiseton Hall, Nottinghamshire, Oct. 1, 1845.

Spencer (JOSEPH), b. at East Haddam, Conn., 1714; chosen judge of probate in 1753; was major in the northern army under Col. Whiting 1758; appointed brigadier-general in the Continental army June 22, 1775, major-general Aug. 9, 1776; assisted in the expedition against Rhode Island 1778, also in Sullivan's retreat; resigned his command June 14, 1778, because of an order by Congress inquiring into the reasons for his not executing the plan of an expedition against the British in Rhode Island the year before; was elected to Congress in 1779, and the following year saw him elected into the council, of which he had been a member in 1766; and to this office he was reelected annually until his death, which occurred at East Haddam Jan. 13, 1789.

Spencer (WILLIAM ROBERT), son of Lord Charles Spencer and grandson of the second duke of Marlborough, b. in England in 1769; educated at Harrow and at Oxford; was for some years a commissioner of stamps; became involved in pecuniary difficulties, and consequently fixed his residence in Paris, where he d. Oct. 23, 1834. For many years he occupied a prominent position in London social circles as a wit and a writer of *vers de société*, some of which, like *Beth Gelert* and *Too Late I Stayed*, have become widely known through collections of "elegant extracts." Author of *Urania, or the Illuminé, a Comedy* (1802), and *The Year of Sorrow* (1803), a poetical tribute to the memory of several friends who had died in 1802; and translator of Bürger's *Lenore*, published in folio (1796), with designs by his aunt, Lady Diana Beauclerc. After his death a volume of *Poems by the late Hon. W. R. Spencer, to which is prefixed a Biographical Memoir* (1835), was published. Two of Mr. Spencer's sons became bishops: AUBREY GEORGE, b. in London Feb. 12, 1795, educated at Oxford, was appointed archdeacon of Bermuda 1825, bishop of Newfoundland 1839, and of Jamaica 1839. D. Feb. 24, 1872.—GEORGE TREVOR, b. 1801, graduated at University College, Oxford, 1822; was incumbent of Buxton 1824–29, of Leadon-Roding 1829–37; bishop of Madras 1837–49; became chancellor of St. Paul's cathedral 1860, and rector of Walton 1861. D. near Buxton July 16, 1866. Author of 3 vols. of travels in India.

Spencer Brook, p.-v. and tp., Isanti co., Minn. P. 403.

Spen'cerport, p.-v., Ogden tp., Monroe co., N. Y., on Erie Canal and on Niagara Falls branch of New York Central R. R. P. 591.

Spencer Rifle, a breech-loading magazine gun, extensively used as an arm for the Union cavalry during the civil war in the U. S., is characterized by having in the butt of the stock a magazine holding seven cartridges, which are brought one by one into the chamber by a movement of the trigger-guard as a lever, which at the same time throws out the shell of the exploded cartridge. A new magazine can be inserted whenever the cartridges have been exhausted, or the magazine may be shut off and the rifle used as a single breech-loader.

Spen'cerville, p.-v., Spencer tp., Allen co., O., on Miami Canal. P. 364.

Spe'ner (Philipp Jakob), b. at Rappoltsweiler, Upper Alsace, Jan. 25, 1635; studied theology at Strasbourg, Tübingen, and Bâle; visited several Swiss theological seminaries of the Reformed denomination, though a Lutheran divine, and began to preach at Strasbourg in 1663; was appointed first pastor in 1666 at Frankfort, where he instituted his famous *collegia pietatis* (prayer-meetings), which finally brought him into conflict with the orthodox clergy; became preacher to the electoral court of Dresden in 1686, but lost favor here by calling the elector's attention (privately) to the vices of his own life; was invited in 1695 to Berlin, where he was appointed provost of the church of St. Nicolai. D. Feb. 5, 1705. He was the founder of the so-called *pietism*, but neither in his writings nor in his person was there anything of that mysticism and eccentricity which characterized some of his adherents. In opposition to the orthodox theological system of his time, he conceived Christianity principally as a living duty and comfort, not as a science; and, leaving all subtle definitions to others, he simply recommended his hearers to look at the Bible in the light of their own lives, and then to look at their lives in the light of the Bible. The impression he made was both wide and deep, and after his death his tendency was for a long time represented by the theological faculty of the University of Halle. He wrote *Pia Desideria* (1675), *Das geistliche Priesterthum* (1677), *Des thätigen Christenthums Nothwendigkeit* (1679), *Evangelische Glaubenslehre* (1688). His *Life* was written by Hossbach (2 vols., 1828) and Wildenhahn (1842).

Spen'ser (Edmund), b. at East Smithfield, near the Tower, London, England, in 1552 or 1553. Nothing is known with certainty of his family, but from passages of his poems it may be inferred that he was descended from the Spencers of Hurstwood, Lancashire, and was related to the Spencers of Althorp. He entered as a sizar at Pembroke Hall May 20, 1569, in which month he contributed a number of sonnets and epigrams to a volume printed at London by Dr. John van der Noodt, a Flemish physician; graduated Jan. 16, 1573; visited his relatives in Lancashire, where he fell in love with a lady supposed to have been Rose Daniel (sister of Samuel Daniel the poet), whose charms he celebrated under the name of "Rosalinde" in a pastoral poem, *The Shepheardes Calendar*, published anonymously in 1579, the dedication of which to Sir Philip Sidney had been preceded by personal acquaintance in London; printed soon afterward *Three Proper and Wittie Familiar Letters lately passed betweene two Universitie Men* (1580), being a literary correspondence with his college-friend, Gabriel Harvey; obtained in the autumn of 1580, through the influence of Sidney, the post of secretary to Lord Grey of Wilton, lord lieutenant of Ireland; rendered in that capacity services which were rewarded in 1586 by a grant from the crown of an estate forfeited by the earl of Desmond, consisting of 3028 acres of land, including the castle and manor of Kilcolman, near Doneraile, in the county of Cork, and took up his residence at that place, where he began the composition of his *Faerie Queene;* wrote in that year his *Astrophel*, a pastoral elegy on the death of Sir Philip Sidney; was in 1588 appointed clerk of the council of Munster; received in 1589 a memorable visit from Sir Walter Raleigh on his return from the Lisbon expedition; read to Raleigh the first two books of his great poem, which the latter thought "a dish to set before a queen," and accordingly persuaded the poet to accompany him to London. His reception by Queen Elizabeth appears to have been appreciative, for the publication of the first three books of the *Faerie Queene* in 1590 not only placed him in the front rank of poets, but procured him a pension of £50. During this visit to London, Spenser also published a volume of *Complaints, containing Sundrie Small Poems of the World's Vanitie* (1591). His marriage in 1594 to a Miss Nagle inspired his beautiful love-sonnets entitled *Amoretti* and a magnificent *Epithalamium* (1595), which were shortly followed by *Colin Clout's come Home Again*. In 1596 he published *The Second Part of the Faerie Queene, containing the Fourth, Fifth, and Sixth Bookes*, and *Foure Hymnes* addressed to the countess of Cumberland; he also presented the queen a MS. dialogue, *A View of the State of Ireland*, not published until 1633. Spenser was appointed in 1598 sheriff of the county of Cork, thus incurring the enmity of the insurgents of "the earl of Tyrone's rebellion," who toward the close of that year burned his house and plundered his estate, forcing him to fly to England, on which occasion an infant child of the poet is said to have perished in the flames. Reduced to poverty, Spenser passed a few miserable months in London, and d. in King street, Westminster, Jan. 16, 1599. According to Ben Jonson, he "died for lack of bread," after having refused twenty pieces (of gold?) sent him by the earl of Essex, saying "he was sorry he had no time to spend them;" but these details rest upon the memory of Drummond of Hawthornden, and are discredited by most biographers. He was buried in Westminster Abbey, near the tomb of Chaucer, as he had desired, the funeral being at the expense of the earl of Essex: and a monument in his honor was erected in 1620 by Anne Clifford, countess of Dorset, afterward countess of Pembroke. He left two sons, Sylvanus and Peregrine. Hugolin, a son of Peregrine, was outlawed for adhesion to James II., and was living, "very old and unmarried," in 1700. Many editions of Spenser's complete works have appeared, the best being the variorum edition of Henry J. Todd (London, 8 vols., 1805), that of J. Payne Collier (London, 5 vols., 1862), with glossary, notes, and a *Life*, and that of Rev. R. Morris (Globe ed., 1869). These will, however, be superseded by a critical edition announced by Rev. A. B. Grosart as in preparation (1876), with the assistance of leading members of the British Philological Society. G. L. Craik's *Spenser and his Poetry* (3 vols., 1845) is perhaps the most satisfactory critical work. (For a view of his style and poetical rank see English Language and Literature.)

Porter C. Bliss.

Spe'onk, p.-v., Southampton tp., Suffolk co., N. Y., on Sag Harbor branch of Long Island R. R. P. 174.

Speran'sky (Mikhail), Count, b. in the government of Vladimeer, Russia, Jan. 1, 1772; educated at the Academy of St. Petersburg, where he principally studied mathematics and physics, in which he became professor in 1797; was appointed secretary to the imperial council in 1801, and charged with the reorganization of the ministry of the interior, the committee on laws, and the imperial council; exercised considerable influence on the government, and carried through several improvements in the method of taxation, the system of public education, etc., but was banished in 1812 to Nizhnee-Novgorod, and afterward to Perm. In 1814 he was allowed to settle on a small estate near St. Petersburg, and in 1816 he re-entered the public service; was made governor of the province of Penza in 1817; governor-general of Siberia in 1819; was recalled to the court in 1821, and made president of the chancery in 1825. D. at St. Petersburg Feb. 23, 1839. His work, written in Russian, but translated into French under the title *Précis des Notions historiques sur la Réformation du Corps des Lois russes*, acquired a great reputation.—His daughter, Elizabeth Bagrejew-Speransky, b. at St. Petersburg Sept. 17, 1799, was an authoress of note, and wrote, besides several novels, *Les dernières Heures de l'Empereur Nicolaus* (Leipsic, 1855) and *Les Pèlerins russes à Jérusalem* (2 vols., Brussels, 1854). D. at Vienna Apr. 4, 1859.

Spermace'ti [Lat. *sperma*, "sperm," and *cetus*, "whale"], **Spermaceti Fat,** or **Cetine** ($C_{32}H_{64}O_4$). Spermaceti exists ready formed in the cavities of the head of the sperm whale (*Physeter macrocephalus*), and also in that of some other whales and of *Delphinus edentulus*. It crystallizes out of the sperm oil of the head-cavities after the vital heat is lost, forming a magma or mirole, from which in cold weather the sperm oil is expressed by hydraulic pressure ("cold-drawn sperm oil"), the spermaceti being left behind. It is purified by melting it by steam to separate mechanical impurities, and recrystallizing. It then forms a lustrous, pearly, white mass of eminent crystalline texture, feeling soft and soapy to the touch; does not grease paper if quite freed from oil; is brittle; melts at 100°–116° F., and has a density of 0.943 at 60°. The pure spermaceti has a less density — 0.843 at 122°, 0.824 at 178°, and 0.813 at 201° F. (*Saussure.*) If pure, it is without taste or odor, and reacts neutral. The natural product, freed from sperm oil by cold alcohol and repeatedly crystallized from hot alcohol or ether, is the *cetine* of Chevreul, which melts at 120°–128°. Spermaceti was carefully investigated in 1840 by Dr. J. Laurens Smith (*Silliman's Journal*, xliii. 301, and *Scientific Researches*, Louisville, 1873, pp. 229–249), who demonstrated that it is an ether formed from palmitic acid and ethal, with elimination of water, and hence is a palmitate of ethal. It yields by saponification neither oleic or margaric acids nor glycerine, but in addition to palmitic acid small quantities of stearic, myristic, and tannic acids were found by Heintz, and also, besides ethal, small quan-

tities of stethal, methal, and lethal, which acids and alcohols are [illegible] form of compounds analogous to palmitate of cetyl. The chemical nature of spermaceti was [illegible] by Chevreul (*Recherches sur les* [illegible]). [illegible] is decomposed by dry distillation at [illegible] into a body of lower melting point, and which [illegible] saponified by potash, but it has an acid [illegible] no longer spermaceti. It does not yield [illegible] whence it follows that cetine contains no oleic [illegible] found in this decomposition. (*Smith.*) It [illegible] decomposed by steam at 320° F. in the same [illegible] by potash. No *acroleine* results from the destructive distillation of spermaceti, whence it is inferred no [illegible] present. (*Smith.*) This highly-valued product [illegible] with sperm oil) finds its chief use in the production of sperm candles, which are no longer so common as in the prosperous days of the sperm-whale fisheries, the decline of which dates from the general introduction of refined petroleum and paraffine. Spermaceti burns with a bright, clear flame like wax. The standard sperm candle, which is the common unit of comparison for photometric experiments in Great Britain and America, is taken to burn 120 grains of sperm in an hour, which it rarely does with accuracy. B. SILLIMAN.

Spermatozo'a [Gr. σπερμα, "seed," and ζῶα, "living creatures"], minute animalcular bodies found in the semen of living creatures, which are the essential agents in producing the fecundation of the ova. Viewed through a microscope, each is seen to consist of a small flattened oval extremity or body, to which is attached a long slender caudal filament; and in the centre of the body a little spot may be detected. They appear to be in constant motion in the seminal fluid, the movements being performed by a lashing or undulatory motion of the tail. The term is also applied by botanists to minute microscopic bodies found in the antheridia of some cryptogamous plants, which are supposed to perform a function analogous to that of the animal spermatozoa. (See HISTOLOGY.)

Sperm Oil. See OILS and SPERMACETI.

Spermophile. See PRAIRIE SQUIRREL.

Sperm Whale. See CACHALOT and PHYSETERIDÆ.

Sper'ry, tp., Clayton co., Ia. P. 1141.

Speusip'pus, b. at Athens about 380 B. C., a nephew of Plato; received the instruction of his uncle, whom he accompanied to Syracuse, and succeeded as president of the Academy. D. at Athens in 339 B. C. Of his writings nothing is left.

Spey'er, or **Speier,** city of Germany, the capital of Rhenish Bavaria, at the influx of the Speyerbach into the Rhine, is surrounded with walls. It has some sugar-refineries and manufactures of vinegar and tobacco, and carries on an active trade in grain, timber, and wine on the Rhine. It is one of the oldest cities of Germany, and in the Middle Ages the German emperors often resided and held their diets here. Nevertheless, it has only one monumental building, the cathedral, erected in the eleventh century, thoroughly restored in 1858, and one of the finest church buildings of Germany. The other great edifices it once possessed have been destroyed by the French, who twice conquered and devastated the unhappy city in the most barbarous manner, blowing up with gunpowder her public buildings and transforming the whole town to a heap of ruins and rubbish. P. 14,806.

Spezer, tp., Richardson co., Neb. P. 338.

Spe'zia, or **La Spezia,** town of Italy, province of Genoa, beautifully situated on a gulf of the same name in lat. 44° 7′ N., lon. 9° 48′ E. The old walls and gates of Spezia have been mostly demolished in the course of the changes necessitated by the recent rapid growth of the town. This growth has been, in a large measure, consequent upon the construction of a great naval arsenal, begun here in 1861, and carried on with much energy and at an expense of about $9,000,000. The Gulf of Spezia (anciently called the Gulf of Luna) is formed by an offshoot of the Apennines, which, separating from the central chain N. E. of Sestri Levante, runs along the sea to the S. E., until at Spezia it divides into two arms which embrace the waters of this deep and broad gulf, and thus form the finest harbor in Italy. The two extreme points are Portovenere on the W. and Corvo on the E.; the mouth of the gulf opens S. S. E., and the distance from the lighthouse of the Tinotto on one side to that of the Telaro on the other is about [illegible] miles, while the inland stretch of the gulf as far as the town of Spezia is [illegible] miles. The principal entrance is between the above-mentioned points, but there is also a passage from the W. between the promontory and the island of Palmaria, and another between this island and the islet of Tino, on which the pharos of Tinotto stands. This port is entirely safe from every wind except the sirocco, and the many mountain-spurs partially projecting into it and forming, as it were, so many separate little harbors, make it easy to secure complete shelter even from S. E. gales. Besides size and security, the harbor of Spezia is remarkable for its uniform depth (sufficient for the largest vessels), and for a bottom admirably suited for anchorage. With such immense natural advantages it was thought very important for the interests of Italy, as connected with the great highways of Mont Cenis, St. Gothard, and the Splügen, to strengthen and improve this harbor as far as possible, and to make it one of the chief naval stations of the kingdom—a work now wellnigh accomplished. About 1500 trading vessels enter this port annually. P. 24,127.

Spez'zia, an island of Greece, lies at the entrance of the Gulf of Nauplia. It comprises an area of 26 sq. m., with 9400 inhabitants, who are mostly engaged in commerce and navigation. The soil is unproductive, but the climate is remarkably salubrious.

Sphag'num [Gr. σφάγνος], a large and interesting genus of mosses, several species of which grow in the U. S., mainly in bogs, forming deep, spongy masses, almost always damp. They are called peat-moss, being a principal ingredient in pure peat. Peat-moss is the very best material for packing plants for transportation, as it retains moisture and never heats or putrefies.

Spheg'idæ [Gr. σφήξ, "wasp"], a family of hymenopterous insects, including the well known sand-wasps, so called because all the females make their nests in the sand. The abdomen is connected by a slender stem with the thorax; the antennæ are filiform, and the feet adapted for digging. The species are numerous, of moderate size, and generally decorated with gay colors, often being banded with yellow. They revel in the sunshine, and are very active and restless. They are armed with a powerful sting; by means of this sting they provide food for their young. The victims (caterpillars, spiders, etc.) are paralyzed by the poison transmitted by the sting, and remain in a torpid condition until the young hatched from the eggs are ready to devour them. *Sphex ichneumonia* is one of the largest and most common in the U. S. This family also contains the mud-wasps. (See DAUBER.) THEODORE GILL.

Sphenis'cidæ [from *Spheniscus*—diminutive of Gr. σφήν, a "wedge"—the typical genus], a family of birds containing the true penguins, exhibiting some quite peculiar characters, and isolated by Prof. Huxley as a peculiar group (Spheniscomorphæ) of the sub-order Schizognathæ in his system. The form is generally carried erect, the legs being inserted far behind; the bill is moderately long, nearly straight, but with the culmen decurved at the tip, compressed, and longitudinally grooved on the sides; the nostrils are linear, and situated in the grooves of the bill; the wings are quite rudimentary (incapable of flight) and imperfect, and covered with scale-like feathers; the legs arise very far behind; the tibiæ are enclosed within the integuments; the tarsi are short and depressed, covered with small scales, and carried nearly or quite prone; the feet are moderate, with four toes, the three anterior depressed, well-developed, covered with transverse scales, and connected by a membrane, the posterior rudimentary, and united to the side of the tarsus. The skull belongs to the schizognathous type, and the maxillo-palatines are concavo-convex and lamellar; the shaft of the humerus is flattened from side to side, and its distal end presents an obliquely truncated surface, with which the similarly compressed radius and ulna articulate—the former altogether with the fore part, the latter with the hinder part of the humeral articular surface; "there is no free pollex;" "the pelvic bones are less firmly connected with the sacrum than in any other birds;" and "the short tarso-metatarsus is perforated by two very large clefts which lie between the middle and the lateral metatarsals." These osteological characters especially distinguish the group Spheniscomorphæ, according to Huxley. The family is entirely confined to the southern hemisphere, and by the latest systematic reviser (Dr. Elliot Coues) is differentiated into four genera and twelve species—viz. (1) *Aptenodytes*, with two; (2) *Pygoscelis*, with three; (3) *Eudyptes*, with five; and (4) *Spheniscus*, with two species. The *Spheniscus demersus* extends nearly as far N. as the equator—*i. e.* to at least 8° S. on the eastern and 10° S. on the western side of South America—and has by far the most northern range. Most of them inhabit the colder regions of the southern hemisphere, and species have been found in the Antarctic seas as near the pole as travellers have penetrated. The Falkland Islands, according to Coues, appear to be a centre of the family, no less than half of the known species occurring there. But all the continents and great islands of the temperate and cold portions of the southern hemisphere have representatives. All the species live in communities. They are incapable of flight, but are

very powerful swimmers, and their wings are used as fins. They live along the coast, and when at rest sit on their tarsi in an erect posture. In this posture, too, they walk, or rather waddle, till they approach the sea, when they throw themselves in, and are again at ease. According to Dr. Kidder, "no living thing that he ever saw expresses so graphically a state of *hurry* as a penguin when trying to escape. Its neck is stretched out, flippers whirring like the sails of a wind-mill, and body wagging from side to side as its short legs make stumbling and frantic efforts to get over the ground. There is such an expression of anxiety written all over the bird, it picks itself up from every fall, and stumbles again, with such an air of having an armful of bundles, that it escapes capture quite as often by the laughter of the pursuers as by its own really considerable speed." The water is their natural element, and in this they disport themselves with ease and grace. They are expert divers, and by repeated incursions into the depths catch the fishes, crustaceans, and mollusks upon which they feed. The females lay one or two eggs each, according to the species, generally in slight depressions of the ground or in burrows. (See also PENGUIN.) THEODORE GILL.

Sphenodont'idæ [from *Sphenodon*—Gr. σφήν, a "wedge," and ὀδούς, "tooth"—the typical and only living genus], a family of reptiles representing, according to some herpetologists, a peculiar order related to the saurians or lizards, and according to others a family of that order. In external form and characters the genus *Sphenodon* is so much like the Agamidæ as to have been originally referred without hesitation to that family. The body is rather robust; the scales on the back are rather small, and on the abdomen larger, quadrangular, and placed in transverse series; the head is quadrangular, covered with small scales; the teeth inserted on the edges of the jaws and on the premaxillary bones enlarged; the tongue papillose and simple; the tail compressed; the legs strong, and each with five toes, all of which are parallel and directed forward. Such are the superficial characteristics. The osteological peculiarities are numerous, and isolate the type from all true lizards. (1) The quadrate bones are perforate, and instead of being simply articulated with the cranial box, are firmly and immovably united with it, as well as with the pterygoid bones, by suture. (2) The rami of the lower jaw are united by ligament, and provided with an elongate articular surface, and their postorbicular processes are very short. (3) The palatine bones are displaced and separated by the pterygoids, and replace a palatal portion of the maxillaries. (4) The dentition is unique—viz. "two large cutting teeth above, formed by the confluence of two pairs of conical 'milk' teeth; alveolar edges of the jaws and palatines cutting and polished (in the adult), only partially armed with teeth (forming a serrature); palatine teeth in close proximity and parallel to maxillary series, both series receiving between them in a groove the similarly-serrated edge of the mandible." (*Günther.*) It need only be further added that the vertebræ are biconcave, and that there are no copulatory organs. Dr. Günther in 1867, in a *Contribution to the Anatomy of Hatteria* (*Rhynchocephalus*, Owen), was the first to recognize the peculiarities and ordinal distinctness of the type. Only one existing species is known—the *Sphenodon punctatum*, Gray (*Hatteria punctata*, Gray, and *Rhynchocephalus sp.*, Owen). "It is peculiar to the island of New Zealand, and attains a considerable size. It is sluggish in its movements, and lives in holes and often in sandhills near the seashore." It feeds upon young birds (probably mostly nestlings) and insects. Formerly, it was abundant, but its large size rendered it conspicuous, and its sluggishness an easy prey, and now, on account of the combined attacks of man and hogs, it has become very rare. It is so inert that it makes little or no resistance, and may be handled with impunity and without attempting to bite. Nevertheless, fabulous tales of its poisonous qualities were formerly told of it by the natives, who gave it the name "tuatera" or "narara." It owes its interest chiefly to the fact of its being the sole existing representative of the order Rhynchocephalia, which was rich in species in the Mesozoic as well as Later Palæozoic epochs. (See also RHYNCHOCEPHALIA.)

THEODORE GILL.

Sphenograms, or Cuneiform Characters. See CUNEIFORM INSCRIPTIONS, by REV. W. H. WARD, S. T. D.

Sphe'noid Bone [Gr. σφήν, a "wedge"], a bone of the skull, situated in man at the anterior part of the base. It has been likened in shape to a bat with open wings. It consists of a body, four wings, two greater and two less, and the two pterygoid processes. The body is quadrilateral, and hollowed out into a mere shell. This body is conceived to represent the centrum of the third cephalic vertebra (constituting the posterior portion of the sphenoid), joined to the centrum of the second vertebra (the anterior portion). The two greater wings are the neurapophyses of the third vertebra, and the two lesser wings are neurapophyses of the second vertebra. The sphenoid is exceedingly complicated and irregular in its outlines. It is developed from ten centres. It is usually joined anteriorly in the adult to the two sphenoidal spongy bones (a pair of thin, curved irregular plates). Posteriorly, it becomes continuously united to the occipital bone. It articulates with all the bones of the skull and with five of those of the face.

Sphere [Gr. σφαῖρα], a volume bounded by a surface all of whose points are equally distant from a point within called the *centre*. It may be generated by a semicircle revolving about its diameter as an axis. Any line from the centre to a point of the surface is a *radius*, and any line drawn through the centre and limited by the surface is a *diameter*; all radii of the same sphere are equal; also all diameters of the same sphere are equal. Every plane section of a sphere is a circle; if the plane passes through the centre, the section is called a *great circle*; if it does not pass through the centre, the section is called a *small circle*; the radius of a great circle is equal to that of the sphere; the radius of a small circle may have any value from the radius of the sphere to 0, in which case the cutting plane merges into a tangent plane. The surface of a sphere is equal to four great circles, or it is equal to the circumference of a great circle multiplied by its diameter. The surface of a zone is equal to the circumference of a great circle multiplied by the altitude of the zone. The volume of a sphere is equal to its surface multiplied by one-third of its radius. The volume of a spherical sector is equal to the zone which forms its base multiplied by one-third of the radius of the sphere.

In analysis, the surface of a sphere is a surface of the second order, whose equation is of the form

$$(x-\alpha)^2+(y-\beta)^2+(z-\gamma)^2=R^2,$$

in which α, β, and γ are the co-ordinates of the centre, and R the radius of the sphere. W. G. PECK.

Spher'ical Angle, an angle included between arcs of two great circles intersecting on the surface of a sphere. It is the same as the diedral angle included between planes of the two arcs, and is consequently equal to the angle between two tangents, one to each arc at their common point.

Spherical Excess, the excess of the sum of the three angles of a spherical triangle over two right angles, the right angle being taken as a unit.

Spherical Lune, a portion of the surface of a sphere included between two great semicircles. The angle between the planes of the semicircles is the angle of the lune.

Spherical Polygon, a portion of the surface of a sphere bounded by arcs of three or more great circles, called sides; if the polygon has but three sides, it is a spherical triangle. In a spherical triangle the sum of the three angles is always greater than two right angles, and less than six right angles.

Spherical Pyramid, a portion of a sphere bounded by a spherical polygon, called the *base*, and by three or more circular sectors having their centres at the centre of the sphere.

Spherical Trigonometry, that branch of trigonometry which explains the method of solving spherical triangles when three parts are given; it also treats of the general relation between the six parts of which a spherical triangle is composed.

Spherical Zone, a portion of the surface of a sphere included between two parallel planes. The lines in which these planes cut the surface of the sphere are the bases of the zone, and the distance between the planes is the altitude of the zone.

Spher'ograph [Gr. σφαῖρα, "sphere," and γράφειν, to "write"], an instrument for solving by inspection numerous practical questions in spherics, such as arise in navigation, geodesy, etc. Special modifications of the instrument are made for special uses. Among its uses are the finding of the course, distance, etc., in great-circle sailing; the sun's place at noon; his meridian altitude; the time of sunset; the length of the day; right ascensions by night; finding latitudes when the horizon is hidden, etc. It consists of two concentric circular paper disks, the upper one transparent, and capable of being turned around upon the centre as it lies upon the face of the lower disk. Suitable lines and figures are drawn upon each disk, the lines varying according to the special use of the instrument. Readings are obtained by rotating the upper disk upon its centre to a certain point indicated in the data of the problem to be solved. The spherograph is the invention of S. M. Saxby, a British seaman. Its readings are very fairly accurate for mechanical solutions.

Sphe'roid [Gr. σφαῖρα and εἶδος], a volume resembling a sphere, and which may be generated by an ellipse revolv-

ing about one of its principal axes. If the ellipse is revolved about its conjugate axis, it generates a flattened volume called an oblate spheroid; if it revolves about its transverse axis, it generates an elongated volume called a *prolate spheroid*.

Spheroid'al Condition, the globular form assumed by a liquid when dropped upon a heated metallic surface. It was first noticed by Leidenfrost in 1856, and afterward studied by Klaproth, Rumford, Dumas, and others. But to Boutigny we owe the largest amount of information on the subject. When water is gently dropped upon an intensely-heated plate of metal, or, better still, into a red-hot platinum crucible by means of a pipette, the liquid particles, instead of boiling, coalesce into spheres, which roll and jump about upon the metallic surface; in this way the crucible may be about one fourth filled with the moving spheres, the water slowly evaporating, but not boiling. When the heat is withdrawn, the water-drops remain for an instant quiet, and then burst into steam and disappear. In 1837, Mr. Tomlinson showed that other liquids—pyroxylic acid, spirits of wine, sulphuric ether, and even mercury—under the proper conditions assume the spheroidal state. Some fluids, those which come into contact with the plate, such as turpentine, olive oil, and sulphuric acid, do not assume this condition. A hot liquid surface may be used instead of a metallic plate: a fixed oil, for instance, may be heated to 450° or 500°, and upon its surface water may be carefully dropped; if this is carelessly done, the water-drop sometimes penetrates beneath the oil, is then transformed into steam, which by its sudden expansion scatters the heated oil in every direction. When water is thus rotating, if a drop of ether be added, the two drops coalesce and rotate as one globule, the ether enveloping the oil and forming its outer layer. Turpentine forms a disk upon a hot oil surface, but pyroxylic acid and bisulphide of carbon form globules; sulphuric ether also forms a globe upon the surface of hot water or hot mercury. A cold platinum plate pierced with holes large enough to permit water to pass freely, will, when maintained at a red heat, retain the water if it be dropped gently on the surface, the spheres being too large to pass through the apertures.

Water when in the spheroidal condition is below the boiling-point: that portion of the spherical drops nearest the plate is continually being converted into steam, whose elastic force holds the globe above the surface. The drop rolls off from the eminence formed by its cushion of steam, and instantly another is formed beneath it, and its rolling motion is thus occasioned. The enormous amount of heat required for the continual conversion of water into steam withdraws a portion of heat from the globule, and the fact that steam is a poor conductor of heat prevents this loss being made good by conduction from the metal plate. If a liquid at boiling-point be introduced into the red-hot crucible, its temperature falls from 5° to 7° as it assumes the spheroidal condition. The lowest temperature of a heated plate necessary to cause the spheroidal condition of water is 340°, of alcohol 273°, of ether 142° F. The temperature of each liquid for its spheroidal condition is supposed to be as fixed as is its boiling-point. Boutigny gives 205.7° for water, 167.9° for alcohol, 93.6° for ether, and 31.1° for sulphurous acid. There is a constant escape of steam from beneath the moving drop, the vapor generally escaping laterally; but when the drops rests upon a flat or concave surface, the lateral escape is difficult, and the vapor then frequently bursts upward through the middle of the drop. At times the escape of the vapor is rhythmic; where it is so, the ordinary oblate spheroid of water becomes beautifully incurved about the border, with a regular sinuous line. Illuminating the drop, and throwing its image, by means of a lens, upon a horizontal screen above it, the form of the drop may be easily seen. By suitable contrivances it is also possible to see with the naked eye the interval between the drop and the heated metal plate.

Many boiler explosions are supposed to be due to the spheroidal condition assumed by the water. "It might happen," says Dumas, "that it [the boiler] ceases to furnish steam, and nevertheless a reduction of temperature would cause an explosion." The water, already in a spheroidal state, coming into direct contact with the heated metal, would suddenly be converted into steam, which from its enormous expansive power would shatter the boiler. The form of the drops is that of a flattened sphere: this is due to the combined action of gravity and the molecular forces controlling the particles of water. When by any means a mass of liquid is removed from the action of gravity, it assumes the spherical form; a mass of oil suspended in a mixture of alcohol and water of precisely its own specific gravity is virtually removed from the attraction of gravity. The molecules of the oil are then free to follow the internal molecular forces, and in obedience to these they form a globe; in the case of a falling stream of water, the attraction of gravitation being satisfied by the motion, the particles are free to yield themselves to the controlling power of the molecular forces; and every mass which separates itself from the jet, or the masses into which the lower part of the jet is broken up, assume a spherical form. In the case of the water-drop supported on its cushion of steam, the downward pull of gravity, though not fully compensated by the upward elastic spring of the steam, and the consequent continual motion of the drop, is partially so, and the spherical form, due to the interaction of the molecular forces, is modified into the oblate spheroid by the attraction of gravity. In consequence of the protective action of vapor, the hand when thoroughly moistened may be passed with impunity through a stream of molten iron, the vapor formed by the heat of the iron protecting the flesh from injury.

Water, and even mercury, may be frozen in a red-hot crucible in consequence of the low temperature at which the intervening mass of frozen carbonic acid and ether assumes the spheroidal state. The carbonic acid snow, which is intensely cold, is placed in a red-hot crucible; a cushion of vapor protects the snow from melting rapidly; water, or mercury, whose freezing-point is 39° below zero, may be placed in the mass of carbonic acid snow within the red-hot crucible, and turned out almost immediately frozen solid. S. B. Herrick.

Sphinc'ter [Gr. σφιγκτήρ, "binder"], in anatomy, is a muscle whose fibres, generally circular, surround some passage in the animal organism, closing the passage, in opposition to certain other muscles called dilators. Some of the sphincters are composed of striped fibre, some of unstriped, and some of both combined. The eyes, pupils, mouth, rectum, vagina, bladder, and urethra are the most important passages which are provided with sphincters; but there are numerous other sets of circular fibres which have more or less of the action of sphincter muscles.

Sphingidæ. See Hawk-Moths and Lepidoptera.

Sphinx [Gr. σφίγξ], the combination of the body of a lion with a human or animal head, called in Egyptian *hu* or *akar*. Those with the human head (*androsphinx*) according to the Greek represented the union of intellect and force, or the inundation in the time of the constellations Virgo and Leo; but in reality they symbolized gods or kings, of which their face was the portrait. Several kings of the eighteenth dynasty, and two queens, Mutnetem, mother of the pharaoh Horus, and Batanta, daughter of Rameses II., are depicted under this type. The sphinx also represented the god Har-em-χu, or Harmachis, one of the forms of the solar Horus. The hawk-headed sphinx, or hieracosphinx, was the type of the god Mentu, another solar form; and the ram, or criosphinx, that of Xnum or Chnoumis, a demiurgic type of Ammon, worshipped at Elephantiné. The most remarkable sphinx is that placed before the second pyramid of Gizeh, sculptured partly out of the solid rock of the Libyan chain of hills, 40 feet high above them, 51 feet from the belly to the top of the head, and 110 feet long. It appears to have been carved before the eighteenth dynasty, and from inscriptions recently discovered, which speak of it as near the temple of Isis and the second pyramid, possibly as old as the fourth dynasty, and contemporaneous with Safra or Chefren, the builder of that monument. In the neighborhood, close to it, was found a shrine lined with aragonite or Egyptian alabaster, containing diorite statues of that king, connecting it with him, while tablets placed between its paws by Thothmes IV. record his worship of the sphinx, which continued during the nineteenth dynasty, and was renewed under the Roman empire. According to Pliny, it was the sepulchre of Amasis. Other sphinxes of smaller size are known; amongst the finest of which are those of Amenophis III., of red granite, at St. Petersburg, found behind the vocal Memnon; one of Menephtah, in the Louvre at Paris; others of black basalt, of Nepherites and Achoris. Sphinxes have occasionally two human arms instead of fore paws, and, although generally represented couchant, on smaller monuments are seen standing and trampling under foot the enemies of Egypt. Those which represent kings have the royal headdress and uræus serpent. Sphinxes are represented in Phœnician, Assyrian, and Etruscan art, and many are introduced at a time, and often are seen as ornaments of thrones and furniture. In Assyrian art they were ministers of the great gods. They appear on some of the oldest monuments of Greek art, but always as females with human heads, lions' bodies, and wings, this last adjunct seldom appearing in Egyptian sphinxes.

The myth of the Sphinx, which first appears in Hesiod, was especially Theban. The Sphinx was supposed to have been brought by the anger of Hera to that part of Greece

from the farthest parts of Ethiopia, or to have been a bacchante changed by Dionysos into that form. Other traditions make her sent by Hades from hell, and to have been the daughter of Typhon and Echidna, or the dog Orthos and the Chimæra. She lays waste the country and destroys many of the inhabitants, whom she devours—amongst others, Hæmon, the son of Creon. This she was supposed to do by proposing a riddle for their explanation in her song called *Aigros*. The riddle asked was, What animal walks on four legs in the morning, two at noon, and three in the evening? This Œdipus explained as man, who crawls on all-fours in the morning of life, walks erect in the meridian of his days, but is compelled to use a stick in his evening or declining years. As a reward for his interpretation, Œdipus received the crown of Thebes and married Jocasta—unfortunately, his own mother. On works of art Œdipus is represented killing the Sphinx with a sword. The esoterical explanations are various; as that it alluded to one of the daughters of Cadmus or Laius, or represented human destiny. It was the type of the coins of Chios, and appears on the helmet of the Minerva of the Parthenon. The sphinx was handed down in Christian art, and has been at all times considered an elegant combination. According to Pliny, a kind of ape so called was found in Ethiopia. The emperor Augustus used the sphinx for the device of his signet. S. BIRCH.

Sphinx Caterpillar. See HAWK-MOTHS.

Sphyg'mograph [Gr. σφυγμός, "pulse," and γράφειν, to "write"], an instrument for measuring and recording the shape, frequency, and force of the blood-wave in an artery. It consists of a series of delicate levers set in motion by the pulse-beat, and of a moving surface of paper, on which are recorded the results of the measurement. There are two forms of sphygmograph. The first was that of Vierordt, which has been superseded by the more delicate instrument of Marey. Both simply amplify on the record the successive changes in the calibre of the blood-vessel. Considerable skill is requisite in working with the sphygmograph. In diseased conditions of the heart its records have a conceded diagnostic value, which, however, can be fully appreciated only after a careful study of the physics of the blood-wave in a state of health.

Sphyræn'idæ [from *Sphyræna*—σφύραινα, the Greek name of a species of the family—the typical genus], a family of fishes of the order Teleocephali, distinguished by the pike-like form, combined with two distant dorsal and abdominal ventral fins. The body is elongate and subcylindrical, with parallel dorsal and abdominal outlines; the scales small and cycloid; the lateral line continuous; the head elongate, conic, and compressed; the eyes lateral; the opercular bones normally developed and unarmed; the mouth with a deep lateral and slightly-oblique cleft; the upper jaw scarcely protractile; teeth well developed (large mixed with small) on the jaws as well as palatine bones; branchial apertures continuous below; branchiostegal rays in seven pairs; dorsal fins two, far apart, the first with few (five) spinous rays, the second with a spine and eight to ten articulated rays; anal fin opposite, and resembling the second dorsal; pectoral fins pointed, with branched rays; ventral fins abdominal, and inserted under the first dorsal. The vertebræ are few for the length, there being only about twenty-four—twelve abdominal and twelve caudal. The pyloric appendages are developed in large number. The air-bladder is large and bifurcate in front. The family is chiefly represented in the tropical and subtropical seas all round the world, but species wander both northward and southward, one being found occasionally on the North European as well as North American coasts. One of the largest species is the barracuda of the West Indies (*Sphyræna picuda*), a fish much feared on account of its savage disposition and formidable teeth. Its flesh is often poisonous, though at other times quite savory. This quality depends on a peculiar condition of the fish, and is said to be co-ordinated with a milky sanies which follows the knife on the fish being cut. THEODORE GILL.

Spice [remotely from the Lat. *species*, "kinds"—*i. e.* kinds of goods, put for the most highly esteemed of goods], a general name for certain aromatic seeds, barks, roots, dried fruits, etc., used in cookery for their flavoring qualities, and in medicine as stimulants and carminatives. Such are cloves, ginger, allspice, nutmeg, pepper, mace, capsicum, cinnamon, cassia, vanilla, etc. Besides the above, which are now extensively imported from tropical countries, and especially from the East, there are others now nearly forgotten, such as cassamuniar, zerumbet, zedoary, culilawan, and the so-called clove-bark. These have nearly disappeared from general commerce—some because they are inferior in quality, and others on account of their limited supply. Most of the spices are natives of the Old World, but a few are American, and nearly all the important ones are now generally naturalized throughout the tropical world.

Spice Bush. See FEVER BUSH.

Spice Islands. See MOLUCCAS.

Spice'land, p.-v. and tp., Henry co., Ind., 40 miles E. of Indianapolis, contains Spiceland Academy, 2 churches, 1 newspaper, and no saloons. P. of v. 370; of tp. 2014.
FLEMING RATCLIFF, ED. "REPORTER."

Spice Valley, tp., Lawrence co., Ind. P. 1939.

Spichern, or **Speichern.** See SAARBRÜCKEN.

Spider. See ENTOMOLOGY, by PROF. S. TENNEY, A. M.

Spider Crab, a name given to several short-tailed decapod crustaceans or true crabs. Such are *Maia squinado* (Maiadæ) and *Lithodes maia* (Homolidæ) of Europe, and *Libinia canaliculata* of North American Atlantic waters, and others. (See CRAB.)

Spie'gel (FRIEDRICH), b. at Kitzingen, near Würzburg, July 11, 1820; studied Oriental languages at Erlangen, Leipsic, and Bonn 1838–42, and at Copenhagen and Oxford 1842–47, and was appointed professor in 1849 of Oriental languages at the University of Erlangen. Besides editions of various Persian works and grammars of the Old Persian and Old Bactrian languages, he published *Einleitung in die traditionellen Schriften der Parsen* (2 vols., 1856–60), *Die Altpersischen Keilinschriften* (1862), *Eran, das Land zwischen Indus und Tigris* (1863), *Eranische Alterthumskunde* (2 vols., 1871–73).

Spiegeleisen. See IRON, ORES OF, by J. B. PEARSE.

Spic'gle, tp., Winston co., Ala. P. 493.

Spiel'hagen (FRIEDRICH), b. at Magdeburg, Prussian Saxony, Feb. 24, 1829; studied philology and philosophy at Berlin, Bonn, and Greifswald, but devoted himself afterward to literature, and acquired some reputation as a novel-writer. His first books, *Clara Vere* (1857) and *Auf der Düne* (1858), were well received, and his *Problematische Naturen* (4 vols., 1860) gave him a name. Several of his novels have been translated by Prof. Schele de Vere: *Problematic Characters* (1869), *Through Night to Light* (1869), *The Hohensteins* (1870); and by W. H. Browne: *Hammer and Anvil* (1873), *What the Swallow Sang* (1873).

Spiers (ALEXANDER), PH. D., b. at Gosport, England, in 1807; graduated at the universities of Paris and Giessen; settled at Paris 1829; was professor of English successively at the School of Commerce, at the School of Public Works (Ponts et Chaussées), at the Lycée Bonaparte (1833), and at the University of France; became inspector of colleges; received from Napoleon III. in 1869 the cross of the Legion of Honor in acknowledgment of the value of his series of English grammars, and especially of his standard French-English and English-French *Dictionary* (Paris and London, 2 vols., 1846–49), of which two eds. appeared in the U. S.—one edited by G. P. Quackenbos (N. Y., 1852), the other by J. L. Jewett (1856). D. at Passy, near Paris, Aug. 26, 1869.

Spigelia. See PINKROOT.

Spike [Lat. *spica*], in botany, is a flower-cluster, of the centripetal or indeterminate order, in which sessile flowers are arranged along an axis. The spadix, ament, and cone are varieties of the spike. The ears of wheat and rye are familiar instances of the spike, which in some instances is compound—that is, contains many sessile spikelets. When the flowers are stalked instead of sessile, the spike becomes a raceme.

Spike'nard, or **Nard** [Gr. νάρδος; Lat. *nardus, spica nardi*; Heb. *nerd*; Sans. *nalada*, "perfume-giver"], (1) in the East the *Nardostachys jatamansi*, a valerianaceous plant of India. Its strong odor is disagreeable to most persons of European and American birth, but it is considered very precious in the East. Its medicinal properties are precisely those of valerian. (2) Valerian roots of various species are exported from Europe to the Levant under the name of Frankish nard, Celtic nard, and mountain nard. Cretan nard is also valerian root. These are much used in the East as substitutes for the true spikenard. (3) In England the fragrant oil of *Andropogon nardus*, an East Indian grass, is called oil of spikenard. It is used in perfumery. (4) In the U. S. the name spikenard is given to *Aralia racemosa*, and the *A. nudicaulis*, or false sarsaparilla, is called small spikenard. They have each a limited use in domestic medicine.

Spike, Oil of, the volatile oil of *Lavandula spica*, the broad-leafed lavender of Europe. It has an odor much like that of oil of turpentine. It is used by artists in preparing their varnishes, and by veterinarians as a horse-medicine. Much of the commercial oil of spike is an entirely factitious mixture, of which oil of turpentine is the basis.

Spin′ach, or **Spin′age,** the *Spinacia oleracea*, a chenopodiaceous plant of Western Asia, much cultivated in nearly all parts of the world as a potherb, especially for use in the spring. There are several varieties. Other plants of this and other genera having similar uses are locally called by this name.

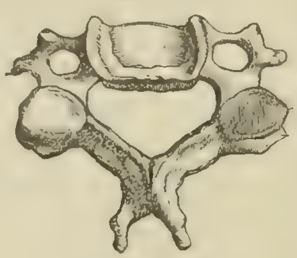
Spinac′idæ (from *Spinax*, the name of the typical genus), a family of sharks (order Squali), including species with a spine in front of each dorsal fin, and destitute of an anal fin. The body is rather elongated and subcylindrical; the scales variable in development, in some scale-like, and in others spiniform; the head depressed oval; the eyes without nictitating membrane; the nostrils inferior, with simple edges at the anterior margin; the mouth inferior, far back, and crescentiform in outline; the teeth variable, but always compressed and with incisorial edges; branchial apertures five, and all in advance of pectorals; spiracle behind the eye large; dorsal fins two, each armed with a spine in front, the first more or less behind the pectorals, the second near the caudal; anal undeveloped; caudal with extended upper and lower lobes; pectorals moderate and produced toward the inner angles; ventral fins far behind. The family includes a number of genera represented in different seas. On our own coast is found the genus *Squalus* (= *Acanthias*), represented by the common piked dog fish (*S. Americanus*). THEODORE GILL.

Spi′nal Col′umn, the backbone, the composite bony column of the back, which sustains the weight of the head, connects the upper and lower extremities, and affords attachments, direct or indirect, for the ribs and for the numerous groups of voluntary muscles which act upon the surfaces and members of the symmetrically developed lateral halves of the body. It is a flexible column of thirty-three vertebræ united by ligaments, with interposed cartilaginous cushions. The column is from two to two and a half feet in length, and viewed laterally presents marked curves, which add to the grace and free movements of the trunk. (Fig. 1.) The column is divided into regions—the *cervical*, *dorsal*, *lumbar*, and *pelvic*—corresponding to the neck, chest, abdomen, and pelvis. The vertebræ, excepting in the pelvic region, rotate freely and flex both antero-posteriorly and laterally. A single vertebra (Fig. 2) consists of the *body*, which unites it to other vertebræ, and a bony ring which encloses the vertebral foramen or vertebral canal, transmitting and protecting the spinal cord; this ring has articular and spinous processes for attachment of ribs, ligaments, and muscles. The spinal column is liable to fractures, dislocations, curvature (see SPINAL CURVATURES), and the various diseases of bone.

FIG. 1.

Lateral view of spine.

FIG. 2.



A vertebra.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Spinal Cord. See MEDULLA SPINALIS, by E. C. SEGUIN, JR., M. D.

Spinal Curvatures, two kinds—(1) lateral curvature; (2) angular curvature. Lateral curvature is a deviation of the spinal column at one or several points from the position which it occupies in health in the median line of the back. It occurs in children, in young, imperfectly-developed, feeble, and growing adults, more especially women, and less often in men. The spine normally occupies the middle of the back, with a slight convexity to the right in the dorsal region; in this central position it is acted upon by many forces—the weight of the head and trunk, the lateral traction of the arms in all physical efforts, of the thoracic and abdominal muscles in breathing—and beneath has a divided support of the two lower extremities through the intervention of the pelvis. A lateral curvature may develop connected with any one of these forces; when the bones are poorly nourished, the spine may yield to the weight it supports. Habitual use of one arm to the exclusion of the other may cause deviation of the spine, cervico-dorsal, to the stronger side—a common occurrence in weakly children at school, housemaids, and in some confining mechanical vocations. Disease of one lung, as phthisis, chronic pneumonia, pleuritic adhesions, and chest contraction, by limiting respiratory movement on one side, often causes dorsal curvature to the more active side. Shortening of one limb, hip joint disease, persistent limping from any cause, by tilting the pelvis throw the spine out of centre and develop lumbar curvature. Whenever a curvature is thus primarily established, a secondary curvature develops at another part of the vertebral column, and to the opposite side, and thus the erect position of the body is maintained. The affected spine, viewed anteriorly or posteriorly, presents a double curvature, a tortuous line whose upper and lower ends can be connected by a vertical straight line, representing the component of all the forces, weight, etc. which the spine sustains. The collective vertebræ of the spinal column are so articulated and curved antero-posteriorly (see cut in SPINAL COLUMN), the pressure taken in the "bodies" only, the lateral and posterior processes restrained by attached muscles, that lateral curvature causes rotations of individual vertebræ.

Lateral curvature, if of long standing, may so modify the size and conformation of the lung, so change the nutrition and structure of the intervertebral cartilages, and the muscular volume of the two sides of the body, that cure is impossible or incomplete. More often it is curable by correcting bad habits, as favoring one side in standing, sitting, or sleeping, resort to light gymnastics and special passive movements, and the use of apparatus which removes weight from the spine and applies pressure or traction to counteract the curves. General tonic treatment, cod-liver oil, and phosphates, out-of door life, warm clothing, stimulating baths, and regulated diet are indicated in all cases.

Angular curvature is of more serious nature. It is termed Potts's disease, and is usually an expression of a tubercular or scrofulous blood-taint. Exceptionally, it may arise in previously vigorous persons, starting from a local injury of the vertebræ, followed by disintegration. More often, when health is reduced and the nutrition of the osseous and cartilaginous structures is defective, the intervertebral bodies atrophy, or are absorbed owing to pressure; the bony vertebræ thus brought in contact form an abrupt joint or antero-posterior angle, which replaces the normal graceful curve, and presents a more or less angular prominence on the back. The approximated vertebræ tend to caries or death and gradual disintegration: in proportion to the extent of this destruction of the vertebral bones and the intermediate cushion of cartilage, the body above sinks forward and downward upon the parts beneath, and the angle is abrupt and acute. Caries of the spine usually develops a local abscess, slow in formation, often with little pain or heat, and tending to disseminate its contained pus beneath adjacent flat muscles of the back; the pus may finally point under the skin of the back or side, or travel around to the front of the abdomen, appearing as a soft tumor in the groin, or even below the flexure of the thigh; in these latter positions erroneously taken for hernia.

Early vertebral disease is indicated by pain in a fixed spot, increased by pressure, by firm tapping, by the sudden concussion of jumping, or by sudden turning; the pain often shoots around the body. The strength wanes, and the weight of the body causes fatigue, which is relieved by reclining, by supporting the shoulders, or by traction on the lower extremities when lying down. Loss of flesh and appetite, elevated temperature, and hectic fever develop as caries is established, and local inspection reveals a change of the normal curves or a perceptible projecting apex. The early arrest of angular curvature is secured in various ways—by rest on the side, with ice-bags to the irritated congested spine, rest with extension and counter-extension; but, when admissible, the plaster-of-Paris bandage may be applied to the body while suspended by axillary supports, the weight of the body counter-extending, and with this immobile apparatus the patient may exercise. Cod-liver oil, phosphates, Peruvian bark, iron, and concentrated diet are to be faithfully administered. When abscess has developed, it may be "aspirated"—subcutaneously removed by needle-tube and pump, incision being injudicious. Where bone is destroyed and angular curvature is fully developed, apparatus is employed to place the body erect, remove the angular protrusion in the back, and permit the spinal column to become "ankylosed," or rigidly united, with as little deformity as possible.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Spinal Diseases. See MENINGITIS and SPINAL CURVATURES.

Spinaz′zola, town of Southern Italy, province of Bari delle Puglie, on a hill near the source of the Locone. The site, otherwise attractive, is subject to frequent and great changes of temperature. The town contains six churches, one of them very large and imposing. The streets are of good width and well paved, and there is considerable industry and traffic in the place. Spinazzola was an old Roman military station on the Appian Way, known as *Ad Pinum*, from a celebrated pine tree which stood here, and the modern name is supposed to be derived indirectly from the same source. Spinazzola was the birthplace of Innocent XII. P. 10,078.

Spind′ler (Karl), b. at Breslau, in Prussian Silesia, Oct. 16, 1796; was educated at Strasbourg, afterward at Augsburg; entered for some time a company of strolling actors; published in 1824 his first novel, *Eugen von Kronstein* (2 vols.); chose literature for his occupation; lived at Hanau, Stuttgart, Munich, and finally at Baden-Baden, where he d. July 12, 1855. The best of his novels are *Der Bastard* (3 vols., 1826), *Der Jude* (4 vols., 1827), and *Der Jesuit* (3 vols., 1829). Many of his minor novels were published in a periodical, *Vergissmeinnicht*, which he edited after 1831. A collected edition of his works appeared in 102 vols. at Stuttgart from 1831 to 1854.

Spin′dle-Tree, a popular name for shrubs of the genus Euonymus (which see).

Spine. See Spinal Column.

Spinel′ [Fr. *spinelle*], a mineral, of which the finest specimens, often very beautiful, are employed as gems. It is an impure anhydrous aluminate of magnesia, sometimes white or black, but commonly of some red tint. The finest are often sold for rubies. The best are from Southern Asia.

Spinello (Aretino). See Aretino (Spinello).

Spink, a new county of S. E. Dakota, intersected by James River, has a broken prairie surface and a fertile soil. Area, about 800 sq. m.

Spin′ner (Francis Elias), b. at German Flats (now Mohawk), Herkimer co., N. Y., Jan. 21, 1802, son of a German clergyman, from whom he received a careful early education, and who insisted on his learning a trade; was successively apprentice to a confectioner in Albany and to a saddle and harness maker at Amsterdam, N. Y.; read all the books in the circulating library at the latter place, giving especial attention to natural science; became in 1824 a merchant at Herkimer; was deputy sheriff of Herkimer co. 1829–34, and sheriff 1835–37; was chosen lieutenant of militia 1825; passed by election through all the intermediate grades up to major-general of the third division of artillery 1834, having meanwhile raised the "La Fayette Guards" and helped to organize the 26th regiment New York Artillery; was appointed in 1838, by Gov. Marcy, commissioner for building the State lunatic asylum at Utica; was removed on political grounds by Gov. Seward in the following year, when he accepted the cashiership to the newly-organized Mohawk Valley Bank at Mohawk; was subsequently president of that institution, and for twenty years was its executive officer; was auditor and deputy naval officer of the port of New York 1845–49, having previously filled by election various town and county offices, such as school commissioner and supervisor; was a Democratic member of the 34th Congress, 1855–57, sitting on the committee on elections, on the special committee to investigate the assault upon Senator Sumner, and on the famous "conference committee" that disagreed on the army appropriation bill; was an original member of the Republican party, and re-elected by it to Congress by 9000 majority in 1856, and again by a similar majority in 1858; was chairman of the committee on accounts 1859–61; was appointed by Pres. Lincoln, on the recommendation of Sec. Chase, to the post of treasurer of the U. S. Mar. 1861, and confirmed by the Senate after an examination of witnesses and a three days' debate in secret session; entered upon his duties Mar. 22, 1861, and held that post until July, 1875. During this period his name was a synonym for official integrity, and his curious signature on the "greenbacks" became more familiar to the American public than the autograph of any other living man. He was defeated in the election of 1875 as Republican candidate for comptroller of the State of New York.

Spinning, the art of producing from vegetable or animal fibres an even and compact thread suitable for sewing or weaving, is one of the most ancient of industries, and still practised in many parts of the globe by the spindle and distaff in the same manner that the process is pictured on Egyptian monuments. The distaff, held in the left hand, was a simple stick around which the fibre was loosely coiled; the spindle was a species of top which was set in motion by a twirl of the hand, and by combining its rotary motion with a gradual movement away from the spinner, who equalized the size of the fibre by passing it between the finger and thumb of the right hand until the motion of the spindle was exhausted, when the thread was wound around it, and the process was repeated. The first and most obvious improvement consisted in placing the spindle in a frame and making it revolve by mechanical action of the hand or foot in connection with a wheel and treadle. This constituted the spinning-wheel, which, notwithstanding its simplicity, cannot be traced farther back than 1530. Modern invention has added little to this implement, the chief improvement being a bobbin for winding the yarn by a motion separate from that of the spindle. Up to the invention of the spinning-jenny by Hargreaves in 1764 (see Cotton Manufacture) no contrivance had been devised for spinning more than two threads at a time, but from that date the eight original threads were quickly augmented to eighty, and the number was ultimately dependent entirely upon mechanical convenience. But the spinning-jenny, however developed, could perform but one process, and it was consequently soon supplemented by Arkwright's throstle-machine (1769), and superseded by Crompton's mule-jenny (1779). The former was an ingenious mechanism for passing the rough cotton or woollen fibres through a revolving hollow cylinder furnished on the inside with rows of spikes, by which process they were loosened, freed from lumps and knots, and thus prepared to be moulded by rollers into "laps," or symmetrical compressed layers. The latter are then subjected to the "carding-machine," which consists of a series of cylinders thickly set with steel wires, revolving in opposite directions, so close to each other that the fibres of the "lap" passing between them are rapidly and alternately caught and subjected to such tension by the wire teeth that they come out straightened, side by side in a cobweb-like film. It is then passed through a smooth metal ring and two polished rollers, which form it into a loose, untwisted column an inch thick, called a "sliver," and deposit it in a tin can. The sliver is then, by another process of tension, drawn out into "rovings," not thicker than a quill, slightly twisted to give them consistency, then wound and drawn upon large reels, and subjected to the spinning-jenny. By the operation of Arkwright's throstle-machine the "rovings" were drawn through a succession of pairs of rollers connected together, but each successive pair moving at an accelerated rate of speed, so that the roving when it emerges from the last machine is many times longer than the "sliver." It is then wound upon spools or reels, transferred to the spinning-frame, is brought by similar processes to the thinness deemed desirable, when a rapidly-revolving spindle twists it into thread and winds it ready for the weaver. Modern French manufacturers have carried their spinning processes to such an extreme of tenuity that a pound of cotton has been drawn into a yarn 4770 miles in length. A recent invention patented by Platt & Co. of Oldham, England, combines in a single machine all the operations of carding, roving, and spinning.

Spinning-Jenny. See Cotton Manufacture, Hargreaves, and Spinning.

Spi′nola, de (Ambrosio), Marquis, b. in Genoa, Italy, in 1569, son of a wealthy Levant merchant and of a princess of Salerno; took service at an early age under his brother, an admiral in the Spanish navy; participated in the war against the Dutch and English 1588; raised and equipped at his own expense in Spain a numerous corps of veterans, at whose head he proceeded to the Spanish Netherlands 1602; was instrumental in rescuing the archduke Albert from the superior forces of Prince Maurice of Nassau; became chief commander of the Spanish armies in Flanders 1603; effected the capture of Ostend after a siege of three years, Sept., 1604; conducted the war with great ability, but varying success, until the truce of twelve years (1609), which he favored; commanded in the interval the Spanish forces in Germany; took Aix-la-Chapelle, Wesel, and Jülich 1622; was repulsed from Bergen-op-Zoom 1623; captured Breda after a protracted siege 1625; was subsequently commander of the Spanish army in Italy, and captured the city of Casale, Piedmont, but d. while pressing the siege of the citadel, Sept. 25, 1630.

Spinoylic Acid. See Salicylic Acid.

Spi′noza (Baruch), (Benedict), [Sp. *D'Espinoza*], b. Nov. 24, 1632, at Amsterdam; a member of the Portuguese Jewish community at that place, then the chief seat of European Judaism. He had two sisters, Rebecca and Miriam, the first remaining unmarried. His parents were traders, and, noticing the extraordinary faculties of the son, allowed him all the advantages of a good education. Accordingly, he entered upon the customary path of a Jewish scholar, passing through all the steps of the ordinary rabbinistic school, from the elements of Hebrew to the

holy writings of the Old Testament, thence to the Talmud, the Jewish commentaries, and the scholastic writers of the Middle Ages. By this he became the pride and hope of the synagogue, though it is evident that at this time already he began to entertain those doubts in regard to his religion which subsequently led him to the elaboration of his peculiar system of philosophy. Thus, Jewish literature led him, through the literature of the scholastics, wherein the Cabbala had played so prominent a part, gradually to the portals of the then developing modern views of the school of Descartes. In short, the rabbi Spinoza became a skeptic, even as Descartes, the scholar of the Jesuits, had become a skeptic before him. Descartes, however, was enabled to fall back upon Christianity for salvation from skepticism. This Spinoza could not do. Cut loose from Judaism, unable or perhaps traditionally so opposed to it that he did not feel any way inclined to accept Christianity, he was left without any support or guidance. The Jewish God, as the cause and creator of the universe, he had discarded: the Christian conception of God, as the moral harmony and order of the universe, which Leibnitz so beautifully elaborated, was utterly repugnant to his originally Jewish mind; and thus he had no other recourse left than the so called "pantheism" of Substantiality. This rupture with Jewish theology brought about a dispute between him and his rabbinistic teachers, which finally led to his expulsion from the synagogue at Amsterdam (July, 1656). Spinoza wrote a protest against the anathema pronounced against him, but otherwise paid little attention to it. He simply changed his name from *Baruch* to *Benedict* Spinoza, by which last name he is now generally known, and when he discovered that he was still persecuted by both the orthodox Jews and orthodox Christians of Amsterdam, he retired to the country-house of a friend in the vicinity of Amsterdam, a member of one of the persecuted sects of Protestants of that time, with whom he lived in deep seclusion from 1656 to 1661. He subsequently accompanied him to Rynsburg, where he remained till 1664, in May of which year he removed to Voorburg, where he remained in the house of the painter Tydenau till 1669. He then, at the entreaty of his friends, removed in 1671 to the Hague, where he remained till his death, on Feb. 21, 1677. In personal appearance Spinoza was of middle height; his features were regular and well formed, complexion dark, hair curly and black, long black eyelashes, and, as Leibnitz remarks, "with somewhat of the Spanish in his face." To earn his livelihood he learned to grind optical glasses, and also the art of painting. His mode of living, however, was throughout extremely frugal and secluded. He never was married, though it is rumored that he was at one period of his life deeply in love.

But all this is of minor importance. The life, character, and personal appearance of the man Spinoza are of no more interest to the student than the life, character, and personal appearance of Kant. The ground of the extraordinary interest taken in Spinoza—whilst Leibnitz, in all respects so infinitely his superior, remains comparatively unnoticed—is to be found in the pantheistic view of the universe which he has carried out in the completest of extant forms in his *Ethics*. Hence, none of the other works of Spinoza claim special notice. Interesting as they may be in connection with the *Ethics*, they have no intrinsic merit of their own. All his few published minor works, as well as his published correspondence, have their central point in the *Ethics*. Students of Spinoza are here referred, first, to the remarks of Goethe concerning Spinoza's philosophical system; secondly, to the remarks of G. E. Lessing; and, in this connection, thirdly, to the essays of Jacobi on Spinoza and Lessing. Fichte's works are also full of references to Spinoza. Spinoza's view of the universe may be very concisely described as follows: Taking hold of the category of substantiality, he altogether abandoned the Jewish conception of a First Cause—a self-conscious Jehovah calling the world into existence by his mere word—and adopted in its place the Oriental notion of an unconscious substance of the universe as a whole, of which all the separate phenomena of that universe—stars, heaven, earth, mankind, animals, plants, and minerals—were but so many attributes. In his scheme there was, therefore, no God, no Freedom, no Immortality. Whenever he uses the word "God," it is to be interpreted as coequal with the word "nature" or "universal substance;" when he uses the word "freedom," it is to be understood as the equivalent of "necessity;" and his conception of the word "immortality" means simply that the human soul, after death of the body, will merge again into the infinite substance, wherein no self-consciousness can possibly exist. His God is therefore no God, in the ordinary acceptance of the term; his freedom, no freedom; his immortality, the very reverse of what men mean when they lay claim to being immortal.

To understand thoroughly the style of the *Ethics*, it must always be kept in mind that Spinoza was a Jew, and that the Jewish tendency of mind betrays itself not only in the subject-matter under discussion, but also and equally in its mode of utterance. The style of all Jewish writers is abrupt, disregarding transition, and loving above everything parallelisms, as every chapter of the Bible shows. This explains, although seemingly in a paradoxical way, why Spinoza chose what he calls the "geometrical or mathematical" method for his chief work. The opening sentences are as disjointed as the opening propositions of Euclid; the first does not involve the second, nor the second the third, etc.; and none are proven, nor is there any attempt in the whole book to prove any of them. Hence, the very fundamental principles of philosophy, about which alone there is any dispute, are at the beginning of the work laid down as axioms; and, what is equally objectionable, at the beginning of each new part of the *Ethics*, of which there are four parts, new axioms are introduced in the same arbitrary, abrupt manner. Besides this grave defect, the *Ethics* are subject to the reproach, already alluded to, that they are full of the most misleading word-quibbles. Take as an instance that opening definition of the *Ethics* wherein *causa sui* is defined as that the essence or nature whereof includes existence. Now, here the word *causa* is either utterly meaningless, or else surreptitiously carries along the conception of cause, which, in the case applied to "God" or "substance," would be the very point in dispute; so also the word "existence" has here either the surreptitiously-appended meaning of "existence in time," or else none at all. Now, a thing—call it "A" if you please—existing in time can, in no meaning of the word, be called its own cause, since it would then have to be thought existing previous to its existence in order to become thinkable as its own effect. The phrase "self-cause" or "cause of itself" is, therefore, utterly meaningless and absurd. In the same way he uses the word freedom as expressive of the very reverse of what the word signifies in ordinary language. That the word freedom had no significance to him in its current meaning is abundantly evident from the following extracts that occur in his letters, wherein he is usually a little more outspoken than in his very guardedly-worded published works. Taking the example of a stone thrown by some hand, and hence impelled by an external cause: "Now conceive, further, that the stone as it proceeds in its motion thinks and knows that it is striving, so far as in it lies, to continue in motion; then, inasmuch as it is conscious only of its endeavor, and in nowise indifferent, it will believe itself to be most free, and to persevere in its motion from no other cause than that it wills to do so. *And this is precisely that human freedom of which all men boast themselves possessed, but which consists of this alone—that men are conscious of their desires, and ignorant of the causes by which these are determined.*" To remove the last objection, that we might be free at least in thinking, Spinoza adds: "Your friend, however, affirms that we can use our reason with perfect freedom. . . . 'Who,' he asks, 'without a contradiction of his proper consciousness, can deny that he is free to think his thoughts, to write what he pleases, or to leave writing alone?' . . . I, for my part, and that I may not contradict my consciousness—that is, that I may not contradict reason and experience, and yield to ignorance and prejudice—*deny that I possess any absolute power of thinking, and that at pleasure I can will, or not will, to do this or that—to write, for example.*"

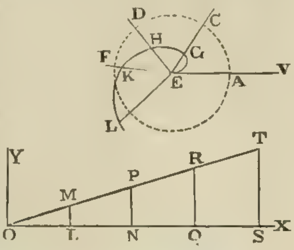
The same criticism applies to his doctrine of immortality. He speaks of it often enough and with sufficient eloquence, but does not mean by it a self-conscious existence of man after death, which is the only proper definition of immortality. It is, on the contrary, complete final annihilation of the individual as such, and submergence into the universal substance, of which it was a mere attribute.—There are numerous Latin and German editions of the *Ethics*, and of most of the other of Spinoza's works. The best English work on the subject is *Benedict de Spinoza, his Life, Correspondence, and Ethics*, by R. Willis, M. D. (London, 1870). It includes all his correspondence, a very valuable feature. In German, Kuno Fischer's *Geschichte der neuern Philosophie, erster Band, zweiter Theil*, is devoted entirely to Spinoza and his antecedents, and is the most satisfactory work extant on the subject.

A. E. KRŒGER.

Spinozism. See SPINOZA.

Spiræ'a [Gr. σπειραία], a genus of herbs and shrubs of the order Rosaceæ, including numerous species, such as hardhack (*S. tomentosa*), queen of the prairie (*S. lobata*), and several other American, besides numerous Old-World species, many of them very fine in garden-culture. Some species of *Astilbe* (order Saxifragaceæ), having somewhat the aspect of *Spiræa*, are cultivated under this name, incorrectly bestowed.

Spi′ral [Lat. *spira*], a curve that may be generated by a point moving along a straight line in accordance with a fixed law, whilst the line revolves uniformly about one of its points, always remaining in the same plane. The portion generated during one revolution of the line is called a *spire;* the moving point is the *generatrix;* the fixed point is the *pole* or *eye;* and the distance from the pole to any point of the curve is the *radius-vector*. If we take any position of the revolving line as the initial radius, and denote the angle through which the line has revolved by t, and the corresponding value of the radius-vector by u, the equation of any spiral may be written $u = f(t)$. A great variety of spirals have been investigated, of which the following are the most interesting:



(1) *The Spiral of Archimedes.*—In this spiral the generatrix moves uniformly along the revolving line, and the equation of the curve is

$$u = at, \qquad (1)$$

in which a is an arbitrary constant. Starting from the eye of the spiral, the radius-vector is proportional to the arc swept over by any fixed point of the revolving line. The relation between this spiral and a straight line is indicated by the form of its equation. This relation leads to a mode of construction which is applicable to this and also to many other spirals. Let the circumference E A be drawn from E as a centre, with a radius equal to 1, and let E V be taken as the initial line. Again, let O T be an auxiliary straight line whose equation is

$$y = ax. \qquad (2)$$

Lay off equal parts on O X, and at the points of division draw ordinates. Make the arc A C equal to O L, draw E C, and lay off E G equal to L M; make the arc C D equal to L N, draw E D, and lay off E H equal to N P; and so on. Through E, G, H, etc., draw a curve, and it will be the required spiral, as is evident from equations (1) and (2).

(2) *The Parabolic Spiral.*—In this spiral the generatrix moves along the radius-vector so as to satisfy the equation

$$u = at^2. \qquad (3)$$

The spiral bears the same relation to the parabola, whose equation is

$$y = ax^2, \qquad (4)$$

that the straight line does to the spiral of Archimedes, and may be constructed in a similar manner.

(3) *The Hyperbolic Spiral.*—The equation of this curve is

$$ut = a, \qquad (5)$$

and that of the corresponding hyperbola, referred to its rectangular asymptotes, is

$$yx = a. \qquad (6)$$

The curve can be constructed as before.

Every curve having an infinite branch has a corresponding spiral, which may be constructed in the manner indicated. Besides the spirals enumerated, we may name the logarithmic spiral, whose equation is $t = aln$, and the lituous spiral, whose equation is $u^2t = a^2$, each of which has some curious properties. The evolute of the logarithmic spiral is a similar logarithmic spiral. W. G. PECK.

Spiral Ducts, or **Spiral Vessels,** of plants, are long cells, or tubes produced by the confluence of cells, on the inner surface of whose walls there are spiral markings. The spirals are secondary deposits of cellulose, and exist as rounded threads or as flattened bands. When cut across, the thread presents under the microscope the appearance of being tubular, but it is solid, although the interior is sometimes less dense than its outer portion. The coils are usually left-handed, but in some plants they are found turning indifferently to the right or the left. The threads are much stronger in most cases than the cell-wall to which they cling; therefore they may be torn out and uncoiled when the duct is pulled asunder. When a succulent shoot or leaf stalk is broken, these extended threads appear like cobwebs. In some cases they become detached naturally from the cell-wall during growth.

Although spiral ducts constitute only one class of the elongated or confluent cells with peculiar markings, and grade by all possible varieties into *dotted*, *annular*, and *lattice-marked* ducts, they possess special interest from the part they were supposed to play in vegetable life. They were described by the earliest vegetable histologists, who regarded them as tubes for the transfer of air, and looked upon them as analogous to the air-tubes of animals. Subsequent observers have found that the ducts contain, at times, not only air, but sap. They are now understood to share with other forms of vascular tissue in the transmission of liquids as well as gases. (For a more detailed account of their functions see VEGETABLE PHYSIOLOGY.) When anatomical characters first came to be used in classification, they were deemed of much importance, being regarded as peculiar to flowering plants; but this proves to be not altogether true. G. L. GOODALE.

Spire [Gr. σπεῖρα], in architecture, an acute pyramid or cone, taller than a turret. It appears chiefly in the Gothic architecture and in styles which have descended from it, and is almost peculiar to ecclesiastical structures, in which it commonly surmounts a tower.

Spire, or **Spires.** See SPEYER.

Spirit-Duck. See GARROT.

Spirit, Holy. See HOLY GHOST, by PROF. A. A. HODGE, S. T. D.

Spirit Lake, tp., Dickinson co., Ia. P. 268.

Spirit Lake, p.-v., Centre Grove tp., cap. of Dickinson co., Ia., 90 miles N. of Fort Dodge, has good schools, 1 newspaper, and is surrounded by a rich agricultural region in the midst of the most picturesque scenery in the West. P. 76. SMITH & FUNK, EDS. "BEACON."

Spirit-Level. See HYPSOMETRY, by C. A. SCHOTT.

Spirit of Salt. See HYDROCHLORIC ACID.

Spirit of Wine and **Spirits.** See ALCOHOLS.

Spirit Plant. See HOLY-SPIRIT PLANT.

Spirit-Rapping. See SPIRITUALISM.

Spir′itualism [in French usually *spiritisme*]. The term, in its modern and restricted application, expresses the doctrine of those who believe that communion between this world and the next is, and always has been, a reality more or less frequent at different periods of history. In its present phase, Spiritualism may be said to have had birth about a quarter of a century since, during the same year that witnessed great political convulsions in Europe—to wit, on Mar. 31, 1848. On the evening of that day, in a small village in Western New York, a family of German ancestry (originally named *Voss*, but native-born, and well known now under the name of *Fox*), who had been disturbed for several months with inexplicable noises, discovered, in the knockings that had previously alarmed them, an element of intelligence. They obtained pertinent answers to various questions by raps. It is asserted by those who have made a critical study of the subject that this phenomenon, usually called the spirit-rap, whatever its true explanation, is genuine, and is not referable to any known mundane agency. Spiritualists, however, consider the rap to be one only among many agencies of communication between this world and the next, other modes of communion, according to their view, being through writing by impression, through direct spirit-writing, and through spirit-touches. They believe also in manifestations through outward voices and appearances, through dreams, sometimes of warning, sometimes of prophecy, and through inward spiritual impressions; sharing, in each of these last phases of belief, the opinions of the primitive Quakers. (See Barclay's *Apology*, proposition 2.) They assent, in a modified form, to the faith of the past in regard to what are called apparitions; not, however, as disembodied ghosts or hideous spectres—naked skeletons, with clank of chains and blue lights burning—but as *eidola*, specimens, it may be said, of spiritual sculpture, occasionally though rarely presenting themselves; sometimes to strangers, more frequently to friends or relatives, who recognize the familiar features and dress; these eidola appearing suddenly, and disappearing usually after a brief space, without any known agency heretofore recognized by physical science or by psychology to produce or to dissolve them.

Spiritualists hold that if we admit the probability of another life of which the present is a novitiate, we must also admit the likelihood that means should be afforded us to obtain assurance touching a world for which we have to prepare ourselves. They allege, further, that experimental proof in regard to these matters is needed to arrest the increase of skepticism and the growing indifference to religion of an age which is ceasing to regard ancient historical evidence as sufficient authority for religious doctrine. But aside from mere probabilities, Spiritualists aver that what may be called the epiphanies of Spiritualism are attested by evidence as strong as that which is daily admitted in our courts of justice to decide the life or death of men. The validity of this evidence is at present (Feb., 1872) being tested in London by William Crookes, fellow of the Royal Society, and other eminent scientific men.

Spiritualists do not believe in miracles, asserting that

natural law is universal, invariable, persistent, and that all spiritual epiphanies are natural phenomena. In connection with the principle of invariable and perpetual law, now all but universally acknowledged, they hold that the phenomena of modern Spiritualism are the best proofs of the substantial truth of the gospel narratives, and that these narratives are, in turn, the best proofs of Spiritualism. For, if natural law be invariable, then either the wonderful works ascribed by the evangelists to Christ and his disciples were not performed, or they were not miracles. If they were not performed, then Christ, assuming to perform them, lent himself to deception. But if they were performed under natural law, then, inasmuch as the same laws under which these signs and wonders occurred exist still, we may expect similar phenomena at any time. Again, Spiritualists claim that they have the same evidence for immortality as that upon which was based the faith of the first century. "If the dead rise not, then is not Christ raised; and if Christ be not raised, your faith is vain."

There can, of course, be no unbelievers in another world among Spiritualists, but as regards the person and office of Christ there is, for the present, diversity of opinion. As a general rule, Spiritualists do not regard Christ as one of the Persons of the Godhead, but a large number among them may be called Christian Spiritualists, while others term themselves radical. The former—a majority probably, and said to be on the increase—regard Christ with reverence as the great spiritual and ethical Teacher of mankind; the latter speak of him but as one of the ancient philosophers, with no claims to distinction beyond sages like Confucius, Socrates, or Seneca. This latter element may be chiefly due to this, that Spiritualism has converted millions from materialism, and that some of these converts still retain a portion of their former opinions.

Spiritualists, as a rule, reject the idea of a personal devil. Some believe in the occasional agency and influence of evil spirits, amounting, now and then, to what might be called possession; while others hold that such influences may, in almost all cases, be explained by human agency. Both, however, agree in this—that spiritual communications are by no means infallible, and that great care should be taken to accept nothing, come whence it may, until it has been submitted to the scrutiny of reason and conscience. As happens in all great revolutions of opinion, religious or political, Spiritualism has attracted its waifs and strays possessed by vagrant and fantastic opinions. The best writers on the subject speak of this in warning terms. So also as to seeking wealth or worldly profit through spiritual revealings. This is considered to be pregnant with danger. Money-changers, it is alleged, are out of place in the spiritual temple, and man's destiny is to earn his bread by labor, not by divination.

An examination of the alleged spirit-communications of the day seems to prove (if we admit the origin claimed for them) that, as regards side-issues and non essentials, there is in the next world the same variety of opinion as in this. There are, however, certain great, leading principles on which it may be said that all intelligent Spiritualists substantially unite. From a recent work we transcribe a summary of these, as follows: (1) This is a world governed by a God of love and mercy, in which all things work together for good to those who reverently conform to his eternal laws. (2) In strictness there is no death. Life continues from the life which now is into that which is to come, even as it continues from one day to another; the sleep which goes by the name of death being but a brief transition slumber, from which, for the good, the awakening is immeasurably more glorious than in the dawn of earthly morning, even the brightest that ever shone. In all cases in which life is well spent, the change which men are wont to call death is God's last and best gift to his creatures here. (3) The earth-phase of life is an essential preparation for the life which is to come. Its appropriate duties and callings cannot be neglected without injury to human welfare and development, both in this world and in the next. Even its enjoyments, temperately accepted, are fit preludes to the happiness of a higher state. (4) The phase of life which follows the death-change is, in strictest sense, the supplement of that which precedes it. It has the same variety of avocations, duties, enjoyments, corresponding, in a measure, to those of earth, but far more elevated; and its denizens have the same variety of character and of intelligence, existing, too, as men do here, in a state of progress. Released from bodily earth-clog, their periscope is wider, their judgment clearer, their progress more rapid, than ours. Vastly wiser and more dispassionate than we, they are still, however, fallible; and they are governed by the same general laws of being, modified only by corporeal disinthralment, to which they were subjected here. (5) Our state here determines our initial state there. The habitual promptings, the pervading impulses, the life-long yearnings—in a word, the moving spirit, or what Swedenborg calls the "ruling loves" of man—these decide his condition on entering the next world; not the written articles of his creed, nor the incidental errors of his life. (6) We do not, either by faith or works, *earn* heaven, nor are we sentenced, on any day of wrath, to hell. In the next life we simply gravitate to the position for which by life on earth we have fitted ourselves; and we occupy that position *because* we are fitted for it. (7) There is no instantaneous change of character when we pass from the present phase of life. Our virtues, our vices, our intelligence, our ignorance, our aspirations, our grovellings, our habits, propensities, prejudices even,—all pass over with us; modified, doubtless (but to what extent we know not), when the spiritual body emerges divested of its fleshly incumbrance, yet essentially the same as when the death-slumber came over us. (8) The sufferings there, natural sequents of evil-doing and evil-thinking here, are as various in character and in degree as the enjoyments, but they are mental, not bodily. There is no escape from them except only, as on earth, by the door of repentance. There, as here, sorrow for sin committed and desire for an amended life are the indispensable conditions precedent of advancement to a better state of being. (9) In the next world love ranks higher than what we call wisdom, being itself the highest wisdom; there deeds of benevolence far outweigh professions of faith; there simple goodness rates above intellectual power; there the humble are exalted; there the meek find their heritage; there the merciful obtain mercy. The better denizens of that world are charitable to frailty and compassionate to sin far beyond the dwellers in this: they forgive the erring brethren they have left behind them even to seventy times seven. There, is no respect of persons: there, too, self-righteousness is rebuked and pride brought low. (10) A trustful, childlike spirit is the state of mind in which men are most receptive of beneficent spiritual impressions; and such a spirit is the best preparation for entrance into the next world. (11) There have always existed intermundane laws, according to which men can occasionally obtain, under certain conditions, revealings from those who have passed to the next world before them. A certain portion of human beings are more sensitive to spiritual perceptions and influences than their fellows; and it is usually in the presence or through the medium of one or more of these that ultramundane intercourse occurs. (12) When the conditions are favorable, and the sensitive individual through whom the manifestations come is highly gifted, these may supply important materials for thought and valuable rules of conduct. But the spiritual phenomena sometimes do much more than this. In their highest phases they furnish proof, strong as that which Christ's disciples enjoyed—proof addressed to the reason and tangible to the senses—of the reality of another life better and happier than this, and of which our earthly pilgrimage is but the novitiate. They bring immortality to light under a blaze of evidence which outshines, as the sun the stars, all traditional or historical testimonies. For surmise they give us conviction, and assured knowledge for wavering belief. (13) The chief motives which induce spirits to communicate with men seem to be—a benevolent desire to convince us, past doubt or denial, that there *is* a world to come; now and then the attraction of unpleasant memories, such as murder or suicide: sometimes (in the worldly-minded) the earth-binding influence of cumber and trouble; but far more frequently the divine impulse of human affection, seeking the good of the loved ones it has left behind, and at times called forth, perhaps, by their yearning cries. (14) Under unfavorable or imperfect conditions spiritual communications, however honestly reported, often prove vapid and valueless; and this chiefly happens when communications are too assiduously sought or continuously persisted in, brief volunteered messages being the most trustworthy. Imprudence, inexperience, supineness, or the idiosyncrasy of the recipient may occasionally result in arbitrary control by spirits of a low order, as men here sometimes yield to the infatuation exerted by evil associates. Or, again, there may be exerted by the inquirer, especially if dogmatic and self-willed, a dominating influence over the medium, so strong as to produce results that might be readily mistaken for what has been called possession. As a general rule, however, any person of common intelligence and ordinary will can, in either case, cast off such mischievous control; or, if the weak and incautious give way, one who may not improperly be called an exorcist, if possessed of strong magnetic will, moved by benevolence, and, it may be, aided by prayer, can usually rid, or at least assist to rid, the sensitive from such abnormal influence.

While there is very little variance of opinion among the enlightened class of Spiritualists as to the above proposi-

tions, there are local differences as to other matters of speculation, one of which is of a remarkable character. The majority of French Spiritualists seem to have adopted a phase of the old Pythagorean doctrine of transmigration of souls, believing in pre-existence and re-incarnation; while on the other side of the British Channel such a belief scarcely finds a place, nor has it been accepted, except perhaps by an insignificant minority, in the U. S.

As regards the relation of Spiritualism to the mission of Christ, it may be said that, while its votaries usually reject Trinitarianism and dissent from the theology of St. Paul, the better opinion among experienced Spiritualists seems to be that if spiritual communications be sought in an earnest, becoming mood, the views presented will, in the vast majority of cases, be in strict accordance with the teachings of Christ, substantially as these are given by his evangelical biographers. It is held that while such communications touch upon many things which Christ left untouched, the spirit is absolutely identical: they breathe the very essence of his divine philosophy. Thus, enlightened Spiritualists do not set up any theory of ethics deduced from spirit-communion as a substitute for Christ's system: what they find is, as far as it goes, corroboratory evidence for that system. Especially in recent works on Spiritualism is this view set forth. It is also alleged that Christ himself promised (John xiv. 12) that his followers should do the works that he did, and greater works also; and, further, that there is, in point of fact, substantial coincidence between the signs and wonders related in the Gospels and the spiritual epiphanies of the present day.

It is admitted by candid Spiritualists that many of the communications obtained appear to be but a reflection of the opinions or expectations, sometimes of the medium, sometimes of the inquirer; but it is also claimed that in many other cases the replies not only contain information unknown to both, and which is afterward found true, but opinions and assertions utterly opposed to the convictions of all the assistants. In this way, it is held, stubborn facts come to light which unmistakably connect the two worlds, and through which, in the cases referred to, the identity of the alleged communicating spirits is demonstrated.

Spiritualism, its friends declare, is not to be regarded as forming a sect, nor do they ever desire that it should become a separate Church, with prescribed creed and ordained ministers and formal professors. It is spreading, they think, as fast as the world can bear it, and in the manner most desirable; in part through the agency of numerous volunteer lecturers, but chiefly in silence through the agency of daily intercourse, in the privacy of the domestic circle—invading the churches already established, not as an opponent, but as an ally, its tendency being to modify the creed and soften the asperities of Protestant and Romanist, of Presbyterian and Episcopalian, of Baptist and Methodist, of Unitarian and Universalist; and its result being to leaven with invigorating and spiritualizing effect the religious sentiment of the age, increasing its vitality, enlivening its convictions. It is not asserted, however, that such results can be obtained except in proportion as the spiritual mine is wisely worked, its researches judiciously prosecuted, and the millions educated up to the occasion.

Meanwhile, the new faith appears to have overrun every portion of the civilized world. Judge Edmonds, an experienced Spiritualist, formerly of the supreme bench of New York, stated that he had received letters on the subject during the last twenty years from all parts of the U. S., from England, Ireland, Scotland, France, Germany, Russia, Spain, Italy, Greece, the East Indies, Cuba, Jamaica, Brazil, Guatemala, Australia, New Zealand, the Sandwich Islands, the Ionian Islands, Malta, Algiers, and many other places. The author of *Aurelia*, who has spent ten or twelve years travelling all over Europe and in Asia and Africa, says, in a recent work entitled *Scepticism and Spiritualism, or the Experience of a Sceptic*: "There is scarcely a city or a considerable town in continental Europe at the present moment where Spiritualists are not reckoned by hundreds, if not by thousands, where regularly-established communities do not meet for spiritual purposes; and they reckon among them individuals of every class and avocation and intellects of the highest order." It is difficult to estimate, even with approximating accuracy, the number of the believers in Spiritualism. By the author of this article the following statement is made: "The number of those who accept, more or less unreservedly, its phenomena, may be safely assumed to exceed, in the U. S., 7,500,000, and in the rest of Christendom at least as many more. One might have to double this last amount, reaching 30,000,000, to include all in the Christian world whose skepticism in what is called the supernatural—but what *is* the law-governed spiritual—has been, chiefly by this movement, more or less shaken or removed."

The earliest public notice of Spiritualism is contained in a small pamphlet, now very scarce, entitled *Report of the Mysterious Noises at Hydesville, Canandaigua, April, 1848*, from which Mr. Owen (*Footfalls*, pp. 290–297) has copiously extracted. Next came *Spiritualism*, by John W. Edmonds (New York, 1853), causing great excitement and having a large sale; followed by *Modern Spiritualism, its Facts and Fanaticisms*, by E. W. Capron (Boston, 1855), and *Experimental Examination of the Spirit Manifestations*, by Robert Hare, M. D., emeritus professor of chemistry in the University of Pennsylvania (New York, 1856). Judge Edmonds's work has an appendix of 50 pages by Nathaniel P. Tallmadge, U. S. Senator from New York, and afterward governor of Wisconsin. There appeared also, in the earlier days of Spiritualism, *Nature's Divine Revelations* and *The Great Harmonia* (3 vols.), followed by several smaller works, all by A. J. Davis. These works have had a wide circulation, and some of them have been translated into several languages. About the same time were published the *Shekinah*, by S. B. Brittan, and *Spirit Manifestations*, by the Rev. Adin Ballou; while in England appeared *Facts and Fantasies* (London, 1853), by Henry Spicer; and in France, *Arcanes de la Vie future dévoilés* (Paris, 1848), and *Des Esprits et de leurs Manifestations fluidiques*, by the Baron de Mirville (Paris, 1854); also, *Des Tables tournantes, du Surnaturel en général, et des Esprits*, by Count de Gasparin (Paris, 1855). De Mirville's work regards spiritual phenomena, from a Roman Catholic standpoint, as chiefly demoniacal; and a Protestant divine, the Rev. Charles Beecher, in his *Review of Spiritual Manifestations*, though from a different point, takes a similar view. Later works are *Footfalls on the Boundary of Another World* (Philadelphia, 1860), by Robert Dale Owen, formerly member of Congress and American minister to Naples. This work treats of the spontaneous phenomena of Spiritualism, and had in England and the U. S. a circulation of about 20,000 copies. In England were published *History of the Supernatural* (2 vols., London, 1863), by William Howitt, and *From Matter to Spirit*, by Mrs. De Morgan. To this last work was prefixed an introduction by the husband of the authoress, the celebrated mathematician, recently deceased, Prof. De Morgan. From time to time also appeared several additional volumes by A. J. Davis. In 1870 was published a *History of Spiritualism*, by Mrs. Emma Hardinge (now Mrs. Brittan), containing many details connected with the rise and progress of the movement. Finally, about Dec. 1, 1872, there was published, simultaneously in New York and London, the latest work on this subject, entitled *The Debatable Land between this World and the Next*, by Robert Dale Owen. Of this work there have been disposed of, in the two months since it appeared, 5000 copies. Its scope is broad. One-fourth of it is occupied by an "Address to the Protestant Clergy," reviewing the present attitude of the religious world in connection with modern science and with modern ideas touching the reign of law, human infallibility, plenary inspiration, miracles, spiritual gifts. It discusses the effects on morality and on spiritual manifestations of such doctrines as vicarious atonement, original depravity, a personal devil, an eternal hell. More than half the volume consists of narratives, some of them embodying the author's own experience in Spiritualism, others supplying examples of spontaneous spiritual phenomena—all such as would be usually deemed marvellous, or, as a magazine article reviewing the work expressed it, "A most entertaining sheaf of stories, such as human nature has always listened to with terrified delight round the crackling logs of the winter's fire." It called forth a ten-page favorable review by Alfred Wallace, F. R. S., in the (London) *Quarterly Journal of Science*.

There are some eight or ten periodicals in the U. S. devoted to the cause of Spiritualism, the two having the largest circulation being the *Banner of Light*, issued in Boston, and the *Religio-philosophical Journal*, published in Chicago. In London, ten years ago, there was but a single journal, *The Spiritual Magazine*; now there are five, three representing Christian Spiritualism, and two advocating Spiritualism in connection with opinions of a radical tone. In the U. S., it would seem, Spiritualism has spread throughout the whole body of the people, while in England the majority of its adherents are to be found, it is said, among the nobility and gentry. So far, it appears, on the whole, to be steadily on the increase, its phenomena gradually becoming more marked and frequent. Since the above was written there has appeared an elaborate work, *The Identity of Primitive Christianity and Modern Spiritualism* (2 vols.), by Eugene Crowell, M. D.

ROBERT DALE OWEN.

Spiritualists. See SPIRITUALISM.

Spir'ula [diminutive of the Lat. *spira*, a "coil"], a genus of ten-armed dibranchiate cephalopods, of which

there are three species, found in most warm seas. They constitute a family, Spirulidæ, which has interesting relations to the nautilus and the ammonites. The creature has an extremely delicate, nacreous, chambered shell, especially common on the New Zealand shores, but the animal itself is very rarely seen in a perfect condition.

Spit'head, the name by which is known the important roadstead off Portsmouth, England, being the eastern portion of the sea channel separating the Isle of Wight from the English main. (See PORTSMOUTH and SOUTHAMPTON.) Its security as an anchorage, its contiguity to the great naval establishment at Portsmouth, and its proximity to the coasts of the Continent confer upon it paramount importance in reference to the naval power of England and to the defence of her coast. Its defence has been the subject of profound study (see reports of commissioners on the defences of the United Kingdom) and also of controversy. Besides the works on the Isle of Wight and on the main, there are five iron plated works (see IRON-PLATING), built from the bottom, which are among the most remarkable specimens of modern iron-plated fortification. (See *Prof. Papers Corps of Engineers U. S. A.*, No. 21.) J. G. BARNARD.

Spitzberg'en, a group of three large and several small islands, situated midway between Greenland and Nova Zembla, in lat. 80° 48' N., lon. 20° 29' E., and the northernmost known land on the globe. The islands are mountainous, the peaks often rising between 4000 and 5000 feet, and mostly covered with perpetual snow and ice. Only along the shore between the ocean and the mountains are in some places found patches of land, where during the two summer months, when the thermometer rises 5° above the freezing-point, the snow melts and a few herbs appear. The mountains contain granite, marble, and coal. Bears, reindeer, and foxes are found, and innumerable whales, seals, and sea fowl gather along the shores. The islands were discovered in 1553, and visited in 1596 by the Dutch navigator Barentz, endeavoring to find a north-eastern passage to India. They have since been often visited by whalers, and parts of the coast land have been explored. The interior highland is entirely unknown, it being impossible to travel over its glaciers.

Spitz Dog [Ger. *Spitz*, "pointed"], a small variety of the Pomeranian dog, which is thought to be a cross between some of the Arctic wolf-dogs and the Arctic fox, like the Esquimaux, Siberian, Lapland, and Iceland dogs, to which, though much smaller, it has a marked resemblance. It is characterized by short and erect ears, a pointed muzzle, a curved bushy tail, and long hair, usually pure white, but sometimes cream-color or even deep black. It is brisk in its movements, useful as a watch-dog, somewhat snappish, handsome, quick of apprehension, and has recently become a favorite lapdog in Europe and the U. S.

Spleen [Gr. σπλήν], the largest of the ductless or blood-glands of the body. It is situated in the left hypochondriac region, its outer convex surface corresponding with the ninth, tenth, and eleventh ribs, from which it is separated by the descending muscular attachments of the diaphragm; its inner concave surface adjoins the great pouch of the stomach. It also comes near to the pancreas, left kidney, left lobe of the liver, and arch of the colon. It is held in position by a peritoneal reflection from the diaphragm, called the suspensory ligament. It is even more directly related to these adjacent viscera by its blood-supply, the splenic artery being the largest branch of the cœliac axis, the trunk which gives off the nutrient vessels of the stomach, liver, and small intestine—the gastric, hepatic, and gastro duodenal arteries. The variable size and gross and minute structure of the spleen indicate that it is a great vascular reservoir. In health, it is five inches long, three to four thick, and one to one and a half in breadth, and weighs seven ounces; it is larger immediately after eating, and in malarial and other congestive attacks may weigh fifteen or twenty pounds, and occupy the abdomen down to the pelvic bones. The fibrous capsule of the spleen is very elastic; it is reflected inward on the vessels as they subdivide, thus forming a system of ramifying partitions, the fibrous framework of the spleen. The interspaces of this structure are occupied by the substance of the spleen, a soft, pulpy mass of dark, reddish brown color, consisting of granular matter, red and white blood-cells in a changed and degenerate state, and the Malpighian corpuscles—sacculated masses of arterial capillaries, which connect with the distensible capillary veins. The relation of the spleen to the blood, which it so freely stores up, is unsettled; by some it is regarded as the origin of white blood-corpuscles, by others as the destroyer of red corpuscles, by others the elaborator of pigment and albuminoid matter. The spleen has been removed in animals and men with no serious or marked result. The function of the spleen is as yet unknown; the object of the other ductless glands—the thymus, thyroid, and the supra-renal capsules—is equally obscure. The spleen is frequently congested, exceptionally inflamed, often permanently enlarged by repeated congestions, infiltration, and hypertrophy of its tissues. There may be supernumerary spleens. The spleen is liable to rupture and fissure from external violence. In typhus fever and many other disorganizing blood-states the spleen is softened and bronzed.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Splint [Ger.], a bony growth, generally upon the inside of the fore leg of the horse, below the knee. It is usually caused by overworking a young horse. Rest, poulticing, and packing with cold wet compresses are recommended for the early stages. At a later stage, iodine, mercurial ointment, blisters, and the actual cautery may be usefully employed, but not till the inflammation is gone. If the tendons are interfered with, veterinary surgeons sometimes remove the splint.

Splint, in surgery, a piece of wood, leather, pasteboard, gutta-percha, metal, or other material employed to prevent displacement of the fractured ends of bones or for other analogous purposes. In many cases surgeons employ bandages stiffened with gypsum, starch, dextrine, or gum-arabic in the place, and a very great number of splints has been devised for special purposes in surgery.

Splü'gen, a mountain-pass of the Alps leading from the Swiss canton of the Grisons into Italy over an elevation of 6939 feet, is on the Italian side covered at many places with galleries of solid masonry to protect travellers from avalanches. These galleries were built by the Austrian government, and finished in 1834.

Spof'ford (AINSWORTH R.), b. at Gilmanton, N. H., Sept. 12, 1825; received a classical education by private tuition; became principal librarian of Congress 1865, after having been previously employed as assistant; is a member of many historical and philosophical societies; has written much for the press on historical topics, and enjoys a wide fame for the universality of his knowledge, which he renders very serviceable to members of Congress and to students generally. He has published an *Alphabetical Catalogue of the Library of Congress* (1864), several supplementary catalogues, and has prepared a vast analytical catalogue, which, it is hoped, will soon be printed (1876). During his tenure of the responsible office of librarian the national collection has grown from 90,000 to more than 300,000 volumes, and the change in the law of copyright has been effected, by which all copyrights are entered and all facts regarding literary property verified at one central office at the Library of Congress, Washington, D. C., instead of being scattered, as was the case prior to 1870, in the offices of the district clerks throughout the country. The advantage to the American public in thus having secured the complete body of American literature in a national fireproof repository, open to the use and reference of all, is obviously very great; and the chief credit for this benefit is attributable to Mr. Spofford.

Spofford (HARRIET ELIZABETH **Prescott**), b. at Calais, Me., Apr. 3, 1835; married in 1865, Richard S. Spofford, a lawyer of Boston, Mass.; is authoress of *Sir Rohan's Ghost* (1859), *The Amber Gods, and other Stories* (1863), *Azarian* (1864), *New England Legends*, *A Thief in the Night*, and other works of fiction, and has contributed to many literary periodicals.

Spohr (LUDWIG), b. at Brunswick Apr. 5, 1784. His father was a physician. He was early noticed by the duke of Brunswick, placed on the civil list, and furnished with means for study and travel. His masters on the violin were Maurer and Eck; visited Russia; in 1804 began his professional career in Germany; was concert conductor under the duke of Saxe-Coburg-Gotha; in 1813 was in Vienna, in 1816 in Italy, in 1817 in Frankfort and London. A residence of some years in Dresden followed, and continued till he was called to the office of chapel-master at Cassel. D. Oct. 22, 1859. Spohr was possessed of fine sensibility and immense activity. Skilful in construction, elaborate in finish, a master of harmony and instrumentation, poetic in sentiment, imaginative, sympathetic, he ranks with the great, if not the greatest, composers. As a violinist he has scarcely been equalled. His book of instruction for the violin is a standard work. He composed in nearly every style—duos, quartettes, quintettes, sonatas, variations, overtures, cantatas, nine symphonies, five or six operas, several oratorios, songs with pianoforte accompaniments. His most famous pieces are the symphony *The Consecration of Tones* and the oratorio *The Last Judgment*, which is rather a collection of musical gems than an evenly-developed structure. A vein of mournful tenderness pervades his compositions, which suggests monotony and mannerism, but is interesting and effective. A critic has said

that "if all the works of Spohr could be destroyed except one specimen in each class of composition, it would be of advantage to his reputation." — His wife, DOROTHEA (SCHINDLER), was an accomplished performer on the harp, and gave concerts with her husband in the principal cities of Europe. O. B. FROTHINGHAM.

Spole'to [*Spoletium*], town of Italy, province of Perugia, about 60 miles N. N. E. of Rome, on a slight elevation, the crater of an extinct volcano. It was the foremost of the Umbrian cities, was reduced to a Roman colony in 242 B. C., suffered in the civil wars of Sulla and Marius, was sacked by Totila, rebuilt by Narses; under the Lombards it became a dukedom that increased rapidly in power, but it was plundered by Luitprand. After Charlemagne it was governed by a Frankish family, and Lambert, the second duke of this line, openly resisted the pope, marched to Rome (878), and held the Holy Father prisoner for some time. In the time of Gregory VII. the celebrated countess Matilda took up her residence here. In the twelfth century Spoleto offered an ineffectual resistance to Barbarossa. After the thirteenth century it became a permanent part of the Papal States. The old castle, whose foundations date from the time of Theodoric, stands on a height above the town, from which it is separated by a chasm-like valley spanned by a bridge 670 feet long and 280 feet high, originally Roman, but rebuilt, probably in the tenth century, and now serving as an aqueduct as well as bridge. This is the most striking object to be seen in Spoleto. The old Roman arched gateway, known as the Porta della Fuga, is according to Livy, a monument of Hannibal's time. The grand Palazzo Comunale has a tower of the eleventh century. The number of less important remains of Roman and mediæval architecture is very large. The churches contain many curious old monuments and some interesting pictures. The inhabitants of Spoleto are mostly engaged in agricultural and pastoral pursuits. P. 20,748.

Spondias. See HOG PLUM.

Sponge. See APPENDIX.

Spon'sor [Lat. from *spondere*, to "bind one's self by solemn promise"], in general, one who in any way becomes surety for another; specifically, one who at the baptism of an infant promises in its name that it shall lead a Christian life: a godfather or godmother. The sponsors also bind themselves to see to it that the child shall receive Christian training. Usually, in the churches of England and Rome, there are two sponsors, a male and a female. In the Church of Rome the relation of godfather or godmother and godchild is held to be a real one, precisely as though it were one of consanguinity.

Spontane'ity [N. Lat. *spontaneitas*], a term used in philosophy to express self-origination. It is sometimes confounded with freedom. Freedom involves not only spontaneity, but also conformity to law or consistency. Mere spontaneity may contradict each act by its successor, and thus its entire series may reduce to zero, thus preventing its realization by external acts. The existence of spontaneity is denied by strict necessitarians, who think all events under the form of causality, making each effect to flow from an external cause. But an examination of the presuppositions of necessity discovers that the ultimate cause—the "totality of conditions"—must be self-determining or spontaneous. Everything that happens must ultimately flow from a spontaneous activity. This spontaneity—all spontaneity—likewise can be shown to be personal will or else dependent on it. Cousin laid much stress in his philosophy upon the spontaneity of reason as contradistinguished from its reflective activity. While reflection depends on the arbitrary will of the individual, and is subject to error, the spontaneous original activity of reason is above reflection and arbitrariness, and not liable to error. Such a theory of reason was applied to the support of *a priori* ideas upon which the eclectic system was built. Schelling's "intellectual intuition" and Reid's "common sense" were used much in the same way; also, "intuition of the reason," which cognizes *a priori* ideas, according to many contemporary philosophers, corresponds to Cousin's "spontaneity." It is noteworthy that Fichte regarded the philosophic perception of the principles of the true science of knowledge to be a higher order of reflection—as it were, a third intuition of the mind (see PHILOSOPHY), whereas Cousin would make it a first "intention." WILLIAM T. HARRIS.

Sponta'neous Combus'tion. Before an ordinary body will unite with oxygen in the energetic manner, attended usually with evolution of both light and heat, which is commonly known as *combustion*, it must be heated to a certain point. Frequently, however, this union begins without any external influence, and it is then called *spontaneous combustion*. Phosphorus will often take fire at the temperature of the hand on account of its affinity for oxygen, and it is this same readiness to combine with oxygen which causes spontaneous combustion in the case of other bodies, so that anything which will increase it will increase the tendency to such combustion. Mechanical division increases it greatly, by affording a larger surface to the action of oxygen, and by lessening the conducting powers of the bodies acted on. If the oxides of nickel, cobalt, or iron are reduced by hydrogen below a red heat, the resulting finely-divided metals take fire when poured into the air; but if heated too highly, they become agglomerated and lose the property, unless some finely-divided powder is present to keep them porous, such as alumina precipitated with the metallic oxides. Freshly burned charcoal is liable to take fire, owing probably to condensation of oxygen in its pores; on this account it is not ground for making gunpowder until it has been kept for a time. Recently-expressed fixed oils absorb oxygen and give out carbon and hydrogen; the temperature of heaps of rags, tow, sawdust, and similar bodies soaked with oil, grease, turpentine, varnishes, etc., will rise on this account, and the low conducting power of such materials helps the process, until very often the mass takes fire. Serious conflagrations have resulted from this cause. So frequent were the accidents arising in the transportation of silks treated with oil to increase their weight that some European railroad companies refused to receive them. Bituminous coal, especially when containing much pyrites, is liable to spontaneous combustion, and it is said that 4 per cent. of all English vessels sailing with as much as 500 tons of coal from the United Kingdom in 1874 met with casualties from this cause, perhaps through the shipment of coal containing more pyrites than usual, owing to the increased demand and the high price of labor. There are on record one or two cases, apparently well authenticated, of heaps of wood-ashes taking fire long after the addition of any fresh ashes, so that care in this respect is advisable, although the cause seems obscure, as a heap of ashes would scarcely be porous enough to admit the air necessary to support internal combustion, although it might, doubtless, take fire on the surface from finely-divided carbon. Moisture sometimes aids spontaneous combustion, as in the cases where piles of damp hay or freshly-mown grass have taken fire. Barns have probably been burned in this way. It is also well to remember that strong nitric acid will act on straw, hay, and such bodies so as to render them spontaneously combustible. Twice within a year, at one of our scientific schools, concentrated nitric acid leaked from bottles into the straw in which it was packed, and the straw in one case took fire before the box was opened—in the other immediately afterward. Some gases ignite spontaneously, as phosphoretted hydrogen. The illuminating oil distilled from petroleum sometimes gives off gases that inflame spontaneously before it is refined in the "agitator." There are also spontaneously combustible liquids, of which cacodyl is an example. Spontaneously-combustible powders, or *pyrophori*, are made by heating tartrate of lead in a closed glass tube until the lead is reduced to metal, or by heating finely-divided sulphate of potash with half its weight of lampblack in a covered crucible, probably forming a very inflammable sulphide of potassium. The pyrophorus of Homberg is a mixture of dried alum and sugar, carbonized in an open pan, and then heated to redness in a glass flask away from the air. There is not on record an instance of reputed spontaneous combustion of the human body which admits of no other explanation. H. B. CORNWALL.

Spontaneous Combustion of the Human Body. There are very grave doubts in the minds of the best scientific authorities whether the human body is, under any conceivable circumstances, liable to inflame spontaneously; so much so, indeed, that one of the best authorities on medical jurisprudence declines to discuss the question under this heading, and substitutes the term "preternatural combustibility of the human body," presupposing that the combustion has in every case been excited by an external source of heat. The analogy between cases of spontaneous combustion in vegetable or mineral materials—which are unquestionable, and explicable in most cases by reference to rapid chemical action in conjunction with highly combustible materials—and cases of so-called spontaneous combustion of the human body fails in several important particulars. Those who believe in its possibility urge that the human body is largely made up of hydrocarbonaceous materials—oils and fats—which are highly inflammable; that under certain circumstances, and as the result of long continued habits, another highly combustible substance, alcohol, may be largely distributed throughout the tissues, not only increasing the natural combustibility, but forming an inflammable atmosphere around the body by its evaporation from the surface; and that as a result of the varied and rapid chemical processes of life it is quite possible that heat enough may be engendered to inflame the tissues, or that, as the result of these chemical changes, gases may be

evolved or formed which inflame at a very low temperature, or even spontaneously upon coming in contact with the air, or which may be inflamed by some electrical influence.

On the other hand, while admitting the combustibility of the body, *after death*, we must remember that about 70 per cent. of it consists of water, so distributed as to repress combustion in its inception, and that experiments show conclusively that the human body (undried) is a very incombustible substance, even when thoroughly impregnated with alcohol. We must also consider that the chemical processes going on in it, although varied and rapid, cannot be proved to evolve such an amount of heat as to make it probable that the combustion could be spontaneous, even if the material to be consumed were highly inflammable; and, finally, that the production and distribution throughout the tissues of spontaneously inflammable, or even of highly-combustible gases, is a theory resting only upon the fact that the materials out of which these gases might be formed exist in the living body, and not upon a demonstration of their formation.

In reviewing the recorded instances to which the theory appeals for support, we find them to be about thirty in number, the great majority of them females and a large proportion inordinate drunkards. "It does not appear that any one on whose judgment reliance can be placed has ever seen a case of spontaneous combustion of the body or recorded the details from actual observation." (Taylor, *Med. Jurisp.*) The destruction has been in many cases surprisingly complete, mere fragments being left uncharred, and in many cases the bones being calcined. In all well-authenticated cases a candle, lamp, fire, or matches have been in close proximity to the remains. Great stress has been laid by the advocates of spontaneous combustion upon a grimy, greasy soot and an empyreumatic odor which pervade the room, but these are equally the results of the ordinary combustion of human flesh in a confined apartment. The complete destruction of the body in comparison with the damage done to its surroundings, which has been more marked in females, has always been considered as the chief argument in favor of the possibility of such an occurrence. As Taylor pertinently remarks, we must remember that the fuel whose combustion destroys the body is itself consumed, and we have no means of estimating its quantity or quality. In cases where bodies have been set on fire to conceal murder, the clothing of the victims has often been intentionally soaked with some highly inflammable substance, or combustibles, such as pillows, etc., have been piled around the body before applying the light. The latter was the case in an instance which was regarded for some years as an example of spontaneous combustion, but which subsequent developments and the confession of the murderer showed to have been an attempt to conceal crime. The loose dress of females, highly combustible in itself, and containing a large amount of air in its folds, may perhaps partly account for their more complete destruction. It is also manifestly impossible in any case to estimate exactly the duration and intensity of the heat to which the body has been subjected from the combustion of the surrounding objects, particularly when we remember that the combustible parts of the body, liquefied by the heat, will saturate the materials beneath, rendering their combustion more intense and prolonged than is natural; as in one case on record, where the investigator reported that unburned pieces of a thick mat which lay under the body were so saturated with fat that they burned "like a link" upon applying a flame.

While, therefore, some of the instances of so-called spontaneous combustion of the human body are difficult of explanation, there are none whose explanation under conceivable conditions, acting according to natural laws, does so much violence to our reasoning as does the assumption of unproven theories as facts. In the words of one of the best and most recent authorities on this subject, "The hypothesis of such a mode of destruction of the human body is not only unsupported by any credible facts, but is as wholly inconsistent with all that science has revealed as witchcraft itself." Subjoined will be found a few references to the principal articles upon the subject in which may be found in detail the cases upon which the theory rests: *Cyc. Pract. Med.*, art. "Spont. Combustion," four cases; *Transylvania Journ.* (vol. vi. p. 143; vol. vii. p. 128); *Archives générales* (Mar., 1829); *Edinburgh Med. and Surg. Journ.* vol. xxvi. p. 210; vol. xix. p. 653; vol. xxii. p. 233); *Am. Med. Recorder* (vol. vi. p. 764); *Lond. Med. and Phys. Journ.* (vol. xlv. p. 347); *Lond. Med. Repository* (vol. iii. p. 239); *New York Med. Repository* (vol. xviii. p. 87); *Foderé* (vol. iii. p. 210); *Dict. des Sciences médicales* (vol. vi., art. "Spont. Comb."); *Am. Med. Recorder* (vol. v. p. 189); Beck's *Med. Jurisp.*, art. "Spont. Comb.;" Taylor's *Med. Jurisp.*, art. "Spont. Comb." S. B. St. John.

Spontaneous Generation. See Generation, Spontaneous, by Pres. F. A. P. Barnard.

Sponti'ni (Luigi Gasparo Pacifico), b. at Majolati, a village in the Papal States, Nov. 14, 1774; entered in 1791 the Conservatory of Music at Naples, and composed in 1796 his first opera, *I Puntigli delle Donne*, which succeeded. His next thirteen operas were also well received in various Italian cities, and he had a name in his native country when in 1803 he went to Paris. Here his first compositions made no impression, but in 1807 his great opera *Vestale* achieved an extraordinary success, as also did *Ferdinand Cortez* in 1809. From 1810 to 1812 he was director of the Italian opera at Paris, but found the position uncongenial to his character, and gave it up in disgust. In 1819 his third great opera, *Olympia*, was received somewhat coldly, and in 1820 he removed to Berlin, where he was director of the opera till 1842. His own compositions from this period—*Nurmahal* (1822), *Alcidor* (1825), etc.—are not very interesting, and he was exposed to much criticism and chicanery from the German musicians. In 1842 he went to Paris, thence to Italy, and d. in his native city Jan. 24, 1851.

Spoon'bill [the bill of the European kind is sometimes made into a spoon], a name applied to several birds of the heron family and of the genus *Platalea*, remarkable for the curious shape of the large bill. The windpipe has a singular and unexplained convolution. The roseate spoonbill (*P. ajaja*) of the Southern U. S. and tropical America is a beautiful rose-colored bird some thirty inches long. It lives in communities, and is considered a good bird for the table. The white spoonbill (*P. leucorodia*) is common in marshy regions in nearly all parts of the Old World. A few other species are known.

Spoon'er (Alden Jermain), b. at Sag Harbor, L. I., Feb. 2, 1810; became a resident of Brooklyn, where he edited the *Evening Star* and the *Long Island Star*; contributed for many years to the *Knickerbocker* and to *Colman's Magazine*, and was editor of Gabriel Furman's *Notes, Geographical and Historical, relating to the Town of Brooklyn* (1865), and Silas Wood's *Sketch of the First Settlement of the Several Towns on Long Island* (1865), contributing to both books memoirs of their authors.

Spooner (Lysander), b. at Petersham, Mass., in 1808; author of *The Deist's Reply to the Alleged Supernatural Evidences of Christianity* (Boston, 1836), *The Unconstitutionality of Slavery* (Boston, 1845; part ii. 1847), and of several legal arguments on trial by jury, credit, currency, banking, and the right of maintaining private mails.

Spooner (Shearjashub), M. D., b. at Brandon, Vt., in 1809; graduated at Middlebury College 1830, and at New York College of Physicians and Surgeons 1835; was a distinguished dentist in New York City until 1858, when he retired from business. Author of several professional treatises, of *Anecdotes of Painters, Engravers, etc.* (3 vols., 1853), and of a *Biographical and Critical Dictionary of Painters, Engravers, Sculptors, and Architects* (1853; new ed., 2 vols., 1865), containing notices of 12,000 artists. Dr. Spooner purchased and reissued the plates of Boydell's *Shakspeare Gallery*, and purchased for the purpose of reissue the plates of the *Musée française*, but the government refusing to remit the heavy import duty, the plates were returned to France. D. at Plainfield, N. J., in Mar., 1859.

Spor'ades [Gr. Σποράδες, "scattered"], the common name of those smaller islands of the Grecian Archipelago which lie scattered around the group of the Cyclades. They belong partly to Turkey and partly to Greece. The Turkish Sporades are Crete, Scarpanto, Rhodes, Cos, Kalimno, Patmos, Nicaria, Samos, Scio, Mytilene, Lemnos, Imbros, Samothrace, and Thasos. The Greek Sporades are Skiatho, Skopelo, Kilidromi, Skyro, Ægina, Salamis, Hydra, and Spezzia.

Spore [Gr. σπόρος, "seed"], a small embryo-cell or cell-mass produced by cryptogamous plants, and *functionally* representing the seeds of the higher plants, while *structurally* it more nearly corresponds with the pollen-cell of the higher vegetation. Spores are often so fine as to be quite invisible to the naked eye. The manner of the origin of the young plant from a spore is totally different from the germination of seed. There is indeed considerable difference in the nature of what are called spores. Some plants produce at least two apparently distinct kinds of spores—one large and another small—while the ferns and others have not a true spore, but a *prothallium* produced by gemmation, the prothallium being in fact an alternate generation of the fern, which, when further developed, performs a true act of generation from which originates the young fern. Strictly speaking, then, the spore of the fern must be the product of the action of the sperm-cell upon the germ-cell of the little prothallium, and not the cell-mass from which the prothallium springs; although the

latter functionally represents the spore, and is always called by that name. Familiar examples of spores are the "spawn" of mushrooms, the inflammable dust of *Lycopodium*, and the "smoke" of the common puff-ball.

Sport. See DANCING, GAMBLING-HOUSES, GRECIAN GAMES, and HORSE-RACING.

Sporting Arms. All small-arms not intended for military service are thus classified, including "double-" and "single-" barrel fowling-pieces and "arms of luxury" for target-firing, and smaller weapons for personal defence. The breech-loading principle has been introduced in sporting arms in great variety, but many experienced sportsmen prefer the muzzle-loader, especially for exact rifle shooting.

The manufacture of "arms of luxury" is considered one of the highest branches of the mechanical arts, and, from the number of the richer classes who use sporting arms, and the enthusiasm of those devoted to sporting, the sales of favorite patterns are always extensive, and large prices readily given for the most popular. The fowling-pieces made by Joseph Manton of London were in universal demand for many years about forty years since; now Greener, Wesley Richards, and Williams & Powell are of high repute with the English, while Belgium, France, and the U. S. have also celebrated manufactories. Double-barrel guns are made at these factories at prices from $5 to $250 each—all deemed strong and serviceable. Greener states in *Gunnery in 1858* that a first-class double-barrel gun need not cost more, and could not be sold for less, than £35. The U. S. "officer's model rifle" is now made at Springfield of the best material and workmanship for service, but plain in finish, for $36, while the army model made there costs $18.

Springfield Rifle, officer's model, 1875.

Some parts of the arm, not affecting the accuracy of aim or delicacy of the trigger, are common to both models. (See figure.) P. V. HAGNER.

Sports, Book of, a proclamation by James I. of Great Britain, issued in 1618, setting forth certain games which might lawfully be indulged in on Sundays after church-service. Among the sports allowed were "dancing, archery, leaping, vaulting, May-games, Whitsun-ales, morris-dances, and the setting up of May-poles." It was designed to prevent unlawful interference by Puritanical magistrates with popular recreations. Bear- and bull-baiting, bowling, and "interludes" were forbidden on Sundays. Charles I. reissued the proclamation in 1633. In 1644 the Long Parliament directed that all copies of the *Book of Sports* be burned by the common hangman. In both instances the publication of the *Book of Sports* gave rise to intense excitement, and aroused the strongest opposition among the Puritans. A fac-simile edition was recently issued in London.

Sportsman. See GAME LAWS.

Spots, Solar. See SUN, by PROF. C. A. YOUNG, LL.D.

Spots'wood, p.-v., East Brunswick tp., Middlesex co., N. J., on Camden and Amboy R. R.

Spotswood (ALEXANDER), b. at Tangier, Africa, 1676; was governor of Virginia 1710–23; was deputy quartermaster-general under Marlborough; postmaster in 1730; leader of the expedition intended to operate against Florida 1739; was the pioneer of iron manufacturing in Virginia; was originator of an act improving the staple of tobacco, and making tobacco-notes a medium of common exchange, and lent great aid to William and Mary College. D. at Annapolis, Md., June 7, 1740.

Spotswood, or **Spotiswood** (JOHN), b. in Scotland in 1565; was educated at Glasgow, and in 1601 went to France as chaplain to the Scottish ambassador. James VI. having in 1603 acceded to the throne of England, Spotswood accompanied him to London, and in the same year was made archbishop of Glasgow and a member of the privy council for Scotland; in 1615 was made archbishop of St. Andrew's and primate of Scotland. In 1633 he crowned Charles I. at Holyrood, and in 1635 became chancellor of Scotland. He drew great obloquy on himself for the part he took in the prosecution of Lord Balmerino, who was arraigned for the crime of "lease-making" (verbal sedition). Balmerino was convicted, sentenced to death, and only pardoned after a long imprisonment, Spotswood, his personal enemy, taking an active part in the proceedings. In 1637 he endeavored to introduce the new liturgy and book of canons into Scotland, urged on by the king and Laud, and, as is said, contrary to his own wish. Deposed from his bishopric by the assembly convened at Glasgow in Nov., 1638, excommunicated, and declared infamous, he fled to London, where he d. Nov. 26, 1639. He wrote a *History of the Church of Scotland* (published in 1625); it begins as early as 203 A. D., but the greater part is devoted to the history of his own times.

Spotted Fever. See FEVER, by E. KRACKOWIZER, M. D.

Spot'tiswoode (WILLIAM), LL.D., F. R. S., b. in London, England, Jan. 11, 1825; educated under Dr. Buckland at Laleham School, subsequently at Eton and at Harrow; graduated at Baliol College, Oxford, 1845; gained university mathematical scholarships 1846 and 1847; became manager of the office of the queen's printer; devoted much study to Oriental languages and philosophy, as well as to astronomy, mathematics, art, and the physical sciences; is a fellow of numerous learned societies; a contributor to their *Transactions* and to scientific periodicals, English and foreign; was public examiner in mathematics at Oxford 1857–58, afterward examiner under the civil service commission, for the Society of Arts, and for the middle-class schools, and became treasurer of the Royal Society 1871. Author of *Meditationes Analyticæ: Elementary Theorems relating to Determinants* (1851), *A Tarantasse Journey through Eastern Russia* (1857), and *The Polarization of Light* (1874), a volume of the "Nature" series.

Spottsylva'nia, county of E. Virginia, bounded by Rappahannock and North Anna Rivers, drained by the Mattapony, and intersected by Rappahannock Canal and Richmond Fredericksburg and Richmond R. R. The surface is hilly, and the soil generally fertile. There are numerous quarries of granite and freestone. Staples, Indian corn, wheat, oats, tobacco, and wool. Cap. Spottsylvania Court-house. Area, about 450 sq. m. P. 11,728.

Spottsylvania Court-house, p.-v., cap. of Spottsylvania co., Va., on Po River.

Spottsylvania Court-house, Battles at. See WILDERNESS.

Sprague, tp., New London co., Conn. P. 3463.

Sprague (CHARLES), b. at Boston, Mass., Oct. 26, 1791; educated at the Franklin School, Boston; became a mercantile clerk at the age of thirteen, partner with his former employer 1816, teller in the State Bank 1820, and cashier of the Globe Bank from 1825 to 1865. He early displayed a talent for poetry; devoted his spare time for many years to the study of old English classics; obtained prizes on five occasions for prologues to be recited at the opening of theatres at New York, Philadelphia, Salem, and Portsmouth; took another prize for a "Shakspeare ode" delivered at the Boston Theatre in 1823 at the exhibition of a pageant; delivered a Phi Beta Kappa poem, *Curiosity*, at Cambridge 1829, and a centennial ode at Boston 1830, on the 200th anniversary of the settlement of that city; was the civic orator at Boston July 4, 1825; wrote various other occasional compositions in prose and verse, which were collected into a single volume at New York in 1841, republished at Boston 1850 and 1855. D. at Boston Jan. 14, 1875. A new edition of his complete writings was issued in Boston in 1876.

Sprague (PELEG), LL.D., b. at Duxbury, Mass., Apr. 28, 1793; graduated at Harvard University 1812, and at once entered Litchfield Law School; was admitted to Plymouth county bar Aug., 1815; practised several years in Augusta, Me., and afterward settled in Hallowell; was a member of the Maine legislature 1820–21, Representative in Congress 1825–29, U. S. Senator 1829–35; removed to Boston in 1835; appointed U. S. district judge of Massachusetts 1841–65. He published *Speeches and Addresses* (1858), *Decisions* (1841–61), edited by F. E. Parker (1861); vol. ii. (1854–64) 1868.

Sprague (WILLIAM), b. at Cranston, R. I., 1800; was a member of the State legislature and Speaker in 1832, Representative in Congress 1833–35, governor of Rhode Island 1838–39, Senator 1842–44, and subsequently again member of the State legislature. He was largely engaged in cotton manufactures, and was president of a railroad and of two banks. D. at Providence Oct. 19, 1851.

Sprague (WILLIAM), b. at Cranston, R. I., Sept. 12, 1830; was educated in the printworks established by his grandfather, and carried on by his father and uncle. His father was murdered in 1844, and he subsequently became a partner with his uncle; was governor of Rhode Island 1860–63; in 1861 offered a regiment and a battery to the President, with which he took the field, having a commission as brigadier-general; was present at the battle of Bull Run, where his horse was shot under him, and was in several other actions during the Peninsular campaign; in 1862 was chosen U. S. Senator, and was made chairman of the committee on manufactures; and was re-elected in 1868, his term closing in 1875, and served as chairman of the committee on public lands.

Sprague (WILLIAM BUELL), D. D., b. at Andover, Conn., Oct. 16, 1795, son of Benjamin Sprague, a farmer, and descended from the Spragues of Duxbury; was fitted for college at Colchester Academy under the care of the venerable John Adams, and also enjoyed in his early education the assistance of Rev. Dr. Abiel Abbot; graduated at Yale 1815; was tutor in the family of Major Lawrence Lewis in Virginia 1815–16; graduated at Princeton Seminary 1819, in which year he was settled at West Springfield, Mass., as colleague pastor with Rev. Dr. Joseph Lathrop over the First Congregational church; became pastor 1821, on the death of Dr. Lathrop; was installed pastor of the Second Presbyterian church at Albany, N. Y., 1829, retaining that post until 1869; visited Europe 1828 and 1836; made the most extensive collection of religious pamphlets and of autographs known in America, the former of which he presented to the New York State library at Albany; was widely known as possessing a most exact biographical knowledge of American celebrities, especially clergymen. In 1869 he settled at Flushing, L. I., where he d. May 7, 1876. Author of more than 100 published sermons, addresses, orations, and essays; of *Letters to a Daughter* (1822), *Lectures to Young People* (1830), *Letters from Europe* (1828), *Life of Edward Dorr Griffin* (1838), *Life of Timothy Dwight* (1845), *Lectures on Revivals of Religion* (1832), *Hints designed to regulate the Intercourse of Christians* (1834), *Lectures illustrating the Contrast between True Christianity and various other Systems* (1837), *Aids to Early Religion* (1847), *Words to a Young Man's Conscience* (1848), *Women of the Bible* (1850), *Letters to Young Men* (2d ed. 1845), *Visits to European Celebrities* (1855), *Memoirs of Rev. John and W. A. McDowell, D. D.* (1864); wrote many introductions to books by other writers, and was a contributor to the biographical department of Appletons' *American Cyclopædia*. The great work to which the labor of a life was given was the *Annals of the American Pulpit* (9 vols., 1857–66).

Sprain [O. Fr. *espreindre*], or **Subluxation**, a stretching or wrenching of the non-osseous parts of a joint, without displacement of the bones, and either with or without lesion of ligaments or tendons. Severe sprains are sometimes quite as serious and lasting in their effects as dislocations. Perfect rest, cold or sometimes hot lotions (if the latter be more agreeable to the patient), accompanied by the use of splints for mechanical support and of opiates for the relief of pain, are required in the treatment.

Sprat, or **Garvie**, the *Harengulus sprattus*, a little herring of the European seas. Sprats are spiced, salted, dried, and potted in many ways, and are very good fresh, but are generally eaten by the poorer classes. The French preserve great quantities of small sprats and sell them for sardines. Great quantities are also used for fertilizing land. The sprat is seldom over six inches long.

Sprat (THOMAS), b. in Devonshire in 1636; was educated at Oxford, where he was made D. D.; became chaplain to the duke of Buckingham, and afterward to Charles I.; prebendary of Westminster in 1668, dean in 1683, and bishop of Rochester in 1684. He was a member of the ecclesiastical commission created by James II., and read the famous declaration of indulgence in Westminster Abbey, but soon after resigned his place on the commission in an able letter, which was the cause of the extinction of that tribunal. He took the oath of fealty to William and Mary, and was appointed a member of the new ecclesiastical commission, but soon after withdrew. In 1692 he was arrested and kept in confinement ten days on a false charge of conspiracy against the new government. He was one of the first members of the Royal Society; wrote a *Life of Cowley*, a *History of the Royal Society*, an *Account of the Rye-House Plot*, and poems. D. at Bromley May 20, 1713.

Spree, a river of Prussia, rises in the kingdom of Saxony, passes through Berlin, and joins the Havel at Spandau, after a course of 220 miles. At Kosenblatt it becomes navigable for small craft, and considerable traffic is carried on along its whole course.

Sprem'berg, town of Prussia, province of Brandenburg, on an island in the Spree, has manufactures of stockings, hosiery, tobacco, and tiles. It has a royal palace and some barracks. P. 5924.

Spreng'el (KURT), b. at Boldekow, a village near Anklam, in the Prussian province of Pomerania, Aug. 3, 1766; studied medicine at Halle; became professor of medicine there in 1789, and in 1797 of botany. D. Mar. 15, 1833. The most noticeable of his numerous writings are *Versuch einer pragmatischen Geschichte der Arzneikunde* (5 vols., 1792–1803), several times reprinted, *Geschichte der Botanik* (1817–18), and *Systema Vegetabilium* (1825–28).

Sprengel's Air-Pump. See PNEUMATICS.

Spreng'er (ALOYS), b. at Nassereut in the Tyrol Sept. 3, 1813; studied medicine, natural science, and Oriental languages at Vienna; went in 1836 to London, where he assisted the earl of Munster in his work on the *Military Science of the Mohammedan Nations*; entered the service of the East India Company, and exercised during his stay in India (1843–57) a great influence on the introduction and establishment of European civilization among the Hindoo nations as president of the college of Delhi, where he lectured with great success in Hindostani on logic, mathematics, political economy, etc.; by his lithographic press, whence he issued a Hindostani weekly, *Kiran alsadain*, and the *Bibliotheca Indica*; as government interpreter, secretary to the Asiatic Society, assistant resident at Lucknow, director of the Mohammedan college in Calcutta, etc. He returned to Europe through Palestine, Syria, and Egypt in 1857, and was appointed professor of Oriental languages at Bonn. He published *Das Leben und die Lehre des Mohammad* (3 vols., Berlin, 1861–65), in which he brings to light the Mohammedanism which antedates Mohammed.

Sprigg, tp., Adams co., O. P. 2086.

Spring, one of the four seasons of the year, properly the first, so called because it is the time when vegetation "springs," as it were, to life. In the temperate regions of the northern hemisphere it includes, in a vague and indefinite way, the months of March, April, and May; June, July, and August being the summer; September, October, and November, the autumn; December, January, and February, the winter. In the temperate regions of the southern hemisphere the order is reversed, September, October, and November being the spring, and March, April, and May the autumn. In the tropical regions there is strictly neither spring nor autumn, but only two seasons, the wet and the dry; in the polar regions, only two seasons, summer and winter. Spring may be regarded as occupying the same relative position among the seasons of the year as morning does among the periods of the day, and youth among the stages of human life.

Spring [Ang.-Sax.], a fountain or a stream of water flowing out of the earth, and fed by rains on higher lands, frequently quite distant. As the water of springs often flows through subterranean channels which are beyond the reach of changes in surface temperature, it is little affected by the seasons, and is often maintained at about the average annual temperature of the locality. When it emanates from a deeper source, it is sometimes highly heated, producing THERMAL SPRINGS (which see). When, as is often the case, the water is impregnated with chemical substances, such springs are called mineral springs. (See WATER.)

J. S. NEWBERRY.

Spring, tp., Jefferson co., Ark. P. 406.

Spring, tp., Boone co., Ill. P. 1068.

Spring, tp., Cherokee co., Ia. P. 33.

Spring, tp., Berks co., Pa. P. 2253.

Spring, tp., Centre co., Pa. P. 1608.

Spring, tp., Crawford co., Pa., on Erie and Pittsburg R. R. and on Beaver and Erie Canal. P. 1522.

Spring, tp., Perry co., Pa. P. 1492.

Spring (GARDINER), D.D., son of Samuel, b. at Newburyport, Mass., Feb. 24, 1785; graduated at Yale in 1805; studied law at New Haven; taught school for nearly two years in Bermuda; was admitted to the bar in 1808; commenced practice, but abandoned law for theology, which he studied at Andover; was licensed to preach in 1809, and in the following year became pastor of the Brick church in New York, then located in Beekman street, near the present site of the post office, but which was removed in 1856 to Fifth avenue and Thirty-sixth street. Although invited to the presidency of Hamilton and Dartmouth colleges, he

remained in this pastorate until the close of his life, but seldom preached during the later years, the pulpit being usually filled by an assistant pastor. His published works are—*Essays on the Distinguishing Traits of Christian Character* (1813), *Memoirs of Rev. S. J. Mills* (1820), *Fragments from the Study of a Pastor* (1838), *Obligations of the World to the Bible* (1844), *The Attraction of the Cross* (1845), *The Bible not of Man* (1847), *Discourses to Seamen* (1847), *The Power of the Pulpit* (1848), *The Mercy-Seat* (1849), *First Things* (1851), *Contrast between Good and Bad Men* (1855), *Brick Church Memorial* (1861), *Pulpit Ministrations* (1864), *Personal Reminiscences* (1866). D. Aug. 18, 1873.

Spring (Samuel), D. D., b. at Northbridge, Mass., Feb. 27, 1746; graduated at Princeton College in 1771; became chaplain in the army, and accompanied Arnold's expedition to Canada in 1775; was ordained pastor of the Congregational church in Newburyport in 1777, and continued there until his death. He was prominent in his denomination, a recognized leader of the Hopkinsian party; aided in founding the theological seminary at Andover, and in the establishment of the American Board of Commissioners for Foreign Missions. He published several controversial essays and about 25 occasional sermons. D. Mar. 4, 1819.

Spring Arbor, p.-v. and tp., Jackson co., Mich., on Air-line division of Michigan Central R. R. P. 1117.

Spring Balance. See Balance, by Pres. F. A. P. Barnard.

Spring Bay, p.-v. and tp., Woodford co., Ill. P. of v. 235; of tp. 475.

Spring-Boc [Dutch for "spring-buck," so called from its habit of leaping when alarmed], a very beautiful, active, and graceful antelope of South Africa, the *Antidorcas euchore*. It goes in immense herds upon the plains. Its flesh is in some estimation as food, and the hides are much sought for by tanners. This timid creature, when taken in hand young, becomes very tame, and is sportive and too familiar, sometimes butting at all who come near it.

Springboro, p.-v., Crawford co., Pa., on Erie and Pittsburg R. R. and the Beaver and Erie Canal. P. 323.

Springbo'rough, p.-v., Clear Creek tp., Warren co., O. P. 477.

Spring Brook, p.-v. and tp., Luzerne co., Pa. P. 426.

Spring Brook, tp., Dunn co., Wis. P. 1061.

Spring City, p.-v., Chester co., Pa., 30 miles N. of Philadelphia, on Schuylkill River, has 2 churches, a fine school-house, 1 bank, 1 newspaper, a wood-paper mill, stove-foundry, sash-factory, planing-mill, and a brick-yard. P. about 2000. J. H. Royer, Ed. "Sun."

Spring City, p.-v., San Pete co., Ut.

Spring Creek, tp., Shelby co., Ala. P. 1183.

Spring Creek, tp., Phillips co., Ark. P. 1563.

Spring Creek, tp., Yell co., Ark. P. 778.

Spring Creek, tp., Pike co., Ill. P. 1009.

Spring Creek, tp., Black Hawk co., Ia. P. 707.

Spring Creek, p.-v. and tp., Tama co., Ia. P. 573.

Spring Creek, tp., Saline co., Kan. P. 726.

Spring Creek, tp., Dent co., Mo. P. 1281.

Spring Creek, tp., Douglas co., Mo. P. 386.

Spring Creek, tp., Howell co., Mo. P. 448.

Spring Creek, tp., Maries co., Mo. P. 244.

Spring Creek, p.-v. and tp., Phelps co., Mo. P. 1119.

Spring Creek, p.-v. and tp., Johnson co., Neb. P. 521.

Spring Creek, p.-v. and tp., Madison co., N. C. P. 944.

Spring Creek, tp., Miami co., O. P. 1606.

Spring Creek, tp., Elk co., Pa. P. 357.

Spring Creek, p.-v. and tp., Warren co., Pa., on Philadelphia and Erie division of Pennsylvania R. R. P. 1116.

Spring Creek, tp., Wirt co., West Va. P. 490.

Springdale, p.-v. and tp., Cedar co., Ia., on Red Cedar River. P. 1539.

Spring Dale, p.-v., Springfield tp., Hamilton co., O. P. 382.

Spring'dale, p.-v. and tp., Dane co., Wis. P. 1138.

Spring'er, a name given by sportsmen to several varieties or sub-varieties of the hunting spaniel, used for starting birds from bushy coverts. The Clumber, Sussex, and Norfolk breeds are the best. The springer should weigh from fourteen to forty pounds, and should have a good coat, a feathery tail, carried low, and an active, graceful style of work. The Clumber is especially liked, because it gives no tongue while at its duty.

Spring'field, p.-v. and tp., Green co., Ala. P. 915.

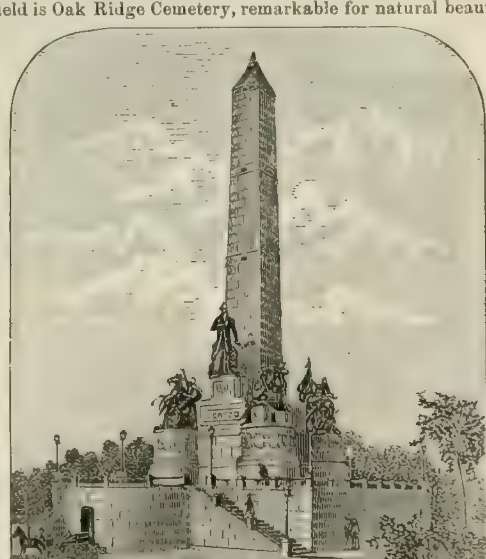
Springfield, p.-v., cap. of Bon Homme co., Dak., 30 miles W. of Yankton, has 3 churches, U. S. land-office, good schools, 1 newspaper, a public hall, incorporated library association, and 1 hotel. Principal business, stock-raising and farming. P. about 500.
L. D. F. Poore, Ed. "Times."

Springfield, p.-v., cap. of Effingham co., Ga. P. 32.

Springfield, city and tp., capital of the State of Illinois, and also of Sangamon co., is situated on Chicago Alton and St. Louis, Toledo Wabash and Western, Gilman Clinton and Springfield, Springfield and Illinois, South-eastern division of Ohio and Mississippi, and Springfield and North-western R. Rs. P. (1870) of v. 17,364; of tp. 2447. Its population, taken by local authorities recently, is 25,600, making it the fourth city in size in the State, Chicago, Peoria, and Quincy being larger. It was selected as the capital in 1837. Two street horse-railways permeate the city N. and S., E. and W.; 6 coal-shafts are operated on the verge of the city, where superior coal in inexhaustible quantities is mined. Springfield has gas-works, a paid fire department, and adequate waterworks. The principal manufactories are, the Springfield woollen-mills, paper and pulp manufactory, corn-planter and baby-wagon manufactory, Springfield Watch Co., Springfield iron, steel, and rolling mills, machine-shops, spice and hominy mills. Sixteen churches adorn its streets, several of superior architectural beauty. There are 4 ward schools, and a fifth for colored children; also a tasteful high-school building; the Bettie Stuart Institute, Ursuline convent, and St. Joseph's of Notre Dame; the home for the friendless and other charitable institutions; a public library and a law library, the latter belonging to the State. There are two daily, 1 tri-weekly, 4 weekly, and 1 monthly newspaper, and a book and job office. Springfield was the

Lincoln's Home, Springfield, Ill.

home of the late President Lincoln. Adjoining Springfield is Oak Ridge Cemetery, remarkable for natural beauty



National Lincoln Monument, Springfield, Ill.

and æsthetic embellishment. Here repose the remains of the lamented Lincoln, and here is erected the Lincoln national

monument. It was designed by Larkin G. Mead, Jr., of Vermont, and [illegible] William D. Richardson of Springfield, Ill. The former engaged to mould, cast, and deliver the following [illegible] for the sum of $70,000, the latter to erect the monument [illegible]. The statuary to consist of a statue of [illegible] not less than ten feet high; a group representing [illegible], containing three figures, with appropriate [illegible], figures 7½ feet in height; group of cavalry, one horse and two horsemen, with accessories, the human figures 7 feet high, and the horse in proportion; group of artillery, of three figures, same height; marine group of three figures, of same height; and a coat-of arms of the U.S. The monument proper, excepting the groups, occupies on the ground, fitted with concrete, a space of 119½ feet from N. to S. and 72½ feet from E. to W.; is built with solid masonry of block Massachusetts or Quincy gray granite, [illegible] feet 4 inches high. The monumental shaft or obelisk from ground line to apex is 98 feet 4½ inches high. There is a catacomb and memorial hall at its base: the former has five crypts side by side three feet above the vestibule, each 3 feet square and 7 in length. These are reached by stone steps protected by an iron balustrade. The central crypt only is visible through a glass plate; in it is the sarcophagus containing all that was mortal of Abraham Lincoln. From the terrace to the apex of the obelisk is 82 feet 6½ inches; from grade-line to top of the pedestals for groups, 28 feet 4 inches; and to the top of the pedestal occupied by the statue of Lincoln is 35 feet 6 inches. It is understood that several cities of the Union intend to furnish the groups at their individual expense. When these are constructed and placed in position, the monument will be complete. Within Memorial Hall are deposited articles used by Mr. Lincoln or associated with his memory. Here is a stone given to him by Roman patriots during the early part of his second term. It was detached from the wall built by Servius Tullius. The stone bears a Latin inscription, translated as follows: "To Abraham Lincoln, President for the second time of the American republic, citizens of Rome present this stone from the wall of Servius Tullius, by which the memory of each of those brave assertors of human liberty may be associated. Anno 1865." This block is 27½ inches long, 19 inches wide, and 8¾ inches thick. Other objects of interest are deposited in Memorial Hall. Two of the crypts contain the remains of two of the children of Mr. Lincoln—Eddie and Willie.

The new capitol at Springfield was authorized by statute in 1867, under the supervision of a board of commissioners. Its cost is limited to $3,500,000. The cornerstone was laid Oct. 5, 1868, with imposing Masonic ceremonies. The ground-plan forms a great cross; the superstructure is of

State-house, Springfield, Ill.

the style of architecture termed classic. It blends the ancient and modern arts of building, so as to secure the greatest strength and solidity and preserve an exterior light and airy appearance. The grand outlines are—total length from N. to S., [illegible] feet, exclusive of porticoes, which add 20 feet to each front. From E. to W. it is 286 feet, including the portico on the eastern or principal front. The first floor above the basement is 19 feet high, its floor supported by brick arches, double in the halls, 2 feet below each other, forming viaducts for a supply of fresh air. A layer of concrete covers the area of the arches; upon this, imbedded in cement, is laid marble flooring. This first floor is devoted to private rooms for the judges of the State supreme court, rooms for consultation, for storage of stationery, etc. Here, also, are geological specimens in rooms. Another apartment is occupied by the adjutant-general and the museum. The story is lighted by windows and the glass ceiling in the centre, forming the floor of the rotunda. Next above is the principal story, 22½ feet from floor to ceiling. Here is the main corridor, running the entire length of the building N. and S., 359 feet long and 24 feet wide; the grand corridor crosses it at right angles under the dome from E. to W. The main corridor is finished with marble pilasters. The grand corridor, extending from the eastern portico to the grand stairway in the western wing, is 32 feet wide, with massive marble pillars very elaborately finished. On this floor are the governor's reception and private rooms, offices of the secretary of state, State treasurer, auditor, superintendent of public instruction, a law library, State document library, attorney-general's office, supreme court-room, supreme court clerk's office, four massive stone fireproof vaults, the treasurer's burglar-proof safe, and geologists' store-rooms. Its steps are sixteen feet long, of Tennessee marble. The floors in the halls and corridors are chequered marble in alternate squares of various colors. The prin-

cipal entrance is from the E. by a flight of stone steps 73 feet wide, ascending to the grand portico. The second principal story is 45 feet from floor to ceiling. Upon this floor is the senate chamber and hall of representatives. The former is 75 by 62 feet. Adjoining are rooms for the several officers of the senate. Crossing the corridor is Representative Hall, 100 by 66 feet. Another story above is devoted to galleries, committee-rooms, etc. Mansard roofs, sides lined with copper, top with slate, cover the building. In the centre a stately dome, surmounted by lantern with ball on pinnacle, rises 320 feet from the ground, 43 feet higher than the Capitol at Washington. The lantern is 16 feet wide and 24 feet high; frame of iron, sides of glass. Two sets of elevators from first floor ascend to the upper stories. The rotunda is 76 feet in diameter. From the glass floor, where the grand and main corridors intersect, to the frescoed work beneath the dome, is a view 217 feet without obstruction to sight. Each portico has ten columns, 45 feet high above the plinth-box, 4½ feet in diameter. The eastern or principal portico is 90 feet wide. On each front corner is a turret 132 feet high, surmounted, that of the northern by a statue of Lincoln, that of the southern by one of Douglas. For heating and ventilation, a steam-engine of 40 horse-power occupies a lot 200 feet from the State-house. Hot air in pipes under ground is conveyed, and a fan 12 feet in diameter connects for purposes of ventilation. The State-house is constructed of cut stone, iron, and marble. Its interior arrangement, finish, and the furniture of the rooms and halls are in perfect keeping with the style of the building.

In 1866, during Pres. Johnson's administration, the U. S. government began the erection in this city of the U. S. court-house and post-office building, finishing it in 1868. It is built of Nauvoo stone, is three stories high, cost $300,000 completed, and is a good, substantial building.

E. L. Merritt, Ed. "Register."

Springfield, tp., Allen co., Ind. P. 1749.

Springfield, p.-v. and tp., Franklin co., Ind. P. 1513.

Springfield, tp., La Grange co., Ind. P. 928.

Springfield, tp., La Porte co., Ind. P. 1072.

Springfield, tp., Cedar co., Ia. P. 1509.

Springfield, tp., Winneshiek co., Ia. P. 1260.

Springfield, p.-v., cap. of Washington co., Ky., has 1 newspaper. P. 502.

Springfield, p.-v., Livingston parish, La., on Tickfaw River.

Springfield, p.-v. and tp., Penobscot co., Me. P. 879.

Springfield, city, cap. of Hampden co., Mass., on the E. bank of Connecticut River, 98 miles W. by S. from Boston and 138 miles N. N. E. from New York, in lat. 42° 6′ 10″ N., lon. 72° 35′ 12′ W. The western part of the city is level; the eastern part is on high ground, which rises gradually from the river-valley, commanding an extensive prospect and furnishing many beautiful sites for residences and public buildings. The city is well built; its streets are wide, and are adorned with fine shade-trees. Five railroads centre here—viz. Boston and Albany, New York New Haven and Hartford, Connecticut River, Springfield Athol and North-eastern, Connecticut Valley and Springfield. The three former meet in one spacious and commodious station, and all of them have extensive connections. The city hall is a large building of the Romanesque order, and contains the city offices and an audience-room seating 2300 persons. The city library is one of the finest of the public buildings. It is built of brick, in the modern Gothic style, with facings of stone. It contains, besides a library of 39,500 volumes, a museum of natural history and ethnology. The court-house and the Boston and Albany R. R. block are handsome structures of granite. The high-school building is large and convenient. Six grammar schools are located in various sections of the city in new and substantial buildings of modern design. The entire school system embraces 29 buildings and furnishes employment for 140 teachers and instruction for 6000 pupils. Besides the public schools, there are several private educational institutions. The city contains 27 churches—viz. 7 Congregational, 5 Methodist, 5 Roman Catholic, 3 Baptist, 1 Episcopal, 1 Unitarian, 1 Universalist, 1 Advent, 1 Union Evangelical, 1 Swedenborgian, 1 Free Religion. There are 7 national banks, 3 savings banks, 1 trust banking company, 1 clearing-house, 3 insurance companies. Two daily papers are published here, which also issue weekly editions; there are also 3 weekly papers. The U. S. armory is located here. During the Revolution there was a dépôt for military stores and a place for repairing arms, but the armory was not established for the manufacture of arms until 1794. The arsenal, offices, store houses, and principal workshops are on the high ground in the eastern part of the city, but the heavier operations required are carried on in the southerly part of the city, on Mill River. The breech-loader, model of 1873, is now manufactured here. About 350 men are employed. During the civil war the armory gave occupation to 3000 men, and 1000 rifles were turned out in a day. The arsenal is a spacious building, 200 feet by 70, and three stories high, and is capable of containing 100,000 stand of arms on each floor. An extensive and beautiful view is obtained from the tower. A pistol manufactory and the Wason Co. Car-works are known throughout the country, and have filled large orders for foreign nations. There are also extensive manufactures of cotton and woollen goods, boilers, blank books, engines, buttons, carriages, confectionery, furniture, cards, corrugated iron, gold and silver plating, trunks and harnesses, paper, paper boxes, paper collars, picture frames, soda fountains, spectacles, tools, envelopes, etc.

The waterworks are under the care of a board of commissioners, and the city is plentifully supplied with water for daily use, while numerous reservoirs and high-service hydrants furnish protection against fire. The fire department consists of a chief and 5 assistant engineers, together with 116 officers and men. There are 6 steam fire engines and 1 chemical engine, several hose-carts, and about 8000 feet of hose. The leading hotels are the Massasoit House, Cooley's, and Haynes's hotels. The Springfield cemetery contains about 40 acres, and is rendered beautiful by the diversity of its natural scenery and the variety of its shade trees and fountains. Hampden Park, containing about 60 acres, is under the control of the Hampden Park Association, and is used for public recreations and active sports. The street railway corporation was organized in 1869; the tracks connect the extreme sections of the city. Indian Orchard is a busy manufacturing suburb in the eastern part of the city, containing 3 churches and several cotton-mills. Springfield was first settled in 1636 by emigrants from Roxbury, under the leadership of William Pynchon, a gentleman of wealth and education. The town was first called *Agawam*, the Indian name for a portion of the territory occupied. West Springfield, Chicopee, and several of the neighboring towns were then included in its boundaries. In 1637 the first church was organized, with Rev. George Moxon as pastor. In 1640 the name of the settlement was changed to *Springfield* in compliment to Mr. Pynchon, who came from Springfield, Eng. In 1675, during King Philip's war, the town was burned by the Indians. During Shays's rebellion, in 1787, the U. S. arsenal was attacked, but the insurgents were dispersed by the State militia, under the command of Gen. Shepard. Springfield became a city in 1852. P. in 1875, 31,053; in 1870, 26,703.

William Rice.

Springfield, p.-v. and tp., Oakland co., Mich. P. 1378.

Springfield, city, and county-seat of Greene co., Mo., on the summit of the Ozark Mountains, on Atlantic and Pacific R. R., 241 miles from St. Louis, has 9000 inhabitants, and is the business centre for the whole of S. W. Missouri and Northern Arkansas. The lead and zinc mines developed and in process of development in Christian, Jasper, Newton, Dade, Wright, Webster, Hickory, and other counties in S. W. Missouri are the richest and most extensive in the world. Its climate is very mild and healthful. 5 weekly newspapers are published; 2 large public school buildings, each under a corps of competent teachers, offer the advantages of education; and Drury College furnishes a complete scientific and classical course. In connection with the college is an incorporated and well-organized musical conservatory. There are 11 church buildings and 3 banks; the leading manufactories are a cotton-mill, woollen-mill, wagon-factory, 3 flouring-mills, 2 planing-mills, 2 iron-foundries, furniture factory, and 4 tobacco-factories; the streets, business-houses, and public buildings are lit with gas. It is the largest town in the South-west, and is growing rapidly, over $200,000 having been expended last year for improvements. P. in 1870, 5555. J. P. Tracy, Ed. "Springfield Advertiser."

Springfield, tp., Henry co., Mo. P. 1896.

Springfield, p.-v. and tp., Sullivan co., N. H. P. 781.

Springfield, tp., Burlington co., N. J. P. 1761.

Springfield, p.-v. and tp., Union co., N. J. P. 770.

Springfield, p.-v. and tp., Otsego co., N. Y. P. 2022.

Springfield, tp., Nash co., N. C. P. 2111.

Springfield, city and tp., cap. of Clark co., O., is on Cleveland Columbus Cincinnati and Indianapolis, Cleveland Sandusky and Cincinnati, Columbus Springfield and Cincinnati, Pan Handle, and Atlantic and Great Western R. Rs., 80 miles from Cincinnati, 40 from Columbus, and 164 from Cleveland. Springfield has over 20 churches, and 1 horse railroad. The city has among its literary institutions Wittenberg College, the Springfield Seminary for Young Women, and excellent public schools; has 1 daily, 1

tri weekly, 5 weekly, and 2 monthly newspapers: it has 70 different factories, employing about 4000 men. In June, 1874, 23,000 Champion reapers and mowers were made and sold. Among the other products are grain-drills, cider-mills, grain-separators, horse-powers, water-wheels, steam-engines, steam-boilers, steam-heaters, woollen goods, cutlery, wrapping paper, spring beds, wringers, furniture of all kinds, baking-powder, iron fencing, malleable iron work, reaper and mower knives, cutter-bars, reaper-guards, galvanized iron work, house-heaters, lime, dressed limestone, pork, linseed oil, flour, whisky, beer, etc. The city is in close proximity to Mad River. P. (1870) of city, 12,652; of tp. 2888.

C. M. NICHOLS, ED. "DAILY REPUBLIC."

Springfield, tp., Gallia co., O. P. 1824.

Springfield, tp., Hamilton co., O. P. 6548.

Springfield, tp., Jefferson co., O. P. 826.

Springfield, tp., Lucas co., O. P. 701.

Springfield, tp., Mahoning co., O. P. 2150.

Springfield, tp., Muskingum co., O. P. 4022.

Springfield, tp., Richland co., O. P. 2046.

Springfield, tp., Ross co., O. P. 1238.

Springfield, tp., Summit co., O. P. 2085.

Springfield, tp., Williams co., O. P. 1981.

Springfield, p.-v. and tp., Bradford co., Pa. P. 1455.

Springfield, tp., Bucks co., Pa. P. 2551.

Springfield, tp., Delaware co., Pa. P. 1267.

Springfield, tp., Erie co., Pa. P. 1742.

Springfield, tp., Fayette co., Pa. P. 1629.

Springfield, tp., Huntingdon co., Pa. P. 738.

Springfield, tp., Mercer co., Pa. P. 1318.

Springfield, tp., Montgomery co., Pa. P. 1222.

Springfield, tp., York co., Pa. P. 1958.

Springfield, tp., Edgefield co., S. C. P. 1861.

Springfield, p.-v., cap. of Robertson co., Tenn., on St. Louis and South-eastern R. R., 30 miles N. of Nashville, contains 2 churches, 2 academies, 1 bank, 1 newspaper, and 2 large merchant mills. It is noted for its production of the finest corn whisky in America. P. about 2000.

ARCHIE THOMAS, ED. "RECORD."

Springfield, p.-v., Limestone co., Tex.

Springfield, p.-v. and tp., Windsor co., Vt., on Black and Connecticut rivers, and opposite Charlestown, N. H., on Vermont Central R. R., has 2 newspapers. P. of v. 1337; of tp. 2937.

Springfield, tp., Page co., Va. P. 1935.

Springfield, tp., Hampshire co., West Va. P. 1273.

Springfield, tp., Monroe co., West Va. P. 1624.

Springfield, tp., Adams co., Wis. P. 386.

Springfield, tp., Dane co., Wis. P. 1439.

Springfield, tp., Jackson co., Wis. P. 711.

Springfield, tp., Marquette co., Wis. P. 261.

Springfield, tp., St. Croix co., Wis. P. 372.

Springfield Centre, p.-v., Springfield tp., Otsego co., N. Y.

Spring Garden, p.-v. and tp., Cherokee co., Ala. P. 161.

Spring Garden, p.-v. and tp., Jefferson co., Ill. P. 205.

Spring Garden, tp., York co., Pa. P. 3040.

Spring Green, p.-v. and tp., Sauk co., Wis., on Wisconsin River and on Prairie du Chien division of Milwaukee and St. Paul R. R. P. of v. 422; of tp. 1156.

Spring Grove, p.-v. and tp., Warren co., Ill. P. 1080.

Spring Grove, p.-v. and tp., Linn co., Ia. P. 795.

Spring Grove, p.-v. and tp., Houston co., Minn. P. 1331.

Spring Grove, tp., Edgefield co., S. C. P. 2477.

Spring Grove, tp., Green co., Wis. P. 1236.

Spring Hill, tp., Drew co., Ala. P. 1128.

Spring Hill, tp., Marengo co., Ala. P. 2972.

Spring Hill, tp., Pickens co., Ala. P. 942.

Spring Hill, p.-v. and tp., Hempstead co., Ark. P. 1240.

Spring Hill, p.-v. and tp., Johnson co., Kan., on Missouri River Fort Scott and Gulf R. R. P. [illegible].

Spring Hill, tp., Wilson co., N. C. P. 636.

Spring Hill, tp., Fayette co., Pa. P. 1644.

Spring Hill, tp., Greene co., Pa. P. 1484.

Spring Hill, tp., Lancaster co., S. C. P. 1142.

Spring Hill, p.-v., Maury co., Tenn., on Louisville and Memphis line of Louisville Nashville and Great Southern R. R.

Spring Hill College, situated about 5 miles from Mobile, Ala., was founded in 1830 by Rev. Michael Portier, first Roman Catholic bishop of Alabama. In 1836 a charter was granted by which the president and faculty were empowered to confer the usual academic degrees; and in Aug., 1840, Pope Gregory XVI. raised the college to the rank of a Roman Catholic university. In 1847 it passed into the hands of the Jesuits, under whose control it still remains. The edifice was burned Feb. 4, 1869, and was rebuilt the same year.

Spring Hills, p.-v., Harrison tp., Champaign co., O. P. 172.

Spring Lake, tp., Tazewell co., Ill. P. 857.

Spring Lake, p.-v. and tp., Ottawa co., Mich., on the E. shore of Lake Michigan, and on Detroit and Milwaukee R. R., in the centre of the "peach belt," contains 5 churches, excellent schools, 1 newspaper, a horticultural hall, 3 hotels, 7 steam saw-mills, a mineral spring, and one of the best harbors on the lake. P. of v. 1156; of tp. 1836.

D. R. WATERS, ED. "INDEPENDENT."

Spring Lake, tp., Scott co., Minn. P. 939.

Spring Lake, tp., Pierce co., Wis. P. 386.

Spring Place, p.-v., cap. of Murray co., Ga. P. 248.

Spring Point, tp., Cumberland co., Ill. P. 833.

Springport, p.-v. and tp., Jackson co., Mich. P. 1292.

Springport, tp., Cayuga co., N. Y. P. 2175.

Spring Prairie, p.-v. and tp., Walworth co., Wis. P. 1209.

Spring River, tp., Lawrence co., Ark. P. 729.

Spring River, tp., Lawrence co., Mo. P. 1098.

Spring Rock, tp., Clinton co., Ia. P. 1694.

Spring Vale, v. and tp., Humboldt co., Ia. P. of v. 335; of tp. 533.

Springvale, p.-v., York co., Me., on Portland and Rochester R. R.

Spring Vale, tp., Isanti co., Minn. P. 93.

Springvale, tp., Columbia co., Wis. P. 797.

Springvale, tp., Fond du Lac co., Wis. P. 1246.

Spring Valley, tp., Colusa co., Cal. P. 850.

Spring Valley, tp., Dallas co., Ia. P. 908.

Spring Valley, tp., Monona co., Ia. P. 142.

Spring Valley, tp., Cherokee co., Kan. P. 1080.

Spring Valley, p.-v. and tp., Fillmore co., Minn., on Southern Minnesota R. R., 75 miles W. of La Crosse, Wis., has 4 churches, a high school, 1 bank, 2 public halls, 1 newspaper, a foundry, 1 fanning-mill factory, 2 planing-mills, 3 hotels, and a wagon-factory. It is the business-centre of a large wheat-growing region. P. 1279.

A. M. HUTCHINSON, ED. "WESTERN PROGRESS."

Spring Valley, tp., Shannon co., Mo. P. 251.

Spring Valley, p.-v., Ramapo tp., Rockland co., N. Y., on Piermont branch of Erie R. R.

Spring Valley, p.-v. and tp., Greene co., O., on Little Miami R. R. P. of v. 290; of tp. 1555.

Spring Valley, tp., Rock co., Wis. P. 1253.

Spring'ville, p.-v. and tp., St. Clair co., Ala., on Alabama and Chattanooga R. R. P. 1080.

Springville, p.-v., Linn tp., Linn co., Ia., on Dubuque and South-western R. R.

Springville, tp., Wexford co., Mich. P. 107.

Springville, p.-v., Erie co., N. Y., 30 miles S. of Buffalo, has 6 churches, an endowed academy, 1 newspaper, a banking-house, iron-foundry and machine-shops, a handsome park, and mills. It is the centre of one of the richest dairying sections in the State. P. 1006.

W. W. BLAKELEY, ED. "JOURNAL AND HERALD."

Springville, p.-v. and tp., Susquehanna co., Pa. P. 1424.

Springwater, p.-v. and tp., Livingston co., N. Y., on Rochester branch of Erie R. R. P. 2174.

Springwater, p.-v. and tp., Waushara co., Wis. P. 466.

Spring Wells, p.-v. and tp., Wayne co., Mich. P. 3488.

Sproat (EBENEZER), b. at Middleborough, Mass., in 1752; served in the Revolutionary army as captain, major, and lieutenant-colonel, commanding 2d Massachusetts regiment; was in Glover's brigade at Trenton, Princeton, and

Monmouth; was made inspector of the brigade by Baron Steuben; settled after the war as a surveyor at Providence, R. I., where he married a daughter of Commodore Whipple; began a survey of Ohio lands 1786; was the leader of the party of emigrants who founded Marietta 1788; was fourteen years sheriff and colonel of militia, and was called by the Indians "the Big Buckeye." D. at Marietta in Feb., 1805.

Sprot'tau, town of Prussia, province of Silesia, at the influx of the Sprottau in the Bober, manufactures cloth, linen, and cotton fabrics, tobacco, beer, and tiles, and has 5280 inhabitants.

Spruce, a name applied to several trees of the fir genus (*Abies*), and in the U. S. especially to *A. nigra*, black or double spruce, and *A. alba*, white or single spruce. Both of these afford much useful timber, superior to that of hemlock, but inferior to the best pine. There are also several trees called spruce on our Pacific coast. (A full list of these and of the Old-World spruces is given in the article EVERGREEN. See also FIR and PINE.) Much the finest of the foreign evergreens here seen in culture is the Norway spruce (*A. excelsa*), a noble forest tree of the N. of Europe. Our native spruces afford a resinous substance called spruce-gum, much used as a masticatory. The tops are often brewed to make a pleasant drink called spruce beer, which is regarded as antiscorbutic.

Spruce, tp., Bates co., Mo. P. 1506.

Spruce Creek, p.-v., Morris tp., Huntingdon co., Pa., on Pennsylvania R. R.

Spruce Head, an island on the Atlantic coast, constituting a tp. of Hancock co., Me. P. 22.

Spruce Hill, p.-v. and tp., Juniata co., Pa. P. 899.

Spurge. See EUPHORBIA.

Spur'geon (CHARLES HADDON), b. at Kelvedon, Essex, June 19, 1834, the son of an Independent preacher; was educated at Colchester; became usher of a school at Newmarket, but, embracing Baptist views, joined a congregation of that denomination in Cambridge; became a tract distributor and village preacher, and at the age of eighteen minister of a small chapel at Waterbeach, where he soon became noted for his zeal and eloquence. He went to London in 1853, where he at once attracted audiences so numerous that the congregation was compelled to remove first to Exeter Hall, and thence to the still larger Surrey Hall. In 1861 an immense chapel, called "the Tabernacle," was built for him in Newington Butts, London, where he has since preached. Nearly 20,000 persons have been admitted to his church, and thirty-six other chapels have been opened in London, the ministers of which were trained at a college founded and directed by him. His sermons are regularly reported and printed weekly, and from them nearly a score of volumes has been made up. He has also published—*The Saint and his Saviour* (1857), *Gleanings among the Sheaves* (1868), *John Ploughman's Talk*, *Evening by Evening* and *Readings for the Closet* (1869), *Feathers for Arrows* (1870), *Types and Emblems* and *Lectures to my Students* (1875). In 1867 he laid the foundation of an orphanage established by his congregation, and since 1865 has edited a journal, *The Sword and the Trowel*.

Spur'rey, a popular name for plants of the genera *Spergula* and *Spergularia*, belonging to the order Caryophyllaceæ. *Spergula arvensis*, well known to farmers of Europe and North America as a weed, is profitably cultivated in the Low Countries and Germany as a forage-plant, and its seeds yield a valuable oil and oil-cake. *S. pilifera*, a dwarf alpine plant, has been recommended as a lawn-plant in proper climates, handsomer than grass, and requiring much less care.

Spurz'heim (KASPAR), b. at Longwich, near Treves, in Rhenish Prussia, Dec. 31, 1776; studied medicine at Treves and Vienna, and became a zealous disciple of Dr. Gall, whom he accompanied on his travels in Germany and France, and assisted in popularizing his phrenological doctrines by lecturing, newspaper articles, etc. In 1813 he separated from Gall, and undertook the introduction of the new doctrines in England, where he resided from 1813 to 1817, and from 1821 to 1828, and gave very popular lectures. In 1832 he came to the U. S., and had just created a great sensation when he d. at Boston Nov. 10, 1832. Among his writings are—*The Physiognomical System of Drs. Gall and Spurzheim* (London, 1815), *Outlines of the Physiognomical System* (1815), *Sur la Folie* (Paris, 1818), *Essai philosophique sur la Nature morale et intellectuelle de l'Homme* (1820), *A View of the Elementary Principles of Education* (1821).

Spuy'ten Duy'vil, formerly a p.-v. of Yonkers tp., Westchester co., N. Y., on Hudson River and Spuyten Duyvil Creek, now annexed to city of NEW YORK (which see).

Spuyten Duyvil Creek [probably from the Dutch *Spuyt den Duyvil*, "in spite of the devil"], the channel connecting the Hudson River with the Harlem River, and thence with the East River, on Long Island Sound. The creek forms the northern boundary of Manhattan Island. Flaws of wind are apt to burst along the depression through which the creek runs, impeding the navigation by sailing craft, and the name is probably derived from an oath sworn by an old Dutch shipmaster, that he would pass the mouth of the creek "in spite of the devil."

Spy [O. Dutch, *spie*]. Under that branch of the laws of nations termed the "laws and usages of war" the term "spy" has a definite and well-understood meaning. A spy is a person who in time of war, whether public or local, surreptitiously and in disguise or by false pretences, seeks military information within or near the lines of one belligerent with an intent to communicate it to the other, or who in disguise or by false pretences seeks to pass through the enemy's lines with despatches. By the customs of war the punishment for the offence is death by hanging on apprehension and conviction.

"Spies," says Vattel, "are generally condemned to capital punishment; and not unjustly, there being scarcely any other way of preventing the mischief which they may do. For this reason a man of honor, who would not expose himself to die by the hand of a common executioner, ever declines serving as a spy. He considers it beneath him, as it seldom can be done without some kind of treachery. The sovereign, therefore, cannot lawfully require such a service of subjects, except, perhaps, in some singular case, and that of the last importance. It remains for him to hold out the temptation of a reward as an inducement for mercenary souls to engage in the business. If those whom he employs make a voluntary tender of their services, or if they be neither subject to, nor in any wise connected with, the enemy, he may unquestionably take advantage of their exertions without any violation of justice or honor." (Vattel, *Droit des Gens*, liv. 3, ch. 10, sec. 179.)

By the customs of war of a century ago a person captured as a spy, with proofs of the fact upon his person, could, by order of the commanding general, be executed without delay. This was illustrated in the case of Capt. Nathan Hale of the Connecticut volunteer infantry, who during the American Revolution was captured by the British in New York City, then militarily occupied by them, and executed (1776) without trial by order of Sir William Howe, the British commander. In the American service the more humane practice has always been adopted of giving the accused a hearing and trial before a general court-martial or military commission; and this practice has now become the rule in modern warfare. This was early illustrated in the case of Major John André, adjutant-general to the British army in America during the same Revolution. He was captured in disguise, under a false name and pass, within the American outposts, and before he had reached the British lines. A full board of thirteen general officers, containing such distinguished military men as Maj.-Gens. Nathaniel Green, Marquis de La Fayette, and Baron de Steuben, unanimously found him guilty on a full hearing. The proceedings were duly approved by Washington, and Major André was accordingly executed as a spy. In this case, on the facts found, Major André could have been convicted of being a spy on one of two grounds: (1) for having landed under a *flag of truce* with sole intent to obtain information, for belligerent purposes, of the character, state, and condition of the garrison and works of the U. S. military post of West Point and its dependencies; (2) for having been subsequently captured in disguise, within the American lines, while seeking to escape with documents concealed on his person containing the desired information.

The commander who employs a spy is not, by the laws of nations, personally responsible for so doing. The offence of being a spy is considered as absolutely condoned after the individual has returned before trial and condemnation to his own lines.

During the American civil war of 1861–65 the U. S. government, in a code which it published for the government of its armies, announced the acknowledged rule that "the spy is punishable with death by hanging by the neck, whether or not he succeed in obtaining the information or in conveying it to the enemy," and that "if it be discovered and fairly proved that a flag of truce has been abused for surreptitiously obtaining military knowledge, the bearer of the flag thus abusing his sacred character is deemed a spy." (*General Orders No. 100*, Apr. 24, 1863.) Under the laws of war any person convicted of the offence will, irrespective of sex, be amenable to the stated penalty. By the *Revised Statutes of the U. S.* (sec. 1343) it is declared that "all persons who in time of war or of rebellion against the supreme authority of the U. S. shall be found lurking or

acting as spies in or about any of the fortifications, posts, quarters, or encampments of any of the armies of the U. S. or elsewhere, shall be triable by a general court-martial or by a military commission, and shall, on conviction thereof, suffer death." ASA BIRD GARDNER.

Squadron. See NAVAL TACTICS, by CAPT. S. B. LUCE.

Squalidæ [from Lat. *squalus*, "shark"], a group of selachians comprising the sharks, by some considered as an independent order, but by most referred to an order, Plagiostomi, as a sub-order. They mostly have a more or less cylindrical body, but sometimes it is quite depressed forward, and there is a gradual attenuation from the visceral region into the tail; the branchial apertures are lateral, and either entirely in front of the pectoral fins, or, behind, opening over the bases of those fins. The pectoral fins are moderately developed, and distinctly differentiated from the sides. In these respects they differ from the Raiæ, which they otherwise essentially resemble in structure, the two groups constituting the super-order or order Plagiostomi, and thus in combination contrasting with the order Holocephali. The species, as is notorious, are mostly carnivorous, and among the most formidable and most dreaded of the inhabitants of the water; but a few are not so, and are quite harmless to man and the larger animals at least. While the carnivorous species are almost all those with which the name "shark" is connected, the known or supposed herbivorous species, or those at least feeding on small marine animals, are only about four in number—viz. (1) *Cetorhinus maximus*, the great basking shark; (2) *Cetorhinus angiova*, a related Mediterranean species; (3) *Rhinodon typicus*, of the Pacific Ocean; and (4) *Micristodus punctatus*, known only from California. The species, too, are almost all strictly inhabitants of the salt waters, but are not necessarily confined thereto, as they sometimes wander into fresh water, and one species is confined to the Lake of Nicaragua, a purely fresh body of water, entirely shut off from communication with salt water except by a long river. In time they have existed at least from the closing period of the Silurian age (and probably much before) to the present, but under gradually modified forms, the earlier representatives of the family being supposed to have been more nearly related to the heterodontids or cestracionts of the Pacific than to the predominant living species. In space they are found everywhere in salt water, but are most abundant in warm regions. The species of the Arctic regions are few in number, the most northern forms, so far as known, being the *Centroscyllium Fabricii* of Greenland, and *Somniosus microcephalus* of the northern Atlantic generally; those of the tropical seas are numerous; and not a few seek their living in mid ocean. The jaws are frequent objects of curiosity; they do not correspond exactly with the jaws of true fishes and other animals, but rather partly with the lower jaw and the palatal arch of the higher animals. The teeth are generally movably articulated with the jaws, and developed in several rows which are successively shed and renewed from behind forward, and the outermost row, as a rule, is the only one erect, the rest being recumbent; in some, however (*e. g.* Heterodontidæ and Mustelinæ, or dog-fishes), a pavement-like surface is developed. There is some difference of opinion respecting the natural arrangement of the order, and the relative value and relations of the constituent groups, but the following families have been adopted for the present work, and have received the sanction of some of the most approved authorities: (1) Sub-order Rhinæ, family Squatinidæ. (2) Sub-order Galei: group 1, Heterodontidæ; group 2, Notidanidæ; group 3, Rhinodontidæ, Cetorhinidæ, Lamnidæ, Odontaspididæ, Alopeciidæ, Sphyrnidæ or Zygænidæ, Galeorhinidæ; group 4, Scylliidæ, Ginglymostomidæ, Crossorhinidæ; group 5, Spinacidæ, Scymnidæ, Oxynotidæ, Pristiophoridæ. (See the family names and SELACHIANS.) THEODORE GILL.

Squamipennes. See CHÆTODONTIDÆ.

Square [Lat. *quadratus*], an equilateral and equiangular quadrilateral. Each of its angles is a right angle, and its diagonals are equal and mutually bisect each other. The square described on the linear unit as a side is taken as the unit of measure for surfaces; hence, the term *square measure* sometimes used in that connection. W. G. PECK.

Square Number, a number whose square root is a whole number. The following are some of the properties of square numbers: (1) Every even square number is divisible by 4, and every odd square number, diminished by 1, is divisible by 4. (2) The sum of two odd squares cannot be a square. (3) If an odd square is taken from an even square, the remainder can never be a square. (4) If the sum of two squares is a square, one of the three must be divisible by 25. (5) Square numbers always terminate with one of the digits, 0, 1, 4, 5, 6, 9. (6) In the series of squares of natural numbers—that is 1^2, 2^2, 3^2, etc.—the mean proportional between any two is equal to the less, *plus* its square root multiplied by the difference of the roots of the two squares. (7) The arithmetical mean of any two exceeds their geometrical mean by half the square of the difference of their roots. (8) The difference between any two consecutive terms is equal to twice the root of the less, *plus* 1. (9) In the series of cubes of natural numbers, 1^3, 2^3, 3^3, etc., the sum of any number of terms beginning at the first, is a square number. W. G. PECK.

Square of the Circle. See QUADRATURE OF THE CIRCLE.

Square Root. The square root of a quantity is a quantity which taken twice as a factor will produce the given quantity. It is one of the two equal factors into which the given quantity may be separated. Sometimes we can find the exact value of these factors, in which case the quantity is said to be a perfect square, and sometimes we can only find their approximate value, in which case the indicated root is called a *surd*. W. G. PECK.

Squares, Least, Method of. In all measures, from the ordinary rude weighings and measurings of agriculture and commerce up to the most refined astronomical work, there is a liability to error which cannot be avoided. An ordinary scale, for instance, can be used to measure down to a sixteenth of an inch; that is, if carefully used, its results will be correct to that limit. The level of a transit instrument can make its measures, when used with care, to a ten-thousandth of an inch or even less; but in this case the hundred-thousandths will be uncertain. An ordinary observer notes his time to minutes only, and is liable to state the time incorrectly to the extent of at least half a minute; the man who is trying a fine watch will note its errors to seconds, or even half seconds; the astronomer uses tenths of seconds in his rough data, and hundredths or thousandths in his calculations, but even here there is uncertainty in the fractions of a hundredth or a thousandth of a second.

One of the essential conditions of good observing or measuring is to make these small errors, which we cannot wholly avoid, as much smaller as possible; just as the marksman considers himself to be improving when he comes nearer and nearer the target.

But the best marksman is not he who hits the bull's-eye once only, but that one who comes nearest on the average or in a string of shots. So the average deviation of a series of observations from the truth may, in a rough way, be taken as a measure of the goodness of that series.

Observations or measures of the same thing never agree perfectly—that is, in the minutest fractions: how shall the true result be ascertained from discordant evidence? The ordinary experience of mankind has shown that it is best to "strike an average." When, for instance, two equally good surveyors measure a field a little differently, the half sum of their results is taken. When a boy in school has different marks upon different subjects—in some more, in some less—their average is taken to represent his general merit or demerit as a scholar. The average prices of commodities are taken for their real prices, or at least for a better estimate of their real value than the extreme prices either way as affected by temporary fluctuations. The whole business of insurance rests upon this law of averages.

The "method of least squares" is the application of this law to the results of physical measurements, especially in astronomy and geodesy. The mathematicians whose names are most prominently connected with it are Legendre, Gauss, Bessel, and Encke; Legendre and Gauss seem to have discovered it independently. A short sketch of the history of the method will help in its explanation. Before the method of least squares, as we now have it, was discovered, the method of averages, or of the arithmetical mean, was applied to all physical measures which give a direct result. But especially in astronomy the things to be found out cannot be directly measured, but must be indirectly inferred from measurements of other things. The observations upon the transit of Venus afford an instance. Here the main thing to be found out is the solar parallax; the thing directly observed is the planet's ingress upon or egress from the sun. The time of this depends upon several unknown quantities, of which the solar parallax is one, and also the unknown time of conjunction, and the unknown distance of the planet's and sun's centre at that time, as well as the apparent angular diameters of planet and sun. Each observation, then, gives an *equation of condition* between these five unknown quantities, and at any one place four observations of contacts are made. At thirty stations there would be 120 equations for five unknown quantities; if the best five of these were selected, a good value of the solar parallax might be obtained; but there could many thousand good combinations be made, each of which would give a different result, owing to the errors of the observations. How, then, can such a combination be made as to answer to the average in more direct measures? or, to express it mathematically, How can

the superfluous equations of condition be combined so as to give the best possible result? The mathematical problem here treated is analogous to the combination of ordinarily discordant evidence in a perplexed case in the courts of law: when the result here needed is one capable of numerical expression, as in the assessment of damages, the average is taken; but where not, the evidence is reconciled as well as possible.

Let us go back to the illustration of the marksman. A target which has been a good deal used exhibits bullet-holes at various distances from the centre, but more crowded together in the middle. They are found to be distributed according to a well-defined general law, which can be partially expressed in common language, thus: if a ring be selected to include one-half the shots, and be, say, 12 inches in diameter, then about a sixth will be outside a ring of 24 inches, about a twentieth outside one of 36 inches, while one of 6 inches will include about a quarter of the whole number. This law is expressed by the formula

$$\int_{\Delta_0}^{\Delta_1} e^{-h^2\Delta^2} d\Delta,$$

where Δ is any distance from the centre, and Δ_0 and Δ_1 are two special distances. Experience shows that owing to accidents there are always stray shots on the outside not fully accounted for.

This same law applies to observations and measurements of all kinds. From it Gauss has shown that in simple cases the ordinary law of averages is justified, and that in complex work, like the transit-of-Venus reductions, the following rule is to be used, which is the more general form of the same law: "In treating observations of equal precision the unknown quantities are to be so determined that, after allowing for constant error, the sum of squares of the remaining errors shall be the least possible." This is the "method of least squares." Its practical working is easy after the data are put into proper shape. The equations of condition are first formed, and solved by multiplying both members of each by the coefficient of the first unknown quantity in that equation, and adding together the results, forming one new equation. The members of the equations are now multiplied by the coefficients of the second unknown quantity, and a second equation formed; and so on till as many such equations are obtained as there are unknown quantities; which are then solved in the usual way. The residual errors of observation are squared, their sum taken, and divided by the number of observations less that of unknown quantities. The quotient is the square of the "mean error" of one observation; two-thirds of this plus a ninetieth (nearly) is the probable error; from which may be calculated the relative value of the observations and the uncertainty of the final results.

The difficulties of the method, aside from the mere calculations, are, that it is an extremely nice matter to judge what are observations of equal precision, and make the poorer observations enough less influential than the good ones. The careless witnesses do not wish to see their testimony depreciated. Much, too, has been written about the criteria which distinguish between the worst ordinary observations and those which are affected by some unusual accident, such as a collision between the eyepiece of a telescope and a careless astronomer's head. Prof. Peirce and others have proposed a mathematical formula to decide such cases, but the usual rule is to let each rest on its own merits. It is, above all, difficult to avoid constant errors of observation.

The advantages of this method are so great that it is very largely used. It affords a thorough criticism upon one's own work and that of others, and for this reason is in great favor where the observers are most delicate, keen, and courageous, especially in Russia, Germany, and latterly in America.

The best elementary treatise on this subject is Prof. Chauvenet's, published also as part of his *Spherical and Practical Astronomy*. A classical work upon the subject is Gauss's *Theoria Combinationis Observationum Erroribus Minimis Obnoxiæ*, also translated into French by Bertrand as *Méthode des Moindres Carrés*. T. H. Safford.

Squares, Magic. See Magic Squares, by Pres. F. A. P. Barnard.

Squash [Mass. Indian, *asq*; pl. *asquash*], called **Edible Gourd** in England, the fruit of *Cucurbita melopepo*, *C. verrucosa*, and other species or races of this genus. Squashes are extremely variable in size, quality, color, etc., the better sorts having great value as food. Squashes were cultivated upon both continents long before the time of Columbus, and it is probable that most of our squashes have had a hybrid origin.

Squash′-Bug, the *Coreus tristis*, an hemipterous insect, well known for its destructive ravages upon squash and pumpkin vines. It belongs to the Coreidæ (Corisiæ). It is six-tenths of an inch long, about three-tenths of an inch in breadth, and of a dirty black color. It emits a powerful and offensive odor, supposed to be due to the presence of the formate of amylic ether in its secretions. The striped squash-bug is *Diabrothica vittata*, a coleopterous insect of the family Chrysomelidæ, a much smaller but even more destructive insect, which infests cucurbitaceous vines of almost all kinds in the U. S. The larva of *Melittia cucurbitæ*, the squash-vine borer, is quite destructive in some places. The insect is lepidopterous, and of the family Ægeriadæ. As a rule, the two former insects are most destructive while the plants are young; and the squash-hills should be protected by a frame covered with millinet, or powdered gypsum and shell-lime may be freely sprinkled upon the plants, and will be found to impede the destructive work, particularly that of the striped bug.

Squaw, tp., Warren co., Ia. P. 695.

Squaw Grove, tp., De Kalb co., Ill. P. 886.

Squeteague′, or **Weak-Fish,** the *Otolithus regalis*, a marine fish of the family Sciænidæ (which see).

Squid, a popular name for many decapod cephalopods, particularly those of the family Teuthidæ (calamaries), but also extended to the Sepiadæ or true cuttle-fishes, and even to the poulpes or Octopodidæ. The squids proper are found in nearly all seas; they form an important part of the food of many fishes and crustaceans, are extensively used as fish-bait, and in many countries are much used as food. Of late, the eating of squid has been introduced into the U. S. Properly cooked, squid is considered a delicacy of the first order. (See Cephalopoda, Conchology, Cuttle-Fish, Flying Squid, Hook Squid, etc.) There are several true squids which are common on our coast.

Squid, Flying. See Flying Squid.

Squi′er (Ephraim George), b. at Bethlehem, N. Y., June 17, 1821; was brought up on a farm; subsequently taught school, edited several local newspapers, and studied engineering. Removing to Ohio, he undertook, in conjunction with Dr. E. H. Davis, an exploration of the aboriginal monuments in the Valley of the Mississippi, the results of which were issued in 1848 in the *Smithsonian Contributions to Knowledge*, and in the following year appeared his *Aboriginal Monuments of the State of New York*. In 1848 he was appointed chargé d'affaires to the republics of Central America, and in 1853 he went again to that region to examine the proposed line for an interoceanic railway—a project in which he was deeply interested, but which was finally abandoned. For several years he was engaged in literary labor in New York. In 1863 he was appointed U. S. commissioner to Peru, where he remained two years; made extensive journeys to explore the remaining works of the Incas with the design of preparing an exhaustive work on the subject. Returning to New York, he set about this task, which was nearly completed when in 1874 he was attacked by a severe illness which incapacitated him from continuous mental labor, but not before his abundant materials had been arranged and the work was nearly ready for the press, and it is now (July, 1876) on the eve of publication. Besides numerous contributions to periodical literature and to the proceedings of learned societies, translations, and scientific reports, he has published, among others—*Nicaragua, its People, etc.* (1852), *The Serpent Symbol* (1852), *Notes on Central America* (1854), *Waikna, or Adventures on the Mosquito Shore* (1855), *Question Anglo-Américaine* (Paris, 1857), *The States of Central America* (1857), *Report of the Survey of the Honduras Interoceanic Railway* (London, 1859), *Monograph of Authors who have Written on the Aboriginal Languages of Central America* (1861), *Tropical Fibres, and their Economical Extraction* (1861), *Is Cotton King? Sources of Cotton-Supply* (1861), *Honduras, Descriptive, Historical, and Statistical* (1870), and *Peru: Incidents of Travel and Exploration in the Land of the Incas* (1876). Most of his works have been translated into German, French, and Spanish. He has received the gold medal of the French Geographical Society, is a member of many learned associations in Europe and America, and in 1871 was president of the Anthropological Society of New York. A. H. Guernsey.

Squill [Gr. σκίλλα], a drug, being the bulb of *Scilla maritima* (sea-onion), a perennial plant of the natural order Liliaceæ, growing on the Mediterranean coast. The bulb is pear-shaped, of the size of a man's fist, or even larger. It is made up of concentric scales, like other tunicated bulbs, of which the outer are dry and dark-colored, but the inner fleshy and juicy, and either colorless or of a pale roseate tint. For use in medicine the bulbs are dried and sliced, and offer the varieties known as white and red squill, according to the tint of the bulb. Squill has but little smell, but an acrid, nauseous, bitter taste. It contains a

good deal of mucilage, but there is still much uncertainty concerning the nature of the active principles. A resin and a bitter principle probably both have to do with the medicinal effects. Squill has been known as a medicine from a very remote period. It is an acrid irritant, affecting the mucous membranes and glands, and in large dose causes vomiting, purging, strangury, and may even prove fatally poisonous. Its medicinal use is from its producing, in small doses, an increased flow of urine, and also modifying in some unknown way the morbid condition of a mucous membrane affected with catarrh, and especially of the bronchia. In other words, it is used as a so-called "diuretic" and "expectorant." EDWARD CURTIS.

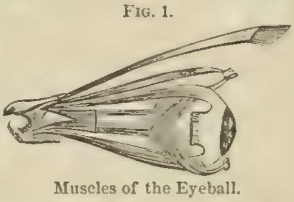
Squil'la [the old Latin name for one of its species], a genus of stomapod crustaceans of the family Squillidæ. They are voracious and active creatures, all marine, and

Squilla.

mostly found at a distance from shore. The best known of the numerous species is the mantis shrimp (*S. mantis* of the Mediterranean), so called from its resemblance in form to the insects called MANTIS (which see). *Squilla empusa* is found in our Atlantic waters. *S. chiragra* is the gouty shrimp, a curious inhabitant of the Indian Ocean. The name mantis shrimp is not peculiar to the *S. mantis*, nor to the genus, but is applied to other crustaceans, notably to *Caprella linearis*.

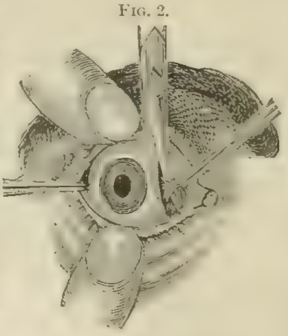
Squint'ing [Dutch, *schuinte*], technically termed **Strabis'mus** (from Gr. στραβισμός, "squinting"), obliquity of the axis of one eye: inability to bring both visual lines to bear simultaneously upon one point, one always deviating from the object. If the squinting eye deviates inward, it is termed convergent strabismus; if outward, divergent strabismus; if downward, which is rare, *strabismus deorsum vergens*. The normal position of the eye and correct direction of its visual line depend on the tonicity of the four recti muscles, attached one above, one beneath, and one on each side of the eyeball. If one muscle is relatively weak or paralyzed, the eye is deflected to the opposite by the stronger or intact muscle. Convergent squint is very common in young children of four to six years when learning to spell or read with small letters. It may be periodic, and present only when looking intently and with effort, one eye being converged to facilitate or compensate the "accommodation" or power of the eye to adapt itself for different distances and objects. Such internal squint may be checked by use of larger letters or by checking the bad habit of approximating objects. When the eye is hypermetropic, having a low refractive power, a short antero-posterior diameter, and rays are not focused in the retina, voluntary convergence of the eye and habitual squint are the common result. Children suffering from indigestion, worms, or debility often suffer from convergent squint, in some cases due to spasm of the internal rectus muscle, in others to debility or paralysis of the external rectus muscle. In disease of the brain, convulsions, meningitis, hydrocephalus, etc., squint may occur. Divergent squint is most often present in myopic or near-sighted persons in efforts to see distant objects, the squint disappearing when the object is approximated or by the use of spectacles for distance. It may also occur from paralysis of the internal rectus, or when that muscle has been too freely cut for the cure of convergent squint. In convergent strabismus, unless very marked, in order to determine the squinting eye it may be necessary to place a lighted candle or the finger two or three feet in front of the face in the median line, or, again, closing each eye alternately, to study the extreme lateral movements inward and outward of each. Periodic strabismus may yield to correct use of the eyes, the aid of spectacles, galvanizing the weak muscle, and improving the general health. When marked and persistent, it calls for operation—incision of the ocular conjunctiva or mucous membrane, hooking up the tendon of the muscle close to the cornea and severing it.

FIG. 1.



Muscles of the Eyeball.

FIG. 2.



Operation for Strabismus.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Squire (SAMUEL), D. D., b. at Warminster, Wiltshire, England, in 1714; educated at St. John's College, Cambridge, where he obtained a fellowship; became chaplain to Dr. Wynn, bishop of Bath and Wells, by whom he was made chancellor of the diocese and canon of Wells 1739, prebendary of Wells and archdeacon of Bath 1743; became rector of Topsfield, Essex, 1748, and of St. Anne's, Westminster, 1750; was shortly afterward made vicar of Greenwich and clerk of the closet to Frederick, prince of Wales; was appointed dean of Bristol 1760 and bishop of St. David's 1761. D. in 1766. Author of *The Ancient History of the Hebrews Vindicated* (1741), *Two Essays: A Defence of the Ancient Greek Chronology, etc.*, and *An Inquiry into the Origin of the Greek Language* (1741), *An Enquiry into the Foundation of the English Constitution* (1745), *An Essay on the Balance of Civil Power in England* (1753); published several sermons and religious treatises; edited Plutarch's *De Iside et Osiride* (Cambridge, 1744), accompanied by an English translation, and left in MS. an *Anglo-Saxon Grammar*.

Squire's Store, tp., Tuscaloosa co., Ala. P. 518.

Squir'rel [Gr. σκίουρος, from σκιά, "shade," and οὐρά, "tail"], the name given to certain species of the family Sciuridæ, and sometimes employed as the vernacular equivalent of the family name—*i. e.* the squirrel family. It is, however, more properly applicable to the slender arboreal forms constituting the genus *Sciurus* of most naturalists, and in this sense it will be here used. These animals are of moderate or small size, have a rather slender head, no cheek-pouches, rather long ears, no lateral wing-like extension of the skin, a large distichous tail, and the teeth are, as in all the other genera of the family, 24—viz. M.$\frac{5}{4}$, I.$\frac{1}{1}$ $\times$ 2—but the foremost upper molars are often early deciduous, and when present very small; the molars are parallel at least as to their inner walls, the incisors compressed. Such are the most conspicuous and typical characters. The genus, however, grades into others—*e. g. Tamias*, or the chipmunks, and *Spermophilus*, or the ground-squirrels—but is still apparently sufficiently distinct to be entitled to the segregation generally accorded to it. The species are numerous, and representatives are found in almost every region, Australasia and Polynesia, the southern extremity of South America, and the West Indies being the only considerable bodies of land in the temperate or tropical zones destitute of them. Over 100 species have been made known, and these are distributed approximately as follows: North America has about 5 species (10 including sub-species), Europe and Northern Asia 6 or 7, the Indian region over 50, the African about 18, and the South American about 30. In time they existed, according to some authors, as early as the Eocene Tertiary, but the affinities of those early forms are doubtful. In habits the living species are all essentially similar. Most of their life is spent among the trees, and they exhibit great agility in running up the trunks and leaping from branch to branch. Their principal food consists of the nuts of trees, and in nut-bearing forests they are especially to be found; they also eat to some extent the larvæ of insects, and attack the nests of birds for their eggs, and even for their young. Their favorite attitude in eating is to sit on their haunches, with their tail thrown upward on the back, and holding the eatables in their paws. In the colder countries they lay up stores of provisions in holes and nooks in or near the trees in which they live. They are mostly readily tamed, and are generally kept in cages with revolving wheels or treadmills, wherein they exercise. The North American species recognized by the latest monographer of the group, Mr. J. A. Allen, are the following: (1) the great fox or cat squirrel (*S. cinereus*), with the varieties (*a*) *cinereus* of the Northern Atlantic States, (*b*) *niger* of the Southern Atlantic and Gulf States, and (*c*) *ludovicianus* of the Mississippi Valley; (2) the gray squirrel (*S. carolinensis*), with two varieties; (3) the small red or pine squirrel (*S. hudsonius*), with four varieties; and on the Pacific slope of the continent, (4) the California gray squirrel (*S. fossor*) and (5) the tuft-eared squirrel (*S. Aberti*). (See also SCIURIDÆ.) THEODORE GILL.

Squirrel Corn. See Dicentra.

Squirrel, Flying. See Flying Squirrel.

Srinagar. See Serinagur.

SS, Collar of. See Esses, Collar of.

Staal, de (Marguerite Jeanne Cordier de Launay), Baroness, b. at Paris Aug. 30, 1684, the daughter of a poor painter; was educated in a convent at Rouen; became maid to the duchess of Maine; took part in Cellamare's conspiracy for depriving the duke of Orleans of the regency, and was confined in the Bastile 1718–20; married afterward a Baron de Staal, who held a company in the guard of the duke of Maine, and spent the rest of her life at the ducal court at Sceaux. D. June 15, 1750. Her *Mémoires* were published in 1755, her letters in 1806, her *Œuvres complèts* (2 vols.) in 1821. (See Sainte-Beuve, *Derniers Portraits littéraires*, 1852.)

Staats'burg, p.-v., Hyde Park tp., Dutchess co., N. Y., on Hudson River and Hudson River R. R.

Stabat Mater, the first words, and hence the name, of a Latin hymn ranked among the seven great hymns of the mediæval Church (*The Celestial Country*, *Dies Iræ*, *Stabat Mater*, *Veni Sancte Spiritus*, *Veni Creator Spiritus*, *Vexilla Regis*, *The Alleluiatic Sequence*). It commences—

Stabat Mater dolorosa, By the cross, sad vigil keeping,
Juxta crucem lacrymosa. Stood the mournful mother weeping.

As the Dies Iræ (which see) has been pronounced the greatest, so the *Stabat Mater* is deemed the most pathetic of hymns. It is, however, neither so simple nor so grand, nor is it free from sectarian faults. It was written (1268) by a Franciscan friar known as Jacobus de Benedictes, one of the noble Italian house of Benedette. The hymn is still in constant use in the Roman Catholic Church, being sung during the Holy Week and on the festival of the Seven Dolors of the Virgin Mary (which see), and it is well known in a musical sense to all through the very beautiful and sympathetic music of Rossini. It has been the theme of several of the world's great composers of different eras, of whom, prior to Rossini, Pergolesi perhaps has produced the most famous and masterly, if not the most popular work. J. G. Barnard.

Sta'ceyville Plantation, tp., Penobscot co., Me. P. 138.

Stack'elberg, de (Ernest), Count, b. Mar. 21, 1813; was educated in the military academy of St. Petersburg; distinguished himself as an officer of artillery in the campaign in the Caucasus 1852, and was attached to the Russian embassy in Paris as its military member. In 1856 he was sent as minister plenipotentiary to Turin, afterward to Madrid; in 1862 to Florence, in 1864 to Vienna, and in 1868 to Paris, succeeding M. de Budberg.

Sta'cyville, tp., Mitchell co., Ia. P. 344.

Sta'de, an old fortified town of Prussia, province of Hanover, on the Schwinge, near its influx in the Elbe. The so-called "Stade dues," a toll which Hanover levied on all merchandise carried up the Elbe, but which was abolished in 1864, were paid here. Manufactures woollen, linen, and cotton stuffs, tobacco, and beer. P. 8693.

Sta'dium [Lat.; Gr. στάδιον], the principal Greek measure of length for journeys, used in later times also for other linear measurements, especially by the Romans. Its length was fixed by that of the foot-race course (*stadium*) at Olympia, and was 600 Greek = 625 Roman = 606¾ English feet, or one-eighth of the Roman mile.—Stadium was originally the name of the foot-race course in which running and other athletic exercises took place. Stadia existed at many Greek cities, but the most famous was that of Olympia. The stadium was laid out in two parallel oblong areas, connected at one end by a semicircular tract. The whole was surrounded by seats for spectators.

Stadt'holder [Dutch *Stadhouder*, "city-holder"], a title given by the United Provinces of Holland to William, prince of Orange, upon beginning their memorable rebellion against Spain. The title was intentionally a modest one, intimating that the revolt was not against the sovereign, but against the tyranny of his viceroy, the duke of Alva. It involved, however, the chief civil and military command, was given to Maurice, son of William, in 1587, and became the hereditary title of the head of the state until the annexation of Holland to the French empire in 1802. On the restoration of the house of Orange in 1814 the title of king was assumed.

Staël-Holstein, de (Anne Louise Germaine), Baroness, b. at Paris Apr. 22, 1766, a daughter of Jacques Necker, at that time a clerk in the banking-house of Thélusson, afterward minister of finance to Louis XVI., and the hero of the coming Revolution; was married in 1786 to the Swedish ambassador at Paris, Baron de Staël-Holstein, to whom she bore three children, two sons and a daughter. The marriage was not happy, and she separated from her husband, but when he became old and sick, she returned to him, and stayed with him till he died, at Poligni May 9, 1802. In 1810 she married a French officer, De Rocca, a man much younger than herself, to whom she bore a son, but the marriage was kept secret till after her death. She made her début in literature in 1786 by her *Lettres sur les Écrits et le Caractère de J. J. Rousseau*—a book which owed its success not so much to any powerful originality as to the fresh enthusiasm and peculiar eloquence with which it preached the new revolutionary ideas. It is an interesting book, however, in literary respects. It shows that she stood in a primitive and natural relation to that literary movement called the romantic school which she more than any one else contributed to introduce in France, and which she is often said to have adopted at second hand from the Schlegels. In both respects, literary as well as political, she afterward developed further the ideas of this her first book in her *De la Littérature considérée dans ses Rapports avec les Institutions sociales* (2 vols., 1796), and her *Considérations sur les principaux Événements de la Révolution française*, not published until after her death. In the latter she shows that her political stand-point was the constitutional monarchy, the same as that of her father, whom she almost idolized, and the same as that afterward represented by her most intimate friends, Chateaubriand, Benjamin Constant, Guizot, and her son-in-law, the duke de Broglie. Her first celebrity, however, she owed less to her writings than to the powerful personal impression she made. Firm in her ideas, true to her feelings, impassioned and courageous as a lioness, she was tender-hearted, generous, beautiful, and gifted with an irresistible eloquence. Her salon was the centre around which all the most prominent talents of France gathered, and during the first stage of the Revolution she was a political power. Very active in saving her friends, she barely escaped the guillotine herself. She fled, and sent from London, in 1793, the beautiful pamphlet, *Réflexions sur le Procès de la Reine*. After residing for some time at her paternal estate, Coppet, near Geneva, she returned to Paris during the Directory, and played again a brilliant and influential part in public life. To this period belong *De l'Influence des Passions sur le Bonheur des Individus et des Nations* (1796), one of her most characteristic works, and *Delphine*, a romance in 6 vols. (1802). But she was a decided adversary of Napoleon. An enmity sprang up between these two persons, which cannot be fully explained from the difference of their political views. Napoleon tried to gain her over by offering to pay the two million francs which the treasury owed to her father, but she refused to be reconciled. In 1802 he banished her from Paris, and when, after a journey in Germany, she returned to France and settled in the neighborhood of Paris, she was ordered to remove to Coppet, where she actually lived in a sort of confinement. She kept a court here more brilliant, and for the moment more influential, than that Goethe kept at Weimar. Every great literary man's biography of that period contains some pages on his visit to Coppet, and Frederick Schlegel, the founder and lawgiver of the romantic school in Germany, lived there as her chamberlain. Still, this court was a prison. In 1812 she fled, first to Vienna, then to St. Petersburg, where she was received with enthusiasm; to Stockholm, where she wrote *Dix Années d'Exil* and *Réflexions sur le Suicide*; to London, etc. After the fall of Napoleon, she returned to Paris in 1815. Louis XVIII. showed her the most flattering courtesy, and the Assembly paid the debt to her father. She d. July 14, 1817. Her two most prominent works are *Corinne, ou l'Italie* (1807), the fruit of a journey in Italy, and *De l'Allemagne* (1810), the result of her visit to Germany. The first is an inspiration of a high order, giving, although simply a novel, a picture of Italy, the country, its sky, its mountains, its seas, and of the people, its genius, its history, its life, marvellous both for completeness and for precision and magic impressiveness. It was translated into all European languages, and exercised a great influence; from that day the European painters ceased to copy the old Italian masters, and began to portray the living Italian peasants. The second book is of an inferior order. She did not understand the German language, and the German spirit remained foreign to her; its natural naïveté, simplicity, and purity she mistook for a product of refinement, and its strength she discovered only in its eccentricities. But the book exercised an enormous influence, as from it, for the first time, the French heard that there was something in the world which could be called German civilization. Clemens Petersen.

Staff and **Staff-Schools.** See Appendix.

Staf'fa, a small island of Scotland, one of the Inner Hebrides, belonging to the county of Argyle, celebrated

for its curious caverns, among which that called Fingal's Cave is the most remarkable, formed by gigantic masses of columnar basalt roofed with a shapeless stratum of the same material, and presenting a most singular resemblance to an architectural design. The cave of Fingal is 227 feet long and 66 feet high from the sea to the entablature.

Staf'ford, town of England, capital of Staffordshire, on the Sow, has manufactures of leather, shoes, cutlery, and general hardware. P. 14,437.

Stafford, new county of S. W. Kansas, intersected in the N. W. corner by the Arkansas River, traversed by the Atchison Topeka and Santa Fé R. R., consists mainly of fertile, rolling prairies. Area, 900 sq. m. It is still unorganized.

Stafford, county of E. Virginia, bordering on Potomac and Rappahannock rivers, drained by Aquia and other creeks, and intersected by Richmond Fredericksburg and Potomac R. R. The surface is usually hilly, but is fertile along the Potomac. Excellent granite and freestone abound, and gold has been discovered in small quantities. Staples, Indian corn, wheat, oats, and sawed lumber. Cap. Stafford Court-house. Area, 335 sq. m. P. 6420.

Stafford, p.-tp., Tolland co., Conn., on New London R. R., 30 miles N. of New Haven, has 4 churches, good schools, 1 newspaper, 3 banks, an insurance company, several mills, a woollen factory, and 1 hotel. It is a summer resort for invalids and pleasure-seekers. P. 3405.

JAMES McLAUGHLIN, ED. "TOLLAND COUNTY PRESS."

Stafford, tp., De Kalb co., Ind. P. 584.

Stafford, tp., Greene co., Ind. P. 841.

Stafford, tp., Ocean co., N. J. P. 1514.

Stafford, p.-v. and tp., Genesee co., N. Y., on New York Central R. R. P. 1847.

Stafford, p.-v., Franklin tp., Monroe co., O. P. 150.

Stafford (EDWARD), son of Henry, b. in England about 1470; was restored to his titles and estates by Henry VII. 1486; was educated at Cambridge; acquired enormous wealth; commanded the guard at the "battle of the Spurs," 1515; freely asserted his claim to the throne (by descent from Thomas of Woodstock, duke of Gloucester), as next heir to Henry VIII., in case of his death without issue; entered into a correspondence on the subject with Friar Nicholas Hopkins of Henton, Somersetshire, who pretended to the gift of prophecy, and foretold he should be king; excited the hostility of Wolsey by treating him with contempt on account of his humble origin; was accused of treason May, 1521; seized while on his way to court; tried and condemned May 13, and, disdaining to solicit mercy, was beheaded on Tower Hill May 17, 1521. He was attainted by Parliament two years later, and the dukedom thereby became extinct in his family.

Stafford (HENRY), duke of Buckingham, son of Humphrey, b. in England about 1440; succeeded to the title 1460; was the most prominent supporter of the duke of Gloucester (Richard III.) when Protector in his plot to obtain the throne 1483; met that prince at Northampton Apr. 29; aided him to effect the arrest and destruction of Earl Rivers and Lord Gray; was appointed chief-justice and constable of the royal castles in Wales May 16; asserted the claims of Richard to the throne in a harangue at Guildhall June 24, and was appointed constable of England July 15, but soon changed his allegiance, conspiring with the Lancastrians; was betrayed to the king in October, attainted, and beheaded at Salisbury Nov. 1, 1483. His name and fame are familiar to modern readers through Shakspeare's tragedy of *King Richard III.*

Stafford (HUMPHREY), earl of Stafford, afterward duke of Buckingham, b. in England in 1404; was present at the coronation of Henry VI. as king of France at Paris Dec., 1431; was in command at Calais 1440; married a daughter of Prince Thomas of Woodstock, duke of Gloucester, whose estate he inherited on the death of a brother-in-law; was thereupon created duke of Buckingham Sept. 14, 1444; was declared first peer of the realm; made first constable of Dover and warden of the Cinque Ports about 1449; was wounded at the battle of St. Alban's, 1454, and killed at that of Northampton, July 10, 1460.

Stafford (WILLIAM **Howard**), VISCOUNT, second son of Thomas Howard, twentieth earl of Arundel, b. in England Nov. 20, 1612; was brought up a Roman Catholic; was knighted in early life; married, about 1634, Mary, a sister of Henry, thirteenth Baron Stafford. On the death of the latter without issue in 1637, Sir William assumed the title of Baron Stafford in right of his wife, but it was soon discovered that the true heir was a distant relative in obscure life, named Roger Fludd, *alias* Stafford, whose sister was married to a joiner at Newport, Shropshire, and had a son, then following the trade of a cobbler in that town. Roger was induced for a consideration to submit his claim to the arbitration of the king, who decided in favor of Howard, and by royal order Roger executed a deed of surrender of the peerage to his rival Dec. 9, 1639. The king soon afterward (Sept. 12, 1640) created Howard Baron and his wife Baroness Stafford, and in order to settle in his favor a question of precedency among the barons made him a viscount Nov. 11 of the same year. During the civil war Stafford adhered to the royal cause, but after the Restoration often opposed in the House of Peers the measures of the court; was intimate with Shaftesbury, and was, on account of his religion, selected by the infamous Titus Oates as one of his victims. Accused of participation in the "Popish plot" by Oates in his first examination before the House of Commons, Oct. 23, 1678, Stafford surrendered himself the following day; was committed to the Tower with four other accused noblemen Oct. 30; was excluded from Parliament with twenty other Roman Catholic peers by the act approved Nov. 30 of that year; was impeached of high treason Dec. 5, and again, with the other four accused lords, Apr. 7, 1679, when he pleaded not guilty; but the trial, being prevented by a prorogation and a subsequent dissolution of Parliament, did not commence until Nov. 30, 1680, when the impeachment was begun before the House of Lords, Sir Heneage Finch (afterward earl of Nottingham) presiding as lord high steward. Stephen Dugdale and one Turberville, the chief witnesses, swore that Stafford had offered them rewards to participate in a conspiracy against the life of the king, and Bedloe, Dangerfield, and Denis offered confirmatory testimony. Stafford defended himself with spirit, but he was convicted Dec. 7, by 55 votes against 31, four of the Howard family being of the majority. Stafford was executed on Tower Hill Dec. 29, 1680, protesting his innocence in terms which carried great weight with the spectators. His widow was created countess by James, and his eldest son earl of Stafford by James II. (1688), but the title became extinct on the death of the fourth earl in 1762. The attainder was reversed by act of Parliament in 1824, and Sir George William Jerningham, Bart., was recognized as Baron Stafford 1825.

PORTER C. BLISS.

Stafford Court-house, p.-v., cap. of Stafford co., Va.

Staf'fordshire, an inland county of England, comprises an area of 1138 sq. m., with 857,333 inhabitants. The central part of the county is low and undulating, but both in the N. and the S. the ground rises and the surface becomes hilly. The soil is generally cold, clayey, and little productive. The principal occupations are mining and manufactures. The coal-fields are very rich both in the northern and southern parts of the county; iron, copper, and lead are found, together with marble, freestone, and an excellent potter's clay. With respect to its manufacturing interests this county is the third in rank in England.

Staf'fordsville, p.-v. and tp., Giles co., Va. P. 1888.

Stag, or **Red Deer,** the largest deer of Europe, the *Cervus elaphus*. The male is called the *hart*, the female the *hind*, and the young the *calf;* the male under three years is called a *brocket;* under four, a *spayad;* under five, a *staggard;* and under six, a *stag;* so that strictly, in sporting parlance, a stag is a red deer five years old. At six years he is a *hart of ten*, and when seven years old he is a *hart crowned*, and is considered fair game. The stag is found in England, but at present only in paddocks, half domesticated; but in Scotland it is still found wild. Its pursuit is the noblest of European sports. The flesh is inferior to that of the fallow deer.

Stag'-Beetle and **Horn-Bug** are popular names for *Lucanus dama* of the U. S., *L. cervus* of Europe, and of many other Lucanidæ, large coleopterous insects, remarkable for the great size of the head and for the large horn-like mandibles. The American species named above is a well-known inhabitant of decaying wood, piles of chips, etc., and is capable of inflicting a severe bite.

Stage-coach. See CARRIAGES, by L. P. BROCKETT, M. D.

Stage Road, p.-v., McIntosh co., Ga. P. 36.

Stag'gers, a popular name for some diseases of horses and sheep, is, like many popular names, a very vague one. "Blind staggers" in horses is a sort of epilepsy; "mad staggers," an inflammation of the brain; "grass staggers" is an acute and dangerous gastritis. The treatment of the first is by setons about the head, but the disease is incurable. The second usually receives powerfully revulsive treatment by means of blisters, cathartics, and thorough bleeding. The last-mentioned disease calls for active enemata and good-sized doses of calomel and opium. "Staggers" in sheep is caused by grubs in the nostrils (larvæ of *Œstrus ovis*), which may sometimes be removed by throwing up snuff mixed with whisky.

Stagg's Creek, p.-v. and tp., Ashe co., N. C. P. 861.

Stag'hound, a dog formerly kept in Europe for the chase of the red deer, is now nearly extinct. This is a large, rough-haired dog, much like the foxhound, but longer in the legs. It is a strong, swift, and fearless creature, and is the rival of the bloodhound in powers of scent.

Stagi'ra [Στάγειρα], town of Chalcidice, in Macedonia, was a colony from Andros, but fell into decay during the Peloponnesian war. It was the birthplace of Aristotle, and in honor of his great tutor Alexander restored the city, but its prosperity was merely temporary.

Stagirite, Aristotle, the. See ARISTOTLE.

Stah'el (JULIUS), b. in Hungary in 1825; entering the Austrian military service, he rose to the rank of first lieutenant; upon the breaking out of the Hungarian revolution joined the patriots, and served on the staffs of Görgei and Guyon. When the revolution was suppressed, he went to Germany, thence to England, and finally to New York, where he engaged in journalism. When the civil war broke out, he was made lieutenant-colonel of the 8th New York Vols., which he commanded at the battle of Bull Run, and of which he soon after became colonel; was promoted to brigadier-general in 1861; in 1862 commanded a division in Sigel's 11th army corps, and was made major-general of volunteers in Mar., 1864.

Stahl (FRIEDRICH JULIUS), b. at Munich Jan. 16, 1802, of Jewish parents; embraced Christianity in 1819; studied law at Würzburg, Heidelberg, and Erlangen; was appointed professor of jurisprudence in 1832 at Erlangen, and in 1840 at Berlin. D. at Brückenau, near Kissingen, in Bavaria, Aug. 10, 1861. His specialty was the philosophy of law, and in his system he was a disciple of Schelling. Assuming that human reason is incapable of arriving at a positive conception of truth by itself, he deduces the ideas of state, government, etc., from the doctrines of Christian revelation, and bases the authority of officials and the obedience of citizens on a divine ordinance. As a member of the upper house of the Prussian Diet he became the leader of the feudal and aristocratic party during the period of reaction which followed the abortive revolution of 1848 in Berlin. His principal works are—*Philosophie des Rechts* (3 vols., 1854–56), *Ueber den Christlichen Staat* (1847), *Was ist Revolution?* (1853).

Stahl (GEORG ERNST), b. at Ansbach, in Bavaria, Oct. 21, 1660; studied medicine at Jena; was appointed physician to the duke of Weimar in 1687, professor of medicine at the University of Halle in 1694, and physician to the king of Prussia in 1716. D. at Berlin May 14, 1734. He was a great chemist, and had great merit as a systematizer of the science of chemistry; his theory of phlogiston was generally adopted, and considered valid up to the time of Lavoisier. As a physician he also acquired great celebrity. (See A. Lemoine, *Le Vitalisme et l'Animisme de Stahl* (Paris, 1864).) His principal works are—*Experimenta et Observationes Chemicæ* (1731) and *Theoria Medica Vera* (1707).

Stahr (ADOLF WILHELM THEODOR), b. at Prenzlau, in the Prussian province of Brandenburg, Oct. 22, 1805; studied classical languages and literature at Halle; was appointed professor at the gymnasium of Oldenburg in 1836; travelled much in France, Switzerland, and Italy, and settled in 1852 at Berlin, where he married the authoress Fanny Lewald in 1855. He was a very prolific writer; his numerous books and articles for periodicals treat subjects of antiquity and modern times, history and art, critically and in a descriptive manner. Some of his works have been translated into English, as, for instance, *Torso, oder Kunst, Künstler, und Kunstwerke der Alten* (2 vols., 1854–55), in the *Crayon* (New York, 1858–59), and *G. E. Lessing, sein Leben und seine Werke* (2 vols., 1859), by Prof. E. P. Evans, of Michigan University (Boston, 1866). He wrote the text to Kaulbach's *Goethe Gallerie* (Abtheilung I., Goethe's *Frauengestalten*). His *Oldenburgische Theaterschau* (2 vols., 1845) drew some attention to the stage of Oldenburg. D. Oct. 3, 1876.

Staigg (RICHARD M.), b. in England about 1820; coming to America at an early age, he became a mechanic at Newport, R. I., where he took lessons in painting from Washington Allston and Jane Stuart; became eminent as a miniature painter, a branch of art which he subsequently relinquished for *genre* pictures and coast-scenes. Among his best productions are—*The Crossing-Sweeper*, *Cat's Cradle*, *Knitting*, *The Love-Letter*, *The Sailor's Grave*, and *News from the War*.

Stained Glass. See GLASS, by C. G. LELAND, A. M.

Stai'ner (JOHN), Mus. Doc., b. in England in 1840; developed in early childhood a remarkable musical talent; was a chorister at St. Paul's cathedral 1847–56, organist to St. Michael's College, Tenbury, 1856–59, and became in 1859 organist of Magdalen College, and in 1860 of University College, Oxford; received the honorary degree of bachelor of music 1859; embraced the opportunity to pursue the regular course of university studies, as well as to perfect himself in musical theory, graduating as B. A. 1863, Mus. Doc. 1865, and M. A. 1866. In 1872 he was appointed organist of St. Paul's, London. Author of a large number of anthems and church services, as well as songs of a secular character, and of a scientific work on *The Theory of Harmony*.

Stair (JAMES **Dalrymple**), SEVENTH BARON and FIRST VISCOUNT, b. at Drummurchie, Ayrshire, Scotland, in May, 1619; graduated M. A. at the University of Glasgow 1637; obtained a commission as captain in the Scottish army, but at the age of twenty-two accepted the professorship of philosophy at Glasgow, which he held six years (1641–47); was admitted an advocate at the Scottish bar Feb., 1648; was secretary to the commissioners sent to treat with Charles I. at Breda 1649–50; became a lord of session July 1, 1657; was knighted by Charles II. 1660, and confirmed as lord of session Feb. 14, 1661; resigned office 1663 from unwillingness to subscribe the declaration against the Covenants of 1638 and 1643 appended to the oath of allegiance, but his resignation was declined, and he was made a baronet June, 1664; became lord president of the court of session Jan., 1671; refused to take the new test oath, and was removed from his offices 1681; published in that year his *Modus Litigandi* and *The Institutions of the Law of Scotland*—a work which has been called the "Scottish Blackstone;" was accused of complicity in the Rye-House plot, and outlawed, but escaped to Holland Oct., 1682; prepared there his *Decisions of the Lords of Council and Sessions 1661–81* (Edinburgh, 2 vols. folio, 1683–87); published at Leyden his Latin treatises *Physiologia Nova Experimentalis* (1686); received a pardon 1686; accompanied the prince of Orange to England 1688; was reinstated in the presidency of the court of session, and made Viscount Stair Apr. 21, 1690; published an *Apology* for his political course (1690) and a *Vindication of the Divine Perfections* (1695). D. Nov. 25, 1695.

Stair (JOHN **Dalrymple**), FIRST EARL OF, better known as the "Master of Stair," son of Viscount John, b. in Scotland about 1648; was admitted as advocate in the court of session Feb., 1672; was one of the council for the earl of Argyll on his trial for treason 1681; was twice imprisoned between 1681 and 1685; was received into favor on the accession of James II., by whom he was made lord advocate 1685 and lord of session and lord-justice clerk 1686; supported the Revolution 1688; was a leading Scottish member of the "Convention Parliament" Mar., 1689; was one of the three commissioners sent to London to offer the crown of Scotland to William and Mary, May, 1689; was reappointed lord advocate 1690; became one of the secretaries of state for Scotland 1691; plotted the "massacre of Glencoe," which covered his name with infamy, Jan., 1692, for which act he was dismissed from office 1695 and censured by a parliamentary committee of inquiry, but was never subjected to prosecution; succeeded his father as Viscount Stair Nov. 25, 1695; was sworn of the privy council on the accession of Anne 1702; was created earl of Stair Apr. 8, 1703; was one of the commissioners who negotiated the treaty of union between Scotland and England 1706, and was mainly instrumental in passing that measure through the Scottish Parliament. D. Jan. 8, 1707.

Stair (JOHN **Dalrymple**), SECOND EARL OF, second son of the first earl, b. at Edinburgh July 20, 1673; had the misfortune in boyhood to kill his elder brother by the accidental discharge of a pistol; educated at the University of Leyden, where he was distinguished for scholarship; entered the army as a volunteer under the earl of Angus, and commanded the Cameronian regiment at the battle of Steinkirk 1692; was aide-de-camp to the duke of Marlborough at Venloo and Liege 1702; succeeded to the earldom 1707; obtained command of the Scots Greys; was commissioned general; distinguished himself at Ramillies and Oudenarde 1706, and at Malplaquet 1709; withdrew from the army in 1711; became privy councillor and representative peer for Scotland 1714; was appointed commander-in chief of the forces in Scotland on the accession of George I. (1715); was ambassador to France 1715–20; resided on his estate at New Liston, devoted to scientific agriculture, 1720–40, having been the first person in Scotland to plant turnips and cabbages in the open fields; was made field-marshal commander-in-chief of British forces in Flanders and ambassador extraordinary to the States General of Holland 1741; won the battle of Dettingen, June 26, 1743, and subsequently filled several important public posts under the Walpole administration. D. at Edinburgh May 9, 1747. The *Memoirs of the House of Dalrymple*, published from

family papers (1876), contain important historical data heretofore unknown.

Stalac'tite [Gr. *σταλάζειν*, to "drop"], icicle-like masses of lime, limonite, chalcedony, pyrites, etc., which depend from the roofs of caverns; they are formed from the evaporation of water holding these substances in solution. Stalactites sometimes form columns reaching from floor to roof of high chambers; sometimes they imitate curtains, waterfalls, etc., which constitute notable features in some of the famous caves in the world. The name *stalagmite* (Gr. *στάλαγμα*, a "drop") is given to the material which composes stalactites, only accumulating on the floor. This sometimes forms continuous sheets over the surface, sometimes rises into columns, which meet and blend with the stalactites above. J. S. NEWBERRY.

Stalim'ni, or **Stalimeni,** the ancient *Lemnos*, an island in the Ægean Sea, 40 miles S. E. of Mount Athos, belongs to Turkey, and comprises an area of 160 sq. m., with 8000 inhabitants. The surface is mountainous, containing many extinct craters; the soil is very fertile, and produces corn, oil, wine, and fruits.

Stambool. See CONSTANTINOPLE.

Sta'men [Lat., from the Gr. *στήμων*, the warp or its threads in the upright loom of the ancients], the botanical name of the male organ in flowers. (See BOTANY.) It consists of two parts, viz. a stalk, called the *filament*, which, like the stalk of a leaf, is not essential and may be wanting, and of a terminal body, the only essential portion, called the *anther*. This normally is 2-celled, or is formed of a pair of sacs placed side by side, with, or sometimes without, a prolongation of the filament between them (the *connective*), and filled with *pollen*, a powder, composed of minute grains. This is the fertilizing material, which, acting upon the stigma, develops a tube from each grain, which grows down the style, reaches the ovules or rudimentary seeds, and fertilizes them: that is, causes an embryo to be produced, and so an ovule becomes a fertile seed. The pollen is discharged from the anther through openings, generally by a slit from top to bottom of each cell, sometimes by a hole at the top or elsewhere, rarely by one or more uplifted valves or lids. Morphologically, each stamen answers to a leaf, the anther being conceived to be the blade transformed, and the cells of its parenchyma developed as pollen, the filament answering to the leafstalk. As to position, in a complete flower the stamens stand between the petals and the pistil, in the simpler and normal case borne on the receptacle under the pistil (technically *hypogynous*), but not rarely adnate to or apparently growing out of the calyx (perigynous), or out of the corolla (*epipetalous*), or when all these parts are consolidated with the surface of the ovary, then apparently borne on its summit (*epigynous*), or even consolidated with the style, as in the orchis family (*gynandrous*). Terms relating to the number of the stamens are common, as *monandrous*, with a solitary stamen, *diandrous*, with two, and so on; or to number combined with relative length, as *didynamous*, when of four stamens one pair is shorter, and *tetradynamous*, when of six stamens two are shorter than the four; or to connection, whether by the filaments into one set or brotherhood (*monadelphous*) or into two (*diadelphous*), or by the anthers instead into a ring (*syngenesious*). These and the like terms long ago became familiar, being used by Linnæus to characterize artificial classes. As the petals of a flower, taken collectively, compose the corolla, so the stamens, taken collectively, receive the name of *andrœcium ; i. e.* the male members of the household. W. W. BAILEY.

Stam'ford, town of England, county of Lincoln, on the Welland, which here becomes navigable. P. 7846.

Stamford, p.-b. and tp., Fairfield co., Conn., on New York and New Haven R. R., about 32 miles N. E. of New York City, contains 7 churches, public and private schools, 2 military institutes, 4 banks, 1 newspaper, manufacturing establishments, and repair-shops. Stamford is a summer resort, and is the fifth richest town in Connecticut. P. 9714. WM. GILLESPIE, ED. "STAMFORD ADVOCATE."

Stamford, p.-v. and tp., Delaware co., N. Y., at the headwaters of the W. branch of Delaware River, on New York Kingston and Syracuse R. R., has 4 churches, an incorporated seminary with a library, 1 newspaper, 1 furnace and machine-shop, 2 hotels, and several mills. P. 1658. S. B. CHAMPION, ED. "MIRROR."

Stamford, tp., Bennington co., Vt. P. 633.

Stam'mering [Ang. Sax. *stamer*], an affection of the faculty of speech characterized by irregular, imperfect, or spasmodic actions of the muscles concerned in articulation. It is in reality a chorea of the muscles concerned, a defective power of co-ordination. It may be manifested under two somewhat different forms. In the one there is a difficulty in beginning the enunciation of words, and this is especially shown in regard to those words which begin with what are called the "explosive consonants" (*b, p*), and which require the sudden opening of the lips. In the other form the word is begun, but after the enunciation of a syllable there is a spasmodic, and for a time uncontrollable, reiteration of the same syllable. To this variety the term *stuttering* is sometimes applied. Stammering is one of the mimic diseases, and may be acquired by carelessness in speech or by association with others similarly affected, or even by mocking such persons. In the majority of cases it disappears after the attainment of adult age, probably in consequence of the constant efforts of the subject to improve his habit of speaking. It is always increased by emotional disturbance, especially fright and apprehension, and is much mitigated, and often cured, by the patient acquiring confidence in himself, never attempting to speak in a hurry or when the chest is empty of air, or by reading measured sentences slowly and with deliberation. Stammerers never have any difficulty in singing, for they know that a certain definite manner is to be observed, and this gives them the confidence they require. The affection is sometimes permanently removed in time by the patient performing some trifling muscular action consentaneously with the enunciation of the words over which he stumbles. Thus, if he stammers at the word *baby*, he can prevent the fault by moving a finger at the very instant that he begins to utter the word, and so on.

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Stamp Act, a law passed by the British Parliament Mar. 22, 1765, "for granting and applying certain stamp duties and other duties in the British colonies and plantations in America," took effect from Nov. 1, 1765, but was the occasion of such excitement, protests, and overt resistance in most of the States that it was repealed Mar. 18, 1766, and a bill of indemnity for those who had incurred penalties was passed June 6 of the same year.

Stamp'er's Creek, p.-v. and tp., Orange co., Ind. P. 827.

Stämpf'li (JAKOB), b. at Schüpfen, canton of Berne, Switzerland, in 1820, in humble circumstances; acquired by the energy of his character a good education; studied law at Berne, and became an advocate in 1843; was very active in the politics of the state as leader of the radical party in 1845–50 and 1855–65; introduced direct taxation, abolished all feudal burdens, and powerfully opposed the influence of the Jesuits. In 1872 he was one of the arbitrators at Geneva under the Treaty of Washington. D. May, 1879.

Stamp-Mill. See GRINDING AND CRUSHING MACHINERY, by PROF. R. H. THURSTON, C. E.

Stan'ardsville, p.-v. and tp., cap. of Greene co., Va. P. 1789.

Stan'bery (HENRY), b. in New York Feb. 20, 1803; graduated at Washington College, Pa., in 1819; admitted to the bar in Ohio in 1824; became attorney-general of the State in 1846, and attorney-general of the U. S. in 1866, under the administration of Pres. Johnson, for whom he acted as leading counsel in the impeachment trial of 1868.

Stan'bridge (JOHN), b. at Heyford, Northamptonshire, England, about 1450; became perpetual fellow of New College, Oxford, 1481; first usher of the free school connected with Magdalen College about 1486, and afterward for many years its head-master. D. about 1525. He was the first author of schoolbooks that were extensively printed and used in England, though now so rare as to have become bibliographical curiosities. Among them were *The Accydence of Mayster Stanbrydge's owne Makynge* (printed before 1500), *Embryon Relimatum, sive Vocabularium* (of which at least 8 eds. were printed by Wynkin de Worde), *Vocabula Magistri Stanbrigi* (1510), and *Parvulorum Institutiones* (1520).

Stanchio. See COS.

Standard of Values. See COINAGE, by E. B. ELLIOT.

Standard of Weights and Measures. See WEIGHTS AND MEASURES, by PRES. F. A. P. BARNARD.

Standards. See BANNER and FLAG.

Standing Stone, p.-v. and tp., Bradford co., Pa., on Susquehanna River and on Lehigh Valley R. R. P. 905.

Standing Stones. See STONES, STANDING.

Stan'dish, p.-v. and tp., Cumberland co., Me. P. 2089.

Standish (Miles), b. in Lancashire, England, about 1584; claimed to be descended from, and the true heir of, the knightly family of Standish of Duxbury Hall; became a soldier in the Netherlands, attaining the rank of captain, and, though not a member of the Leyden church or congregation, accompanied the Pilgrims of the Mayflower to New England 1620; lost his wife, Rose, during the first winter; is said by tradition to have employed his friend John Alden to negotiate his marriage with the fair Priscilla Mullins (see Longfellow's *Courtship of Miles Standish*), with the well-known result that Alden married the maiden; rendered important services to the colonists in preserving them from the open and secret hostilities of the Indians, having with his own hand killed, at Weymouth (1623), Pecksuot, an Indian chief who had planned a massacre; visited England as agent for the colony 1625, returning with supplies 1626; was one of the original proprietors and settlers of Duxbury, having given that name to the town in memory of the seat of his English ancestors; was for the remainder of his life either magistrate or a member of the board of assistants to the governor, and took part in the settlement of Bridgewater 1649. D. at Duxbury Oct. 3, 1656. He was of small stature and choleric temper, possessed great energy and force of will, and was long a terror to hostile Indians, and an object of admiration to the friendly natives, among whom was Hobomok (the hero of Lydia Maria Child's *Hobomok*), who made his home with Standish. By a second wife, Barbara, he left numerous children, more than one of whom married in the family of John Alden. His sword is preserved in the Pilgrim Hall, Plymouth. On the commanding eminence in South Duxbury, formerly called Captain's Hill, from having been the place of his residence, the cornerstone of a monument to his memory was laid Oct. 7, 1872. This structure, still (1876) in process of construction, is to consist of an octagonal base 28 feet in diameter and 25 feet high, surmounted by a circular tower crowned by a statue of "the first commissioned military officer of New England," the whole to be 110 feet in height. A good view of the monument and the beautiful prospect it will command is given in Rev. E. Nason's *Gazetteer of Massachusetts* (1874). The will of Capt. Standish may be read in the *General Register*, vol. v., and many incidents of his career are given, with a partial genealogy of his descendants, in Justin Winsor's *History of Duxbury* (1849). Porter C. Bliss.

Stan'field (Clarkson), R. A., b. at Sunderland, county of Durham, England, in 1798; began life as a sailor, thus acquiring the practical knowledge of the sea that has given him his fame. Ruskin says: "One work of Stanfield's presents us with as much concentrated knowledge of sea and sky as, diluted, would have lasted any one of the old masters his life." He first exhibited in 1827; was elected an associate in 1832, academician in 1835; made frequent visits to the Continent, and studied in Italy, France, Holland, Venice, Naples, and the Pyrenees; was for many years scenic artist at Drury Lane, theatrical decorator, and painter of landscape. D. in 1867. His masterpiece is conceded to be *The Battle of Trafalgar*, painted for the Senior United Service Club in 1836. This work is characterized by beauty rather than grandeur, by elaboration of detail and carefulness of finish. He has been styled "the English Vandervelde." O. B. Frothingham.

Stan'ford, tp., Clay co., Ill. P. 1349.

Stanford, p.-v., Allen tp., McLean co., Ill. P. 274.

Stanford, p.-v., cap. of Lincoln co., Ky., on Logan Creek and on Knoxville branch of Louisville Nashville and Great Southern R. R., has 1 newspaper. P. 752.

Stanford, tp., Isanti co., Minn. P. 215.

Stanford, tp., Dutchess co., N. Y. P. 2116.

Stanford (John), D. D., b. in England Oct. 20, 1754; studied medicine; became a teacher, and came to the U. S. in 1786; was pastor of a Baptist church in Providence, R. I., 1787–89; teacher in New York 1789–1813, delivering in the mean time Sunday evening lectures, and acting from 1791 to 1800 as minister of a Baptist church, and subsequently teaching a class of students in theology. In 1811 he became chaplain of the almshouse, and labored in the prisons, hospitals, and charitable institutions. Besides tracts and discourses, he wrote a *History of the First Baptist Church of Providence*, *The Domestic Chaplain* (1806), *Concise Description of the City of New York* (1814), and *The Aged Christian's Companion* (1829; republished, with a memoir, by George Uphold, 1855). D. in New York, Jan. 14, 1834.

Stanford (Leland), b. at Albany, N. Y., Mar. 9, 1824; received a common-school education; studied law, and was admitted to the bar in 1849; soon afterward removed to Port Washington, Wis., where he practised law till 1852, when he went to California and entered into business with three of his brothers. He first appeared in politics as a delegate to the convention at Chicago in 1860 which nominated Abraham Lincoln for the Presidency; was elected governor of California in 1861, and in his inaugural address urged the importance of building the Pacific R. R., and a company for that purpose, with him for president, was formed on July 1 of that year. J. B. Bishop.

Stan'fordville, p.-v., Stanford tp., Dutchess co., N. Y., on Poughkeepsie Hartford and Boston R. R.

Stan'hope, p.-v., Byram tp., Sussex co., N. J., on Morris Canal and Morris and Essex R. R.

Stanhope (Charles Mahon), F. R. S., third Earl Stanhope and Viscount Mahon, grandson of the first earl, b. in London, England, Aug. 3, 1753; educated at Eton and Geneva; manifested great mechanical talent; obtained while at school a prize from a scientific academy at Stockholm for a memoir on the construction of the pendulum; married Lady Hester Pitt, daughter of the earl of Chatham, 1774; was an unsuccessful candidate for Parliament at Westminster in the same year; was elected for Chipping Wycombe by the influence of the earl of Shelburne 1780; lost his wife, who had borne him three daughters, 1780; married Louisa, daughter of Henry Grenville, 1781; succeeded to the peerage 1786; was noted for his radical opinions; declared himself a republican, laid aside the insignia of nobility, and defended the French revolution; was a frequent speaker in the House of Lords, where he obtained the sobriquet of "the minority of one;" constructed two calculating-machines; suggested improvements in canal-locks; was a close student of electricity; made known in 1779 his theory of the "return stroke" of lightning; invented a monochord for tuning musical instruments, a vessel for sailing against wind and tide, made many improvements in the art of printing, and in 1816 the "Stanhope printing-press." D. in London Dec. 15, 1816. Author of *The Gold Coin* (1774), *Principles of Electricity* (1779), *Observations on Mr. Pitt's Plan for Reducing the National Debt* (1786), *A Letter to Edmund Burke on the French Revolution* (1790), *Rights of Juries Defended* (1792), *Principles of Tuning Instruments* (1806), and of papers *On Securing Buildings against Fire* (1778) and *On Thunder-storms* (1787) in the *Philosophical Transactions*.

Stanhope (George), D. D., b. at Hertishorn, Derbyshire, England, Mar. 5, 1660; studied at Eton; graduated at King's College, Cambridge, about 1680; was successively rector of Tewing, vicar of Lewisham and of Deptford, and dean of Canterbury; was chaplain to William and Mary about 1690, and Boyle lecturer 1701. D. at Bath Mar. 18, 1728. He translated the *Imitation of Christ* (1696), the *Meditations of Marcus Aurelius* (1699) and of St. Augustine (1701), the writings of Epictetus (1700), the *Maxims* of La Rochefoucauld, Bishop Launcelot Andrews's *Private Prayers*, and other works; published many sermons, a course of Boyle lectures (1702), and *Paraphrase on the Epistles and Gospels* (4 vols., 1705–08).

Stanhope (Lady Hester Lucy), daughter of Charles, third Earl Stanhope, b. in London, England, Mar. 12, 1776; was for ten years a member of the family of her uncle, William Pitt, to whom she acted as confidential secretary until his death in 1806; received thereafter a pension of £1200, upon which she resided some years in Wales; proceeded in 1810 to Syria; visited Jerusalem, Damascus, Baalbec, and Palmyra; acquired by her magnificent and singular ways of living the respect and veneration of the Arabs, who treated her almost as a queen; established herself in 1813 in the deserted convent of Mar Elias, 8 miles from Sidon, upon a crag of Lebanon; adopted the dress and style of an emir, having at her command a guard of Albanians, over whom she exercised an absolute authority; became a benefactress to political refugees and to the poor of every kind; exerted considerable political influence; and practised astrology. D. at Mar Elias June 23, 1839. Her *Memoirs* (3 vols., 1845) and *Seven Years' Travels* (3 vols., 1846) were published by her physician, Dr. Meryon.

Stanhope (James), first Earl Stanhope, b. at Paris, France, in 1673; was a nephew of the second earl of Chesterfield; resided in Spain, where his father was minister, during several of his early years (1690–94); entered the army 1691; was wounded at the siege of Namur 1695; served in Flanders until the Peace of Ryswick; was elected to Parliament 1702; took part in the expeditions of 1702 and 1704 in Spain; was a brigadier-general at the siege of Barcelona 1705, major-general 1707; commander-in-chief in Spain, and took Port Mahon, Minorca, 1708; defeated the Spaniards at Almenara and Saragossa (Aug., 1710), but was forced to surrender to the duke of Vendôme at Brihueza Dec. 8, 1710; was appointed secretary of state on the accession of George I., 1714; became first lord of the treas-

ury and chancellor of the exchequer 1717; was created Viscount Stanhope of Mahon July 2, 1717, and Earl Stanhope Apr., 1718; was again secretary of state, and took part in negotiating the Quadruple Alliance 1718. D. in London Feb. 5, 1721.

Stanhope (Philip Dormer). See Chesterfield.

Stanhope (Philip Henry), D. C. L., F. R. S., fifth Earl Stanhope, better known as **Lord Mahon,** b. at Walmer, Kent, England, Jan. 31, 1805, was a grandson of Charles, the third earl; graduated from Christ Church, Oxford, 1827; was elected to Parliament for Wootton-Basset 1830; represented the borough of Hertford 1835–52; was under secretary of state for foreign affairs (the duke of Wellington being the secretary) in the first Peel ministry 1834; was secretary to the board of control in the last year of the second Peel ministry 1845–46; supported the repeal of the corn laws; introduced and carried the copyright act of 1842; was chosen president of the Society of Antiquaries 1846; was defeated at the parliamentary elections of 1852 in consequence of having voted with the protectionists against the modification of the navigation laws; succeeded to the earldom Mar. 2, 1855; founded the Stanhope prize for the study of modern history at Oxford 1855; was chosen lord rector of the University of Aberdeen 1858, and one of the six foreign members of the Academy of Moral and Political Sciences at Paris May 11, 1872; was instrumental in the establishment of the National Portrait Gallery (1857), of which he became chairman, and in the creation of the Historical Manuscripts Commission. D. at Bournemouth, Hampshire, Dec. 24, 1875. Author of *The Life of Belisarius* (1830), *History of the War of Succession in Spain* (1832), *History of England from the Peace of Utrecht to the Peace of Versailles, 1713–83* (7 vols. 8vo, 1836–53), *Spain under Charles the Second, or Extracts from the Correspondence of the Hon. Alexander Stanhope, British Minister at Madrid 1690–1700* (1839), *Essai sur la Vie du Grand Condé* (privately printed, 1842, which afterward appeared in English as *The Life of Louis, Prince of Condé*, 1845), *Historical Essays, selected from Contributions to the Quarterly Review* (1848), *The Life of the Right Hon. William Pitt, with Extracts from his Unpublished Correspondence and MS. Papers* (4 vols., 1861–62; 4th ed. 1867), *Miscellanies, Collected and Edited* (1863), and a *History of England, comprising the Reign of Anne, until the Peace of Utrecht* (1870). Several fragments of his great work have been separately published, as *The Forty-Five, being a Narrative of the Rebellion in Scotland in 1745* (1851), and *The Rise of Our Indian Empire* (1858). Lord Stanhope edited, with notes, *The Letters of Philip Dormer Stanhope, Earl of Chesterfield* (4 vols., 1845), *The Memoirs of Sir Robert Peel, Bart.* (2 vols., 1856–57), and privately printed two or three volumes of state papers and family documents. The earlier volumes of his *History of England* were edited in the U. S. by Prof. Henry Reed (2 vols., 1849), with elaborate notes.

Porter C. Bliss.

Stanislas Augustus, king of Poland. See Poniatowski.

Stan'islas Leszczyn'ski, b. at Lemberg, Galicia, Oct. 20, 1677, of one of the oldest and wealthiest families of the French nobility; held a high position at the Polish court, and was palatine of Posen when the war broke out between Charles XII. of Sweden and Augustus II. of Poland and Saxony. By the diplomatic negotiations which he carried on between Augustus and Charles he won the favor, and even the friendship, of the latter, and when, after the complete defeat of Augustus, Charles declared the Polish throne vacant, Stanislas was by his influence elected king of Poland in 1705. He was a noble character, and not without talent as a ruler, but after the disaster of Charles at Poltava in 1709 he was compelled to flee from Poland, where even his private fortune was confiscated. He joined his friends at Bender, and was in 1714 made governor of the duchy of Zweibrücken, but after the death of Charles in 1718 he was bereft also of this position. He found refuge in France, and settled at Weissenburg in Alsace. In 1725 his daughter, Marie Leszczynski, was married to Louis XV., and at the death of Augustus II. (in 1733) he was re-elected king of Poland by French influence. Russia, however, was opposed to his restoration, and by the intervention of a powerful Russian army Augustus III. was raised to the Polish throne. After a desperate resistance at Dantzic, where he was besieged by the Russians, he fled for the second time from his native country, but by the Peace of Vienna (1735) his family estates were restored to him, he received the duchy of Lorraine as a pension, and retained the title of king of Poland. He subsequently resided at Lunéville or Nancy, where he held a brilliant court, gathered scientific men around him, founded splendid educational institutions, erected magnificent public buildings, and was generally called *Le Bienfaisant*. D. Feb. 23, 1766, by accident, his dress catching fire while he sat reading beside a fire. Among his *Œuvres du Philosophe bienfaisant* (4 vols., 1767) is a little essay, *Voix d'un Citoyen*, in which he predicts the division of Poland.

Stan'islaus, county of Central California, bounded in part on the N. by the Stanislaus, and intersected by the San Joaquin and Tuolumne rivers and by a division of Central Pacific R. R. The surface is mostly level, but a strip on the W. border rises in the Coast Range to a height of about 2000 feet. The soil is productive, but timber is scarce; some gold is found in the E. part. There are numerous horses and cattle, and very large flocks of sheep. Staples, wheat, barley, wool, and mill-products. Cap. Modesto. Area, 1350 sq. m. P. 6499.

Stanisla'wow, town of Austria, province of Galicia, on the Bristricza, has several good educational institutions and some manufactures and trade. P. 13,047.

Stan'ley, county of S. W. North Carolina, bounded by Yadkin and Rocky rivers, and watered by their affluents. The surface is mountainous, the soil usually fertile, and considerable quantities of gold and silver have been found. Staples, Indian corn, wheat, oats, sweet potatoes, and sorghum-molasses. Cap. Albemarle. Area, about 300 sq. m. P. 8315.

Stanley, county of S. W. Dakota, recently formed, and not included in the census of 1870; bounded on the N. E. by Missouri River, and intersected by Big Cheyenne and Titon rivers. It has in general a rolling surface.

Stanley, tp., Warwick co., Va. P. 548.

Stanley (Arthur Penrhyn), D. D., LL.D., son of Bishop Edward and nephew of the first Baron Stanley of Alderley, b. at Alderley, Cheshire, Dec. 13, 1815; was a favorite student of Dr. Thomas Arnold at Rugby School 1829–34; gained a scholarship at Baliol College, Oxford, 1834; took the Newdigate prize for his English poem, *The Gypsies*, the Ireland scholarship, and a first class in classics (1837); obtained the Latin prize essay 1839 and the English essay and theological prizes 1840; graduated in 1838 at University College, where he was subsequently fellow tutor for twelve years, and examiner 1841; took orders in the Church of England, affiliating himself with the "Broad Church" party; was select preacher to Oxford University 1845–46, secretary to the University commission 1850–52, canon of Canterbury 1851–58, regius professor of ecclesiastical history at Oxford 1856–64, and canon of Christ Church 1858–64; became chaplain to Prince Albert 1854, to Dr. Tait, bishop of London, 1857, and to Queen Victoria and the prince of Wales 1862; declined the archbishopric of Dublin 1863, was installed dean of Westminster Jan. 9, 1864, and was elected lord rector of the University of St. Andrew's Nov., 1874. He made a tour in the East, visiting Egypt and Palestine, 1852–53, and again as chaplain and *cicerone* to the prince of Wales 1862; was prominent as a defender of free thought in the Church of England in the controversies connected with the celebrated *Essays and Reviews* (1861), Bishop Colenso's work on the *Pentateuch* (1862), and the later series of ecclesiastical prosecutions, having invited dissenters to preach, and Prof. Max Müller to lecture, in Westminster Abbey; has been an active promoter of charitable, missionary, and educational enterprises, and of biblical, antiquarian, and scientific researches, and has been for some years regarded as the best representative of the progressive school of British theology. In Dec., 1862, he married Lady Augusta Bruce, daughter of the late earl of Elgin, and the most intimate friend of the queen—a lady whose death in Feb., 1876, was the occasion of extraordinary manifestations of regard for her memory and of sympathy with Dean Stanley, both in England and in the U. S. Author, among many other publications, of *The Life and Correspondence of Thomas Arnold, D. D.* (2 vols. 1844; 8th ed. 1858; 3d American ed., Boston, 1860), *Sermons and Essays on the Apostolic Age* (1847), *The Epistles of St. Paul to the Corinthians, with Critical Notes and Dissertations* (2 vols., 1855; 4th ed. 1876), *Historical Memorials of Canterbury Cathedral* (1855), *Sinai and Palestine, in connection with their History* (1856; 20th ed. 1874); *Lectures on the History of the Eastern Church* (1861; New York, 1862; new ed. 1870), *Lectures on the History of the Jewish Church* (vol. i. 1862; vol. ii. 1865; vol. iii. 1876), *Sermons preached before the Prince of Wales during his Tour in the East* (1863), *Historical Memorials of Westminster Abbey* (1867; 4th ed. 1874), *Essays on Questions of Church and State from 1850 to 1870* (1870), *The Athanasian Creed* (1871), and *Lectures on the History of the Church of Scotland* (1872). He has been a voluminous contributor to reviews and periodicals; furnished a valuable series of biblical biographies to Dr. William Smith's *Dictionary of the Bible*; and has published many notable sermons, of which that delivered at the funeral of Sir Charles Lyell in Westminster Abbey

Feb. 27, 1875, was remarkable for its hearty recognition of the services of that geologist in having, as he believed, scientifically established the facts in regard to the creation of the earth and of man. He is a member of the new translation company for the revision of the Bible.

PORTER C. BLISS.

Stanley (DAVID SLOANE), b. at Chester, Wayne co., O., June 1, 1828; graduated from the U. S. Military Academy July 1, 1852, when appointed brevet second lieutenant in the 2d Dragoons. As a cavalry officer he served almost constantly on frontier duty, being frequently engaged with hostile Indians, and in 1859 was complimented by Gen. Scott in general orders for a successful fight with the Camanches. On the outbreak of the civil war in 1861 he had attained the rank of captain in the 1st Cavalry, then stationed in the Indian territory, and which was successfully withdrawn in May to Fort Leavenworth. Stanley was at once sent to the field of active operations in Missouri, and Sept. 28 was commissioned a brigadier-general of volunteers, and commanded the second division of the army of the Mississippi at the capture of Island No. 10; in the Corinth campaign, including the battle of Farmington and pursuit of the enemy upon the evacuation of Corinth; at the battles of Iuka (Sept. 19) and Corinth (Oct. 3–4). In Nov., 1862, he was appointed chief of cavalry of the army of the Cumberland, and the same month promoted to be major-general of volunteers, and was engaged in the battle of Murfreesboro', the Tullahoma campaign, including the action of Shelbyville and the frequent minor engagements and skirmishes of that army until Sept., 1863, when compelled by sickness to take a short leave. Returning to duty in November, he was assigned to the first division of the 4th army corps, succeeding to command of the corps July, 1864, which he held until the close of the war. In Sherman's invasion of Georgia he bore a conspicuous part in the severe and almost constant fighting from Dalton to Atlanta, being wounded at the battle of Jonesboro' (Sept. 1), the day preceding the occupation of the latter place. During the month of October his command was engaged in pursuit of Hood's army until the 27th, when it was detached from the army of Gen. Sherman to strengthen Gen. Thomas at Nashville, to whom was entrusted the duty of opposing an invasion of Tennessee. With numerous skirmishes the 4th and 23d corps had arrived at Franklin, Tenn., Nov. 30, where, being closely followed by the enemy, a stand was made and a notable victory gained. During the fight Gen. Stanley was severely wounded, and disabled for two months. He was brevetted lieutenant-colonel, colonel, brigadier-general, and major-general for gallantry in battle. On the 1st of Feb., 1866, he was mustered out of the volunteer service, and resumed his commission in the regular army, he having become major of the 5th Cavalry in 1863. In the reorganization of the army in 1866 he was appointed to the coloneley of the 22d Infantry. In 1872–73 he commanded an expedition upon the Yellowstone River.

Stanley (EDWARD), D. D., F. R. S., brother of the first Baron Stanley of Alderley, b. in London, England, Jan. 1, 1779; graduated at St. John's College, Cambridge, 1802; took orders in the Church of England; was rector of Alderley, Cheshire, from 1805 to 1837, when he was made bishop of Norwich, in which post he displayed energy and zeal as a liberal and a reformer. D. in Scotland Sept. 6, 1849. Author of *A Familiar History of Birds, their Nature, Habits, and Instincts* (2 vols., 1835; 8th ed. 1865), and of numerous miscellaneous publications, and contributed to *Blackwood* and the *British Magazine*. After his death appeared *Addresses and Charges* (1851), with a *Memoir* by his son, Rev. (now Dean) Arthur P. Stanley. Bishop Stanley had filled the posts of president of the Linnæan Society and vice-president of the British Association.

Stanley (EDWARD), b. at Newberne, N. C., early in the present century; studied at the military academy at Middletown, Conn.; became a lawyer; was a member of the State legislature of North Carolina; a Representative in Congress 1836–42, and again 1849–53, serving on the committee on ways and means, and distinguishing himself as a debater. He went to California in 1853; entered upon the practice of law, and in 1857 was the unsuccessful Republican candidate for governor. In 1862 he was appointed by Pres. Lincoln military governor of North Carolina, in which capacity he acted for several months, when he resigned and returned to California. D. at San Francisco July 26, 1872.

Stanley (EDWARD JOHN), SECOND BARON STANLEY OF ALDERLEY, b. at Alderley Park, England, Nov. 13, 1802; studied at Eton; graduated at Christ Church, Oxford, 1823; entered Parliament as a Liberal 1831; was under-secretary of state for the colonies 1833–34; patronage secretary of the treasury 1835–41, paymaster-general of the forces several months in 1841; under-secretary of state for foreign affairs in the Russell administration 1846–51; was raised to the House of Peers as Baron Eddisbury 1848; succeeded to his father's title 1850; held the conjoint offices of paymaster of the forces and vice-president of the board of trade a few weeks in 1852, and again 1853–55; was president of the board of trade 1855–58, and postmaster-general 1860–66. D. in London June 16, 1869.—His son, HENRY EDWARD JOHN, third Baron Stanley of Alderley, b. July 11, 1827, was employed many years in the diplomatic and consular service, and is author of *Rouman Anthology, a Collection of the National Ballads of Moldavia and Wallachia* (Hertford, 1856), *The East and the West, Our Dealings with our Neighbors* (London, 1865), and other works.

Stanley (E. H. SMITH). See DERBY, EARLS OF.

Stanley (HENRY M.), b. near Denbigh, Wales, in 1840, of humble parentage; he was placed in the poorhouse, where he remained until his thirteenth year, after which he taught in a school, and subsequently shipped as cabin-boy for New Orleans, where he was adopted by a merchant, whose name he assumed instead of his own, which was JOHN ROWLANDS. His adoptive father having died without a will, and the civil war breaking out, he enlisted in the Confederate army; was taken prisoner; volunteered in the U. S. navy, and became acting ensign on an iron-clad. After the close of the war, he went as a newspaper correspondent to Turkey and Asia Minor, and in 1868 accompanied the British expedition to Abyssinia as correspondent of the New York *Herald*, a portion of his correspondence being subsequently embodied in a volume. In Oct., 1869, being then in Spain, he was employed by the *Herald* to head an expedition to learn the fate of Livingstone, the African explorer, from whom only vague intimations had been heard for two years. He reached Zanzibar in Jan., 1871, and toward the end of March set out for the interior, with a company of 192 men. In November he found Livingstone, who was living near Lake Tanganyika, whom he furnished with supplies for further explorations. After having explored the N. portion of the lake, Stanley set out on his return journey in Mar., 1872, reaching England in July, where he was received with distinguished honor, the queen sending him a gold snuff-box set with diamonds, and the Royal Geographical Society awarding to him in 1873 its "patron's medal." Under the title *How I Found Livingstone* he published in Nov., 1872, an account of this expedition, which appeared simultaneously in London and New York. Tidings having been received of the death of Livingstone in Central Africa, Stanley was placed at the head of an expedition, the cost of which was jointly undertaken by the New York *Herald* and the London *Telegraph*, to explore the lake-region of Equatorial Africa. He left the coast in Nov., 1874, at the head of 300 men, and after many hardships and some severe contests with the natives, reached Lake Victoria N'yanza Feb. 27, 1875, having in the mean time lost 194 men by death and desertion. He circumnavigated the lake in a boat which he had brought with him in pieces, and found it to be a single large lake, and not, as supposed by Burton and Livingstone, a group of lagoons, thus confirming the opinions of Speke and Grant. Up to this point his despatches to the *Herald* and *Telegraph* detail his proceedings. He started Apr. 17, 1875, to continue his explorations in the direction of Lake Albert N'yanza. He arrived at the mouth of the Congo River Aug. 12, 1877, having explored its whole course, hitherto unknown. A. H. GUERNSEY.

Stanley (J. M.), b. at Canandaigua, N. Y., in 1814; became a portrait-painter at Detroit in 1835, practising his profession in various places, and occupying much of his time in long journeys and residences among the Indian tribes for the purpose of painting the portraits of their principal chiefs. From 1851 to 1863 he resided at Washington, where his collection of Indian portraits and other pictures was one of the attractions of the Smithsonian Institution; these were destroyed by fire in Jan., 1865, after which he again took up his residence in Detroit.

Stanley (JOHN), b. in England in 1713; lost his sight by an accident at the age of two years, but evinced such extraordinary aptitude for music that at the age of eleven he was elected over many competitors organist of All Hallows church, Bread street, London, and two years later of St. Andrew's, Holborn; became organist to the Middle Temple 1734, and master of the king's band 1779; was for many years the conductor of the celebrated Lent oratorios at Drury Lane Theatre, and published many songs, cantatas, and voluntaries which were widely popular. D. in London May 19, 1786.

Stanley (JOHN THOMAS), FIRST BARON STANLEY OF ALDERLEY, b. at Alderley, Cheshire, England, in 177 , being the eldest son of Sir John Thomas Stanley, Bart., the representative of an ancient Cheshire family, descended from the earls of Derby; was for many years an active Whig

member of Parliament, rendering services for which he was created Baron Stanley of Alderley in 1839. D. in 1850.

Stanley (Thomas), b. at Comberlow, Hertfordshire, England, in 1625; was carefully educated at home; graduated M. A. at Pembroke Hall, Cambridge, 1641; travelled on the Continent; studied law at the Middle Temple; published in 1647 a volume of *Poems and Translations* (from Anacreon, Bion, Moschus, etc.), frequently reprinted; issued his great work, *The History of Philosophy, containing the Lives, Opinions, Actions, and Discourses of the Philosophers of every Sect*, in 4 vols., at intervals between 1655 and 1662 (2d ed. folio, 1687; best ed., with *Life* of the author, 4to, 1743), and in 1663 his elaborate edition of *The Tragedies of Æschylus*, with Latin translation, Greek scholia, and commentary, which long maintained its ground among English scholars. D. in London Apr. 12, 1678. A *Memoir* by Sir Egerton Brydges was prefixed to a modern edition of Stanley's *Poems* (1814).

Stan'nard, p.-v. and tp., Caledonia co., Vt. P. 228.

Stannic Acid. See Tin.

Stanovoi' Mountains, a wild and rugged chain of mountains in North-eastern Asia, rising in lat. 50° N., lon. 110° E., forming the boundary between Siberia and the Chinese provinces of Mongolia and Mantchooria, and continuing along the Sea of Okhotsk to Behring Strait. As far N. as lat. 55° they are clad with forests; N. of lat. 65° they are covered with snow. Their eastern part is generally called the Yablonoi Mountains, and is very rich in metals.

Stans'bury (Howard), b. in New York Feb. 8, 1806; became a civil engineer; was engaged in surveys of Western rivers, and in 1835 was in charge of several public works in Indiana; was appointed first lieutenant of topographical engineers in 1838, captain in 1840, and major in 1861. In 1841 he was employed in the survey of the great lakes; in 1842-45 had charge of the survey of the harbor of Portsmouth, N. H.; in 1847 of the construction of the large iron lighthouse on Carysfort Reef, Fla.; in 1849-51 was a member of the Great Salt Lake expedition, of which he prepared an admirable report; in 1852-53 was employed upon the lake harbors; in 1856 was assigned to the charge of military roads in Minnesota; and subsequently was mustering and disbursing officer at Madison, Wis., where he d. Apr. 17, 1863.

Stan'sfeld (James), b. at Halifax, England, in 1820; educated at University College, London; was called to the bar at the Inner Temple 1849; was elected member of Parliament for Halifax as an advanced Liberal Apr., 1859; was appointed a lord of the admiralty Apr., 1863; resigned that position Apr., 1864, in consequence of an official disapproval of his friendship with the patriot Mazzini, whose revolutionary plans in regard to King Victor Emmanuel had just been discovered; was under-secretary of state a few months in 1866; became third lord of the treasury Dec., 1868, one of the joint-secretaries to the treasury Oct., 1869, president of the poor-law board Mar., 1871, was president of the new "local government board" from Aug., 1871, until the resignation of Gladstone's cabinet, Jan., 1874, and in April, 1880, was reappointed to same office.

Stan'stead, county of Quebec, Canada, bounded S. by Vermont and W. chiefly by Lake Memphremagog. It is generally fertile, and possesses much mineral wealth. Cap. Stanstead Plain. P. 13,138.

Stanstead, or **Stanstead Plain**, a port of entry, cap. of Stanstead co., Quebec, Canada, on Massawippi Valley and South eastern Railway, 5 miles N. of North Derby, Vt., to which a branch railroad runs. It has some fine public buildings, a public library, a branch bank, a weekly newspaper, an insurance company, and a seminary. Mineral paint (a soft talcose slate) and fine granite are found here. P. of Stanstead Plain, 574; of Stanstead sub-district, 4022.

Stan'ton, county of S. W. Kansas, not organized or included in the census of 1870. It borders on Colorado River, and is drained by tributaries of the Arkansas. The surface is generally rolling. Area, about 720 sq. m.

Stanton, county of N. E. Nebraska, intersected by Elkhorn River. It consists for the greater part of rolling prairies, adapted to the production of wheat, corn, and other grains, and for grazing. Cap. Stanton. Area, 432 sq. m. P. 636.

Stanton, tp., Champaign co., Ill. P. 1088.

Stanton, tp., Plymouth co., Ia. P. [illegible]56.

Stanton, tp., Linn co., Kan. P. 5[illegible]8.

Stanton, p.-v. and tp., Miami co., Kan. P. 844.

Stanton, p.-v., cap. of Powell co., Ky., on Red River. P. 73.

Stanton, p.-v., cap. of Montcalm co., Mich., at N. terminus of Stanton branch of Detroit Lansing and Lake Michigan R. R., is chiefly in Day tp., but partly in Douglass, Evergreen, and Sidney tps., and has 1 weekly newspaper. P. 600.

Stanton, p.-v. and tp., cap. of Stanton co., Neb., on Elkhorn River, has 1 weekly newspaper.

Stanton, p.-v., Haywood co., Tenn., on Memphis division of Louisville Nashville and Great Southern R. R.

Stanton (Edwin McMasters), b. in Steubenville, O., Dec. 19, 1814; admitted to the bar in 1836; reporter of the supreme court of Ohio 1842-45, reporting vols. xi.-xiii. of *Ohio Reports*. In 1845 he successfully and with distinction defended in the criminal court at Washington Caleb J. McNulty, clerk of the House of Representatives, tried for embezzlement. In 1847, Mr. Stanton became the law partner at Pittsburg, Pa., of Hon. Charles Sharler. He first acquired national reputation as a lawyer in the important case of The State of Pennsylvania *vs.* The Wheeling Bridge Company, involving the question whether control of bridges over navigable rivers of the West flowing between the several States is vested by the Constitution in Congress or the State legislatures. Virginia had authorized the erection across the Ohio at Wheeling of a suspension bridge which would obstruct or retard the passage of first-class river-steamers owned largely at Pittsburg. To avoid irresistible prejudice in Virginia in favor of the bridge, Mr. Stanton conceived the project of making the State of Pennsylvania plaintiff in a suit against the bridge company, on the ground of the State's ownership of canals terminating on the river, the value of which would be injured by obstructing the navigation of the Ohio, and of thus obtaining original jurisdiction in the U. S. Supreme Court. It was decided that Pennsylvania's interest in the controversy gave her standing in that court, and that regulation of bridges over navigable rivers of the West is vested in Congress, exclusive of State control. Successive arguments in the case by Mr. Stanton were so marked by legal learning, logic, and eloquence that at once, and at a comparatively early age, he took place in the front rank of national lawyers. In 1856 he removed to Washington to attend to his practice before the U. S. Supreme Court. Among other important cases at this period, he was counsel for defendant in McCormick *vs.* Manny, a suit for infringement of McCormick's reaper patent, which involved a quarter of a million of dollars, and the question whether by certain improvements in details a monopoly of the entire machine could be appropriated. McCormick's claims were successfully resisted, and in consequence of the declaration of law in this case hundreds of improvers of the reaping-machine immediately entered the field, and the art has since been developed far beyond almost any other kindred to it. In 1858, Mr. Stanton went to California, and remained nearly a year as counsel for the U. S. in certain land cases involving many millions of dollars. Besides carrying to a successful issue those cases to which his employment especially related, Mr. Stanton's services were invaluable in the collection, collation, and translation of Mexican archives. Many of the most important archives were scattered over California in the custody of unauthorized officers, in the possession of private individuals, or in boxes which nobody guarded and which had never been opened. Their value either historically or as evidence in land cases had been almost wholly unknown, but was promptly perceived by Mr. Stanton, who at once took steps for their collection and collation. The archives collected through his efforts furnished conclusive evidence of an organized system of fabricating land-titles carried on for a long time in California. The value of lands claimed under forged grants was estimated at not less than $150,000,000. Large agricultural tracts, some of the richest mines in the world, and the sites of government buildings, of fortifications, and of whole cities, including San Francisco and Sacramento, were claimed under alleged grants from Mexico, forged with consummate skill and boldness, and so well supported by documentary evidence and oral testimony of distinguished officials under the former government that local tribunals of the U. S. in California had acted favorably on many of the claims. Afterward, however, these archives furnished the means of distinguishing valid from forged grants, and enabled a successful defence to be made to every fraudulent claim.

In Dec., 1860, after Mr. Lincoln's election, and before his inauguration, and when active preparations were making for secession, and the indications as to the political future of the country were appalling, Mr. Cass, then secretary of state, suddenly resigned, and Mr. Black, then attorney-general, succeeded him. Mr. Stanton, then in Cincinnati arguing a case before the U. S. circuit court, was appointed attorney-general. Acceptance of the office

involved relinquishment of profitable professional business and assumption of great responsibility, with little prospect of personal distinction. Mr. Stanton had never desired office, nor had he rendered to Mr. Buchanan's administration or party services calling for political preferment. Mr. Buchanan at that time was not so solicitous about conferring political rewards as he was anxious concerning immunity from calamity and disgrace for his administration during its few remaining perilous months. Mr. Stanton's personal and professional qualifications were needed. He accepted the office, and in it his attitude was that of resolute maintenance of national honor and determined opposition to treason, then organizing and arming. Every department then contained traitors and spies; only a handful of U. S. troops was assembled at Washington, and the residents of the capital were mainly in sympathy with secession. To a greater extent probably than any of his associates in the cabinet, Mr. Stanton perceived the danger of an attempt by force and treachery to prevent Mr. Lincoln's inauguration, to seize and hold the capital and insignia of government for the seceding States, and to thus exhibit the latter to the world as a government *de facto*, succeeding to the power and authority of the U. S. Always intense in conviction and earnest in action, he appreciated thoroughly the existence of this peril, and made, and stimulated others to make, preparation against such fatal occurrences. On Mar. 4, 1861, Mr. Stanton retired with the outgoing administration and resumed his profession. After the civil war had existed several months, patriotic citizens and eminent capitalists, without Mr. Stanton's knowledge, urged Pres. Lincoln to place him in charge of the war department. Their motives and arguments were again not political, but proceeded from conviction that Mr. Stanton had the needed nerve, force, judgment, and integrity. On Jan. 20, 1862, he became secretary of war. Excepting a brief meeting in 1857 in Cincinnati, in a lawsuit in which they were both of counsel, there had previously been no intercourse between Mr. Lincoln and Mr. Stanton; but after the latter entered the war department, their mutual friendship and confidence grew with every day. The characteristics of Mr. Stanton's administration were integrity, energy, determination, singleness of purpose, and capacity to comprehend the magnitude of the rebellion and the labor and cost in blood and treasure involved in suppressing it. He believed that the end of the rebellion would come only by exhausting and crushing the forces and resources of the enemy. Exercising indefatigable industry, courage, and self-devotion himself, he visited the slightest indolence, indifference, or cowardice in others with punishment prompt and severe. Honest to the last degree himself, he required the utmost integrity from others.

After Mr. Lincoln's assassination and Mr. Johnson's accession to the Presidency, Mr. Stanton was connected with the latter's administration for three years. He supported many measures which were vetoed by the President and re-enacted by Congress, including those for the establishment of the Freedmen's Bureau, for protection of civil rights, for admission of Colorado as a State, for organization of governments in insurrectionary States, and for conferring suffrage without regard to color in the District of Columbia. These differences of opinion, and the continued adherence of Mr. Stanton to the Republican party, and the President's separation from and aggressive hostility toward it, led the President on Aug. 5, 1867, to notify Mr. Stanton that public considerations of a high character constrained him to request the latter's resignation; to which Mr. Stanton answered that public considerations of a high character, which alone had induced him to remain at the head of the department, constrained him not to resign before the next meeting of Congress. On Aug. 12 the President notified him of his suspension from office. After Congress convened, the Senate refused by a vote of 35 to 6 its concurrence in the suspension. Having received official information of this from the Senate, Mr. Stanton on the next day (Jan. 13, 1868) resumed his office. On Feb. 21, 1868, the President undertook to remove him and to appoint Lorenzo Thomas secretary of war *ad interim*. The Senate, being on the same day officially informed by the President of this action, resolved that under the Constitution and laws the President had no power to remove the secretary of war and designate another officer to perform the duties of that office, and officially communicated this resolution to Mr. Stanton. The House of Representatives immediately decided to impeach the President. In consequence of this action of both houses of Congress, and the general apprehension of revolutionary purposes on the part of the President, Mr. Stanton refused to relinquish control of his department. The President's trial under articles of impeachment followed. A vote was reached on May 26, and 35 Senators voted for conviction, and 19 for acquittal; so that two-thirds not having found the President guilty, he was acquitted. A single vote would have changed the result. Mr. Stanton immediately relinquished his office. The Senate on May 28 again resolved that Mr. Stanton had not been legally removed, and based its confirmation of his successor, Gen. Schofield, upon Mr. Stanton's voluntary retirement. Soon afterward both Houses of Congress passed a vote of thanks to him for his great ability, purity, and fidelity.

With his health shattered by his labors in the war department he resumed his profession and argued several important cases. The last was Whitney *vs.* Mowry, an important patent cause, which, in consequence of Mr. Stanton's feeble health, was heard by Judge Swayne in Mr. Stanton's own library two weeks before the latter's death. The physical pain silently endured during the hearing of this cause exhausted his strength and hastened the progress toward his heart of the dropsy from which he was then suffering. He never again left his chamber. On Dec. 20, 1869, he was nominated by Pres. Grant as an associate justice of the U. S. Supreme Court, and was immediately confirmed by the Senate. But on Dec. 24, and before he had entered upon the duties of a member of that court, he died of the dropsy. The disease was due to the general breaking down of an overworked constitution, and its fatal progress was exceedingly rapid. J. K. BARNES.

Stanton (ELIZABETH **Cady**), b. at Johnstown, N. Y., Nov. 12, 1815, daughter of Judge Daniel Cady and Margaret Livingston; educated at the Johnstown Academy, where she studied with a class of boys; was fitted for college at the age of fifteen, when she pursued her studies at Mrs. Willard's seminary at Troy; had her attention turned to the disabilities of sex by her own educational experience and through a study of Blackstone, Story, and Kent; married, in 1840, to Henry B. Stanton; accompanied him to the World's Anti-Slavery convention at London; there made the acquaintance of Lucretia Mott; resided at Boston until 1847, when they settled at Seneca Falls, N. Y.; with Lucretia Mott signed the call for the first woman's rights convention, which met at her place of residence July 19–20, 1848, on which occasion the first formal claim of suffrage for women was made; addressed the New York legislature in 1854 on the rights of married women, in 1860 in advocacy of divorce for drunkenness, and in 1867 both the legislature and the constitutional convention, maintaining that during the revision of the constitution the State was resolved into its original elements, and that *all* the citizens had therefore a right to vote for members of that convention. Since 1869 she has frequently addressed Congressional committees and State constitutional conventions. She canvassed Kansas in 1867, and Michigan in 1874, when the question of woman suffrage was submitted in those States; was one of the editors of *The Revolution*. Most of the calls and resolutions for conventions, addresses to women, legislatures, and Congress, have been from her pen. She was president of the national committee 1855–65, of the Woman's Loyal League 1863, and of the National Association until she withdrew in 1873, and elected to do the honors of the association this year. She now (1876) resides in Tenafly, N. J. SUSAN B. ANTHONY.

Stanton (HENRY BREWSTER), b. at Griswold, Conn., June, 1805; educated at Lane Seminary, O., while Dr. Lyman Beecher was its president; was closely identified with the anti slavery cause from 1833 till the adoption of the 15th Amendment to the Constitution; was secretary of the World's Anti-Slavery Convention at London 1840, whereof Thomas Clarkson was president; admitted to the bar 1842 at Boston, Mass.; practised there with great success six years, when he removed to Seneca Falls, N. Y.; was elected to the New York senate 1849, and re-elected 1851; deputy collector of New York 1861; practised law twelve years in that city; author of *Reforms and Reformers of Great Britain and Ireland* (New York, 1849; London, 1853); fifteen years a leading editorial contributor to the New York *Tribune* and the New York *Sun*; a large contributor to prominent literary periodicals; an eloquent orator and able writer. On the mother's side he is a lineal descendant of William Brewster, the Pilgrim.

Stantons'burg, tp., Wilson co., N. C. P. 1007.

Stan'wix (JOHN), b. in England about 1690; entered the British army 1706; served as an officer of grenadiers and marines; became lieutenant-colonel 1745; equerry to Frederick, prince of Wales, 1749; was governor of Carlisle and its representative in Parliament 1750; became deputy quartermaster-general of the forces 1754; was made colonel commanding the first battalion of the 60th regiment (Royal Americans) Jan. 1, 1756; was in command of the southern district of the American colonies, with head-quarters at Carlisle, Pa., 1757; was appointed brigadier general Dec. 27, 1757; was relieved by Gen. Forbes early in 1758, and

entrusted 1758 with the erection of the important fortress known as Fort Stanwix at the "Oneida carrying-place" (now Rome) on Mohawk River, at an expense of £60,000, as a defence against incursions from the French in Canada; returned to Pennsylvania; was appointed major-general June 19, 1759; repaired and fortified the old fort Du Quesne at Pittsburg, conciliating the good-will of the Ohio Indians; resigned his commission in America to Gen. Monckton May 4, 1760, and returned to England; was appointed lieutenant-general Jan. 19, 1761; was made lieutenant governor of the Isle of Wight and colonel of the 8th Foot, and was elected member of Parliament for Appleby. He was lost at sea in Dec., 1765, while crossing the Irish Channel from Dublin to Holyhead.

Stan'wood, p.-v., Fremont tp., Cedar co., Ia., on Iowa division of Chicago and North-western R. R. P. 257.

Stan'yhurst (RICHARD), b. in Dublin about 1545; educated at University College, Oxford; studied law; returned to Ireland; married, became a Roman Catholic, and went to the Continent. On the death of his wife became a priest, and was appointed chaplain to Archduke Albert, governor of the Spanish Netherlands. D. at Brussels in 1618. He translated into English heroic verse *The First Foure Bookes of Virgils Æneis* (1583); furnished a *Description of Ireland* to Holinshed's *Chronicles*; wrote historical treatises (in Latin) on Ireland, and English and Latin theological works.

Stapelia. See CARRION FLOWERS.

Staphylea. See BLADDER-NUT.

Staphylinidæ. See ROVE BEETLES.

Sta'ples (WILLIAM READ), LL.D., b. at Providence, R. I., Oct. 10, 1798; graduated at Brown University in 1817; was admitted to the bar in 1819; was associate judge of the supreme court of the State 1835–54, and chief-justice 1854–56. He was one of the founders of the Rhode Island Historical Society; for many years its secretary and librarian, and a vice-president at his death, also editing the 20 vols. of its *Collections*, to the 5th vol. contributing the *Annals of Providence*. Besides historical monographs, he published the *Rhode Island Book of Forms* (1859), and left unfinished a *History of the Criminal Law in Rhode Island*, *Rhode Island in the Continental Congress*, and a *History of the State Convention of 1790*, since published. D. at Providence Oct. 19, 1868.

Sta'pleton, p.-v. and tp., Chickasaw co., Ia. P. 800.

Stapleton, p.-v., Richmond co., N. Y., in lat. 40° 39' N., lon. 74° 04' W., 8 miles S. of New York City, on Staten Island, contains 10 churches, a circulating library, 2 public schools, 1 private institute, water and gas works, paved streets, an infirmary, the Seamen's Retreat, Old Ladies' Home of the Mariner's Industrial Society, 1 savings bank, Keutgen Observatory, 6 large breweries, an efficient police force, several manufactories, a shot-tower, 3 newspapers, and the health officer's station. The heights are occupied by elegant mansions, and a horse railway passes through the principal streets. P. about 10,000.

W. C. ANDERSON, ED. "RICHMOND CO. GAZETTE."

Stapleton (Sir ROBERT), LL.D., b. at Carleton, Yorkshire, England, about 1615; was educated in the Roman Catholic college at Douay, France, but became a Protestant on his return to England; became gentleman usher to the prince of Wales, afterward Charles II.; fought at Edgehill under Charles I., by whom he was knighted; accompanied Charles II. on his entry into London 1660, and was munificently rewarded for previous sufferings on account of his loyalty to the Stuarts. D. July 11, 1669. He translated *Musæus* (1645), *Juvenal* (1647), Strada's *Belgic War* (1650), and Pliny's *Panegyric* (1664), and wrote comedies and poems.

Stapleton (THOMAS), D. D., b. at Henfield, Sussex, England, in 1535; educated at Canterbury and Winchester schools and at New College, Oxford, where he was admitted perpetual fellow 1554; took orders in the Church, turned Roman Catholic; was appointed by Queen Mary prebendary of Chichester; retired on the accession of Elizabeth to Louvain, where he acquired publicity by writing as a Roman Catholic against Jewel, Horne, Whitaker, and other Protestant divines; became regius professor of divinity at the University of Douay and canon of the church of St. Amatus; was for a short time a Jesuit; returned to Louvain, where he was appointed divinity professor, canon of St. Peter's, and dean of Hilverbee, near Bois le Duc. D. at Louvain Oct. 12, 1598. Among his works were an English translation of Bede's *History of the Church of England* (Antwerp, 1565), *Propugnaculum Fidei Primitivæ Anglorum* (1565), *Principiorum Fidei Doctrinalium* (Paris, 1579), *Tres Thomæ*, etc. (1588), being "parallel lives" of Thomas the apostle, Thomas à Becket, and Sir Thomas More, *Promptuarium morale* (Antwerp, 4 vols., 1593), and *Promptuarium Catholicum* (1622). A complete edition of his *Works* appeared at Paris (4 vols. folio, 1620).

Star. See STARS, by P. A. SECCHI.

Star Anise. See ANISE.

Star'-Apple, the large, handsome, and agreeable fruit of *Chrysophyllum cainito*, a West Indian shrub of the order Sapotaceæ.

Staray'a Rus'sa, town of European Russia, government of Novgorod, on the Polista, has an imperial palace and rich salt springs. P. 8700.

Starch, Fecula, Amidon, Amylum, or **Stärke** ($C_6H_{10}O_5$ or $C_{12}H_{20}O_{10}$), a substance widely diffused in the vegetable kingdom, being found in almost every plant, at least at some period of its development. It is especially abundant in some families of plants, and often occurs in large quantities in the seeds, pith, stalks, bark, bulbs, tubers, roots, etc. The following table, by Dr. Dragendorff, taken from S. W. Johnson's *How Crops Grow*, shows the proportion of starch in a few vegetable products. The quantities are, however, somewhat variable. Since the figures below mostly refer to air-dry substances, the proportions of hygroscopic water are also given, the quantity of which, being changeable, must be taken into account in making any strict comparisons:

Amount of Starch in Plants.

	Water, per cent.	Starch, per cent.
Wheat	13.2	59.5
Wheat flour	15.8	68.7
Rye	11.0	59.7
Oats	11.9	46.6
Barley	11.5	57.5
Timothy-seed	12.6	45.0
Rice (hulled)	13.3	61.7
Peas	5.0	37.3
Beans (white)	16.7	33.0
Clover-seed	10.8	10.8
Flaxseed	7.6	23.4
Mustard-seed	8.5	9.9
Colza-seed	5.8	8.6
Teltow turnips	dry substance.	9.8
Potatoes	dry substance.	62.5

There are two other substances found in plants which resemble starch in many respects—the inuline which occurs in the dahlia, elecampane, dandelion, chicory, mustard-seed, etc., and the lichen starch which is found in Iceland moss, carrageen moss, and several of the lichen and fucus tribes of plants. (See INULINE and LICHENINE.) A substance supposed to be starch has been observed in certain parts of the animal body. Granules, which after being moistened with oil of vitriol turn blue on the addition of iodine, occur in the brain, spleen, liver, kidneys, and mucous membranes. This is, however, not true starch; it contains nitrogen, and does not yield sugar when heated with dilute acids. A substance exhibiting the physical and chemical characters of starch has been found in the yolk of hen's eggs and in the testicles. GLYCOGEN (which see), the sugar-forming substance of the liver, has the composition and many of the properties of starch.

Preparation.—Starch is extracted from a great variety of plants, chiefly from wheat, Indian corn, rice, potatoes, the root of manioc or cassava, *Jatropha manihot* (tapioca), the root of several species of the *Maranta* (arrowroot), and the pith of a great variety of palms (sago). (For an elaborate article on the edible starches of commerce by P. L. Simmonds see *Am. Chemist*, iv., Sept., 1873, p. 93.)

Wheat Starch.—Wheat flour contains from 50 to 80 per cent. of starch. Polson gives the following as the composition of samples of the entire wheat:

	Old American.	New Scotch.
Water	10.8	14.8
Starch	62.3	56.9
Fat	1.2	1.2
Cellulose	8.3	12.4
Gum and sugar	3.8	5.3
Gluten, albumen, etc	10.9	7.0
Ash	1.6	1.5
	98.9	99.1

The starch is extracted from the whole wheat by "softening" in cold water and pressing under millstones or rollers, or in bags under water, as long as milky water runs off from it. This liquid, when left to itself, deposits starch containing gluten; the latter, however, dissolves for the most part in the supernatant liquid, which gradually turns sour; and on decanting this acid liquid, repeatedly stirring up the starch with fresh water, and leaving it to settle, it is at length obtained pure, and may be dried in suitable desiccating chambers. Or wheat flour is mixed with 4 to 5 volumes of water, and $\frac{1}{2}$ to $\frac{1}{10}$ volume sour water obtained from former operations; this sets up a fermentation, which lasts from two to four weeks, according to the temperature,

and is interrupted as soon as the nitrogenized substances are decomposed and dissolved. The sediment of starch, which remains at the end of a fermentation, is repeatedly washed with water, sifted, and dried in desiccating chambers. Starch may be freed from gluten by means of cold dilute potash-ley (*Kirchhoff*) or distilled vinegar (*Saussure*); from pieces of fat and other matter by prolonged treatment with cold water, alcohol, or ether. (Watts's *Dict.*)

Corn Starch is extensively manufactured in the U. S. by soaking in water containing caustic soda or hydrochloric acid to dissolve the gluten, grinding, washing on sieves, etc. The manufacture of starch from Indian corn was established in the U. S. by Thomas Kingsford in 1842, while he was superintending the wheat-starch factory of W. Colgate & Co. in New Jersey. In 1848 a factory was built for him at Oswego, N. Y., by a stock company, which by repeated enlargement has reached enormous dimensions. The works occupy about 10 acres, and have a capacity for treating 950,000 bushels of corn per annum. The yield of starch is about 25 pounds per bushel, or nearly 50 per cent. This amounts to a yearly production of 10,300 tons, or 20,600,000 pounds of starch. To pack this starch 300,000 pounds of wrapping-paper are required, and 5,000,000 feet of lumber for boxes. Over 600 operatives are employed in the establishment. The factory is about 615 feet front, partly seven stories high, and contains 12 acres of flooring. There are over 600 cisterns and vats, with a capacity of 2,500,000 gallons, for cleansing and washing the starch; 41 force-pumps are capable of raising 530,000 gallons of water per hour. There are more than 3 miles of gutters for distributing the starch. For grinding the corn 20 pairs of burr-stones and 6 pairs of large heavy iron rollers are used. There are 3 miles of shafting, 20 miles of steam-pipe for drying, 12 turbine water-wheels of 50 horse-power each, with steam-engines sufficient to increase the entire motive-power to 1400 horse-power. The starch is sent to market in three forms: (1) pulverized corn starch, called in England "prepared corn," for culinary use and as food for infants and invalids; (2) refined starch for the laundry; (3) manufacturers' starch for print-works, etc. There is a similar factory at Glen Cove, Long Island, which was established by the Messrs. Duryea in 1858, which is of very nearly the same capacity. The cheapness and excellence of this starch has put an end to the importation of starch from foreign countries, and large quantities are now exported.

Rice Starch is largely manufactured in England, France, and Belgium. The rice is first soaked in a weak ley, then ground, and washed on a sieve.

Potato Starch is largely manufactured in Europe and in the U. S. Potatoes contain—

	Fresh.	Dried at 212° F.
Water	75.1	
Starch	21.	83.8
Albumen, etc	2.3	9.6
Fat	0.2	0.8
Cellulose	0.4	1.7
Salts	1.0	4.1
	100.	100.

"The washed and rasped potatoes are drenched in a sieve with a continuous stream of cold water, and the milky liquid which runs through is set aside for a few minutes till the heavier impurities have settled down, and then left to stand for three or four hours in another pan. The starch which collects at the bottom of the clear liquid is stirred up with water, poured through hair sieves, then left to settle, repeatedly washed with cold water, and dried, first on plates of gypsum, afterward in desiccating chambers." (Watts's *Dict.*) At Stowe, Vt., and Watertown, Mass., there are several factories. A single factory often consumes 20,000 bushels of potatoes annually, averaging 8 pounds of starch per bushel. The land often produces 500 bushels per acre.

Horse-chestnut Starch is made in France. A solution of sodic carbonate is used to remove the bitter principle. The yield is about 20 per cent.

(For Arrow-root, Sago, and Tapioca Starch, see under respective heads.)

Composition of Commercial Starch.—The following analyses are given by Wolff:

	1.	2.	3.	4.	5.	6.
Water	17.83	15.38	14.52	17.41	14.20	17.49
Gum	......	......	0.10	traces.	1.84	4.96
Fibre	0.48	0.50	1.44	1.20	3.77	2.47
Ash	0.21	0.53	0.03	0.40	0.55	1.29
Starch	81.48	83.59	83.91	81.32	79.63	73.79
	100.	100.	100.	100.	100.	100.

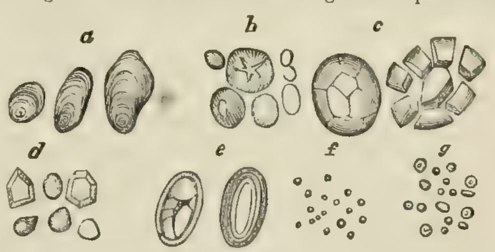
1, the finest white patent starch in stalks, of a bright and crystalline appearance, made from pure potato starch; 2, the finest blue patent starch, potato starch colored with ultramarine; 3, pure wheat powder; 4, fine wheat starch in pieces; 5, medium fine wheat starch in yellowish-white pieces; 6, ordinary wheat starch in grayish-yellow coarse pieces, that upon microscopic examination appear as a mixture of potato and wheat starch. (Wagner's *Tech.*) The following analyses were made by John Dean, Ph. D. (*Proc. Am. Acad. Arts and Sci.*, Apr., 1854):

	Dried at 212°.				
	Starch, etc.	Gluten, etc	Ash.	Water.	Loss at 212° Water.
Corn starch, powder	94.16	0.69	0.32	4.83	16.01
Corn starch, lumps	92.88	2.38	.42	4.32	11.88
Tapioca	95.49	.61	.11	3.79	13.32
Arrow-root	95.44	.88	.21	3.47	16.51
Sago	96.65	.83	.19	2.03	12.83
Wheat starch	94.71	1.12	.51	3.66	11.28
Rice flour	88.65	8.24	.49	2.62	14.01
Macaroni	86.99	9.56	.95	2.50	9.90
Prepared potato	82.77	11.09	3.99	2.15	10.07
Farina	81.23	13.52	.51	4.74	10.30

Properties.—"Starch is a white shining powder, soft to the touch, grating between the fingers or the teeth, sometimes consisting of amorphous masses, but more frequently of granules recognizable by the microscope. Specific gravity, air-dried, 1.50; dried at 212° F., 1.56 to 1.63. These granules, of various diameter [from $\frac{1}{30}$th to $\frac{1}{800}$th of a line (*Fritzsche*), from .185 to .002 millimètre (*Payen*)] and various form, have commonly a small eccentric nucleus, surrounded by layers arranged concentrically one over the other. These envelopes increase by the successive deposition of new layers within the old ones, so that each layer is younger and less compactly aggregated than the one which immediately surrounds it; and since the layers are for the most part of variable thickness, they cause the granule to deviate gradually in form from the originally spherical nucleus, and assume for the most part an ovoid form. According to Maschke, the starch-granules appear like bundles of three to six concentric bladders, with light and dark rings, the light rings being formed of insoluble, the dark of soluble starch, and enclosing the central cavity of the innermost bladder, which is either empty, or filled with liquid amylone." (Watts's *Dict.*) Payen gives the greatest diameter of several kinds of starch-grains; the following are a few of his measurements:

Starch from—	Millimètre.	Inch.
Large Rohan potatoes	0.185	$\frac{1}{137}$
Canna gigantea	0.175	$\frac{1}{145}$
Maranta arundinacea (arrow-root)	0.140	$\frac{1}{181}$
Sago	.070	$\frac{1}{362}$
Wheat	.050	$\frac{1}{510}$
Maize (Indian corn)	.030	$\frac{1}{847}$
Beetroot	.004	$\frac{1}{6369}$

S. W. Johnson (*How Crops Grow*) gives the following account of the forms of starch-granules: "In potato starch they are egg or kidney shaped, and are distinctly marked with curved lines or ridges, which surround a point or eye; *a* of figure. Wheat starch consists of grains shaped like a



Starch-granules.

thick burning-glass or spectacle-lens, having a cavity in the centre, *b*. Oat starch is made up of compound grains, which are easily crushed into smaller granules, *c*. In maize and rice the grains are usually so densely packed in the cells as to present an angular (six-sided) outline, as in *d*. The starch of the bean and the pea has the appearance of *e*. The minute starch-grains of the parsnip are represented at *f*, and those of the beet at *g*." The unaltered and the gelatinous starch in a dry state have the same empirical formula, $C_6H_{10}O_5$ or $C_{12}H_{20}O_{10}$. Heated to 160° C., starch is converted into Dextrine (which see), first passing through the condition of soluble starch, which is rendered blue by iodine. "Starch, so long as it retains its natural state of aggregation, is insoluble in *water*, *alcohol*, and *ether*; but when it is placed in contact with *hot water*, the water penetrates between the different layers of which the granules are composed, swelling them up, and forming a gelatinous mass known as *starch-paste*, and used for stiffening linen, etc. If this paste be largely diluted with water, the swollen starch-granules slowly subside, whilst a certain quantity of amylaceous matter remains in solution. When water into which one or two hundredths of starch have been introduced is heated to boiling, the grains swell, and disintegrate till they appear to be dissolved in the water; but

on exposing the liquid to a temperature below zero, the water freezes, and the starch, recovering a certain degree of aggregation, separates from the liquid in the form of small pellets. When starch is boiled under pressure at about 150°, with from five to fifteen times its weight of water, a clear solution is obtained, which may be filtered from the insoluble portion: this liquid, as it cools, deposits minute spherical granules, which, when dried, have the whiteness of starch without its glistening aspect. These granules are slightly soluble in cold water, but are readily dissolved when the water is heated to 70° or upward. This soluble starch, which is distinguished from dextrine by being turned blue by iodine, and by possessing a greater dextro-rotary power (=211° according to Béchamp, whereas that of dextrine is 176°), is likewise produced from common starch by the action of *diastase* at ordinary temperatures: by heating it for a certain time with *dilute sulphuric acid*; by heating with *glacial acetic acid* in a sealed tube, or with strong *nitric acid* till red vapors begin to pass off: by boiling with *chloride of zinc*; and by trituration for a short time in the cold with *strong sulphuric acid*. If, however, the action of the diastase takes place at a temperature of 65°–80° (it is completely interrupted by boiling), or if the heating with dilute acids be continued beyond a certain time, the starch is converted into dextrine, and ultimately into dextro-glucose." (Watts's *Dict.*) Starch is converted into dextrine and glucose by the diastase of malt (see DIASTASE and BEER), yeast by saliva, pancreatic juice, gelatine, mucous membrane, urine, bile, spermatic fluid, blood-serum, animal tissue, and by watery infusions of the heart, brain, lungs, liver, kidneys, spleen, and muscles, and by boiling with dilute acids.

"It is generally supposed that in the action of acids or of diastase upon starch the starch is first converted into dextrine by a mere alteration of physical structure, and that the dextrine is then converted into glucose by taking up the elements of water, the second stage of the process occupying a much longer time than the first: but from the experiments of Musculus (*Compt. rend.*, l. 785; liv. 194; *Ann. Ch. Phys.* [3], lx. 208) it appears that both dextrine and glucose are produced at the very commencement of the reaction, and always in the proportion of 1 mol. glucose to 2 mol. dextrine, whence it may be inferred that the molecule of starch contains $C_{18}H_{30}O_{15}$, and that it is resolved into glucose and dextrine by taking up 1 mol. water:

$$\underset{\text{Starch.}}{C_{18}H_{30}O_{15}} + H_2O = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Dextrine.}}{2C_6H_{10}O_5}.$$

When the conversion is effected by a dilute acid, the dextrine is, after several hours' boiling, completely converted into glucose; but when diastase is used as the converting agent, the production of glucose goes on only so long as there is any unaltered starch still present, the dextrine undergoing no further alteration. These views have been contested by Payen (*Compt. rend.*, liii. 1217; *Ann. Ch. Phys.* [4], iv. 286; *Jahresb.*, 1861, p. 717; 1865, p. 597), who finds that diastase really possesses the power of converting dextrine into sugar, but that the conversion ceases as soon as a certain quantity of sugar has been produced: if, however, the sugar be removed as fast as it is formed, as in alcoholic fermentation, the transformation of the dextrine into sugar recommences, and goes on nearly to completion. Under favorable circumstances of the action of diastase on dextrine a product may be obtained containing more than 50 per cent. of sugar. Musculus, on the other hand (*Ann. Ch. Phys.* [4], vi. 177), adheres to his view of the unalterability of pure dextrine by diastase, and endeavors to show that the formation of sugar observed by Payen was due to the presence of amylaceous substance in the dextrine submitted to experiment. According to O. Philipp (*Bull. Soc. Chim.* [2], viii. 363), dextrine and glucose are not formed in constant proportions in the action of dilute sulphuric acid upon starch, as asserted by Musculus, but the proportion of glucose increases under otherwise equal circumstances with the quantity of acid employed. This, however, is quite in accordance with the known fact—not denied by Musculus—that dextrine is gradually converted into glucose by the action of dilute acids." (Watts's *Dict., Suppl.*)

Heated with glycerine, starch is gradually dissolved; alcohol precipitates it in the form of soluble starch. "With *nitric acid*, starch yields various products, according to the strength of the acid, the temperature, and the duration of the action: (*a*) Cold concentrated nitric acid (specific gravity = 1.52) dissolves starch without evolution of gas; water added to the solution precipitates xyloïdine or nitramidine, $C_6H_9(NO_2)O_5$, as a white powder. (*Braconnot, Pelouze.*) If water is added immediately, nothing remains dissolved; but if the solution is allowed to stand, it gives with water less and less xyloidine, and at last none, while a substance resembling saccharic acid remains in solution. (Pelouze, *Compt. rend.*, vii. 713.) (*b*) If starch is mixed with its own weight of concentrated nitric acid and twice its weight of ordinary nitric acid ($2NHO_3.3H_2O$), and allowed to stand for twenty-four or thirty hours at the mean temperature, or if it is mixed with enough common nitric acid to form a thick mud, and heated in the water-bath until red fumes are evolved, unorganized insoluble starch is at first produced, then starch soluble in hot water, and lastly starch soluble in cold water. (*Béchamp.*) Starch that has been moistened with $\frac{1}{50}$ per cent. nitric acid and water, and then allowed to dry spontaneously, yields dextrine when heated. (*Payen.*) A mixture of starch with 2 per cent. nitric acid and 4 per cent. water, dried at first in the air, afterward in a water-bath, gives, with 5 parts of warm water, a solution which solidifies to a jelly like lichenine on cooling, and gives sugar when boiled with acids. (Mitscherlich, *Pogg. Ann.*, lv. 121.) (*c*) Hot nitric acid, either concentrated or dilute, employed in excess, evolves nitrous gas and forms oxalic acid, together with malic and acetic acids.—*Nitric peroxide* acting on starch neither evolves gas nor produces oxalic acid. (Bouijs-Ballot, *J. pr. Chem.*, xxxi. 211.) A mixture of strong *nitric* and *sulphuric acids* converts starch into an explosive compound, analogous to or identical with guncotton (De Vrij, *Compt. rend.*, xii. 120). According to Béchamp (*Ann. Ch. Phys.* [3], lxiv. 322), the product consists of nitroxyloïdine or dinitramidine, $C_6H_8(NO_2)_2O_5$." (Watts's *Dict.*)

Chlorine has little effect on starch; bromine forms an orange-yellow compound; iodine forms a blue compound. Fresh starch paste is colored blue by a solution of iodine, or by adding an alkaline iodide and then liberating the iodine by a little chlorine-water, nitrous acid, etc. This reaction furnishes a very delicate test for both starch and iodine. The blue color disappears on heating the liquid, and returns on cooling; it is destroyed by alcohol, alkaline hydrates, sulphydric acid, cyanides, sulphocyanides, and, in fact, by all reagents which take up iodine. The reaction loses its delicacy in the presence of much dextrine, glucose, tannic, gallic, and pyrogallic acids, in urine, blood-serum, etc. Infusion of nut-galls (tannic acid) produces a yellowish precipitate, which redissolves on heating.

Estimation and Separation of Starch.—(1) In seeds, tubers, etc., the starch is separated by mechanical means. A weighed quantity of the material (about 20 grammes) is grated to pulp (potatoes) or softened in water and crushed in a mortar; the pulp is then washed on a fine sieve until the water runs off clear; the starch is allowed to settle, is washed, dried, and weighed. Flour may be made into dough with a little water, and then placed in a piece of muslin and kneaded in a stream of water till it yields no more starch. This method is only approximate. (2) By converting the starch into glucose, and estimating this with an alkaline solution of copper; 1 gramme of material is added to 50 c. c. of water and 2 grammes oil of vitriol. The mixture is heated on a water-bath for two hours, filtered, the filtrate diluted to 100 c. c., 8 grammes of oil of vitriol added, and the whole heated over a water-bath for seven or eight hours, the evaporating water being replaced from time to time. The solution is finally made up to 100 c. c., and the glucose is determined with an alkaline copper solution, as in testing raw sugar. (See article SUGAR.) This method is not accurate. (See *Wagner's Jahresb.*, 1868, 462.) (3) Dragendorff (*Jahresb. der Ch.*, 1862, 631) gives the following process: "Two or three grains of the substance dried at 100°, and pulverized, are mixed with 25 to 30 grains of a solution of 5 to 6 parts of potassic hydrate in 94 to 96 parts of absolute alcohol, and digested at 100° C. for eighteen to thirty hours in a sealed tube (or a flask which can be closed air-tight); and the contents are thrown, while still hot, on a weighed filter and thoroughly washed, first with hot absolute alcohol, then with cold spirit of ordinary strength, and finally with distilled water mixed (in the case of gummy substances) with a small quantity of alcohol. The filter, with its contents, is dried, first at 50°, then at 100°, and weighed. The difference between the weight thus obtained and that of the original substance gives the quantity of proteine substances, fat, sugar, and part of the salts present. The residue, together with the filter cut in pieces, is next heated with water containing 5 per cent. of hydrochloric acid, till a sample is no longer turned blue by solution of iodine; and the residue, separated from the acid liquid, is washed, dried at 100°, and weighed. The loss of weight thus found gives very nearly the quantity of starch in the substance under examination. Any mineral substances insoluble in potash, alcohol, and water, but soluble in hydrochloric acid, that would introduce an error, may be estimated by evaporating the acid liquid to dryness, and incinerating the residue at as low a temperature as possible. This error may also be avoided by extracting the starch with concentrated extract of malt at 56°, instead of acidulated water. In the case of substances which contain a large quantity of mucus it is

best to perform the extraction with a concentrated solution of common salt slightly acidulated with hydrochloric acid, and wash the insoluble residue with weak spirit. The residue left after the extraction of the starch contains cellulose, mucus, lignine, cuticula, and cork-substance, the last four of which may be separated from the cellulose by digestion with chlorate of potassium and dilute nitric acid." (Watts's *Dict.*) (4) "Starch immersed in a saturated solution of *bromide* or *iodide of potassium* swells up to a pasty mass of twenty to thirty times its original volume, which dissolves in water, leaving only a very small quantity of membrane; and on adding iodine-water to the solution the blue compound of starch and iodine is precipitated in flocks. As cellulose is not affected by bromide or iodide of potassium, these salts may be employed for detecting and separating starch in vegetable tissues. Dilute solutions act less strongly." (*Ibid.*)

Applications of Starch.—Starch is used for stiffening cotton and linen cloth, paper, etc. Wiesner says corn starch possesses the highest, wheat the next, and potato starch the most inferior stiffening qualities. It is used for food in the form of arrow-root, tapioca, sago, etc., for making paste, for powdering the hair, for the manufacture of dextrine, glucose ("corn syrup"), etc.

Literature.—Muspratt's *Dict. of Chem.*, especially last Ger. ed.: Watts's *Dict. of Chem.* and *Supplements;* Ure's *Dict.;* Wagner's *Technology;* Gmelin's *Handbook of Chem.;* Payen's *Chem. indust.;* Nägeli, *Beiträge zur näheren Kentniss der Stärkegruppe* (Leipsic, 1874). C. F. CHANDLER.

Star'-Chamber Court [*Curia Cameræ Stellatæ;* probably so called from the starred ceiling of the hall in Westminster Palace in which at one time it sat], in English history, is mentioned as early as Edward III.'s time, when it was composed of the members of the privy council. It was remodelled—or, as some will have it, first really constituted a court—in 1486, under Henry VII. In 1529 (21 Hen. VIII.) it was again modified. It had important criminal and equity jurisdiction, and was to some extent free from the application of the ordinary forms of procedure in courts; and hence arose great abuses, such as the infliction of torture and mutilation, and the sentencing of accused persons without a hearing. Odious to the Commons and the people, it was abolished by statute in 1640 (16 Chas. I. c. 10).

Star City, p.-v., cap. of Lincoln co., Ark.

Star City, p.-v., Van Buren tp., Pulaski co., Ind., on Pittsburg Cincinnati and St. Louis R. R. P. 115.

Sta're Deci'sis [Lat.]. This phrase, *stare decisis et quieta non movere*—"to abide by decided cases, and not to disturb matters once put to rest"—contains the fundamental principle upon which the law has been built up by the courts. In the decision of particular cases the courts have been and are controlled by precedents. Precedents are simply former decisions of competent tribunals preserved in some manner, usually in the volumes of official reports. As these decisions were made after argument and upon careful consideration, the presumption is that they are right, and therefore the general rule is *stare decisis*, which is a rule of sound justice and equity, as well as of expediency. Unless it were obeyed, there could be no certainty in the law as judicially administered, and no security as to individual rights and duties. But this doctrine is not absolutely inflexible. On further examination made in a subsequent case, the court may be satisfied that the former decision was wrong, and that if followed it would produce results widely injurious. Under such circumstances the prior adjudication may be rejected as a precedent. That the courts possess this power and exercise it freely is shown by the multitudes of overruled cases found in the reports; which, it may be remarked, are relatively much more numerous in the U. S. than in England. Instead of expressly overruling the faulty decision, the judges may limit its effect, may distinguish it from the one under consideration, and thus avoid its controlling authority. An acknowledged incorrect precedent will not always, however, be thus abrogated or avoided. A practical rule of expediency is often controlling in this matter. If the prior case established a rule of property, and on the strength of it rights have been acquired and obligations created which would be infringed or destroyed by abolishing the precedent, the doctrine of *stare decisis* is applied; certainty and fixedness are sometimes the most important elements of a legal rule. Nevertheless, the mode of dealing with decisions conceded to have been mistaken depends upon the sound discretion of the courts, and not upon any absolute dogmas. A plainly unjust and inequitable precedent would probably be overruled at the present day, although property rights might thereby be somewhat affected.

JOHN NORTON POMEROY.

Star'-Fishes, radiates of the class Echinodermata and order Asterioidea, organisms more or less star-shaped, and having a disk which gradually merges into the rays, and locomotive suckers along the whole length of the rays. The skeleton is calcareous and made of movable pieces. In some the arms are merged into one. Some are of graceful and others of clumsy form. There are many genera and species, found on most sea-coasts. The term "star-fishes" is equally applicable to the ophiuroids of the family Ophiuridæ (order Ophiuroidea), which have a small central circular disk, having arms which start off abruptly from the centrum. (For illustration see Fig. 20 in COMPARATIVE ANATOMY.)

Star'gard, town of Prussia, province of Pomerania, on the Ihna, manufactures linen and woollen goods and trades much in corn, cattle, horses, and peat. P. 17,280.

Star'gazer, a popular name for the marine fishes of the genus *Uranoscopus* and family Uranoscopidæ, acanthopterous fishes of the group Trachinoidea. The best-known species is *U. scaber* of the Mediterranean; *U. anoplos* has been caught on our S. Atlantic coast, but most of the species are East Indian. They are ugly and spiny fishes, having the eyes on top of the head, whence the name.

STARGAZER is also a popular name for the cyprinodont fishes of the genus *Anableps*, found in Guiana, and popularly named "four-eyes," each eye having a double pupil. Of the three known species, *A. tetrophthalmus* is the best known, called four-eyed loach. (See ANABLEPS.)

Stark, county of N. W. Illinois, intersected by Spoon River, and traversed by Peoria and Rock Island and a branch of Chicago Burlington and Quincy R. Rs. It is generally fertile, consisting in part of prairie-land. Cattle, horses, sheep, and swine are numerous, and there are wagon-factories and woollen and flour mills. Staples, Indian corn, wheat, rye, oats, hay, and dairy products. Cap. Toulon. Area, 325 sq. m. P. 10,751.

Stark, county of N. E. Ohio, watered by Tuscarawas River and its affluents, and traversed by Ohio Canal and several railroads. The surface is undulating and the soil productive. Coal, iron, and limestone are abundant. Besides abundance of live-stock, there are manufactories of agricultural implements, carriages, furniture, iron, leather, and woollen goods, and saw-mills, flour-mills, and breweries. Cap. Canton. Area, 570 sq. m. P. 52,508.

Stark, tp., Brown co., Minn. P. 447.

Stark, tp., Hickory co., Mo. P. 1130.

Stark, p.-v. and tp., Coos co., N. H. P. 464.

Stark, tp., Herkimer co., N. Y. P. 1541.

Stark, tp., Vernon co., Wis. P. 756.

Starke (JOHN), b. at Londonderry, N. H., Aug. 28, 1728; became a farmer, and in 1752 was taken prisoner by the St. Francis Indians, but after six weeks was ransomed, having in the mean time gained so much favor with his captors that he was subsequently adopted into their tribe. In 1755 he was appointed a lieutenant in Rogers's Rangers, and in Jan., 1757, distinguished himself in an engagement with the French and Indians near Ticonderoga; took part in Abercrombie's campaign in 1758, and in Amherst's reduction of Crown Point and Ticonderoga in 1759; early in 1775 was chosen a member of the New Hampshire committee of safety; hurried to Cambridge on learning of the battle of Lexington, and as colonel of the New Hampshire troops took part in the battle of Bunker Hill; accompanied Montgomery's expedition to Canada 1775–76; joined Washington at Newton, N. J., Dec., 1776, and took part in the battle of Trenton. Being aggrieved at the action of Congress in regard to promotions, he resigned his commission in Apr., 1777. Upon the advance of Burgoyne from Canada in the spring of 1778, the authorities of New Hampshire commissioned him to raise a force for the defence of the State, which was then held to include Vermont. He attacked the Hessian colonel Baum near Bennington Aug. 16, 1777, routed him, and later in the day defeated a force under Col. Breymann. For this he received from Congress a commission as brigadier-general; served under Gates in the Saratoga campaign; was with Gates in Rhode Island in 1778–79, and in 1780 joined Washington at Morristown; was a member of the court-martial for the trial of Major André, and in 1781 was placed in command of the northern department. After the close of the war he retired to his farm. D. at Manchester, N. H., May 8, 1822. His *Biography* has been written by Edward Everett, and his *Memoirs and Official Correspondence*, edited by his grandson, were published in 1860.

Starke, county of N. W. Indiana, drained by Yellow and Kankakee rivers, and crossed by several railroads. The surface is generally level, often marshy, with a fertile soil. Staples, Indian corn, wheat, rye, and wool. Cap. Knox. Area, 432 sq. m. P. 3888.

Star'key, p.-v. and tp., Yates co., N. Y., on Seneca Lake and on Northern Central R. R. P. 2370.

Star'kie (THOMAS), b. at Blakeburn, England, in 1782; graduated at St. John's College, Cambridge, where he was senior wrangler and Smith's prizeman, 1803; was called to the bar at Lincoln's Inn 1810; was for many years a leading counsellor in London; became Downing professor of law 1823, and a judge at Clerkenwell 1847. D. in London Apr. 15, 1849. Author of several well-known legal text-books, all of which have repeatedly been reprinted in the U. S.: *A Practical Treatise on the Law of Slander, Libel, and, incidentally, of Malicious Prosecutions* (1812), *A Treatise on Criminal Pleading* (2 vols., 1814), *Reports at Nisi Prius, King's Bench, and Common Pleas* (3 vols., 1817–23), and *A Practical Treatise on the Law of Evidence and Digest of Proofs in Civil and Criminal Proceedings* (3 vols., 1824), of which the 8th American ed. (Philadelphia, 1860) contains *Notes and References to American Cases*, by (Judge) George Sharswood, together with the notes to former American eds. by Theron Metcalf, Edward D. Ingraham, and Benjamin Gerhard.

Starks, tp., Somerset co., Me. P. 1083.

Starks'borough, p.-v. and tp., Addison co., Vt. P. 1361.

Stark'ville, p.-v., Lee co., Ga.

Starkville, p.-v., cap. of Oktibbeha co., Miss., has 2 weekly newspapers. P. 475.

Starkville, p.-v., Stark tp., Herkimer co., N. Y. P. 174.

Star'ling, the *Sturnus vulgaris*, a common European song bird of the family Sturnidæ, now partly naturalized in the U. S. It is a great favorite, especially with the Germans, who often have it caged, and teach it to whistle tunes and even speak words very plainly.

Star Mines, v., Van Buren tp., Clay co., Ind. P. 199.

Starodoob', town of European Russia, government of Tchernigov, on the Babonez, has 13,652 inhabitants.

Star of Beth'lehem, the *Ornithogalum umbellatum*, a common spring garden-flower of the order Liliaceæ. The genus includes many bulbous-rooted plants of the Old World and of S. Africa. The above-mentioned species (the white star of Bethlehem) is a native of Europe, and is sparingly naturalized in the U. S.

Star of India, Order of, was instituted by Queen Victoria in 1861, and reorganized in 1866. There are three classes of knights: 1, knights grand commanders (G. C. S. I.); 2, knights commanders (K. C. S. I.); and 3, companions (C. S. I.), the latter not regarded as of the full rank of knights. The membership is about equally divided between native East Indians and Europeans, most of whom have distinguished themselves in the British-Indian service, military or civil.

Staroi'-Oskol', town of European Russia, government of Koorsk, on the Oskol, has 7176 inhabitants. Much fine fruit is produced in its vicinity.

Staroverski. See PHILIPPINS.

Star Prairie, p.-v. and tp., St. Croix co., Wis. P. 773.

Starr, county of S. Texas, separated from Mexico by the Rio Grande. It is for the most part deficient in water, and only adapted for the raising of stock, which forms the principal occupation of the inhabitants, although there is a considerable area of land along the Rio Grande. There are large herds of cattle, horses, and sheep. Cap. Rio Grande City. Area, about 2100 sq. m. P. 4154.

Starr, p.-v. and tp., Hocking co., O. P. 1551.

Starrs (WILLIAM), D. D., b. at Drumquin, county Tyrone, Ireland; received a classical education; studied theology at Maynooth College; came to the U. S. 1828; completed his theological course at the Sulpician seminary at Baltimore, ordained priest Sept., 1834, at St. Patrick's cathedral, New York, of which he was curate ten years; pastor of St. Mary's from 1844 until 1853, when he was appointed by Archbishop Hughes rector of St. Patrick's and vicar general of the diocese of New York; administrator of the diocese from the death of Archbishop Hughes until the consecration of Archbishop McCloskey (1864); twenty years president of the board of trustees of St. Vincent's Hospital, and theologian to Archbishop McCloskey in the plenary council at Baltimore 1866. D. in New York Feb. 6, 1873.

Stars [Gr. ἀστήρ]. The stars, those innumerable and endlessly varied glittering points which gem the sky on a clear night, which transport and enchant the gazer by their differing splendors, by the continual twinkling of their light, by their capricious distribution, by the constancy of the figures they compose, are a subject rather of contemplation than of study. Fancy loses herself in the search after a trace of law in those infinite mazes which unite them together; the eye is wearied in the effort to count them; the mind finds itself before an immeasurable, inconceivable abyss; it is not a mere surface, a superficies, but it is a boundless width and depth whose mystery is to be fathomed. Science, however, does not shrink before the difficulty of the problem, and, laying aside her delighted admiration of the beauty of the subject, addresses herself to the investigation of its secrets, and by patient and scrutinizing research, and armed with the most powerful instruments which art has been able to construct, she has already made no small rent in that thick veil which seemed impenetrable by the human intellect. Let us, then, also venture into this immense ocean of wonders, certain that if we may not discover its shores, we shall at least be able to gather, without danger of shipwreck, treasures which should satisfy to the full the most ardent imagination.

Stellar astronomy as a science, in so far as relates to its geometrical aspect, may be said to be the work of little more than a century, and researches into its physics are even of a still more recent date; nevertheless, thanks to the activity of our age, it has already made such progress that its labors fill many volumes. We shall endeavor to compress the results into a few pages, and to bring together what may suffice to give an idea of the variety and the immensity of the subject. We shall first consider the apparent phenomena presented by the surface of the sky, and from these we shall endeavor to deduce the relations which exist between the bodies with which it is peopled. We shall especially make it a point to treat with sufficient fulness those numerous questions of celestial physics so much studied in these last years.

§ 1. *The Constellations.*

From the necessity of distinguishing the different parts of the heavens, the stars have, in all ages, been distributed into groups called "constellations." They correspond to the geographical divisions which constitute the states and nations of the terrestrial globe. The most ancient and famous stellar groups are those through which the sun passes in his annual course over the celestial vault, and which constitute the *zodiacal zone*, through the midst of which passes the apparent orbit of the sun, the *ecliptic*. They are familiarly known to all under the names of Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces. The extent of these groups is very unequal, and their forms have no analogy with the objects whose names they bear. The origin of these names is lost in the night of time, and at most seems to allude to the agricultural labors of the *season* in which the sun in ancient ages remained in the several constellations; but even this correspondence has in a great measure disappeared, because, with the precession of the equinoxes, the phases of the tropical year, with which agricultural operations are associated, no longer coincide with the entrance of the sun into the same constellations as before. Thus, the period of the spring equinox, which was once in Aries, is now in the constellation Pisces, and so all the other constellations are displaced to the extent of one sign. The present nomenclature of these starry groups is not much older than the epoch of Greek mythology, and dates not far from the time of the reform in ancient astronomy made by Hipparchus. In fact, in that reformation the spring equinox is considered as corresponding to Aries, and that of the autumn to Libra, which is the symbol of the equality of day and night; while it is certain from more ancient astronomical monuments that at historically known epochs it was in Taurus near the Pleiades; and if the names of the constellations had been bestowed upon them then, the series would certainly have commenced with Taurus. The traditions of the most ancient nations have preserved nothing to explain the origin of these names; the zodiacs found in the Egyptian temples of Esneh and Denderah decide nothing, for it is now demonstrated that these sculptures are of the Roman imperial era. Besides, from the fact that these series of constellations begin with Leo, and not with Aries, it cannot be concluded that the equinox was then in that sign. This arrangement is derived from astrological considerations, or from the order of the Egyptian festivals. The division of the zodiac into twelve parts is also found among the Chinese; and this is very natural, from the close relation which exists between the revolution of the sun and that of the moon; but the names given to the constellations in ancient Chinese astronomy, before the arrival of missionaries in that country, are altogether different—so unlike that even lexicographers do not know their precise signification. The modern Chinese names are a mere translation made by the missionaries of those used in Europe.*

* See John Williams, *Observations of Comets in China* (1871), p. xxiii. *et seq.*; also Gaubil et Biot, *Études d'Astronomie indienne et chinoise* (Paris, 1862).

The zone of the zodiac divides the sky into two hemispheres, the northern and the southern. The principal northern constellations are the following: Pegasus, Andromeda, Cassiopeia, Ursa Minor, Cepheus, Perseus, Triangulum Boreale, Auriga, Ursa Major, Draco, Coma Berenices, Boötes, Mons Menalus, Corona Borealis, Hercules, Ophiuchus or Serpentarius, Serpens, Lyra, Aquila, Antinous, Cygnus, Sagitta, Delphinus, Equuleus; and to these the moderns have added The Reindeer, Messor or Reaper, Giraffe, Harp, Lynx, Herschel's Telescope, Little Lion, Greyhounds, Mural Quadrant, Bull of Poniatowski, Shield of Sobieski, Little Fox, Goose, Fly, Trophy of Frederick, Cerberus, Sextant. The ancient southern constellations are—Cetus, Eridanus, Lepus, Orion, Canis Major, Canis Minor, Argo Navis, Hydra, Crater, Corvus, Centaurus, Lupus, Ara, Corona Australis, Piscis Australis. The modern are—The Lamp, Solitary, Sculptor or Sculptor's Workshop, Phœnix, Electric Machine, Air-pump, Chemical Furnace, Pendulum, Sceptre of Brandenburg, Engraving Tools, Easel, Square, Compass, Telescope, Microscope, Balloon, Crane, Regulus, Toucan, Little Cloud, Water-snake, Clock, Reticulus, Great Cloud, Table Mountain, Flying Fish, Chameleon, Charles's Oak, Cross, Bee, Level, Bird of Paradise, Octant, Peacock, Indian, Cat, Dorado, etc.

The definition of these groups is so arbitrary and so intricate that it has been seriously considered by astronomers whether it would not be worth while to abolish them altogether, and make a new division of the heavens. But, considering that the effect of this might be only to increase the confusion, since all would not accede to this novel reform, it has been thought better rather to return to the old system, and to remove from the constellations the excrescences introduced by the moderns, especially in the northern hemisphere. This has been done by the very laborious Heis. As to the southern hemisphere, the difficulty is irremediable, these groups still retaining the names originally given them by Lacaille and the early navigators. Besides, a division of the sky—one might almost say into provinces—has no serious interest for astronomers, inasmuch as the position of each star, when precision is required, is always indicated by the co-ordinates in right ascension and declination, by which means all ambiguity is removed; and the names of the constellations serve only to abbreviate the indications and to assist the memory. Many stars have proper names which are very ancient, as Sirius, Regulus, Capella, etc.; others have names of Arabic origin, as Betelgeux, Rigel, etc. Most of these names are derived from portions of the body of the animal by which the constellation was represented; for the ancients indicated the various stars of the same constellation by the part of the body of the animal within which they fell. Thus, Sirius was called "that which is in the mouth of the dog;" another, as Rigel, "the knee of Orion;" Aldebaran, "the eye of the bull," etc. This made the determination of the star a slow process, but it was not without convenience. However, the means of indicating the stars lying outside of the principal figure, and which they included under the general name *informes*, were wanting, and it has been precisely of these that the moderns have formed their additional secondary constellations.

A German astronomer, Bayer, began to note the principal stars by the letters of the Greek alphabet, and, when these were not sufficient, he employed those of the Latin. Practically, it would seem his intention to indicate by these letters the order of magnitude, but, whether through inadvertence or because the natural distribution of the stars in the figure occasionally determined him, or because of the variability of the objects themselves, the order is now found not to be fully preserved. The moderns, however, have scrupulously retained these letters for the facility they afford of designating objects without citing their numerical co-ordinates, which are more difficult to remember.

The division of the groups of stars in Chinese astronomical maps differs wholly from ours—a fact which shows that these groups were formed independently of European astronomy. The Chinese, besides the division of the zodiacal zone into twelve parts, have divided the whole heavens into twenty-eight regions, which extend far to the N. and to the S. of the ecliptic, and which are called *sieout*, and are distinguished by twenty-eight stars. These divisions seem to have first originated in the method of observing the sky by means of the passage of the meridian, as we do; and, as they could not trust their timekeepers, which were water-clocks or clepsydræ, they fixed upon several stars by means of which to rectify the computation of time, precisely as is now done. At first, the spaces between the determining stars of these celestial divisions were nearly equal. But now they are most unequal, and, according to the investigations of the very accurate Biot, a great part of this inequality is only an effect of the precession of the equinoxes, which, by changing the positions of the poles of the sphere in relation to the stars, has changed the differences of the ancient right ascensions and declinations of the principal stars to such an extent as to obliterate, and even to reverse, the order of their passage. It was precisely from these studies that this celebrated astronomer concluded that Chinese astronomy had its origin at a very remote epoch, when the equinox nearly corresponded with the Pleiades; that is, at the period of the construction of the pyramid of Cheops in Egypt, in which are found certain galleries and corridors whose axes would point precisely to the altitude of the passage of that group to the S., while to the N. another is directed to the pole star of that period, that is, to Alpha Draconis, in its passage below the pole. The Indians availed themseves of the Chinese *sieout* division of the heavens into twenty-eight parts to compose their *nakshatras* or mansions, applying them to the lunar course; but the inequality of the spaces rendered this system useless, and they long since abandoned it, retaining only the division of the ecliptic into twenty-eight, and afterward into twenty-seven, parts; thus showing that their astronomy originated in China, and was transformed by them in order to adapt it to astrological purposes.

At various periods there have been attempts to combine the figures of the constellations, and form out of them a kind of celestial epopœia. The Greeks filled the whole with their fables, and so perpetuated the memory of the heroes of the Golden Fleece or Argonauts—a new proof of the recent date of this nomenclature. The Gnostics, according to the pseudo-Origen, fancied in the constellations visible in summer-time a supernatural drama, derived, perhaps, from the Egyptians. For them the constellation of Hercules, which the ancients represented by a kneeling person, was the figure of Humanity bowing the knee before the emblem of the Great Spirit (Draco), and imploring immortality, which was symbolized by the Crown. This, however, was snatched from it by the envious Serpent, which, in its turn, was strangled by the redeemer, Serpentarius, who crushed the great monster, the Scorpion, of which the Serpent was a continuation. But these fancies are not less ridiculous than the fables of the Greeks.

The best modern works for the description of the heavens are—the *Atlas* of J. E. Bode, a magnificent volume in large folio, with illustrations of great artistic merit, but in which the very perfection of the shaded figures somewhat diminishes the distinctness of the smaller stars; and for the northern hemisphere, and for all that is visible in Europe, the *Uranometria* of Argelander and the *Atlas* of Heis. In these last two the stars visible to the naked eye are carefully classified according to their magnitude, and they form a true *uranometry*—that is, a precise measure of the stellar magnitudes. As to the limits of the constellations, not a few errors and confusions existing in the ancient maps have been corrected. The device of Argelander and of Heis of printing the outlines of the figures in red and the stars themselves in black, is particularly excellent, on account of its great distinctness, especially by night. Particularly valuable, however, for general study are the great celestial maps of Dien, which represent the sky in two hemispheres, having the poles in the centre and the equator at the circumference, and, beneath, a separate zone which gives the equatorial constellations as far as 45° of N. and S. declination, thus sufficiently well exhibiting those parts which in the circular projection are crowded and divided. In these maps the ancient figures are suppressed, and their places are supplied by geometrical figures which unite together the most beautiful stars, sometimes of different constellations. Though this may be useful to beginners, it is a thing not to be commended, since it cannot be denied that the various parts of the ancient figures greatly assist the memory in distinguishing the stars.

The use of good celestial maps is very important for the *falling stars*: Prof. Dorna of Turin has made an atlas which, projected upon the horizon of the middle N. latitudes, is very convenient. In other charts intended for this purpose the gnomonic projection is introduced, because thus every great circle is represented by a straight line, by means of which every trajectory of the meteors is a straight line. It is to be wished that these maps may be more largely extended. For the most scientific and fully-detailed maps, including the telescopic stars, we would notice the Berlin charts, which extend from +15° of declination to −15, and comprehend all the fixed stars of the tenth magnitude; also the ecliptic maps of Bishop, those of Chacornac, the *Atlas* of Harding, and the large *Atlas* of Argelander, which contains all the stars, down to the ninth magnitude, from the N. pole to 10° of S. declination. The subjoined Table A gives the names of the constellations and the stars contained in them, according to the computation of Heis:

TABLE A.—*Distribution of Stars according to their Constellations and Magnitudes.* (*Stars visible to the naked eye in the middle latitudes of Europe.*)

CONSTELLATION.		Mag. 1.	Mag. 2.	Mag. 3.	Mag. 4.	Mag. 5.	Mag. 6.	Var.	Clus.	Neb.	Total.
A. *Northern Constellations, between the zenith of Münster and the Pole.*											
1 [illegible]		..	2	1	3	8	40	..	..	..	54
2 [illegible]		..	1	9	8	39	163	..	..	..	220
3 [illegible]		..	..	5	4	21	127	2	..	..	159
4 Cassiopeia		..	2	2	6	21	93	2	..	..	126
5 Perseus		.	1	4	13	23	90	2	3	..	136
6 Camelopardus		..	..	..	2	25	110	..	1	..	138
7 Lacerta		..	..	..	1	12	35	..	..	..	48
8 Lynx		..	..	1	1	12	73	..	..	..	87
9 Ursa Major		..	6	9	5	39	166	2	..	..	227
10 Canes Venatici		..	..	1	1	18	65	..	2	1	88
B. *Mean Constellations, between the zenith of Munster and the Equator.*											
11 Andromeda		..	3	1	13	14	106	1	..	1	139
12 Equuleus		..	..	..	1	4	11	..	..	..	16
13 Pegasus		..	2	4	8	22	140	1	..	1	178
14 Pisces		.	..	1	10	21	96	..	..	..	128
15 Triangulum		..	..	1	2	4	22	..	..	1	30
16 Aries		..	1	1	4	11	63	..	..	..	80
17 Auriga		1	1	2	4	18	115	2	1	..	144
18 Taurus		1	1	2	15	28	140	1	..	..	188
19 Gemini		1	2	5	5	13	78	1	1	..	106
20 Canis Minor		1	..	1	..	5	30	..	..	..	37
21 Cancer		..	..	..	5	5	79	1	1	1	92
22 Leo		1	2	5	8	20	124	1	..	..	161
23 Leo Minor		..	..	..	3	6	30	1	..	..	40
24 Coma Berenices		..	..	..	2	17	51	..	..	..	70
25 Boötes		1	1	5	10	23	100	..	..	..	140
26 Corona Borealis		..	1	..	6	7	15	2	..	..	31
27 Hercules		..	1	9	12	28	172	3	..	2	227
28 Lyra		1	..	1	5	8	52	2	..	..	69
29 Cygnus		..	2	4	15	34	138	3	1	..	197
30 Vulpecula		..	..	..	1	14	47	..	..	..	62
31 Sagitta		..	..	..	4	2	12	..	..	..	18
32 Delphinus		..	..	1	4	2	24	..	..	..	31
C. *Southern Constellations, from the Equator to the Southern horizon.*											
33 Cetus		..	2	6	7	24	122	1	..	..	162
34 Eridanus		..	..	7	17	24	99	..	..	..	147
35 Orion		1	3	4	6	25	95	2	..	..	136
36 Monoceros		..	..	..	4	15	90	1	2	..	112
37 Lepus		..	..	2	6	10	26	1	..	..	45
38 Columba Noachi		..	1	1	3	1	2	..	..	..	8
39 Canis Major		1	2	4	5	13	44	..	1	..	70
40 Argo Navis		..	..	1	4	13	52	..	1	..	71
41 Hydra		..	1	4	10	20	117	1	..	..	153
42 Sextans Uraniæ		..	..	..	1	5	42	..	..	..	48
43 Virgo		1	..	6	9	19	144	2	..	..	181
44 Crater		..	..	1	4	2	28	..	..	..	35
45 Corvus		..	3	1	1	4	17	..	..	..	26
46 Centaurus		..	..	2	3	2	5	..	..	..	12
47 Serpens		..	1	5	5	10	59	1	1	..	82
48 Ophiuchus		..	2	7	7	24	71	..	2	..	113
49 Scutum Sobieskii		.	..	..	1	5	4	1	..	..	11
50 Aquila et Antinous		1	.	5	4	17	95	1	..	..	123
51 Libra		..	2	..	1	8	41	1	..	..	53
52 Lupus		.	..	..	..	4	..	..	..	..	4
53 Scorpio		1	1	7	5	10	17	..	..	..	41
54 Sagittarius		..	1	6	8	19	53	2	1	..	90
55 Capricornus		..	..	3	7	12	41	..	..	..	63
56 Aquarius		..	..	5	11	31	98	..	1	..	146
57 Piscis Australis		1	.	..	3	13	5	..	..	..	22
Northern	10	..	12	32	44	218	962	8	6	1	1283
Mean	22	7	17	43	137	306	1645	19	4	6	2184
Southern	25	6	19	77	132	330	1367	14	9	..	1954
Total	57	13	48	152	313	854	3974	41	19	7	5421

§ 2. *Magnitudes of the Stars, and Principles of Uranometry.*

With the division of the stars into groups, remounts to the remotest antiquity their distribution into various orders of magnitude. The most beautiful and brilliant were classed as of the first magnitude, those next to these in brilliancy as of the second, and so on to the number of six visible grades. Here the naked eye fails; instruments must do the rest. The limits by which these grades of brightness are defined are not fixed and distinct, but are arbitrary and conventional only. Thus, of those visible in our hemisphere the first magnitude embraces sixteen or seventeen of the most vivid in brightness, which are—1, Sirius, in Canis Major; 2, Vega, in Lyra; 3, Procyon, in Canis Minor; 4, Pollux, in Gemini (some include also Castor); 5, Capella, in Auriga; 6, Arcturus, in Boötes; 7, Rigel, and 8, Betelgeuse, in Orion; 9, Aldebaran, in Taurus; 10, Regulus, in Leo; 11, Spica, in Virgo; 12, Antares, in Scorpio; and 13, Markab, in Pegasus. To these, in the southern hemisphere we add—14, Canopus, in Navis; 15, Fomalhaut, in Piscis Australis; and 16, Alpha, in the Centaur. Some assign the same rank to certain stars of the Southern Cross, but these do not much surpass those of Ursa Major, and belong more properly to the second order. This second order embraces the six most beautiful of those forming Charles's Wain; the pole-star in Ursa Minor; the four larger stars of Cassiopeia; the three of Orion's Belt; the four of the Square of Pegasus, including Alpha Andromedæ, etc. The brightest in Aquarius belong to the third magnitude. But here let me repeat that this entire classification is purely arbitrary, and must be so, because in the first place there has been no rule antecedently established for measuring the intensity of stellar light; and, secondly, no precise limit separates one class from the next, nor can it be said at what point one series commences and another ends. A general idea of the distribution may be obtained from Table A, above, in which is given a summary from the *Atlas Cœlestus Novus* of Heis, showing the stars which enter into the several constellations visible in middle northern latitudes, arranged according to their magnitudes. From this table it appears that, to an acute eye like that of Heis, though unaided, stars are perceptible which by common usage would be referred to the seventh order. The total number down to this limit would be 5421 in the heavens as visible at Münster—that is to say, in eight-tenths of the entire sphere—whence, supposing the distribution in the remaining part to be in similar proportion, the grand total would amount to 6800.

It being impossible to divest this matter of its arbitrary element, or to fix new conventions without introducing serious confusion, astronomers have reversed the problem, and sought to determine in what ratio the brilliancy of the stars increases according to the various actual orders of conventional magnitude. Diverse methods have been employed for this purpose, and the instruments in use in the investigations are called stellar photometers or astrometers. The science which occupies itself with the inquiry is called *uranometry*.

The first plan proposed was that of Bouguer, who suggested the use of a telescope with two equal objectives, to be directed severally to two unequal stars. The aperture of the one, directed toward the brighter, was then to be reduced until its image should become equal in brightness to the other, when the inverse ratio of the two apertures would be that of the brilliancies. But this method assumes that the absorption of the lenses is in proportion to the intensity of the light, while it is rather a constant quantity. The necessary correction, however, is easily determinable. Sir William Herschel, and later, Johnson of Oxford, made use of this method, the last observer employing for the purpose a magnificent heliometer. Others have used different kinds of photometers. That employed by ourselves is a rapidly-rotating disk with fissures of variable breadth. The light of the brighter star seen through these fissures is diminished until it becomes equal to that of the lesser. Thus we have determined the relative values of the light of various stars, given further on. Among the most important of stellar photometric labors are those of Sir John Herschel, who has arranged all the stars in sequences or successive series, comparing the light of each with that of a neighboring one, either natural or artificial, or with the image of the moon formed by a small lens.

The following are the results to which these inquiries have led. From the labors of Sir William Herschel upon the greater stars, it is inferrible that the ordinary magnitudes are related to each other in respect to splendor according to the following law, viz.:

Magnitudes,	1	2	3	4	5 to 6
Splendors,	1	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{16}$	$\frac{1}{64}$

It results from this, that a star of the first magnitude, at a distance double, triple, or quadruple, would appear of the second, third, or fourth; but the law fails of precision for the fifth and sixth.

From the study of the sequences of Sir John Herschel, and of those of Heis, it follows that the ordinary scale corresponds to the photometric, provided the ordinary magnitudes are increased by the constant quantity 0.414, which would make them 1.414, 2.414, 3.414, etc., respectively. These results are true of the several classes only with respect to their mean brightness; between individual stars the differences are very great. Thus we have found the following proportions of magnitude among the stars here named:

Stars.	Relative photometric values.		Stars.	Rel. phot. values.	
Sirius	= 75.5	1st magnitude.	γ Orionis	= 2.9	2d magn.
Rigel	= 13.0		ζ Orionis	= 2.7	
Procyon	= 9.9		χ Orionis	= 1.0	3d magn.
α Orionis	= 7.3				

From the labors of various astronomers it may be concluded that the ratio of brightness from magnitude to magnitude is not rigorously constant, but decreases as in the following series: 1st to 2d, 3.75; 2d to 3d, 2.25; 3d to 4th, 2.20; 4th to 5th, 1.95; where it is seen that the ratio goes on diminishing with the magnitude, in conformity with the fact of observation that, between two lights, it is more easy to estimate the ratio, in proportion as the lights themselves are fainter.

These results, however, relate only to the stars visible to the naked eye. For telescopic stars the case is notably different. We remark, in the beginning, that the scale of these also is arbitrary and of traditional convention; and hence for these also the problem presents itself, What is the ratio of brightness between two stars of different magnitudes seen in the telescope? Johnson of Oxford, by the method indicated above, arrived at the conclusion that the ratio of the successive magnitudes is 0.424; and hence, if n be the number which expresses the magnitude of a given star, its intensity of light as referred to one of the first magnitude would be expressed by $(0.424)^{n-1}$. Comparing, then, his own observations with those of Struve,

Argelander, Groombridge, and Sir John Herschel, he concluded from the whole a mean progression from the minor to the major as 0.412 : 1, or in the inverse order as 2.43 : 1. Pogson has found 2.42; Steinheil, 2.83; Stampfer, 2.51. But we cannot take the mean of these determinations, because they are severally based on stars differing in number and in magnitude. Struve, after an examination of the magnitudes employed by Bessel, Lalande, and others, assigned the following proportions:

Magnitudes.	Number of stars which make one of the 1st magn.	Ratios of splendors.	
1	1.00		
2	3.25	3.28	Visible to the eye.
3	7.64	2.35	
4	15.26	2.00	
5	29.75	1.95	
6	86.10	2.83	
7	249.10		
8	269.60	2.29	Telescopic.
9	1116.90	1.96	

Whence we might conclude, in a matter so vague, to take a middle course, and say that, generally, the intensity of the light of a star of the second magnitude is about one-fourth as great as that of one of the first, and that the brightness goes on diminishing in a ratio which beyond the second may be taken as constant, and for the telescopic may be assumed at 2.412—a proposition inapplicable, however, beyond the 9th magnitude, on account of the differences of classification employed by different authorities, the subdivisions of Sir William Herschel extending to the 20th magnitude, while Struve has limited his to twelve. The difference arises partly from the individual habits of observers, and partly from the estimate made by each of the penetrating power of his instrument.

It is a matter of importance in this inquiry to know what will be the limiting magnitude of the stars visible in a given telescope. The following proportions of magnitudes with given apertures were established by Johnson:

Apertures in English inches.	1.	2.	3.	4.	8.	9.	10.
Magnitudes visible...............	8.1	9.9	10.6	11.3	12.9	13.2	13.4

But experience shows that it is possible to push much beyond the visibility expressed by these numbers. From researches apposite to the question made with our own refractor, equal to that at Dorpat (of 9.6 English inches), and which we have found to possess a penetrating power little different from that of Herschel's 18-inch speculum, it results that it is possible with this to reach the magnitude 15.2—two orders beyond the limit assigned by Johnson. It is generally agreed that the extreme magnitudes of Herschel are exaggerated, and that the lower extremity of his scale is not in harmony with the upper.

The break between the telescopic magnitudes and those fixed by direct observation with the unaided eye, arises from this, that the telescope, rendering the image on the retina more definite than that of natural vision, greatly promotes the visibility of objects—a thing so true that even a telescope with an aperture no larger than the opening of the pupil, shows many stars which the naked eye fails to discover, precisely because of the superior sharpness of the image.

Though this matter is of little interest to astronomers in general, as not constituting a study of precision, yet, for many questions of celestial physics which we have presently to treat, it is of the highest importance; and on this account we have ventured to consider it somewhat at length. Since the sun is a star, the investigation of the ratio of its brightness to that of other stars will assist us in determining the intensity of the stellar lights generally. Herschel, comparing Alpha Centauri with the moon at full, assigned the ratio at 27,408 : 1. Now, according to Wollaston, the intensity of the lunar light compared with that of the sun, is as 1 : 801,071; whence the light of the sun to that of α Centauri, should be as 21,955,000,000 : 1; and inasmuch as the distance of α Centauri is known, it is inferred by computation that in absolute intensity its light must exceed that of our sun 2.32 times. Alpha Centauri differs little from Arcturus or from α Lyræ, and is estimated at one-quarter the brightness of Sirius. And the light of this last star, as it reaches us, is, according to Wollaston, only one twenty-millionth as intense as that of the sun.

The general light of the starry heavens is not so feeble as at first sight it may seem. Upon a lofty mountain-top, in a pure atmosphere, and in the long-continued absence of artificial light, one can at length read by its aid large printed characters. Mariners dislike artificial lights by night, because they are confusing, and prefer rather to depend on the light of the stars alone. I am not aware that any precise measures have been made as to this matter. But the general light of the heavens includes, along with that of the stars, the light proceeding from the Milky Way and from the zodiacal brightness, and is frequently strengthened by feeble auroras; which disturbing causes render it difficult to distinguish what belongs to the stars alone. I am able, however, to affirm that a steady electric light from a pile of fifty elements of large dimensions, at the distance of 400 mètres (a quarter of a mile), hardly equals the brightness of Sirius. From certain calculations it is concluded that this star must have an intrinsic light sixty-three and a half times greater than that of the sun. We shall presently see that other modes of reasoning confirm in great part this curious conclusion.

§ 3. *Colors of the Stars.*

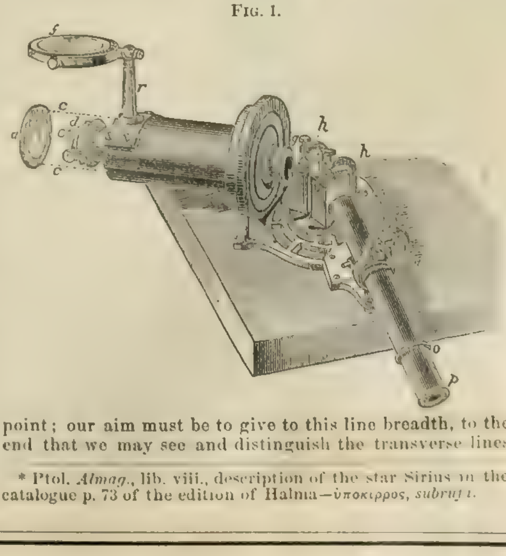
If every star differs from every other in magnitude, the differences in color are not less. The stars are commonly called white, but to the most inattentive eye many appear diversely colored; some are yellow, some are orange, and not a few are decidedly red. The tints of the stars called white are for the most part blue; from this color there is a passage by insensible degrees to true white, then to yellow, to orange-red, and finally to blood-red. Sirius, Lyra, Castor, Regulus, are azure; Procyon, α Aquilæ, white; Capella, Pollux, α Ceti, yellow; Aldebaran, Arcturus, Betelgeuse (α Orionis), orange; Antares, α Herculis, red; the blood-red stars are all small. The shade of color in the yellow and the orange is different at different epochs, as in Betelgeuse, Antares, Aldebaran, Arcturus, etc. In the double stars occurs frequently the curious phenomenon of two different colors, very often complementary—a fact suggestive of illusion, but shown by accurate study to be real. (For examples of this see Table K.)

In certain constellations certain special colors predominate; as in the Pleiades, blue; in Orion, greenish; in Eridanus, the yellows. The azure stars are rare, though we may say generally that a tint of azure prevails in most. Sirius has certainly changed in color. Seneca (*Nat. questionum*, lib. i. c. 1, No. 6, p. 72, ed. Pomba) says that Sirius was redder than Mars ("acrior sit Caniculæ rubor, Martis remissior, Jovis nullus"), while now it is notoriously azure-white. In spite of the philologic doubts which have been raised upon this passage by some who would confound scintillation with color, the fact is confirmed by Ptolemy, who calls it reddish,* and says it is the most splendid of the class; which in truth is not impossible. Beta Geminorum (Pollux), now a yellow star, is also called reddish.

But until very recent times these colors were only vaguely estimated. In endeavoring to classify them by means of the electric spark drawn from different elementary substances, we have been not a little surprised to find that the nebulæ and the comets are green. But the spectroscope has recently taught us how to define their tints with greater precision. Observations of stellar spectra are, however, quite difficult, because of the feebleness of their light. Spectroscopes with fissure, unless with telescopes of great size, can hardly be used even upon stars of the first magnitude. The spectral lines of the stars were discovered by Fraunhofer. Lamont returned to them later, but afterward abandoned the study. Donati was the first recently to resume it, and we have ourselves sought to give it the largest practicable extension. It will not be useless here to say something as to the manner of conducting these observations.

The spectrum obtained directly from a star, by making the focal image of a large telescope fall upon the fissure of the collimator, is a colored line, as its image is a white

FIG. 1.



point; our aim must be to give to this line breadth, to the end that we may see and distinguish the transverse lines

* Ptol. *Almag.*, lib. viii., description of the star Sirius in the catalogue p. 73 of the edition of Halma—ὑπόκιρρος, *subrufi*.

of Fraunhofer. In the common fissure-spectroscope this is accomplished by placing before the fissure of the collimator a cylindrical lens, which dilates in one direction the focal image of the great telescope. Fig. 1 shows the prism spectroscope of Mr. Huggins; Fig. 2, the direct-vision spectroscope.* If we desire to identify the spectral lines of the stars with those of the chemical elements, the fissure is indispensable; but when these are known in a few stars, the labor can be pursued with others by means of simple differential measures, and then we can admit much light. But if we mean to identify the chemical lines and those of the stars with exactness, it will not do to employ a reflecting mirror before the fissure; it is necessary to place the chemical or electric light at the centre of the objective, or at least in the middle of the tube, well adjusting it in the axis of the instrument. For differential observations the best spectroscope is the simplest, employed already by Fraunhofer—viz. a prism placed in front of the object-glass. If the refracting angle is large, the image is naturally dilated, even without the cylindric lens. But ordinary prisms are too small to give light enough. We have caused to be constructed by Merz of Munich a prism six inches wide, with a refracting angle of 13°, which, applied to a refractor of six and a half inches diameter and seven feet focal length, gives superb spectra, requiring, however, to be dilated by a cylindrical lens placed before the ocular, or by the direct use of an ocular constructed with a cylindrical lens. Applied to the great refractor of Merz, this prism gives a magnificent spectrum, even too much dilated, so as to enfeeble the light. For long telescopes, an angle of five or six degrees is sufficient. This instrument, indeed, is rather costly, but we have contrived another much more simple and economical, and have succeeded in producing a spectroscope which collects the entire light of the star so completely as to enable us to recognize spectra of stars down to the 9th magnitude. (Fig. 3.)

Fig. 2.

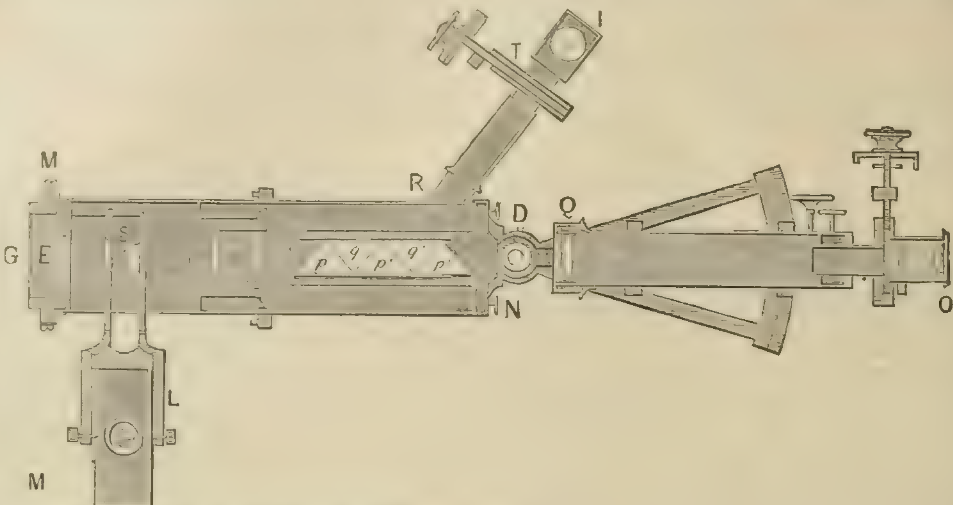
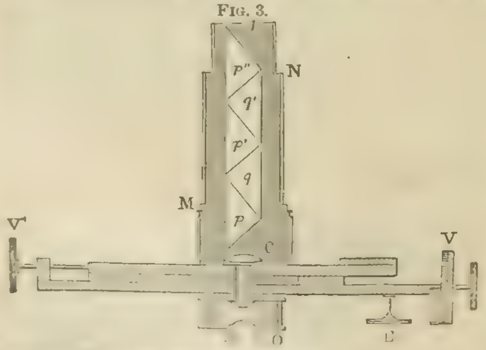


Fig. 3.



This consists simply in a direct-vision prism, behind which is a cylindrical lens C, with its axis parallel to the Fraunhofer lines, placed at a little distance from the ocular (four or five centimètres)—that is, at the point where the most distinct vision is obtained: and the spectra are seen in the field of the ocular with almost the sharpness and vividness of the star itself. V B V' is the micrometer with double screw and double plate, carrying pointers in the field of the ocular O. With an instrument of this kind we have made the analysis of many thousands of stars, and have been conducted to some consequences of the highest importance, which are the following:

All stellar spectra can be distinguished into four categories or types. The first is that of the white or azure-tinted stars, like Sirius, Lyra, etc., β, γ, δ, ϵ, ζ, η of the Great Bear, etc. The spectra of these are almost continuous, only that they are furrowed by four strong black lines, which are absorption-lines of hydrogen. All the four can be seen in the most brilliant, as Sirius, Lyra, etc.; in the feeblest only the $H\beta$, or the F of the sun, is ordinarily visible; but in general this is broad and dilated, and frequently diffused at the edges, especially in Sirius. This is an indication of a very high temperature, and of great density in the hydrogen atmosphere of the stars of this order. There are also seen traces of other lines, as of magnesium, sodium, and some of iron; but these are extremely feeble, and require an atmosphere of exquisite purity. (See colored plate, Type I.) Many stars appear of uniform light, without lines, which studied with care are found to belong to this type.

The second type is that of the yellow stars. They have very fine lines, and their spectra are perfectly similar in character to that of the sun. (See plate, Type II.) Capella, Pollux, and many others feebly yellow have such a character. The fineness of the lines requires that in these researches the atmosphere should be very clear and quiet. Sodium, hydrogen, and iron are very conspicuous in them. Arcturus and Aldebaran, in their periods of lively yellow light, approach this type, and in the periods of red light the following. It is curious that α Ursæ Majoris is of this type, while all the others of that constellation belong to the first.

The third type is that which is exhibited by the orange and red stars. It is formed of lines and zones or nebulous bands. A specially striking example is α Orionis, the prototype of this class (see plate, Type III.), to which belong also α Scorpionis, o Ceti, β Pegasi, α Herculis, and many other beautiful examples, of which we will presently give a brief catalogue. This spectrum ought to be considered as really composed of two spectra superposed—one formed of broad zones of gradually-deepening cloudiness, producing the effect of lights and shadows in a fluted column; the other formed of black absorption-lines of the metals. This, for the structure of the broad zones, has for type α Herculis, where the principal channellings are seven in number, but upon these channellings, in the periods of lively red color, the black lines can be perceived. In some variable red stars, in the period of feebleness, is seen a spectrum of a few lively bright lines; as, for example, in o Ceti. The black reversion-lines of hydrogen are quite

* This instrument may be thus briefly described: G M is the screw of attachment to the great telescope, of which the instrument replaces the eye-piece. L is a cylindric lens designed to dilate the light of the star so that it may form a linear image at the fissure S. K K' are two collimator objectives; p, q, p', q', p'' form the compound direct-vision prism. R T is a micrometric screw which moves a plate with an extremely narrow fissure, of which the purpose is to measure the position of the spectroscopic lines; this is lighted by a little lamp I. D is a hinge supporting the sector and the analyzing telescope (Q O). L is a lamp illuminating the primary fissure of the spectroscope, and introducing, by means of the little plane mirror S', the light of comparison.

feeble, and sometimes not present at all in these spectra; while instead of them the sodium, iron, and magnesium lines are very strong; hydrogen is truly there, but is difficult of detection, because the lines are not perfectly reversed.

The fourth type embraces some quite curious stars, for the most part of a blood-red color. They have only three bands (see plate, Type IV.), coinciding in limits with those of the third type, but having twice the breadth; and they are quite bright notwithstanding the minuteness of the stars. There are lucid lines in some of them, but in general these are feeble and few. They have the bright and well-defined side of their channellings turned toward the violet, while those of the third type turn it toward the red. They appear to give a spectrum similar to that of carbon as it is seen in the central part of the voltaic arch projected between two carbon points; except that, in the stars, the shading off is in the opposite direction—that is, the maximum light is turned toward the violet, while in the carbon arch it is turned toward the red. Many of these stars exhibit only a few luminous lines, and are without the channelled and cloudy spaces. All the stars of this type are of a deep-red color, and among them are found the most beautiful spectra. (See the list in Table B.)

TABLE B.—*The more Remarkable Stars of the Fourth Type.*

No. in catalogue.	Right ascension.	Declination.	Magnitude.
41	4*h*. 36.2*m*.	+67° 54′	6. Fine.
43	4 42.8	+28 16	8
51	4 58.1	+ 0 59	6
78	6 26.9	+38 33	6.5. Fine.
89	7 11.5	−11 43	7.5
124	9 44.6	−22 22	6.5
128	10 5.8	−34 38	7
132	10 30.7	−12 39	6. Fine.
136	10 44.8	−20 30	6.5
152	12 38.5	+46 13	6. Very fine.
159	13 19.3	−11 59	7.5
163	13 47.3	+41 2	7
229	19 26.5	+76 17	6.5
238	20 8.6	−21 45	6
249	21 25.8	+50 58	9
252	21 38.6	+37 13	8.5
273	23 39.2	+ 2 42	6. Fine.

Other stars there are which are not embraced under these types, as they have only simple lines variously situated. Such are those discovered in the Swan by Wolf, whose spectra are composed of only a few bright lines. Such also is the star γ Cassiopeiæ, which presents the spectral lines of hydrogen direct and not reversed—a curiosity up to this time unique in the whole heavens. Only the star β Lyræ, besides, has occasionally, but only occasionally, shown it.

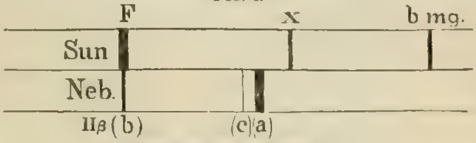
A most momentous occurrence took place in May, 1866. The star T in the Crown burst into flame. While it was of the second magnitude, it gave the direct lines of hydrogen, G and F, quite brightly, together with many other vivid lines undetermined. This was therefore a real conflagration, which in the brief time of its continuance passed through all the phases of incandescence, till from the second magnitude it sank to the eighth. (See APPENDIX.)

The study of this subject is hardly begun. D'Arrest has extended our catalogue, finding many stars of various types, but adopting our classification. This list may be found in the *Memoirs Spectroscopic Soc. of Palermo*, 1876.

From the spectral study of the fixed stars we learn many important truths. First, we are assured that the physical nature of matter is everywhere the same, and that the infinitely numerous worlds of space are formed of chemical elements the same as those which compose our system. More than that, the channelled spectra of the third type being analogous to the spectrum found in the middle of the nuclei of the solar spots, it is demonstrated that these stars are enveloped in atmospheres densely vaporous and of inferior temperature. The cloudy zones indicate the presence of metallic oxides. In fact, from recent chemical studies it would seem that channelled spectra are due to metallic oxides which, by reason of the low intensity of the heat, remain undecomposed. We are therefore justified in believing that the stars which present these zones are less intensely hot than those which give only the lines of the metals. Beyond a doubt, broad hydrogen-lines of the first order show a dense hydrogenic atmosphere and powerful incandescence. The spectrum of the fourth type is evidence of carbon, and this substance is possibly also present in the third. Nor ought it to excite surprise that this element should occur quite abundantly in celestial bodies, since it is found abundantly in certain aërolites, and since comets have shown the direct spectrum of this substance, both as pure and as combined with oxygen and with hydrogen. A true difficulty, nevertheless, is found in the fact that carbon gives a spectrum so proteiform for the minutest intermixture with any other substance, as to render it difficult to establish the condition in which it is present there. Fig. 3, colored plate, shows the spectrum of the polar (electric) arch, and Fig. 4 that of the star 152 of the catalogue of Schjellerup (A. R. 12*h*. 38.3*m*., Decl. 46° 13′ 6″) in the constellation of Ursa Major.

Quite different from the spectra of the stars are those of the nebulæ. The planetary nebulæ, the nebula of Orion, etc., are found to give spectra of very few lines, three at most, one of which (*b*) belongs to hydrogen, and the others to substances unknown, perhaps azote. In Fig. 4, following, is seen the disposition of these lines. This analytic

FIG. 4.



Spectrum of the Nebulæ.

response has cleared up for ever the question whether the nebulæ might not be groups of stars. They are nothing but masses of gas. Some nebulous stars, as that in A. R. 19*h*. 40*m*., Decl. 50° 6′, give the double stellar spectrum and the lines of the nebulæ; but the stellar groups, as also the Milky Way in its white portions, give the stellar spectrum only. Yet there are nebulæ, like that in Andromeda and others, which give only a continuous spectrum, being in this respect analogous to some stars, in whose spectra the lines, on account of their delicacy or for some other cause, are indiscernible.

The spectroscope informs us that stars of the same type are frequently accumulated in the same quarter of the heavens. Thus, we have already seen that the Pleiades and the stars of Ursa Major, except α, have a spectrum of the first type; in Eridanus, Hydra, etc., the yellows prevail; in Orion the first type is general, but with lines of extreme fineness, and very few red, which appear as if seen through a green veil. Certainly, this fact is of great importance, and may indicate the manner in which stars are associated in natural groups or in vast systems, of which we can form no idea. It is confirmatory of this opinion that, in certain groups, the stars of the same type have the same direction of proper motion; as, for example, the five stars of Ursa Major already mentioned—viz. β, γ, δ, ε, ζ, and Alcor, its companion, as Proctor has discovered, and as we shall presently see more fully. (See Table C.)

§ 4. *Variability of the Stars.*

The stars do not all of them preserve invariably the same magnitude, but many change in brilliancy with time. Perhaps not even a single star is perfectly constant; but the attention of astronomers has been especially fixed upon some which are extremely singular, and which for this reason have received the name *variable*. One of the most famous of these is Omicron Ceti, which in a period of 331 days 8 hours dwindles from the 2d magnitude down to the 12th. After decreasing for about three months, it remains for five almost totally invisible, and then in turn increases for three more. Argelander believes that with the short period is associated a longer of 88 years, in which the maxima vary, their duration being about 25 days. The variability of this star was discovered by Fabricius in 1596, and studied carefully by Argelander. Its color is yellow, but when small becomes reddish. The spectroscope has shown that the spectrum of this star is of the third type, lined, and that in the fading of its light it preserves all the principal bright lines reduced to threads of the extremest delicacy. Its period is explained by some by admitting a rotation of the body on its axis, supposing that on one side it may be covered with spots like those of our sun. This is a plausible hypothesis, but has not been directly proved.

The stars whose colors are orange-yellow or red can be said generally to be all variable. Such are α Orionis, which changes irregularly by about one magnitude, and α Tauri, which also varies to the same extent. Arcturus even is not constant. A well-ascertained fact connected with this variability is the corresponding variation of the spectrum. When the stars are at their maximum brightness, their black spectral lines are fine, and the spectra approach the second order; but when they are at their minimum, these spectral lines become broad, with specially large dilatation of those of sodium, magnesium, and iron, and even pass into true zones. The periods of these larger stars are not yet well known. Alpha Herculis is another variable which passes from the 3d to the 4th magnitude. Its spectrum in the period of minimum is more profoundly furrowed than at maximum. Its period is of about 88 days. Upsilon Hydræ passes from the 4th to the 10th magnitude in 449 days; η Aquilæ, from $3\frac{1}{2}$ to $4\frac{1}{2}$ in seven days. From the

TABLE C.—*Prodromus of a Catalogue of the Colored Stars, with their Spectra.*

No.	No. of Cat.	Stars.	Right ascension, 1870.	Decl., 1870.	Magnitude.	Remarks.
			h. m. s.	° ′		
1	1	— Cassiopeiæ	0 2 37	+ 63 13.8	8.5	Ruby-colored.
2	2	— Piscium	0 6 36	+ 0 24.6	9.5	Garnet-red.
3	3	— Andromedæ	0 13 2	+ 43 59.3	8.2	Intensely red; Sp. 3d type, zones faint.
4	.....	101 B. A. C.	0 21 16	+ 17 10.4	6	Orange-yellow; Sp. 3d t., beautiful, intervals broad and dark.
5	.....	δ Andromedæ	0 32 22	+ 30 8.9	3	Yellow; Sp. 3d t., zones faint, but certain.
6	.....	211 B. A. C.	0 39 45	+ 14 45.0	6	Yellowish; Sp. 3d t., magnificent; intervals as in β Pegasi.
7	.....	ζ Andromedæ	0 40 27	+ 23 53.6	4	Yellow; Sp. 3d t., traces of faint zones.
8	4	— Cassiopeiæ	0 49 44	+ 66 59.3	9	Dark orange-yellow.
9	.....	η Andromedæ	0 50 16	+ 22 42.9	5	Sp. apparently zoned.
10	5	— Ceti	0 52 11	— 6 34.9	8	Red.
11	6	— Cassiopeiæ	0 58 13	+ 52 44.5	10	Beautiful garnet-red.
12	.....	Anonymous	1 7 27	+ 34 55.8	var.	Golden-yellow; groups of fine lines sometimes forming zones.
13	7	— Piscium	1 9 0	+ 25 4.8	8	Red.
14	8	— Andromedæ	1 10 17	+ 47 0.7	7.5	Very red.
15	9	S Piscium	1 10 46	+ 8 13.7	var.	Inclining to red.
16	10	— Piscium	1 14 31	+ 6 17.4	9	Red.
17	11	— Sculptoris	1 21 0	— 33 13.5	6	Orange-red, very beautiful; Sp. 3d t., beautiful.
18	12	R Piscium	1 23 56	+ 2 12.6	var.	Fire-red; Sp. diffuse.
19	13	— Cassiopeiæ	1 24 53	+ 59 59.9	10	Red.
20	14	— Cassiopeiæ	1 46 11	+ 69 33.8	8	Very red.
21	.....	LL. 3317	1 53 59	— 9 9.2	6	Red; Sp. 3d t., with well-marked bands, like μ Geminorum.
22	15	Persei	1 54 27	+ 54 35.9	8.5	Nearly ruby-red, with fine lines forming zones more decidedly than β Andromedæ.
23	.....	Anonymous	1 55 55	+ 41 42.3	(?)	
24	16	— Ceti	2 0 6	+ 0 49.4	7	Very red; Sp. uncertain, variable?
25	.....	Anonymous	2 2 0	— 10 52.0	(?)	Yellow; Sp. 3d t., with strongly-marked zones.
26	.....	665 B. A. C.	2 3 25	+ 18 53.2	6	Almost white; Sp. 3d t., with magnificent channellings throughout.
27	17	R Arietis	2 8 44	+ 24 27.1	var.	Orange.
28	18	— Andromedæ	2 9 52	+ 44 36.3	9	Almost ruby-red; Sp. diffuse.
29	19	o Ceti	2 12 47	— 3 34.1	var.	Blood-red; Sp. 3d t. (See text.)
30	20	— Persei	2 13 14	+ 56 32.3	10	Ruby-red, in group 521 H.
31	21	— Ceti	2 16 8	+ 0 22.3	12	Orange.
32	.....	786 B. A. C.	2 27 54	+ 34 7.1	6 var.	Yellowish-red; Sp. 3d t., *par excellence*, like α Ceti. Arr.
33	22	— Andromedæ	2 29 0	+ 56 30.3	9	Beautiful ruby-red.
34	23	855 Weisse, Trianguli	2 35 25	+ 31 52.3	7.5	Red; Sp. 3d t., faint.
35	.....	τ Eridani, 856 B. A. C.	2 39 2	— 19 7.9	4.5	Yellow; Sp. 3d t., zones very distinct.
36	.....	α Ceti	2 55 29	3 24.5	2	Yellow; Sp. 3d t., strongly-marked zones, like β Pegasi.
37	.....	ρ Persei	2 56 51	+ 38 15.0	7	Bright-red; Sp. 3d t., beautiful; strong black lines.
38	24	509 Arg. Ceti	2 58 23	+ 0 12.9	9.3	Red.
39	25	1014 B. A. C., Horologii	3 9 16	— 57 48.6	7.5	Orange-red.
40	26	— Ceti	3 9 56	— 6 12.5	7	Yellowish-red; color variable.
41	27	— Tauri	3 27 27	+ 19 22.5	9	Reddish.
42	28	— Tauri	3 34 55	+ 14 22.4	9	Beautiful and almost ruby-red.
43	29	— Persei	3 36 13	+ 53 29.6	9	Fiery red, almost scarlet.
44	30	— Eridani	3 37 30	— 10 1.1	8	Red.
45	.....	1144 B. A. C.	3 37 38	+ 65 16.8	5	Yellow; Sp. 3d t., well-defined intense zones in yellow and red; feeble in the green.
46	31	1204 B. A. C., Camelopardi	3 46 3	+ 60 43.5	5.5	Red.
47	32	— Eridani	3 48 59	— 15 17.4	8	Yellowish-red.
48	.....	γ Eridani, 1234 B. A. C.	3 51 58	— 13 52.8	2.5	Orange; Sp. 3d t.; magnificent zones, but certainly variable.
49	33	— Eridani	4 14 15	— 6 33.4	7.7	Yellowish-red; Sp. 3d t. (?).
50	34	1342 B. A. C., Tauri	4 14 44	+ 20 30.4	6.5	Pale red; Sp. beautifully lined.
51	35	— Eridani	4 16 37	+ 0 12.3	10	Red.
52	36	R Tauri	4 21 10	+ 9 52.2	var.	Red; Sp. 3d t., zoned.
53	37	S Tauri	4 22 5	+ 9 39.4	var.	Reddish.
54	38	— Eridani	4 27 13	— 11 3.8	6.7	Yellowish-red; Sp. 3d t., lined.
55	.....	1419 B. A. C.	4 27 54	— 8 30.3	6.7	Red; Sp. 3d t., excellent dark zones in the red.
56	39	α Tauri	4 28 27	+ 16 14.8	1	Pale red; Sp. 2d to 3d t., variable.
57	.....	1451 B. A. C.	4 34 46	+ 19 55.3	5	Yellow; Sp. 3d t., with perfectly distinct and very dark intervals.
58	40	— Aurigæ	4 36 50	+ 32 40.6	8.5	Beautiful ruby-red.
59	41	1457 B. A. C., Camelopardi	4 37 47	+ 67 56.0	6.5	Bright red; Sp. 4th t., fine zones.
60	.....	B. A. C. 1470	4 39 55	+ 63 16.8	5.5	Yellow; Sp. 3d t., regular with sharply-defined lines. Arr.
61	42	1317 Rad., Aurigæ	4 40 49	+ 51 59.9	9.5	Fire red.
62	43	— Aurigæ	4 43 23	+ 28 18.0	8	Intense red; Sp. 4th t., zoned, variable.
63	44	O' Orionis	4 45 11	+ 14 2.0	5	Deep red; Sp. 3d t., magnificently channelled.
64	45	5 Orionis	4 46 36	+ 2 16.7	5.5	Pale dark-red; Sp. 3d t., zoned.
65	46	— Orionis	4 48 46	+ 7 34.0	7	Red; Sp. 3d t.
66	47	— Orionis	4 48 57	+ 0 13.5	10	Ruby.
67	48	R Orionis	4 51 58	+ 7 55.9	var.	Reddish; Sp. uniform (?).
68	.....	ζ Aurigæ, 1541 B. A. C.	4 53 24	+ 40 52.2	4	Yellow; zones faint and cloudy.
69	49	R Leporis	4 53 41	— 15 0.2	var.	Hind's crimson star; Sp. uniform.
70	50	— Orionis	4 55 9	+ 0 31.8	6	Yellowish-red; Sp. uniform.
71	51	— Orionis	4 58 41	+ 0 59.8	6.5	Beautiful red; Sp. 4th t., zoned.
72	52	— Orionis	4 59 56	+ 0 22.3	9	Ruby.
73	53	— Orionis	5 3 26	— 0 43.7	7	Yellowish-red.
74	.....	LL. 9785.	5 5 18	— 12 0.7	6.7	Orange-yellow; Sp. 3d t., well marked.
75	.....	Anonymous	5 7 59	— 0 42.7	8.8	White; Sp. 3d t., channelled, faint. Arr.
76	.....	Groomb. 953.	5 8 59	+ 42 38.9	7	Yellowish; Sp. 3d t., luminous columns between dark and light zones.
77	54	— Aurigæ	5 11 7	+ 39 12.2	7 var.	Red; near neb. 1067 H.; Sp. 4th t., variable.
78	55	— Aurigæ	5 12 15	+ 34 7.8	8	Remarkably red.
79	56	— Orionis	5 12 45	+ 0 13.8	10	Reddish.
80	57	— Orionis	5 17 5	— 9 27.1	8	Very red.
81	.....	β Leporis	5 22 41	— 20 51.8	4	Yellow, with fine lines on the borders of zones.
82	58	31 Orionis	5 23 8	— 1 11.8	5	Yellowish-red, variable; Sp. 4th t.
83	59	119 Tauri, B. A. C. 1726	5 24 36	+ 18 29.7	5.5	Red; magnificent Sp. 3d t.; columns; dark broad lines, like π Aurigæ.
84	60	— Orionis	5 25 51	+ 10 57.1	7.5	Red; Sp. faint 4th t., imperfect.
85	61	— Tauri	5 30 33	+ 24 55.2	9.5	Red.
86	62	— Orionis	5 34 30	— 3 54.8	8	Red.
87	63	— Orionis	5 35 31	+ 2 18.0	7.7	Red; Sp. continuous, faint, variable.
88	64	— Tauri	5 37 17	+ 24 21.7	8	Very red.
89	65	— Pictoris	5 39 36	— 46 31.1	8	Like a drop of blood; superb.
90	.....	1844 B. A. C.	5 42 10	+ 37 15.9	5.5	Yellow; 3d t. like ρ Persei; lines somewhat broad. Arr.
91	66	α Orionis	5 48 9	+ 7 22.8	var.	Orange; Sp. superb 3d fundamental t., fluted. (See text.)

No.	No. in Chambers's.	Stars.	Right ascension, 1870.	Decl., 1870.	Magnitude.	Remarks.
			h. m. s.	° ′		
92	67	π Aurigæ	5 50 17	+45 55.3	6	Red; superb 3d t., zoned; variable in magnitude, color, and spectrum.
93	68	— Orionis	5 54 10	+ 0 12.2	10	Reddish.
94	69	— Orionis	5 54 31	+ 0 15.7	10	Red.
95	70	— Orionis	5 55 45	— 5 8.4	7.7	Yellowish-red.
96	71	— Orionis	5 55 51	+ 0 14.6	10	Red.
97	72	— Geminorum	6 2 49	+26 2.5	8	Deep crimson.
98	73	— Geminorum	6 5 24	+27 11.9	8.5	Ruby; Sp. 4th t., superb, brighter than others of its class; broad bright bands, with dark intervals. Arr.
99	74	— Pictoris	6 5 30	—52 29.5	9	Reddish.
100	....	1992 B. A. C	6 5 55	+61 33.8	6	White; Sp. 3d t., magnificently channelled; broad striæ in the red. Arr.
101	......	2029 B. A. C	6 11 29	+23 19.5	7	Deep red; Sp. 4th t., normal, magnificent.
102	75	— Geminorum, LL. 12245	6 18 3	+14 47.4	8	Vivid red; Sp. 4th t., quite irregular; points in the yellow.
103	76	— Canis Majoris	6 18 28	—26 59.0	8	Intense ruby.
104	77	— Monocerotis	6 23 40	+ 0 2.5	9	Reddish.
105	78	— Monocerotis	6 23 56	— 2 56.2	7.7	Red.
106	79	2139 B. A. C., Aurigæ	6 27 36	+38 32.8	6.5	Superb orange-red; Lalande, 12561; Sp. 4th t., with diverse interruptions. (See memoir.)
107	80	— Monocerotis	6 28 13	+ 0 7.2	9.5	Red.
108	81	2169 B. A. C., Argûs	6 35 30	—52 49.0	6	Red.
109	......	2157 B. A. C	6 38 48	+87 14.6	5	Yellow; Sp. 3d t., very decided; dark lines in red and yellow.
110	82	— Canis Majoris	6 41 26	—20 36.6	8	Red; the principal star of group 41 M.
111	83	— Canis Majoris	6 44 13	+ 0 4.5	10	Fine red.
112	84	1854 Rad., Camelopardi	6 51 7	+70 54.9	6	Yellowish-red; Sp. 2d t., uniform.
113	85	2289 B. A. C., Argûs	6 52 48	—48 32.4	5.5	Red.
114	......	LL. 13627	6 55 34	— 5 32.2	6.7	Fluted spectrum, but requiring clear atmosphere.
115	86	22 Canis Major	6 56 32	—27 45.0	3.5	Reddish; Sp. 2d t., golden yellow fine lines.
116	87	— Monocerotis	6 56 42	— 8 9.6	8.5	Red; South of 50 M.
117	88	R Geminorum	6 59 32	+22 54.1	var.	Red; Sp. direct, variable (see text); there is a yellow star near.
118	89	— Monocerotis	7 0 38	— 7 21.6	8	Red.
119	......	1027 Redhill	7 0 49	+82 39.4	5.6	Reddish; Sp. 3d t., with superb zones, various columns, strong dark lines.
120	90	— Monocerotis	7 1 59	—11 43.5	7.5	Red; Sp. 4th t., singular.
121	91	— Camelopardi	7 2 30	+82 39.6	5.4	Reddish.
122	......	1272 Groombr	7 3 15	+51 38.7	6	Yellow; Sp. 3d t., with magnificent striæ in all the zones.
122 bis.		Anon	7 5 54	+16 22.7	5.6	Very bright yellow; Sp. 3d t., with dark zones exceptionally broad.
123	92	44 Camelopardi	7 7 22	+59 8.7	7	Red to yellow; Sp. 2d t., uniform.
124	93	— Geminorum	7 7 47	+22 11.6	7.3	Vivid red; Sp. uniform.
125	94	— Monocerotis	7 14 49	—10 8.7	5	Red, preceding H 1517; Sp. uniform, 2d t. (?).
126	95	— Monocerotis	7 15 47	— 2 41.3	9	Blood-red.
127	96	— Canis Majoris	7 17 39	—25 30.8	7	Intense fiery red.
128	......	η Canis Majoris	7 18 57	—19 3.4	2.5	Yellow; Sp. 3d t., like α Orionis.
129	97	S Canis Majoris	7 25 39	+ 8 35.6	var.	Strongly red.
130	......	2537 B. A. C	7 34 35	+13 46.9	7	Orange; Sp. 3d t., resembling LL. 14961.
131	......	LL. 14961	7 34 43	+14 30.9	7	Yellow; Sp. 3d t., intervals marked, broad and dark in the red.
132	98	σ Geminorum	7 35 11	+29 12.0	5	Reddish.
133	99	S Geminorum	7 35 14	+23 45.2	var.	Deep-orange.
134	100	— Argûs	7 35 49	—31 21.1	9	Red.
135	101	β Geminorum	7 37 22	+28 20.2	1.5	Orange; Sp. 2d t., solar, fine lines.
136	......	W. VII. 1093	7 38 36	+35 16.8	8	Light red; Sp. zoned, but faint.
137	102	— Argûs	7 40 40	—37 39.7	4.5	Orange.
138	103	T Geminorum	7 41 30	+24 3.3	var.	Ruddy.
139	104	— Argûs	7 41 34	—31 48.6	9	Fine ruby.
140	105	— Camelopardi	7 44 23	+79 49.7	......	Red.
141	106	— Argûs	7 47 5	—26 3.5	8	Red; in middle of 1589 H.
142	107	— Argûs	7 53 33	—49 38.3	8	Brick-red.
143	108	— Argûs	7 56 11	—60 30.8	8	Orange.
144	......	2700 B. A. C	7 58 36	+23 0.3	7	White; Sp. 3d t., difficult, but recognizable.
145	109	— Monocerotis	8 7 12	— 0 1.5	9.5	Red.
146	110	R Cancri	8 9 24	+12 7.4	var.	Bright-orange.
147	111	— Hydræ	8 15 25	+ 0 15.1	8	Red.
148	112	2820 B. A. C., Argûs	8 18 29	—37 52.1	6	Red; Sp. uniform (zoned?).
149	......	2826 B. A. C	8 19 32	+13 4.9	6.7	Light-yellow; Sp. 3d t., zones broad, and also dark in the green and blue.
150	113	— Hydræ	8 24 47	+ 0 10.8	11.5	Reddish.
151	114	— Hydræ	8 25 0	+ 0 15.2	10	Orange.
152	115	U Cancri	8 28 19	+19 20.5	var.	Reddish.
153	116	— Argûs	8 40 1	—27 43.7	8.5	Fiery-red.
154	117	— Hydræ	8 40 7	+ 0 7.2	8	Orange.
155	118	— Argûs	8 45 35	—47 53.8	9	Ruby-color.
156	119	— Cancri	8 45 55	+19 48.7	9	Reddish.
157	120	— Cancri	8 48 3	+17 43.4	8.5	Fine red.
158	121	— Hydræ	8 49 3	—10 52.6	8	Red.
159	122	T Cancri	8 49 14	+20 26.7	var.	Very red; Sp. small and insignificant.
160	......	LL. 17803.5	8 55 29	+39 15.5	7.5	White; Sp. 3d t., broad zones, chiefly in green and blue.
161	123	— Argûs	8 59 53	—53 33.0	9	Ruby-red.
162	......	LL. 17988	9 0 17	+ 1 59.8	7	White; Sp. 3d t., pure, entirely discontinuous.
163	124	3121 B. A. C., Argûs	9 2 20	—25 20.1	4.5	Red; Sp. zoned, 3d t. (?).
164	125	— Cancri, LL. 18044	9 2 50	+31 29.7	6 var.	Yellowish-red, admirable; Sp. 3d t., sharp black lines, broad obscure places.
165	......	W. IX. 268	9 14 16	+ 0 43.9	7	Vivid orange; Sp. 3d t., fine example, black lines broad.
166	......	Anonymous	9 17 ...	—21 42.0	8	Fine yellow; new Sp. 3d t., fine.
167	......	α Hydræ	9 21 12	— 8 5.8	3	Yellow; Sp. 3d t., red, strongly striated, and apparently truncated.
168	126	— Argûs	9 28 57	—62 13.3	8	Intense blood-red.
169	......	3321 B. A. C	9 36 39	+14 36.9	6	Yellow; Sp. 3d t., normal; zoned also besides in the green.
170	127	R Leonis Minoris	9 37 46	+35 6.5	var.	Yellowish-red.
171	128	R Leonis, B. A. C. 3345	9 40 34	+12 1.8	var.	Deep-red; Sp. zoned and faint; variable; D'Arrest found strong dark zones.
172	129	— Hydræ	9 45 4	—22 24.6	6.5	Red; Sp. 4th t., brightness almost solely in the green.
173	130	— Argûs	9 50 9	—40 58.4	7.5	Scarlet.
174	......	3415 B. A. C	9 53 21	+ 8 40.1	4.5	Yellow; columns distinct in the red.
175	131	— Argûs	9 55 47	—59 36.1	8.5	Scarlet.
176	......	η Leonis, 3453 B. A. C.	10 0 15	+17 23.8	3.5	Yellow, with faint zones.
177	132	18 Sextantis	10 4 29	— 7 46.6	6 var.	Red, variable, small-zoned spectrum.
178	133	— Antliæ pneumaticæ	10 6 12	—34 40.9	7	Scarlet; zoned Sp. 4th t. (?).
179	......	3510 B. A. C	10 9 42	+14 22.5	6	Yellow; Sp. 3d t., with columns very strongly marked in the red.

No	No. in Chambers.	Stars.	Right ascension, 1870. h m. s.	Decl., 1870. ° ′	Magnitude.	Remarks.
180	134	— Argûs	10 9 59	— 60 2.4	9	Ruby.
181	......	[illegible] B. A. C.	10 18 24	+ 9 26.6	6.7	Vivid yellow; 3d t., columned; intervals narrow.
182	135	[illegible] B. A. C., Antliæ pneumaticæ	10 29 28	— 38 53.7	6.5	Orange.
183	136	[illegible] Carenæ Argûs	10 30 36	— 56 53.1	5.5	Red.
184	137	3637 B. A. C., Hydræ	10 31 9	— 12 42.6	6.5	Red; Sp. 4th t., fine strong yellow.
185	138	— Sextantis	10 34 24	+ 0 6.0	8.5	Pale red.
186	139	R Ursæ Majoris	10 35 25	+ 69 27.4	var.	Pale red.
187	140	— Argûs	10 39 15	— 57 23.3	9	Ruby.
188	141	— Hydræ	10 45 18	— 20 33.7	6.5	Vivid red; Sp. 4th t., blue wanting.
189	..	3750 B. A. C.	10 49 16	+ 6 52.7	7	Almost white; Sp. 3d t., with zones in all the colors.
190	142	— Crateris	10 53 6	— 15 39.4	6	Red; Sp. 3d t., faint; the yellow bright.
191	143	11046 O. A., Crateris	10 54 9	— 17 37.9	8	Intense scarlet; Sp. zoned.
192	......	3775 B. A. C.	10 55 12	— 1 47.3	5.5	White; Sp. 3d t., zones very distinct, especially in the red.
193	144	— Leonis	10 59 3	+ 0 6.4	9.5	Red.
194	......	3811 B. A. C.	11 2 10	+ 37 0.9	6.7	Yellowish; Sp. 3d t., normal; columns striking throughout the spectrum.
195	145	— Chamæleontis	11 5 10	— 81 5.1	8	Ruby.
196	......	3842 B. A. C.	11 8 17	+ 23 48.2	4.5	Bright orange; Sp. 3d t., with broad dark intervals; normal, fine.
197	146	— Argûs	11 9 32	— 60 31.8	10	Red.
198	......	3850 B. A. C.	11 10 36	+ 2 43.6	5.6	White; 3d t., striæ dark and easily made out.
199	147	ν Ursæ Majoris	11 11 28	+ 33 48.3	4.8	Red; Sp. 2d t., with delicate striæ, fine.
200	......	3954 B. A. C.	11 31 45	+ 8 51.2	6	Yellow; Sp. 3d t., brilliant; intervals dark throughout.
201	148	— Muscæ	11 33 42	— 71 50.9	8.5	Fine ruby.
202	149	— Leonis	11 34 27	+ 25 31.6	8	Red; Sp. continuous.
203	......	3982 B. A. C.	11 39 11	+ 7 15.5	5	Light yellow; Sp. 3d t., fine; zones magnificent. Arr.
204	150	— Centauri	11 43 54	— 56 27.4	8	Orange.
205	......	Anonymous	11 48 32	+ 37 29.0	7	Light yellow; Sp. 3d t., all the columns well separated.
206	......	1784 Redhill	11 53 31	+ 81 34.6	...	Orange; Sp. with separate lines, and zones very distinct on one side.
207	......	4148 B. A. C.	12 13 25	+ 49 42.3	6	Yellow; Sp. 3d t., very long zones in the red, narrower in the violet.
208	151	— Chamæleontis	12 15 44	— 74 47.3	8.5	Dark red.
209	152	— Virginis	12 18 35	+ 1 29.4	7.5	Red.
210	......	W. XII. 277	12 18 39	+ 1 36.1	8	Deep red; Sp. 4th t., lines in the red, narrower in the violet.
211	153	— Comæ Berenices	12 22 40	+ 29 0.8	9	Rich ruby-purple.
212	......	W. XII. 378	12 23 44	+ 5 8.2	8	Bright red; Sp. 3d t., marked, singular; interruptions few.
213	154	γ Crucis	12 23 54	— 56 22.7	2	Red.
214	155	— Virginis	12 25 35	+ 5 23.5	9.5	Scarlet.
215	......	4254 B. A. C.	12 31 45	+ 2 34.2	7	White; Sp. 3d t., fine dividing lines, as in π Leonis.
216	156	R Virginis	12 31 55	+ 7 42.2	var.	Pale yellowish-red; Sp. diffuse.
217	157	— Hydræ	12 32 37	— 26 2.1	12	Red (in group 68 M.).
218	158	S Ursæ Majoris	12 38 15	+ 61 48.3	var.	Red or violet.
219	159	4287 B. A. C., Canum Venaticorum	12 39 1	+ 46 9.0	5.5	Red; Sp. 4th t., magnificent (the superb).
220	160	— Crucis	12 39 50	— 58 59.0	8.5	Intense blood-red.
221	161	— Virginis	12 44 4	— 0 2.7	9	Red.
222	162	— Comæ Berenices	12 45 54	+ 17 48.8	8	Brownish-red.
223	163	κ Crucis	12 45 57	— 59 38.6	...	Extremely red.
224	164	— Crucis	12 46 16	— 59 39.8	9	Red.
225	......	LL. 24034	12 47 33	— 10 56.7	6.7 var.	Sp. 3d t., brilliant, marked with dark zones.
226	......	4330 B. A. C.	12 47 36	— 8 49.9	6.6	Bright yellow; Sp. 3d t., fine, like δ Virginis; lines dark.
227	......	δ Virginis	12 49 4	+ 4 6.2	3	Yellow; Sp. 3d t., cloudy zones.
228	......	Oeltzen 13158	12 51 19	+ 66 41.8	7	Dark red; Sp. 4th t., vivid bright zones separated by intensely dark zones (requires further study).
229	165	— Comæ Berenices	12 51 41	+ 18 28.2	8	Red.
230	......	4351 B. A. C.	12 52 30	+ 18 6.8	5	Light orange; Sp. columned, but not so much as 40 Comæ.
231	166	— Centauri	12 56 59	— 60 44.0	9.5	Fine orange.
232	......	4388 B. A. C.	13 0 3	+ 23 19.0	6	Yellow; Sp. 3d t., broad black lines, very obscure, normal throughout the spectrum.
233	167	γ Hydræ	13 11 50	— 22 29.0	3 var.	Yellowish-red (?); Sp. 2d t., lines in the zones.
234	......	Oeltzen 13583	13 17 34	+ 47 41.1	7	White; Sp. 3d t., extremely well marked, though not differing in color from its neighbors.
235	......	4479 B. A. C.	13 18 0	+ 37 42.8	6	Dull red; Sp. 3d t., dark zones in all the colors.
236	168	ι Virginis	13 19 52	— 12 1.8	5.5 var.	Red; Sp. 4th t., yellow-red.
237	169	R Hydræ	13 22 37	— 22 36.4	var.	Red; Sp. 3d t., vivid lines, and superb example; variable.
238	......	Oeltzen 13681	13 23 40	+ 60 31.1	6	Orange; Sp. 3d t., columned, but with narrow zones.
239	......	4516 B. A. C.	13 25 33	— 5 35.1	6	Yellowish; Sp. 3d t., as ψ Virginis.
240	170	S Virginis	13 26 13	— 6 31.4	var.	Bright red; Sp. diffuse and faint.
241	......	W. XIII. 596	13 30 53	+ 25 16.6	6.7	Bright orange; Sp. 3d t., columned, fine.
242	......	Anonymous	13 34 48	— 8 2.8	6.7	Yellowish; Sp. 3d t., columned, zones strong and easily visible.
243	......	4568 B. A. C. = 83 Ursæ Majoris.	13 35 48	+ 55 20.4	5	White; Sp. 3d t., remarkable case of a colorless star with such a spectrum.
244	171	υ Boötis, 4615 B. A. C.	13 43 13	+ 16 26.6	4	Red; Sp. 3d t., black zones in the green; Sp. uncertain, partly 3d and partly 4th; gaps in the green.
245	172	3105 Rad., Canum Venaticorum	13 47 39	+ 40 58.8	7	Brownish-red.
246	173	— Virginis	13 58 11	+ 0 9.9	8	Reddish.
247	174	— Centauri	13 59 55	— 59 6.4	8	Double, both brick-red.
248	......	Groombr. 2078	14 2 44	+ 44 28.3	5.6	Yellowish; Sp. 3d t., of the finest kind.
249	......	4700 B. A. C.	14 3 45	— 15 41.2	5.6	Vivid red; 3d t., of the finest.
250	175	— Centauri	14 7 35	— 59 18.4	7.5	Ruby.
251	......	Groombr. 2091	14 9 38	+ 70 2.6	5	Reddish-yellow; Sp. 3d t., zones very distinct as far as the blue.
252	176	α Boötis	14 9 44	+ 19 52.0	1 var.	Yellow; Sp. 2d and 3d t., sometimes zoned.
253	177	4775 B. A. C., Boötis	14 17 55	+ 8 40.8	6	Yellowish; Sp. 2d t., with traces of zones.
254	178	— Boötis, LL. 26342	14 18 20	+ 26 17.8	7.5	Vivid red; Sp. 3d t., various zones; difficult. Arr.
255	179	— Virginis	14 22 53	— 5 21.1	8	Reddish.
256	180	ρ Boötis	14 26 14	+ 30 56.6	4	Red; Sp. zoned (error 1° in Schjellerup and Chambers).
257	181	— Centauri	14 27 32	— 42 48.0	9	Ruby.
258	182	4825 B. A. C., Boötis	14 29 20	+ 37 11.9	6	Red; Sp. faintly zoned.
259	......	4864 B. A. C.	14 37 43	+ 27 4.9	6 var.	Yellowish-red; 3d t., columns well marked, especially in the red.
260	......	LL. 26918	14 39 59	+ 15 40.7	6	Light yellow; Sp. 3d t., magnificent, fluted, zones broad and dark, sharp on one side.
261	......	Groombr. 2177	14 55 31	+ 66 27.0	5	Dull yellow; Sp. 3d t., like β Pegasi.
262	183	4976 B. A. C., Trianguli Australis	15 1 54	— 69 35.2	6	Almost scarlet.
263	......	W. XV. 106, 107, 108	15 6 9	+ 19 28.2	5.6	Almost white; Sp. 3d t., fine as α Herculis; superb.
264	184	δ Lupi	15 9 55	— 29 40.1	4.7 var.	Bright yellowish-red; Sp. 2d t., dark zones in the green
265	185	— Avis Indicæ	15 11 46	— 75 27.4	7	Ruby.
266	186	S Serpentis	15 15 34	+ 14 47.0	var.	Red.
267	187	τ^4 Serpentis	15 30 27	+ 15 32.0	7.5	Red, variable; Sp. 3d t., channelled; zones in the green.
268	......	α Serpentis	15 37 50	+ 6 50.3	2.5	Yellowish; 3d t., fine dark zones.

No.	No. in Chambers's.	Stars.	Right ascension, 1870.	Decl., 1870.	Magnitude.	Remarks.
			h. m. s	° '		
269	......	5234 B. A. C.	15 42 54	+ 18 32.7	4.5	Yellow ; Sp. 3d t., fine bright lines ; broad dark zones.
270	188	R Coronæ Borealis	15 43 13	+ 28 33.5	var.	Reddish ; Sp. diffuse.
271	......	δ Coronæ	15 44 10	26 28.1	4.5	Yellow ; Sp. fine lines with zones.
272	189	R Serpentis	15 44 44	+ 15 31.8	var.	Red.
273	190	— Coronæ Borealis	15 44 54	+ 39 58.2	9.5	Fine deep-ruby.
274	191	— Avis Indicæ	15 45 24	— 74 6.6	9	Deep-red.
275	......	5287 B. A. C. = 2 Herculis	15 50 18	+ 43 31.1	6	Yellow ; Sp. 3d t., zones like β Pegasi, wanting in the violet.
276	192	— Coronæ Borealis	15 54 19	+ 36 23.8	10	Ruby-red.
277	193	R Herculis	16 0 23	+ 18 43.4	var.	Red.
278	194	— Herculis	16 1 45	+ 22 10.4	7.5	Yellowish-red ; Sp. striated in the green.
279	......	5366 B. A. C.	16 2 12	+ 8 52.9	6	Yellowish ; Sp. 3d t., normal, brilliant.
280	......	5369 B. A. C.	16 2 21	+ 8 57.7	7	Yellow ; Sp. 3d t., dark zones moderately broad.
281	195	— Serpentis	16 3 5	+ 1 10.0	8	Reddish.
282	......	δ Ophiuchi	16 7 30	— 3 21.3	3	Yellowish-white ; Sp. finely lined with traces of zones.
283	196	— Normæ	16 8 41	— 45 28.8	8.5	Ruby.
284	......	5459 B. A. C.	16 15 5	+ 60 5.2	6.3	Yellow ; Sp. 3d t., magnificent ; zones broad and dark, well marked.
285	......	5479 B. A. C., ν^1 Coronæ Borealis	16 17 28	+ 34 6.4	5	Light-orange ; Sp. 3d t., zones well marked.
286	......	2480 B. A. C., ν^2 Coronæ Borealis	16 17 36	+ 34 0.4	5	Light-orange ; Sp. 3d t., zones well marked (ν^1 and ν^2 Coronæ are alike).
287	197	— Ophiuchi	16 17 45	+ 0 6.3	10	Garnet-red.
288	198	— Ophiuchi	16 19 30	— 12 7.3	8	Dull brick-red.
289	199	U Herculis	16 20 3	+ 19 11.4	var.	Red.
290	......	5494 B. A. C.	16 20 42	— 7 17.7	6	Yellow ; Sp. 3d t., finely fluted ; zones broad, dark, normal.
291	200	α Scorpionis	16 21 27	— 26 8.5	1.5	Perfect red ; Sp. 3d t., very fine, variable.
292	......	5523 B. A. C.	16 24 22	+ 42 10.2	5 var.	Sp. 3d t., bright normal like β Pegasi ; zones broad and deep in the blue.
293	201	— Scorpionis	16 32 17	— 32 7.1	8	Deep-red.
294	......	5596 B. A. C. = 42 Herculis	16 35 13	+ 49 10.9	6	Bright-yellow ; Sp. 3d t., channelled ; the neighboring star has a continuous spectrum.
295	......	LL. 30500	16 38 25	+ 36 45.3	7.8 var.	Red, in the large group of Herculis ; Sp. 3d t., finely channelled. Arr.
296	202	— Ophiuchi	16 42 42	+ 0 9.2	9	Reddish.
297	......	W. XVI. 1347	16 43 10	+ 42 28.3	7	Red ; Sp. 3d t., easy ; others similar in the vicinity, but more difficult. Arr.
298	203	— Ophiuchi	16 44 29	— 5 57.1	8	Red.
299	204	S Herculis	16 45 59	+ 15 9.7	var.	Red.
300	205	— Scorpionis	16 46 45	— 39 17.3	9	Red.
301	206	— Ophiuchi	16 49 30	+ 1 37.9	8.5	Red.
302	207	— Aræ	16 51 54	— 54 52.5	9	Intense ruby-red.
303	208	— Ophiuchi	16 52 58	— 4 1.4	8	Yellowish-red.
304	......	5749 B. A. C.	16 57 11	+ 14 16.8	5.6	Almost white ; Sp. 3d t., channelled, with strong dark zones ; normal.
305	......	5763 B. A. C.	16 58 51	+ 35 35.9	7.7	Faint yellowish-red ; Sp. 3d t., fine ; lines well separated.
306	209	α Herculis	17 8 43	+ 14 32.5	var.	Yellowish-red ; Sp. 3d t., superb ; a physical standard.
307	......	W. XVII. 209	17 13 13	+ 2 17.8	7.8	Bright-red ; Sp. 3d t., brilliant ; numerously striated throughout.
308	210	43 Ophiuchi	17 15 11	— 28 0.9	6	Rosy-red ; Sp. zoned in the green.
309	......	5871 B. A. C. = 74 Herculis	17 16 40	+ 46 23.3	6	Yellow ; Sp. 3d t., but with narrow zones ; case of gradation. Arr.
310	211	— Scorpionis	17 21 29	— 35 31.9	9	Very deep red.
311	212	— Ophiuchi	17 22 3	— 19 21.9	8.5	Ruby.
312	213	— Scorpionis	17 31 14	— 41 32.7	8	Fine ruby.
313	214	— Aræ	17 32 9	— 57 39.4	8	Fine orange.
314	......	LL. 32300	17 35 3	+ 31 16.3	6	Light-red ; Sp. finely zoned in a good atmosphere.
315	215	— Serpentis	17 37 18	— 18 35.8	8	Fine red.
316	216	— Ophiuchi	17 47 37	+ 1 47.7	9	Ruby, quite curious.
317	217	— Ophiuchi	17 51 32	+ 2 44.2	7.5	Fine orange ; Sp. 3d t., zoned.
318	218	— Ophiuchi	17 59 36	+ 7 5.3	8	Red.
319	......	6134 B. A. C.	18 0 34	+ 22 12.6	5.5	Yellow ; Sp. faint, striæ broad, with colored zones.
320	219	— Sagittarii	18 2 15	— 15 18.1	8	Red.
321	......	6178 B. A. C.	18 7 1	+ 31 22.5	5	Yellowish-red ; Sp. 3d t., lines neatly separated as in R Lyræ.
322	220	— Serpentis	18 12 49	+ 0 47.5	8	Very red.
323	......	New	18 14 40±	+ 25 2±	6.7	Very fine red ; Sp. 3d t., channelled.
324	221	— Serpentis	18 15 30	+ 0 5.9	7.5	Red ; Sp. exceedingly faint.
325	222	T Serpentis	18 22 28	+ 6 13.0	var.	Yellowish-red.
326	223	6306 B. A. C., Sagittarii	18 25 18	— 14 57.2	6.5	Red ; Sp. 2d and 3d t., lines strong as in Arcturus.
327	224	— Aquilæ	18 26 12	— 5 15.3	7.5	Red, variable ; Sp. 2d t., cloudy.
328	225	— Sagittarii	18 28 28	— 24 0.8	12	Red.
329	......	New	18 28 ...	+ 36 54.	8.5	Intense red (discovered by Bermingham) ; spectrum faintly zoned.
330	226	— Aquilæ	18 29 7	— 6 51.0	8	Red.
331	227	— Aquilæ	18 31 32	— 13 53.4	8	Red.
332	228	— Serpentis	18 31 45	+ 11 20.5	9	Red.
333	229	— Serpentis	18 32 41	+ 9 1.9	10	Red.
334	......	W. XVIII. 1018	18 33 48	+ 39 33.2	7	Sp. 3d t., of surprising beauty, like α Herculis.
335	230	— Aquilæ	18 35 39	+ 0 2.0	8	Red.
336	231	— Serpentis	18 39 29	+ 8 36.9	9	Plum-color, or dusky purple.
337	232	— Aquilæ	18 42 46	— 8 3.1	9	Very remarkably dark red.
338	......	β Lyræ	18 45 15	+ 32 12.8	3	White ; Sp. singular, with bright lines like γ Cassiopeiæ.
339	233	— Sagittarii	18 46 24	— 22 4.4	7.5	Variably red ; Sp. very faint.
340	......	δ^2 Lyræ	18 50 8	+ 36 44.2	6	Sp. 3d t., zones very distinct in the usual places.
341	234	— Aquilæ	18 50 56	+ 0 17.1	9.5	Garnet.
342	235	— Aquilæ	18 52 37	+ 14 11.0	8	Red ; Sp. very faint.
343	......	LL. 35507	18 54 29	+ 22 37.9	7	Yellowish-red ; Sp. 3d t., superb, well marked. Arr.
344	......	Near γ Lyræ	18 54 ·	+ 32 ·	(?)	Yellow ; Sp. 3d t., like α Herculis.
345	......	See Astr. N. n. 1862, p. 220	18 57 27	— 5 52.5	7.5	Not yet studied.
346	236	— Aquilæ	18 57 58	+ 0 19.6	9.5	Reddish.
347	......	τ Sagittarii	18 58 50	— 27 51.3	4	Yellow ; various zones.
348	......	W. XVIII. 1861	18 59 58	+ 30 32.3	7	Sp. 3d t., channels very bright.
349	237	R Aquilæ	19 0 7	+ 8 2.1	var.	Red ; Sp. very faint.
350	238	— Vulpeculæ	19 3 12	+ 23 58.5	7 var.	Red ; Sp. with variable zones.
351	239	R Sagittarii	19 9 4	— 19 32.0	var.	Red.
352	......	6674 B. A. C.	19 23 18	+ 24 21.0	5	Yellow ; Sp. 3d t., dark zones precisely at the typical places.
353	240	36 Aquilæ	19 23 51	— 3 3.5	7	Red ; Sp. 2d and 3d t., like Arcturus ; bright.
354	241	6702 B. A. C., Draconis	19 26 10	+ 76 18.1	6.5	Very red ; Sp. 4th t., bright greenish-yellow zones.
355	242	— Sagittarii	19 26 51	+ 16 39.2	7	Remarkably red ; Sp. with bright green zones ; 4th t. (?).
356	......	LL. 37019	19 27 21	+ 5 11.3	7.4	Almost white ; Sp. 3d t., superb ; deep zones throughout.
357	......	μ Aquilæ	19 27 41	+ 7 6.4	4.5	Sp. 3d t., very distinct.
358	......	κ Aquilæ	19 29 53	— 7 18.9	4	Sp. 3d t., very distinct, like ι Aquilæ.

No.	No. in Catalogue.	Stars.	Right ascension, 1870. h. m. s.	Decl., 1870. ° ′	Magnitude.	Remarks.
359	......	ι Aquilæ	19 29 58	− 1 34.2	5	Sp. 3d t., very distinct.
360	......	6717 B. A. C.	19 30 7	+ 48 58.7	7	White; Sp. 3d t., normal; zones broad in the more refrangible colors.
361	243	— Aquilæ	19 38 5	+ 4 39.2	8	Red; Sp. excellent, but faint.
362	......	δ Sagittæ, B. A. C. 1726	19 41 36	+ 18 12.9	4	Sp. 3d t., zones magnificent (Arr.), but yet variable (see Vogel, 2000).
363	244	— Aquilæ	19 42 35	+ 0 22.6	9.5	Red.
364	......	γ Aquilæ	19 44 24	+ 8 31.7	3	Yellow; 3d t., zones very distinct.
365	245	χ Cygni	19 45 34	+ 32 35.3	var.	Red; Sp. 3d t., weak zones.
366	......	— Cygni, LL. 37858	19 45 57	+ 38 23.1	5.5	Red; Sp. 3d t., zones very distinct.
367	......	LL. 37836, Cygni	19 46 6	+ 37 29.6	6.5	Sp. 3d t., feebly but very decidedly channelled.
368	246	— Aquilæ	19 49 56	+ 0 17.3	10	Reddish.
369	......	6858 B. A. C.	19 54 11	+ 17 9.7	6	Sp. 3d t., magnificent, with zones like δ Sagittæ.
370	247	— Sagittarii	19 58 58	− 27 35.7	7.5	Fine ruby; Sp. 3d t., superbly channelled.
371	248	— Pavonis	19 59 56	− 60 18.6	8 5	Vivid red.
372	......	W. XX. 3	20 1 45	+ 34 32.3	6.8	Yellowish-red; Sp. 3d t., zones sharp in spite of their smallness.
373	249	R Capricorni	20 4 1	− 14 39.2	var.	Reddish.
374	......	A star of Wolf	20 5 22	35 48.0	8.5	Rosy (see text).
375	250	— Cygni	20 5 9	+ 41 6.9	10	Fine dark red.
376	......	A star of Wolf	20 6 50	35 50.0	8	Rosy (see text).
377	......	A star of Wolf	20 9 39	36 16.0	8	Rosy (see text).
378	251	— Capricorni	20 9 30	− 21 42.9	6 var.	The finest of the ruby stars; Sp. 4th t., with two bright zones.
379	252	— Aquilæ	20 12 20	+ 0 11.6	9.5	Orange.
380	......	β Capricorni	20 13 42	− 15 11.4	3.5	Yellow; Sp. with traces of zones.
381	......	New	20 16 0	+ 47 31.0	8	Deep red (Bermingham); Sp. zones doubtful.
382	253	— Aquilæ	20 18 10	+ 0 8.0	10	Red.
383	254	— Delphini	20 19 29	+ 9 38.2	8.5	Red.
384	......	7037 B. A. C.	20 19 30	+ 68 27.8	6.7	White; Sp. 3d t., superb; intervals broad and easy.
385	255	— Capricorni	20 20 0	− 28 41.2	8	Fine ruby; Sp. continuous (?).
386	......	ω′ Cygni	20 23 4	+ 48 57.2	5.5	Dull yellow; Sp. 3d t., zones very decided.
387	256	— Aquilæ	20 24 46	+ 0 22.0	10	Red.
388	......	Groombr. 3210	20 27 18	+ 48 23.2	6.7	Yellowish; Sp. 3d t., zones most visible in the red and orange. Arr.
389	......	LL. 40182	20 42 36	− 1 2.6	7	Sp. with dark zones, especially in the green and blue.
390	......	LL. 40347	20 45 32	+ 49 38.6	7.3	White; Sp. certainly channelled in spite of the faintness.
391	257	— Delphini	20 51 8	+ 15 45.2	8	Red.
392	......	— Delphini, LL. 40682	20 54 31	+ 18 49.6	7	Yellow; Sp. 3d t., channelled, difficult. Arr.
393	......	ξ Cygni, 7333 B. A. C.	21 0 12	+ 43 24.6	4	Sp. 3d t., zones very distinct.
394	258	— Aquarii	21 7 15	+ 0 12.7	9.5	Orange red.
395	......	δ Equulei, 7372 B. A. C.	21 8 10	+ 9 28.9	4.5	Yellow; traces of faint zones.
396	259	— Aquarii	21 8 51	− 3 4.9	8.5	Red.
397	260	— Cephei	21 9 31	+ 59 34.7	8	Red; Sp. faint; many red stars near.
398	261	— Pavonis	21 12 27	− 70 16.7	6	Ruby.
399	......	β Equulei	21 16 26	6 15.26	5.5	Yellow; Sp. with traces of zones.
400	......	LL. 41800	21 23 3	+ 21 36.8	7	Almost white; Sp. 3d t., magnificent; zones dark and intense.
401	......	7474 B. A. C.	21 24 4	+ 23 4.2	6	Light orange; Sp. with superb dark intervals (to be re-observed). Arr.
402	262	— Cygni	21 26 3	+ 51 0.7	11	Reddish.
403	......	Anonymous	21 30 2	+ 58 8.0	6	Red; Sp. 3d t., channelled.
404	......	LL. 42153	21 31 6	+ 44 48.6	6.5	Yellowish; 3d t., of the finest kind; fluted; zones broad in the blue.
405	......	Cygni, LL. 42342	21 36 32	+ 34 55.1	6.7	Deep red; Sp. 4th t., extraordinary; some narrow zones in the red; broad ones in the more refrangible colors.
406	263	S Cephei	21 36 47	+ 78 2.3	var.	Red.
407	......	Anonymous	21 37 46	+ 9 16.8	......	Sp. with fine lines bordering the zones.
408	264	— Cygni	21 37 54	+ 37 25.3	8	Red.
409	265	— Cygni	21 38 59	+ 37 16.1	8.5	Extremely intense ruby.
410	266	μ Cephei, 7585 B. A. C.	21 39 31	+ 58 11.1	var.	Fine deep garnet; Sp. perfect example of 3d t., according to D'Arrest, but found by me to be only linear.
411	267	— Cephei	21 39 39	+ 53 7.0	9.2	Red, in group 4701 H.
412	268	— Aquarii	21 39 48	− 2 48.8	6.5	Red; Sp. 3d t., fine.
413	269	— Aquarii	21 43 28	+ 0 21.6	10	Red.
414	270	— Cygni	21 50 22	+ 49 53.7	9	Fiery red.
415	271	— Pegasi	21 58 5	+ 27 43.3	8	Deep orange.
416	272	— Cephei	22 7 56	+ 56 37.7	10	Ruby; in neb. 4772 H.
417	273	7765 B. A. C., Lacertæ	22 8 18	+ 39 4.2	4.5 var.	Reddish; Sp. 2d to 3d t., fine lines variable.
418	274	— Pegasi	22 10 56	+ 4 29.8	6.8	Red; Sp. with faint zones.
419	275	— Cephei	22 18 15	+ 55 18.4	5	Fine red, variable; Sp. not ascertained.
420	......	ξ Pegasi	22 40 12	+ 11 30.6	5	Sp. with traces of zones strongest in the green.
421	......	λ Pegasi	22 40 16	+ 22 52.9	4.5	Yellow; traces of faint zones.
422	......	ι Cephei, 7967 B. A. C.	22 45 4	+ 65 31.1	4	Yellow; Sp. 3d t., zones very decided.
423	276	— Aquarii	22 53 3	− 25 51.4	6	Red; Sp. 4th t., certainly changeable.
424	277	— Piscium	22 54 38	+ 0 23.2	[illegible]	Red.
425	......	β Pegasi	22 57 28	+ 27 22.7	3 var.	Orange-yellow; Sp. the fundamental 3d t; zones decomposable.
426	278	R Pegasi	23 0 7	+ 9 50.6	var.	Red.
427	279	— Pegasi	23 0 27	+ 8 42.4	5.5	Red, changing to yellow; Sp. 2d t., lines fine and variable.
428	280	8 Andromedæ	23 11 44	+ 48 18.3	5.5	Red; Sp. 3d t., fine.
429	281	— Pegasi	23 13 46	+ 22 22.8	8.5	Red; Sp. very faint.
430	282	— Cassiopeiæ	23 18 29	+ 60 53.0	9	Reddish in group 52 M.
431	283	— Piscium	23 22 52	+ 0 22.6	10.5	Red.
432	284	— Piscium	23 24 2	+ 0 9.7	8	Red; Sp. very faint.
433	285	— Pegasi	23 26 0	+ 23 7.7	8	Red; Sp. with very faint zones; three others near.
434	......	— Pegasi, LL. 46146	23 26 57	+ 21 46.9	6	Red; Sp. 3d t., zoned; very fine; numerous obscure zones.
435	......	8250 B. A. C.	23 36 46	+ 9 36.6	5.5	Yellow; Sp. with very sharp striæ in the red and yellow.
436	286	— Piscium	23 39 45	+ 2 45.9	6	Reddish; Sp. 4th t., but certainly variable.
437	287	— Andromedæ	23 42 31	+ 44 27.7	10	Ruby.
438	288	— Piscium	23 45 53	+ 0 20.4	10	Red.
439	289	— Cephei	23 46 5	+ 74 48.4	6.5	Orange, variable; Sp. 3d t., zones feeble.
440	......	LL. 46859	23 48 8	− 0 57.8	6.7	Almost white; Sp. 3d t., with dark striæ well separated; a rare example. Arr.
441	290	— Ceti	23 50 26	− 27 20.9	5.5	Yellowish-red; Sp. 2d t., variable.
442	291	R Cassiopeiæ	23 51 49	− 50 39.9	var.	Red.
443	292	— Piscium	23 53 55	+ 0 20.5	10	Rosy.
444	293	— 6259 Rad., Cassiopeiæ	23 54 39	+ 59 37.9	6 var.	Red; Sp. a bright-green zone.
445	......	γ Cassiopeiæ	0 48 52	+ 60 0.8	3	White; Sp. reversed of the 1st order; lines H bright.

NOTE.—*Rad.* signifies Radcliffe's catalogue; *Argel.*, that of Argelander; B. A. C., that of the British Association; LL., that of Lalande; *Neb. H.*, Sir John Herschel's catalogue of nebulæ and groups; *Group M.*, group in Messier's catalogue; *Arg. Oelz.*, catalogue of Oelzen in Argelander's works; *Arr.* signifies D'Arrest; *W.* signifies Weisse; *Sp.* denotes spectrum.

fact that the spectra of these stars change in this manner there can be no doubt that the variation depends on the occurrence of eruptions of metallic vapors, as in the spots of our sun.

Beta Lyræ, a star of the first type, and a famous variable, has a double period—that is to say, a period formed of two maxima separated by two minima, unequal in quantity, but approximately equal in time. The general period is 12*d.* 21*h.* 53*m.* At its maximum it is of the order 3.4; at the first minimum, 4.3; and at the second 4.5; the period moreover of this seems to be variable in duration. This star, at its maximum brightness, presented to us sometimes formerly the bright lines of hydrogen, but in repeated subsequent searches we have never been able to see them again. Delta Cephei is another variable, whose period is 5*d.* 8*h.* 7*m.*, and the extent of its variation from the 3d to the 5th magnitude. The interval between the maximum and minimum is 3*d.* 19*h.*, and that from the minimum to the maximum 1*d.* 14*h.* It was discovered by Goodricke in 1784.

Algol, or β Persei, in the head of Medusa, is quite an important star. Being ordinarily of the second magnitude, it remains at its maximum splendor for 2*d.* 13*h.*, and then begins to decline slowly to such a degree that, in three hours and thirty minutes, it is reduced to a minimum of hardly the fourth magnitude. In this condition it remains but for a very short time—say, seven or eight minutes at most—and, in another three hours and thirty minutes, it resumes its former state. The total duration of the complete period is 2*d.* 20*h.* 48*m.* 55*s.* The variability of this star was discovered by Montanari in 1669. The spectroscopic study of it, made many times, has not shown any variation of type in its various phases. It is of the first type, which it has always preserved constant, even at its minimum. This fact, combined with that of a change of rate in its period, shows that, in this case, the origin of the variations is not an emanation of vapors, but a dark body which, during a certain time, partially occults the star. An accurate study of the period has proved that it is not constant, and that it is apparently at the present time shorter than formerly; but as the rate of change is not itself constant, perhaps the disturbances are periodic, and due to the motion of the principal star, or to perturbations occasioned by other obscure satellites. Up to this time Algol is the only star of which it can be affirmed, with any certainty, that it has dark satellites circulating round it.

A star quite important for its variations of brightness is η Argus in the southern hemisphere. Halley in 1667 placed it in his catalogue as of the fourth magnitude. In 1751, La Caille made it of the second. In 1814 it was again, according to Burchell, of the fourth. From 1822 to 1826, according to Brisbane, it was of the second. In 1827 it was of the first, according to Burchell; in 1834 between the first and second, according to Herschel. It afterward increased to the first, and from 1837 to 1850 became equal to α Centauri; in 1875 it was once more of the fourth. It is difficult to form an idea of the cause of such phenomena. The spectrum, as I am assured by one who has examined it, is banded.

Variable stars, when they have no other proper letter, are indicated in catalogues by capitals; as, for example, J Coronæ, R Herculis, etc.

To the category of the variables belong the temporary stars. A famous object of this kind, which appeared in Cassiopeia in the time of Hipparchus (125 B. C.), determined that astronomer to construct his catalogue, in order that he might leave to posterity a record, which should enable them to judge whether even the stars called fixed are not liable to change their places or to disappear. Another presented itself in 1572, in the time of Tycho, in the same constellation, and excited unbounded admiration. Resplendent as Venus for seventeen months, it afterward passed from white to yellow, and then to red, and finally disappeared altogether, or left at least but a doubtful trace. Argelander, having discussed the observations of Tycho, gave for the position of this star A. R. 0*h.* 17*m.* 52.6*s.*, Decl. N. 63° 27′ 18″. In this precise point of the heavens no star exists, but, at less than a minute of distance from the spot, there is a little one which is also variable, and this may be the same. There remains also a record of stars similarly seen in Cassiopeia in the years 945 and 1264—facts which have given ground for a suspicion that all these may have been the same star from time to time reappearing. The ancient Chinese speak of many stars appearing and afterward vanishing. Many of these are comets, but of some there can be no doubt that they were stars. The uncertainty of their positions, however, prevents any comparison.

In the time of Kepler, in 1604, also, a star of this class, which appeared in the foot of Serpentarius, lasted fifteen months with the brilliancy of Venus, and after passing from white to yellow, and then to red, finally vanished. It was situated in A. R. 17*h.* 23*m.* 8.9*s.*, Decl. S. 21° 22′ 16″, in which place there is no star now, though there is a small one at less than 2½′ distance.

In 1670, in the constellation of the Swan, a temporary star appeared, which lasted two years and reached the 3d magnitude. In 1848, Hind saw one in Ophiuchus, which sprang suddenly to the 4th magnitude, and is now of the 11th. Finally, in 1866, as mentioned in the preceding section, a new star made its appearance in the constellation of the Crown, which, from the 8th, grew to be of the 2d magnitude. Its spectrum was studied almost solely by Mr. Huggins, because no notice of it reached the public until after it had greatly dwindled. We were able to verify the lines of this spectrum; and we have found also another variable in the Gemini, which, on a small scale, presented the same phenomena. As we have said before, this spectrum had the direct lines of hydrogen, and there was every indication of an enormous conflagration. Perhaps also such is the origin of the other temporary stars. As Sir John Herschel justly remarks, the mind is lost in the endeavor to conceive such a phenomenon. How immense must be a conflagration vast enough to be visible at the distance of millions of millions of miles! But for us such occurrences are still more surprising, in consequence of the revelation they bring, that infinite space is probably strewed with innumerable obscure bodies, which we never see, except on the occasional occurrence in them of catastrophes of this frightful character.

Many of the stars set down in the catalogues of the ancients are now lost; it is impossible to believe all these to have been errors of observation. Some certainly were planets, and some have made themselves known as really Uranus or Neptune, since, by subsequent discovery, the elements of the orbits of these planets have been ascertained; but of divers others it is manifest that they have really disappeared. Annihilated they certainly have not been; there accordingly remains only the conclusion that they have become extinct—that is to say, reduced to the condition of dark bodies like the planets. (See Tables D and E.)

TABLE D.—*Stars possibly Variable.*

No.	Name.	R. A. 1870	Decl. 1870	Magnitude.	Authority.
		h. m. s.	° ′		
1	— Orionis	5 23 33	— 1 8.0	9	Argelander.
2	— Cancri...........	5 27 6	+21 51.2	8.9—11.12	Schmidt, 1864.
3	α Argûs	6 21 4	—52 37.5	1	
4	α Ursæ Majoris..	10 55 42	+62 27.2	1.5—2	Lalande, 1786.
5	21 Virginis.........	12 27 4	— 8 44.1	5.5	
6	W Virginis.........	13 23 39	— 8 56.1	8.5	Hind.
7	η Ursæ Majoris .	13 42 24	+49 57.8	1.5—2	Lalande, 1786.
8	X Virginis.........	13 47 39	+11 42.5	8.5	Hind.
9	β Ursæ Minoris..	14 51 7	+74 41.2	2—2.5	Struve, 1838.
10	κ Coron. Austr...	18 24 24	—38 48.9	3—6	Halley, 1676.
11	S Capricorni.......	20 34 9	—19 30.8	9—11	Hind, 1854.
12	λ^1 Cygni	20 41 58	+33 53.7	5.5	Schmidt, 1864.
13	— Aquarii (1)......	22 22 31	—10 36.0	7.8—0	Rümker, 1848.
14	— Aquarii (2)......	22 29 4	— 8 16.7	9—0	Hind.
15	T Cephei............	23 14 44	+55 24.1	8 2—8.8	Argeland 1863.

Even the sun itself is a variable star. The undecennial variations of its spots, and of the protuberances or eruptions, prove that it has not a constant activity, and that on this account it must vary; but the direct proof of this variability and of its limits is, we may say, next to impossible. Light is not measurable with precision, and the greater abundance of spots does not prove that the sun's light is less during their prevalence, because the greater intensity of light in the luminous parts may compensate for that which fails in the obscure—a thing which is also very probable, considering the greater energy of action then evident. Again, as all our observations are necessarily made through the atmosphere, the excessive instability of this medium prevents the exact measurement of the solar radiation and temperature. A proof of variation in these has been sought in the variations of the mean annual climatological temperature, but such variations do not in all places accord with the solar period above mentioned. Such proof has also been sought by Meldrum in the frequency of the equatorial cyclonic storms, but this also is insufficiently trustworthy. A variability of the sun is therefore certain, but the direct demonstration of it is difficult. The very intensity of solar light and heat is an obstacle. Wollaston estimated this intensity at twenty million times that of Sirius, but others put it at sixty thousand millions; whence it is obvious how far we may be from the truth. Spectral research only, by enabling us better to understand the tendency of these variations, can perhaps yet give us some such direct demonstration and measure.

§ 5. *Number of the Stars.*

The stars pass for innumerable, and are a most emphatic emblem of whatever exceeds in number the power of human computation. Nothing could more forcibly impress this idea. To the ancients, judging by the naked eye, it appeared nothing less than miraculous that Hipparchus

TABLE E.—*Variable Stars.*

Number.	Star.	R. A. 1870.	Decl. 1870.	Period.	Change of magnitude. From	to	Authority.
		h. m. s.	° ′	Days.			
1	R Andromedæ	0 17 12	+ 37 51.3	....	6		Argelander, 1860.
2	B Cassiopeiæ	0 17 36	+ 63 25.5	....	....		Tycho, 1572.
3	T Piscium	0 25 16	+ 13 52.9	143 ±	9.5	11	R. Luther, 1855.
4	α Cassiopeiæ	0 33 9	+ 55 49.4	79.1	2	2.5	Birt, 1831.
5	U Piscium	0 37 35	+ 6 35.3	....	9	12 <	Hind.
6	S Cassiopeiæ	1 10 8	+ 71 55.6	....		13 <	Argelander.
7	S Piscium	1 10 46	+ 8 13.7	13 m. ±	9	13 <	Hind, 1851.
8	R Piscium	1 23 56	+ 2 12.6	346	7	9.5	Hind, 1850.
9	V Piscium	1 47 30	+ 8 8.5	....	6	9	Argelander, 1863.
10	S Arietis	1 57 40	+ 11 54.1	....	9	13 <	C. H. Peters, 1865.
11	R Arietis	2 8 44	+ 24 27.1	186	8	12 <	Argelander, 1855.
12	o Ceti	2 12 47	— 3 34.1	331.336	2	12 <	D. Fabricius, 1596.
13	ρ Persei	2 56 51	+ 38 20.1	33	4		Schmidt.
14	β Persei	2 59 43	+ 40 27.2	2.86727	2.5	4	Montanari, 1669.
15	R Persei	3 21 47	+ 35 13.2	419	8.6	13 <	Schönfeld, 1861.
16	λ Tauri	3 53 29	+ 12 7.3	3.952	4	4.5	Baxendell, 1848.
17	U Tauri	4 14 15	+ 19 30.2	....	9	10.4	Baxendell, 1862.
18	T Tauri	4 14 25	+ 19 13.5	....	9.7	13.5 <	Hind.
19	R Tauri	4 21 10	+ 9 52.2	327	8	13.5 <	Hind, 1849.
20	S Tauri	4 22 5	+ 9 39.4	375	10	13 <	Oudemans.
21	R Orionis	4 51 55	+ 7 55.7	378	9	12.5 <	Hind, 1848.
22	ε Aurigæ	4 52 38	+ 43 37.7	250	3.5	4.5	Heis, 1846.
23	R Leporis	4 53 41	— 15 0.2	411	7		Schmidt, 1855.
24	μ Doradûs	5 5 47	— 61 58.4	Long.	5	9	Moesta, 1865.
25	R Aurigæ	5 6 48	+ 53 26.2	....	....		Argelander.
26	α Orionis	5 48 8	+ 7 22.8	196 ±	1	1.5	J. Herschel, 1836.
27	R Monocerotis	6 32 4	+ 8 50.9	....	10	13	Schmidt.
28	ζ Geminorum	6 56 24	+ 20 45.5	10.16	3.8	4.5	Schmidt, 1847.
29	R Geminorum	6 59 32	+ 22 54.1	370	7.3	11	Hind, 1848.
30	R Canis Minoris	7 1 32	+ 10 13.6	329	8	10	Argelander, 1854.
31	S Canis Minoris	7 25 39	+ 8 35.6	335	7.5	13 <	Hind, 1856.
32	S Geminorum	7 35 14	+ 23 45.2	294.07	9.2	13.5 <	Hind, 1848.
33	T Geminorum	7 41 30	+ 24 3.3	288.64	9.5	13.5 <	Hind, 1848.
34	U Geminorum	7 47 23	+ 22 20.5	97	9	13.5 <	Hind, 1848.
35	R Cancri	8 9 24	+ 12 7.4	359	6	10 <	Schwerd, 1829.
36	U Cancri	8 28 19	+ 19 20.5	306	9	13.5 <	Chacornac.
37	S Cancri	8 36 30	+ 19 30.0	9.48	8	10.5	Hind, 1848.
38	S Hydræ	8 46 47	+ 3 33.5	256	8.5	13.5	Hind, 1848.
39	T Cancri	8 49 14	+ 20 20.7	455 ±	9.5	12	Hind, 1850.
40	T Hydræ	8 49 20	— 8 38.7	291 or 326 ±	6.5	10.5	Hind, 1851.
41	α Hydræ	9 21 12	— 8 5.9	55	2.5	3	J. Herschel, 1837.
42	R Leonis Minoris	9 37 46	+ 35 6.5	1 year ±	7	11	Schönfeld, 1863.
43	R Leonis	9 40 34	+ 12 1.8	331	5	11.5	Koch, 1782.
44	R Ursæ Majoris	10 35 25	+ 69 27.4	301.90	7	13	Pogson, 1853.
45	η Argûs	10 40 2	— 59 0.1	46 years.	1	4	Burchell, 1827.
46	S Leonis	11 4 7	+ 6 10.1	192	9	13	Chacornac.
47	U Leonis	11 31 47	+ 4 5.5	....	10	14 <	C. H. Peters, 1865.
48	R Comæ Berenicis	11 57 55	+ 19 30.3	1 year ±	8	13 <	Schönfeld, 1856.
49	T Virginis	12 7 56	— 5 18.7	337	8	13 <	Boguslawski.
50	T Ursæ Majoris	12 30 28	+ 60 12.2	257	6.7	13 <	Argelander.
51	R Virginis	12 31 54	+ 7 42.2	146	6.5	11 <	Harding, 1809.
52	S Ursæ Majoris	12 38 15	+ 61 48.3	222.6	7.5	12 <	Pogson, 1853.
53	U Virginis	12 44 30	+ 6 15.7	212	7.5	12 <	Harding.
54	Y Virginis	13 19 18	— 2 42.1	....	8.5	10	Schönfeld, 1866.
55	V Virginis	13 21 6	— 2 29.7	252	7		Goldschmidt, 1857.
56	R (v) Hydræ	13 22 37	— 22 36.4	447.8	4	10 <	T. P. Maraldi, 1704.
57	S Virginis	13 26 13	— 6 31.4	380.11	6	11	Hind, 1852.
58	Z Virginis	13 27 45	— 12 32.7	....	5	8	Schmidt, 1866.
59	T Boötis	14 8 0	+ 19 40.5	....	9.7	14 <	Baxendell, 1860.
60	S Boötis	14 18 32	+ 54 24.2	....	8	12	Argelander, 1860.
61	R Camelopardi	14 27 35	+ 84 25.2	265	7	13	Winnecke.
62	R Boötis	14 31 27	+ 27 18.1	296	8	12	Argelander.
63	U Boötis	14 34 48	+ 28 1.4	....	9.5	13	Baxendell, 1864.
64	δ Libræ	14 54 2	— 8 0.1	6.98	....		Schmidt.
65	S Serpentis	15 15 34	+ 14 47.0	359	8	10 <	Harding, 1828.
66	S Coronæ	15 16 6	+ 31 50.2	....	6.5		Hencke, 1860.
67	R Coronæ	15 43 13	+ 28 33.5	350	6.2	13 <	Pigott, 1795.
68	R Serpentis	15 44 42	+ 15 31.8	352	6.5	10 <	Harding, 1826.
69	R Libræ	15 46 15	— 15 50.8	722	9	13.5	Pogson, 1858.
70	T Coronæ	15 54 4	+ 26 17.5	....	2.5	9.8	Bermingham, 1866.
71	R Herculis	16 0 23	+ 18 43.4	310	8.5	13.5	Argelander.
72	T Scorpii	16 9 18	— 22 39.0	....	7	13 <	Auwers, 1860.
73	R Scorpii	16 9 54	— 22 37.3	648	9	14 <	Chacornac, 1853.
74	S Scorpii	16 9 56	— 22 34.3	364	9	13 <	Chacornac, 1854.
75	U Scorpii	16 14 59	— 17 34.5	....	9.5	13.5	Pogson, 1863.
76	U Herculis	16 20 3	+ 19 11.4	....	7	13	Hencke, 1860.
77	30 Herculis	16 24 22	+ 42 10.1	106	5	6	Baxendell, 1857.
78	T Ophiuchi	16 26 18	— 15 51.2	....	10.5	13 <	Pogson, 1860.
79	S Ophiuchi	16 26 47	— 16 53.1	229.3	9.3	13.5 <	Pogson, 1854.
80	S Herculis	16 45 59	+ 15 9.7	305	7.7	12.5	Schönfeld, 1856.
81	— Ophiuchi	16 52 13	— 12 41.4	....	4.5	13.5 <	Hind, 1848.
82	R Ophiuchi	17 0 18	— 15 55.6	304.6	8	13.5 <	Pogson, 1853.
83	α Herculis	17 8 43	+ 14 32.4	....	3.1	3.9	W. Herschel, 1795.
84	— Ophiuchi	17 22 51	— 21 22.1	....	....		D. Fabricius, 1604.
85	T Herculis	18 4 11	+ 31 0.0	164.7	7.9	13 <	Argelander.
86	T Serpentis	18 22 28	+ 6 13.0	310	10.5	14 <	Baxendell, 1860.
87	U Sagittarii	18 24 14	— 19 12.8	6.8	7.5	9	Schmidt, 1866.
88	R Clypei Sobieski	18 40 33	— 5 50.5	69	5	9	Pigott, 1795.
89	β Lyræ	18 45 17	+ 33 12.7	12.906	3.5	4.5	Goodricke, 1784.
90	13 Lyræ	18 51 23	+ 43 46.6	46	4.2	4.6	Baxendell, 1855.
91	R Aquilæ	19 0 7	+ 8 2.1	351.5	6.5		Argelander, 1855.
92	T Sagittarii	19 8 43	— 17 11.0	....	8.5	12 <	Pogson, 1863.
93	R Sagittarii	19 9 4	— 19 32.0	465	8	13 <	Pogson, 1858.
94	S Sagittarii	19 11 49	— 19 15.6	....	10.5		Pogson, 1860.
95	R Cygni	19 33 20	+ 49 54.5	416.72	8	14	Pogson, 1852.
96	11 Vulpeculæ	19 42 14	+ 26 59.8	....	....		Anthelm, 1670.
97	S Vulpeculæ	19 43 4	+ 26 57.9	67.9	8.8	9.8	Rogerson, 1873.
98	χ^2 Cygni	19 45 34	+ 32 35.2	409.2	5	13 <	G. Kirch, 1686.
99	η Aquilæ	19 45 51	+ 0 40.4	7.1763	3.6	4.4	Pigott, 1784.
100	S Cygni	20 2 47	+ 57 36.7	324	9	13 <	Argelander, 1860.
101	R Capricorni	20 4 1	— 14 39.2	....	9.5	13.5	Hind, 1848.
102	T Aquilæ	20 5 39	+ 15 14.3	124 ±	8.9	11.3	Baxendell, 1863.
103	R Sagittarii	20 8 8	+ 16 20.0	70.88	8.3	10.3	Baxendell, 1859.
104	S Aquilæ	20 8 39	+ 8 41.4	....	9	12 <	Hencke, 1815.
105	34 Cygni	20 13 0	+ 37 37.8	18 years ±	3	6 <	Jansen, 1600.

Number.	Star.	R. A. 1870.	Decl. 1870.	Period.	Change of magnitude.	Authority.
		h. m. s.	° ′	*Days.*	*From to*	
106	R (24) Cephei	20 23 41	− 15 42.6	73 years	5 11	Pogson, 1856.
107	R Delphini	20 37 5	+ 78 2.3	248	8 13.5	Baxendell, 1860.
108	S Delphini	20 39 20	+ 58 11.1	....	8.6 12	Baxendell, 1863.
109	U Capricorni	20 40 54	+ 11 54.2	420	11 13.5 <	Pogson, 1857.
110	T Aquarii	20 4 36	+ 57 45.0	197	7.8 0	Goldschmidt, 1861.
111	R Vulpeculæ	20 58 36	− 21 2.1	138.6	8 13.5	Argelander.
112	T Capricorni	21 14 50	+ 27 22.7	274	9 11 <	Hind, 1854.
113	S Cephei	21 36 47	+ 9 50.6	470	8.9 11.12	Winnecke.
114	μ Cephei	21 39 31	− 16 0.3	5 or 6 years.	4 6	W. Herschel, 1782.
115	T Pegasi	22 2 33	+ 50 39.9	....	10 13 <	Hind, 1863.
116	δ Cephei	22 24 21	+ 88 44.0	5.3664	3.7 4.8	Goodricke, 1784.
117	S Aquarii	22 50 8	+ 16 37.4	279.3	8 11 <	Argelander, 1853.
118	β Pegasi	22 57 28	+ 15 55.7	31.5 or 43.4	2 2.5	Schmidt, 1848.
119	R Pegasi	23 0 7	− 15 15.6	578	8.5 13.5	Hind, 1848.
120	R Aquarii	23 37 5	− 5 37.6	354 or 388.5	7 10 <	Harding, 1810.
121	R Cassiopeiæ	23 51 49	+ 23 18.4	434.81	6 14 <	Pogson, 1853.

should have made a catalogue of only a little over a thousand of them. But this work, worthy of the gods as Pliny called it, contained something more than a simple enumeration; it contained a precise determination of positions—a thing much more difficult. Really, however, also the simple counting of the stars is by no means easy; the sight becomes confused, and when we attempt to fix precisely the number of those we see, we find it quite small, and are at the same time convinced that all have certainly not been counted. The very diligent Heis avers that, for an observer in Middle Europe, it is not possible, with the naked eye alone, to count more than four or five thousand. Possessing an extremely acute vision himself, and using special precautions—such, for example, as removing all artificial light, limiting by means of a large tube the extent of sky under observation, and making his charts black and the stars white—this acute observer was able, at Münster, to see 5421; and since, from this station, eight-tenths of the total superficies of the heavens are visible, he argued that, supposing the remainder of the southern hemisphere to be furnished with equal abundance, the entire number barely reaches 6800.* But these certainly are not all the stars of the heavens. The naked eye sees really more than it is possible to count, because in fixing one in the centre of the retina, others seen on the surrounding portions, or, as the common saying is, "out of the corner of the eye," seem to vanish.

Instruments sublimely undeceive us in this matter. How many times have we made proof of this for the pleasure it affords! With the equatorial of Merz directed to whatever point of the Milky Way, and looking through the finder, which has an aperture of sixty millimètres and a field of half a degree, it is common to see within that narrow limit quite as many stars as the motionless naked eye can take in, in any single direct view.† Passing from the finder to the great telescope of 9.6 inches aperture, with a moderate magnifying power and field of 15′ for the greatest power employed, it is easy to see as many stars as before in the finder; that is to say, as many as were seen before in a space four times as large. Increasing the power, and reducing the field to five minutes, it is still true that the number of stars visible is not in the least diminished, the penetrating power of the enlargement enabling us to discern very minute stars which were before invisible. It therefore results that, in some places in the heavens, in a field of hardly five minutes diameter, there are seen as many stars as with the naked eye in the entire natural field of direct vision. But it is manifest that, in such places, a larger telescope—for example, one of 12 or 14 inches—would make visible a still larger number; and, in fine, the most gigantic of all, the large refractor of Lord Rosse, would increase the number in a proportion corresponding to its extraordinary power. Not all the heavens, however, are thus rich; in many places, even with the most powerful instruments, and in a field of 15′, are hardly found so many as five or six stragglers; whence it follows that, from the examination of a few particular localities, it could not be possible to infer at all the total number of the stars.

The telescopic enumeration of the stars was attempted by both the Herschels—Sir William in the northern hemisphere, and Sir John in the southern. It was one of the most colossal labors ever instituted in astronomy, though incomplete, for the reason that it could not be otherwise; the lifetime of one man being insufficient for the accomplishment of so great a task.

The method employed by the elder Herschel was only indirect. He used for the purpose his 20-foot reflector with 18 inches aperture, directing it successively to various points of the heavens disposed in a certain regular order, of which he recorded the right ascension and declination. These points were so distributed as, in the end, to cover the heavens with a kind of network, sensibly uniform in every direction. The field of the telescope was of 15′ 4″ diameter, and the magnifying power 120. He counted in each field the number of stars visible, and, where this was impossible because of their multitude, or where to count the whole would have occupied too much time, he counted a part, and made a proportionate estimate for the rest. These enumerations he called "star gauges," or soundings of the heavens. Having united several of these gauges in a determinate part of the sky, he divided the sum by the number of gauges, and took the quotient to represent the density of the stars in the neighboring region. This method, the only one practically available, is in many respects imperfect, but, applied on a large scale, gives valuable results. It may sometimes happen that a spot greatly abounding in stars may occur in the neighborhood of another almost desert, and in such a case the telescope would give an error of excess; but this would be balanced by an error of deficiency similarly occurring elsewhere; and thus, in the long run, there would be a general compensation.

We have said that this enumeration of the stars, though incomplete, forms one of the greatest labors of astronomy. To conceive it, it suffices to reflect that, in his 3400 gauges (of which many were repetitions, the whole number of distinct areas examined having been only 683), Herschel studied no more than the $\frac{1}{250}$th part of the celestial vault; to have embraced the whole would have required not less than 83 years. In fact, as the field of the telescope, 15′ 4″ in diameter, was only equivalent to $\frac{1}{832975}$th of the starry sphere, we may find by computation that, at the rate of 100 gauges per night, and 100 favorable nights (the largest number which can be counted on) per annum, this great length of time would be consumed in completing the work. The results of this immense labor are published by Sir William Herschel in the *Philosophical Transactions* (vol. lxxv.) for 1785, and, for the southern hemisphere, by Sir John Herschel, in his work on the observations made at the Cape of Good Hope. The character of the results obtained in gauges taken at different points of the sky, is immensely various. In some spots, so excessive is the number of stars, that not fewer than 588 are found in a single field; and with a constant density as great as this, they continue to pass for many minutes. In one locality, at about A. R. 19*h*. 27*m*., Polar Dist. 72° 54′, fully 116,000 stars passed in a single quarter of an hour, while in other points, the field embraced but one or two. The law of distribution of these objects will be a subject of inquiry elsewhere; we remark only here, that the number visible in the telescope of Herschel is computed to amount to 20,374,304. In the southern hemisphere, the phenomena are found to present a perfect similarity with those of the northern. But it is beyond a doubt that, while the stars visible in great instruments may be stated at between 20 and 30 millions, the number really existing is immensely greater. The Via Lactea alone, in certain portions, is absolutely white, without giving, like the nebulæ, a gaseous spectrum, and is thus proved to be composed of innumerable stars.

We have already given a numerical list of the stars according to their relative magnitudes as assigned by Heis, from which it is apparent that the numbers go on increasing as the magnitudes diminish. But for the smaller and telescopic stars all precise data are wanting. It is only from the prodigious labors expended upon catalogues designed to fix their positions, that we can derive any idea of them. Such has been the object of many enumerations made by zones, which serve to give an idea of the countless number, but make it clear that we shall never succeed in gathering up the whole. Lalande, by the method of

* Heis, *Atlas Cœlestis Novus*, p. xiii.

† It is necessary to distinguish what we call a direct view of the heavens, from that which is meant by a general view. In a glance, the field of vision embraces hardly more than 13° or 14°; by turning the eye, it is clear that we may sweep over the whole heavens.

zones, fixed the position of more than 50,000 stars, keeping within the limit of the 9th magnitude, and neglecting all the inferior in the immediate vicinity of the more brilliant. The zones of Bessel give a contingent of 52,199 not below the 9th magnitude, within the limits of 15° of N. and 15° of S. declination. Those of Argelander give the astounding number of 324,198 in the northern hemisphere almost wholly, but including 2° of S. declination, all being catalogued down to the 9th magnitude, and some between the 9th and 10th. We still await the results of the extended examination of the southern heavens (celestial survey), made by the Americans at Santiago de Chili, and of that undertaken by Harvard College with the great equatorial of 15 inches. These partial labors only show how far from exaggeration was the result reached by Herschel, when we consider the manner in which it was attained: since, putting the most moderate estimate upon the penetrating power of his telescope, the speculum being in good condition of polish, it assured the visibility of stars of at least the 15th magnitude.

A catalogue of stars is a list in which the stars are entered by their names and magnitudes, together with their co-ordinates of position. The ancients referred these co-ordinates to the ecliptic, in order to facilitate reductions of place from one epoch to another. The moderns, on the contrary, prefer the equatorial co-ordinates of right ascension and declination. The most celebrated catalogues are the following: The catalogue of Hipparchus, made at Rhodes B. C. 128, preserved by Ptolemy, and reduced with an erroneous precession to the year 137 of the common era, containing 1025 stars; that of Ulugh Beigh, made at Samarcand in 1437, containing 1019; that of Tycho Brahe, made at Uranibourg in 1602, and afterward republished by Kepler, containing 1005; that of Halley, embracing 341 southern stars, observed at St. Helena during the year 1677; that of Hevelius, made at Dantzic in 1690, containing 1564, which was the last of these labors conducted without telescopes—that is, by observations made with the naked eye, aided only by instruments with pinnules or plane sights.

From this time forward, labors of this character succeed each other in numbers too great for enumeration here. We limit ourselves to a mention of the principal, and refer for the rest to Chambers's *Descriptive Astronomy*, p. 593 *et seq.* The catalogue of Flamsteed, constructed in 1725, reduced to 1690, contains 3310 stars; the catalogues of Lacaille—viz. 1, that of 1750, containing 398 stars; 2, that of the zodiacal stars, containing 515; 3, that of 1924 southern stars observed at the Cape of Good Hope; the catalogue of Bradley, made at Greenwich and reduced to 1760—a work regarded as surpassing in precision all the preceding, on account both of the exquisite perfection of the instruments employed and of the accuracy of the observer. This was discussed anew by Bessel in 1818, in the *Fundamenta Astronomiæ*, and contains 389 stars; Bessel, from the same observations, augmented it to 3222. The catalogue of Lalande, taken from his *Histoire céleste*, contains 47,390 stars, and has been reduced to 1800 at the expense of the British Association. That of Piazzi, made at Palermo, reduced to 1801, contains 6748. This was the work which immortalized its celebrated author, being unrivalled in richness, and most accurately reduced to his time; a second edition, which he prepared in 1814, contained 7646 stars. The catalogue of the Astronomical Society of London, published in 1826, contains 2881 stars; that of Pond, made at Greenwich, contains 1112; that of Argelander, prepared at Åbo—a work which has served to fix with precision the proper motions of the stars—embraces 560; that of Rümker, 1836, contains 11,978, observed at Hamburg; that of the British Astronomical Society contains 8377 stars, and was compiled from various sources, chiefly by the labors of Bailey; besides the positions of the stars it gives also the coefficients of reduction. This classic work, reduced to 1850, deserves to be brought down to the actual state of science, by taking advantage of the labors of the quarter of a century since passed. The catalogue of Airy, of 1849, deduced from the observations of twelve years at Greenwich, and containing 2156 stars, is a work of great precision. Soon after its publication it was followed by other catalogues, embracing the very meritorious results of seven years' and of three years' subsequent labors. The catalogue of Argelander, published at intervals in three parts, embraces stars between the 2d degree of S. declination and the North Pole to the number of 324,188. The catalogue of Weisse, constructed on the zones of Bessel between 15° S. and 45° N., published in two parts at different dates, contains 62,530 stars, observed at Königsberg. The catalogue of circumpolar stars by Groombridge, published 1838, reduced by Airy to 1810, embraces 4243. The Oxford catalogue of Johnson, a work of exactness, contains 6317. That of Carrington, made at Redhill, reduced to 1855 and published by the British government in 1857, contains 3735.

Many other large collections most worthy of mention we omit, but the foregoing will suffice to convey an idea of the perseverance and precision with which stellar astronomy is cultivated in our day. It need only be added that no fewer than 52 catalogues, containing in the mean from 6000 to 8000 stars each, may be counted among the labors, so far, of the present century (from 1800 to 1876), and that many similar works are now in course of publication. Our age will leave to others yet to come a splendid heritage, equally admirable for the abundance and for the precision of the labors which have created it.

§ 6. *Proper Motions of the Stars.*

From the earliest times, the luminous bodies which adorn the firmament have been divided into the classes "fixed" and "wandering." The fixed were called stars—the others, planets or comets. In the infancy of science, when the celestial sphere was conceived to be a solid dome, the stars were believed not only to be fixed in place, but permanently and mechanically affixed to the dome itself. Nor could this be otherwise, since, even after the human mind had made the grand stride to the conception of the earth as suspended in space, it could not yet account for the stability of the body, except by supposing it to occupy the centre of the universe. It was only after a gigantic measure of advancement in science, that it became possible to grasp the conception of an earth stable in mass, and at the same time revolving round the sun, assumed in its turn as the centre. But after the mind had once entered upon this order of ideas, and had succeeded in comprehending that the stability of things upon the surface of a celestial body is entirely compatible with the translation of the body in space, the suggestion naturally occurred that the sun himself might be in motion, and with him all the stars; since already the solid firmament had vanished for ever, and the stars could no longer be regarded otherwise than as so many suns independent of ours, and situated at distances from us so immense as to transcend our conceptions. The mobility of the stars was thus a corollary of the prevalent theory of the *cosmos*, and it remained only to verify it by observation. In this, as in so many things, the genius of Halley displayed its superiority. Comparing the actual positions of Sirius, Arcturus, Aldebaran, and other stars with those given in the primitive catalogues, he saw that, after taking account of all the progressive variations, of precession, and of the annual periodic motions, there remained differences of 37′, 42′, and 33′—quantities entirely too great to be ascribed to errors of copyists. As to Aldebaran, the reality of the change was confirmed by an occultation observed on the 11th of March, A. D. 509, at Athens—an occurrence which, according to the lunar theory, could not possibly have taken place, if the star had at that time occupied its present position. In view of these facts, the conjecture became a certainty; but the rude observations of the earlier astronomers, and the minuteness of the movements themselves, furnished no safe ground for inferences of practical value. It was reserved to modern times to give to observation a precision adequate to form a firm foundation on which to establish laws and deduce consequences, even when the intervals between the observations are by no means great. The difficulty of the subject will be understood by simply reflecting that, for most of the stars, the motions in question do not amount to so much as a single second of space per annum; and that the largest—which, moreover, occur in only a very few exceptional cases—do not exceed six or seven seconds. So long, therefore, as observations were not such as to be relied on within some seconds, the stellar motions were liable to be confounded for many years with errors of observation. That an observation may be good, it is not sufficient that the astronomer should be himself able; there is demanded also a high degree of perfection in his instruments; and this was not secured until the time of Flamsteed and of Bradley, when, a century ago, Bird and Graham carried to such perfection the division of the circle, and the construction of transit instruments and clocks. Then the foundations of success in exploring this maze began first to be laid. More modern observers, profiting by these earlier-gathered data, have been able to determine the movements in question with great precision, and will continue, with the progress of time, to fix them more and more exactly. Thus, Argelander, comparing his observations with those of Bradley and others after him, was successful in directing science to the exact solution of this great problem. The following table, taken from the catalogue of Struve entitled *Stellarum fixarum duplicium positiones mediæ*, etc. (St. Petersburg, 1852), contains a list of the brighter of the stars which have a proper motion of more than ten seconds in seventy years:

Table F.—*Table of the Principal Stars whose Proper Motions are not less than Ten Seconds in Seventy Years.*

Name of Star.	Place of star, 1790.0. A. R.	Place of star, 1790.0. Decl.	Reciprocal of distance. λ.	Observed proper motion. In A. R. *P*.	Observed proper motion. In Decl. *P′*.	Observed proper motion. In great circle. *Π*.	Reduced proper motion. In A. R. *q*.	Reduced proper motion. In Decl. *q′*.	Reduced proper motion. Great cir. *σ*.	Reduced proper motion. Great cir minim. *τ*.
	h. m.	°		″	″	″	″	″	″	″
β Cassiopeiæ	23 58	58.0	0.488	+ 39.5	− 13.8	41.8	+ 29.6	− 11.1	31.6	3.1
η Cassiopeiæ	0 37	56.7	0.256	+ 79.7	− 36.2	85.5	+ 74.8	− 34.0	82.2	0.7
β Andromedæ	58	34.5	0.488	+ 13.7	− 4.4	14.4	+ 4.7	− 0.1	4.7	1.8
ζ Piscium	1 3	6.5	0.240	+ 10.6	− 3.8	11.3	6.2	− 2.5	6.7	0.8
δ Cassiopeiæ	12	59.1	0.362	+ 23.2	− 3.6	23.5	+ 16.7	+ 0.4	16.7	8.8
α Arietis	55	22.5	0.555	+ 13.9	− 9.7	16.9	+ 5.2	− 4.6	6.9	1.5
ο (Mira) Ceti	2 9	− 3.9	0.256	+ 0.8	− 13.9	13.9	− 3.0	− 13.0	13.3	13.2
θ Persei	30	48.3	0.240	+ 25.0	− 7.8	26.2	+ 21.7	− 4.3	22.1	12.7
γ Ceti	32	2.3	0.362	− 9.4	− 10.0	13.7	− 14.2	− 8.1	16.3	13.7
40 Eridani	4 5	− 8.0	0.256	− 162.6	− 256.7	303.9	− 164.2	− 256.2	304.3	304.3
α Tauri	24	16.1	0.940	+ 4.4	− 11.0	11.8	− 0.0	− 1.5	1.5	0.4
ω Tauri	45	37.6	0.256	+ 8.1	− 7.0	10.7	7.4	− 2.9	7.9	6.9
Capella	5 1	45.8	1.250	+ 6.2	− 30.4	31.0	+ 4.6	− 8.0	9.2	4.1
β Tauri	13	28.4	0.555	+ 4.2	− 14.0	14.6	+ 3.9	− 6.3	7.4	3.9
Sirius	6 36	16.5	2.000	− 38.6	− 90.3	98.2	− 24.8	− 92.5	95.8	95.2
Castor	7 21	32.3	0.770	− 15.2	− 3.5	15.6	− 7.1	+ 6.8	9.8	9.6
Procyon	28	5.7	1.030	− 51.4	− 77.1	92.7	− 40.0	− 70.6	81.1	41.5
Pollux	32	28.5	0.830	− 48.3	− 3.4	48.4	− 38.8	+ 6.6	39.3	32.7
ζ Cancri	8 0	18.3	0.217	+ 7.3	− 8.8	11.4	+ 10.1	− 6.8	12.2	11.5
1 Ursæ Majoris	13	61.4	0.326	− 9.4	− 9.1	13.1	− 4.8	− 4.2	6.4	0.7
ε Hydræ	36	7.2	0.274	− 14.2	+ 0.5	14.2	− 9.9	+ 2.2	10.1	5.7
ι Ursæ Majoris	45	48.9	0.362	− 35.0	− 20.3	40.5	− 29.1	− 15.8	33.1	5.2
θ Ursæ Majoris	9 19	52.6	0.362	− 73.7	− 41.7	84.7	− 67.3	− 37.8	77.2	2.9
υ Ursæ Majoris	36	60.0	0.284	− 19.7	− 120.0	23.1	− 14.4	− 9.2	17.1	1.2
Regulus	57	13.0	0.840	− 20.5	+ 2.5	20.7	− 4.4	+ 7.6	8.8	8.7
λ Ursæ Majoris	10 4	44.0	0.326	− 13.0	− 3.6	13.5	− 6.6	− 1.0	6.7	1.9
γ Leonis	8	20.9	0.588	+ 20.8	− 9.4	22.8	+ 32.3	− 5.6	32.8	23.1
α Ursæ Majoris	51	62.9	0.555	− 9.0	− 6.4	11.0	+ 2.2	− 4.1	4.7	4.2
ξ Ursæ Majoris	11 7	32.7	0.284	− 33.6	− 43.8	55.2	− 27.8	− 42.5	50.8	35.2
ι Leonis	11 13	11.7	0.265	+ 10.0	− 2.1	10.2	+ 15.4	− 0.8	15.4	10.7
β Leonis	38	15.7	0.555	− 38.7	− 5.9	39.1	− 27.4	− 3.7	27.6	1.8
β Virginis	40	2.9	0.326	+ 55.1	− 18.7	58.2	+ 61.7	− 17.2	64.1	58.6
δ Ursæ Majoris	12 5	58.2	0.326	+ 9.5	− 3.2	10.0	+ 16.0	− 3.6	16.4	10.1
γ Virginis	31	0.3	0.448	− 40.8	+ 1.9	40.8	− 32.0	+ 4.0	32.2	11.5
12 Canis	46	39.5	0.338	− 18.5	+ 5.6	19.3	− 12.1	+ 5.2	13.2	4.7
ζ Ursæ Majoris	13 15	56.0	0.531	+ 10.5	− 1.4	10.6	+ 20.0	− 4.5	20.5	10.9
Arcturus	14 6	20.3	1.320	− 84.1	− 146.1	168.6	− 64.1	− 146.5	159.9	147.3
θ Boötis	18	52.8	0.284	− 19.7	− 29.2	35.2	− 15.6	− 31.7	35.3	34.8
γ Boötis	24	39.2	0.411	− 0.4	+ 13.2	13.2	+ 5.3	+ 10.8	12.0	12.0
μ Boötis	15 17	38.1	0.256	− 11.2	+ 9.1	14.4	− 8.6	+ 7.2	11.2	1.3
γ Coronæ	34	27.0	0.265	− 7.3	+ 8.0	10.8	− 5.0	+ 6.9	8.5	4.5
α Serpentis	34	7.1	0.488	+ 12.7	+ 6.9	14.5	+ 17.0	+ 8.0	18.8	15.0
ζ Herculis	16 33	32.0	0.378	− 32.1	+ 34.5	47.0	− 30.7	+ 32.0	44.3	10.6
δ Herculis	17 6	25.1	0.362	− 7.4	− 8.8	11.5	− 7.1	− 10.4	12.6	11.1
α Ophiuchi	25	12.7	0.555	+ 6.2	− 12.9	14.3	+ 5.8	− 12.8	14.0	10.8
μ Herculis	38	27.9	0.274	− 27.7	− 53.1	59.9	− 28.2	− 54.6	61.3	59.7
ψ Draconis	46	72.2	0.256	− 2.3	− 18.7	18.9	− 3.2	− 23.3	23.5	18.8
70 p Ophiuchi	55	2.6	0.256	+ 15.8	− 81.3	82.8	+ 14.9	− 80.3	81.7	42.3
χ Draconis	18 25	72.6	0.284	+ 37.9	− 26.9	46.5	+ 36.2	− 31.7	48.1	46.8
α Lyræ	30	38.6	1.300	+ 15.2	+ 22.4	27.1	+ 6.8	+ 11.5	13.4	1.0
δ Draconis	19 12	67.3	0.362	+ 8.7	+ 5.2	10.1	+ 5.1	− 0.2	5.1	4.8
α Aquilæ	41	8.3	0.840	+ 40.5	+ 30.7	50.8	+ 30.4	+ 32.5	44.5	37.2
β Aquilæ	45	5.9	0.256	+ 4.9	− 33.2	33.6	+ 1.8	− 32.4	32.4	31.0
γ Delphini	20 37	15.4	0.284	− 3.3	− 12.5	12.9	− 7.7	− 12.2	14.4	13.0
ε Cygni	38	33.2	0.411	+ 26.7	+ 26.5	37.6	+ 20.2	+ 25.2	32.3	20.3
η Cephei	41	61.0	0.284	+ 5.9	+ 60.7	61.0	+ 1.4	+ 58.2	58.2	49.8
61 Cygni	58	37.8	1.690	+ 304.9	+ 236.0	385.6	+ 276.4	+ 230.2	359.7	168.8
δ Herculis	21 4	9.2	0.248	+ 5.7	− 20.7	21.5	+ 1.4	− 20.0	20.0	19.7
ι Pegasi	12	18.9	0.217	+ 10.2	+ 8.1	13.0	+ 6.4	+ 8.3	10.5	8.5
α Cephei	14	61.7	0.411	+ 11.0	+ 0.2	11.0	+ 3.8	− 2.7	4.7	4.3
μ Cygni	35	27.8	0.274	+ 15.1	− 16.9	22.7	+ 10.0	− 16.9	19.6	17.0
3 Cygni	22 15	51.2	0.232	− 2.7	− 13.5	13.8	− 7.3	− 13.8	15.6	14.0
ζ Aquarii	18	− 1.5	0.294	+ 11.4	+ 3.6	12.0	+ 5.6	+ 5.0	7.5	6.0
ι Cephei	42	65.1	0.284	− 6.8	− 10.2	12.3	− 12.6	− 10.4	16.3	12.3
ψ′ Aquarii	23 5	−10.2	0.217	+ 28.3	+ 0.8	28.3	+ 23.9	+ 1.8	24.0	6.9
λ Andromedæ	27	45.3	0.256	+ 11.4	− 29.6	31.7	+ 6.2	− 28.6	29.3	27.1
γ Cephei	31	76.5	0.326	− 4.9	+ 12.2	13.1	− 11.6	+ 13.0	17.4	12.8
α Andromedæ	58	27.9	0.718	+ 8.5	− 9.5	12.7	− 5.8	− 5.4	7.9	6.9

Note.—Col. 1st gives name of star; 2d and 3d, position; 4th, reciprocal of probable distance, deduced by Struve's method; 5th, 6th, and 7th, proper motion observed; 8th, 9th, and 10th, same corrected for parallactic effect (dependent on λ, of sun's motion; 11th, minimum proper motion, deducting possible error which may proceed from uncertain value of λ.

The minuteness of the motions is here made evident. A more attentive examination reveals other important peculiarities.

(1) It is impossible not to recognize in this list a law of signs. In right ascension, the signs are in the first six hours nearly all positive, and in the following six negative; they are again positive between 12*h*. and 18*h*., and finally in the last six the negative sign once more prevails.

(2) Mr. Proctor has in several tables graphically represented the principal proper motions of many stars, and has deduced the important conclusion that the directions of these motions are identical in many of the individuals of certain natural groups. Thus, in the group of the seven principal stars of Ursa Major, the five, β, γ, δ, ε, ζ, and some companions of these, tend all in the same direction, while the other two are moving in the direction opposite. This shows that the first five form a common system, to which the other two do not belong. In the Pleiades, one half move in one direction, and the other half in the other. In Gemini, very many groups have the same direction, which differs for the different groups. From this systematic distribution of signs, it follows that there ought to be some common cause which gives them such laws, and which could not *a priori* be supposed to control the proper motions of the individual stars severally, since these should naturally be distributed impartially throughout all directions. It is true that these motions may be either real or apparent, or both at the same time. In the first case, a definite law could not be perceptible unless the visible stars should form an integral system distinct from, and perfectly penetrable by us, subject also to certain laws of common motion —a thing very difficult to admit; but the motions may also be apparent, and due to the motion of the observer in space—that is, to the motion of the sun which transports our whole system; or, finally, they may be both real and apparent. It must therefore be our endeavor to study thoroughly the peculiarities of these movements; and on this account the importance of these facts is very great, but it will appear greater when we shall have studied these motions in relation to other peculiar characteristics of the stars.

(3) The first thing we have to study is the relation between the proper motions and the magnitudes of the stars. But here we may observe that, in this inquiry, it is necessary to take the result derived from a great number of stars united, since, when we come to particular cases, the irregularity is too great. In fact, a glance at the table just given, suffices to show that, in general, the larger stars have certainly the greater proper motions; but there are also

minor ones—such, for example, as 61 Cygni, 1830 of Groombridge, 40 Eridani, etc., etc.—which are quite small, and yet have very large proper motions. W. Struve, from a discussion of the proper motions of Bradley's brightest stars to the number of 180, deduced the following conclusions:

1st Category. Stars of major brilliancy—mag. 2.75...	Motion in A. R. ... 11.60″ / " " Decl ... 11.46″ / " " great circle.. 17.67″	180 stars in 75 years.
2d Category. Stars of feeble brilliancy—mag. 5.5....	Motion in A. R. ... 4.68″ / " " Decl ... 3.53″ / " " great circle.... 6.71″	206 stars in 75 years.
All the foregoing, taken without distinction, in mean...	Motion in A. R. ... 7.94″ / " " Decl ... 7.29″ / " " great circle.. 11.87″	386 stars in 75 years.

Considering next the smaller stars not comprised in the observations of Bradley, but observed by Lalande, Groombridge, and Piazzi, it is found that 30 years give a proper motion in A. R. of 1.117″, and in Decl. of 0.821″; and recapitulating, and reducing the whole to the interval of 30 years, we have—

Categories.	Magnitudes.	Motion in A. R.	Motion in Decl.
Class I., 180 large.....	2.75	4.64″	4.58
" II., 206 small....	5.65	1.87″	1.41
" III., 1276 minute.	10.34	1.12″	0.82

Whence it follows that the proper motions are proportioned to the magnitudes. But if we separate the stars into single and double, we obtain the result that the double stars have, in general, a larger proper motion than the single; the mean for the single being 9.28″, and that for the double 15.01″, with a ratio of 1.618.

From this discussion it results (1st) that the largest stars have the largest proper motion; (2d) that, magnitudes being equal, the double stars move faster than the single. The last conclusion was to have been expected, considering that the division of a cosmical mass into two parts might be originally facilitated by a primitive impulse of superior energy and more eccentric application. We shall soon see the importance of the first of these consequences.

Whether, therefore, the observed motions are truly the motions of the stars themselves, or whether they are merely apparent and dependent on the motion of the observer, upon the principles of probability it follows, from this sole consideration, that the larger stars must be our nearest neighbors, and the smaller more distant; since the linear space passed over by any body whatever ought to appear so much the larger as the body is nearer. But in order to decide whether the motion is due to the one or the other of these causes, it is necessary to study the problem more intimately and by a different method; and to inquire (1st) what other criterion we may possess for ascertaining the distances of the stars; (2d) what apparent systematic movements the motion of the observer himself ought to introduce. Observations of proper motion with the usual astronomical instruments give only the component of movement perpendicular to the visual ray, and furnish no indication of the motion which may take place in the longitudinal direction of the same ray. Spectral discoveries have provided, however, a very delicate means of learning the motion in this direction. See briefly in what manner.

As early as 1842, Döppler suggested that, if a star should have a proper motion of any kind, it ought to change in color. It is known, in fact, that vibratory movements are propagated with uniform velocity in a space filled with a homogeneous and elastic medium; consequently, if the vibrating body should be fixed, and the duration of its vibrations constant, the medium agitated by it is divided into so many zones of equal length, called waves; and we may define a wave to be "the space passed over by the undulatory movement in the time of one molecular vibration." But if the vibrating molecule should be in motion toward the observer, the wave would be shortened relatively to a wave generated by the same molecule at rest; since there must be subtracted, from its primitive length, the space passed over by the molecule during the vibration. On the other hand, if the molecule is receding, the wave will be lengthened by the same amount. Hence, in the case of sound, the pitch will rise in the first case, and fall in the second. The same thing will happen if the observer himself travels toward the origin of the vibratory movement or in the opposite direction; since the waves will seem shorter to him in the first instance, and longer in the second. These variations were demonstrated in regard to sound by Fizeau, and any one can verify them for himself by attending to the whistle of a locomotive passing before him, of which the note will be perceived to be quite different in pitch as it approaches and recedes. This principle being established, Döppler argued that similar consequences ought to result from the motion of the stars, and therefore that, if in any case the effect of such motion should be to shorten the wave, the star would lose its red, which would, for example, be transformed into orange or yellow; while, in the opposite case, the lengthening of the wave would convert the violet into blue or green. Hence a general change in the color of the star. But in 1863* I showed that this consequence would not follow, for the reason that, as there are invisible rays beyond the red and the violet, these rays, with change of wave-length, would assume tints corresponding to the red and the violet respectively, so that the general color would not be altered. I added, however, in the same place, that such a motion might be revealed by the aid of the spectroscope. If, for instance, the yellow, in consequence of such motion, should become green, the change of color could not affect the dark lines of Fraunhofer, nor supply the light wanting in the lines D, since, in the shortening of all the waves, those of D would be shortened likewise. Their refrangibility would accordingly be changed, and they would no longer be seen in the place where we find the lines of the sodium known to our globe, but would be displaced relatively to those, in one direction or the other. Should the star be approaching us, the displacement would be toward the violet; should it be receding, toward the red. And what would be true of the sodium-lines, would be true also of those of hydrogen and of every other chemical element which we might compare with the star. I not only indicated this possible phenomenon, but even endeavored to verify it experimentally, but my instrumental means were too deficient in delicacy for this. To convey an idea of the difficulty of the experimental test, I demonstrated that, in order to shorten the wave 40.63 millionth parts of a millimètre, so as to cause the line E to pass to the place of F, it would be necessary that the star should have a velocity of 32,000 kilomètres (nearly 20,000 miles) per second—a thing very unlikely to be true. But the spectroscopes in actual use were capable of indicating displacements much less than this, and a velocity of only 304 kilomètres per second would suffice to effect a displacement equal to the space which separates D_1 and D_2 in the spectrum of sodium. The tenth part of such a displacement would be obtained by a velocity no greater than that of our earth around the sun. It was not till 1868 that I was able to institute new experimental examinations. I found then that, while the line F coincided with $H\beta$ in Lyra, the same was not the case in ζ Ursæ Majoris, and in other stars; but the imperfection of my instrumental resources left the amount, and often even the direction, of the displacement, doubtful; whereupon I abandoned the task, but resumed it again to a small extent in 1869, for some of the more brilliant stars. As a result of these observations, it appeared that Sirius has a rapid motion toward the observer, since the hydrogen-line falls quite on the side of the red in the bright part of the spectrum of that star, at the place of the cloudy band due to this gas. In Lyra, no sensible motion could be detected.

Meanwhile, Mr. Huggins, furnished with better instruments than mine, took up the investigation where I left it, and he has obtained results in which he professes great confidence. The Royal Society of London has provided for his use a parallactic refractor of 15 inches aperture, with the necessary auxiliary apparatus and accessories, all of the most exquisite delicacy. According to him, Sirius should have an absolute motion, or a motion corrected for the motion of the earth, of 27 kilomètres per second, receding. Some of his observations, repeated at Greenwich, give for Lyra — 19 kilomètres; for Sirius and various other stars, negative or receding motions, likewise, in every instance; for α Aquilæ, a doubtful result; and for α Pegasi, — 20 km. The stars β, γ, δ, ϵ, and ζ of Ursa Major are said to be receding at the rate of 20 miles per second, and α and η, approaching. It is worth noting here that the spectra of these five stars are of the first order, while those of α and η are of the second; and we have already seen that, according to Proctor, the proper motions of the same five are opposed to those of the other two. We do not pretend to set our own observations above those of others, but, so various and so uncertain have been the results hitherto obtained, that there seems to be just ground for suspecting some systematic error. If these results, however, shall be confirmed and cleared of the many objections which may possibly be raised in regard to the method of experimenting, the proper motion of the star in the direction of the visual ray will be thenceforth ascertained; and, by compounding this with meridian observations, it will be possible to determine the complex resultant (the absolute velocity and direction of motion in space) at least approximately. For the present, however, considering the minuteness of the deviations, and the difficulty of the observations,†

* See *Bolletino Meteorologico del Collegio Romano*, July, 1863.

† To show that this difficulty is not exaggerated, it is worth mentioning that, while the spectroscope assigned to the comet of Coggia a velocity of approach toward the earth of 46 miles per second, its real velocity of approach was only 24; this, too, according to the observations of Mr. Huggins himself.

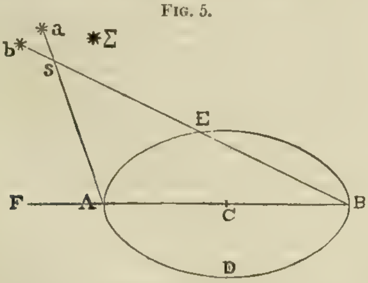
the spectroscopic method fails to inspire us with the same confidence as the other.

§ 7. *Distances of the Stars.*

The vastness of the creation is one of those ideas which overwhelm the limited human intelligence. When it was for the first time announced that no material barrier exists to shut in the ethereal expanse, and that the stars are so many suns, the immensity of the universe and the infinite multitude of the bodies composing it, thus presented as logical inferences, were conceptions which left the mind stupefied with amazement. It endeavored to escape from these consequences by intrenching itself behind ill-interpreted passages of Sacred Writ. Nor should we wonder at these errors of the past, when, even in our own day, we see renewed, over the question of extension in time, the same conflict which then arose in regard to the vastness of space. Notwithstanding that we can touch with our very hands geological formations which have required myriads of ages for their deposition, it is with the utmost difficulty that we bring ourselves to admit the belief, that such an antiquity can belong to our globe. But one of these ideas will help us to comprehend the other, convinced as we must be that the work of the Creator, if not in absolute infinity and eternity, at least in immensity of space and illimitable duration of time, is commensurable with him alone, and that we shall always be incapable of conceiving it in its completeness.

The distances of celestial objects in general are computed by means of their parallaxes; but, for the stars, it was perceived, even by the early astronomers, that the diurnal parallax must necessarily be excessively minute, and hence they sought to find an annual parallax. Galileo made it evident that the altitude of a star above the plane of the ecliptic (its celestial latitude) must be different, as observed from the opposite extremities of the diameter of the earth's orbit round the sun which lies in the plane of the circle of

FIG. 5.



latitude. For if A D B E be this orbit, C its centre, S the star, S A B the plane perpendicular to A D B E passing through S and C, and A B the diameter in which this plane intersects the orbit, then, from the station A, the star will appear in the direction A S, and from the station B, in the direction B S; and the latitude at station A will be F A S, and at station B, F B S. The difference between these latitudes will be = A S B, and half this difference will be the parallax of the star. Even supposing the star at a measurable distance, the direct and absolute determination of this angle might still be difficult on account of its minuteness. Galileo proposed, therefore, that differential measures should be attempted; and, to this end, that a very minute star *a* should be chosen in the near vicinity of a very large one Σ, and that measurements should be made of the distances Σ *a* and Σ *b* at opposite seasons of the year. The variation observed would be the indication of parallax sought for. He assures us that he had tried this method without success. The fact is, that his telescope was far from being capable of resolving this question. But having tested the method in the case of many stars, and found the angles observed as above described apparently in the most positive sense constant, he concluded that the stars are so immensely distant as to reduce the entire great orbit of the earth to absolute evanescence in comparison. His contemporaries were startled by this conclusion, which nevertheless was the only legitimate one, and which magnified a million-fold the Creator's work.

The astronomers who followed Galileo all of them attempted the determination of stellar parallaxes, being stimulated by the hope of thus demonstrating the motion of the earth; and after Flamsteed, Roemer, and Picard had detected that annual fluctuation of star-position which found a later explanation in the aberration of light, Horrebow imagined that the parallax had here been certainly ascertained, and wrote accordingly his *Copernicus Triumphans*. He failed to notice that the displacement then discovered took place in a plane perpendicular to that of the parallax—that is, in the plane of the tangent to the earth's orbit—whereas the parallax should occur in the plane of the radius vector. And it is a marvellous fact, as Bradley afterward made evident, that the sought for proof of the motion of the earth was really obtained, though not understood for a long time after. The proof was even more certain and grand than the parallax itself could have given, but it was not of a nature to determine the distance of the stars. Long afterward, Sir William Herschel, confident in the power, previously unexampled, of his new instruments, attempted the problem again, but vainly. He found, nevertheless, a compensation for his disappointment, in the discovery of double stars: that is to say, of pairs, in which one star revolves around another in a proper period of many years' duration. Thus, the search for the stellar parallax led to two grand cosmical discoveries, itself remaining still unresolved. It was reserved for the perfection of modern instruments to give to this problem a decisive answer. Bessel, on studying with his heliometer the star 61 Cygni, and comparing this with others neighboring, detected an annual difference of position of seven tenths of a second, and fixed the parallax at 0.35″. The distance of this star is hence concluded to be equal to 589,043 mean radii of the earth's orbit, and the time required for its light to reach us is no less than twelve years. The longest line, therefore, which astronomers are able to command as a base, observed from this star, would subtend hardly more than one-third of a second. Thus, the distance of the stars becomes so great, that the unit which serves as a scale for the dimensions of the whole solar system is too small for its measurement; on which account it is more common to state it in terms of the time occupied by light in passing over these immeasurable spaces. Since the velocity of light is about 299,000 kilomètres, or 192,000 English miles, per second, it reaches us from the sun in 493.3*s.*, or is 8*m.* 13.3*s.* in passing over the ordinary unit of measure of celestial distances.* Since, then, a parallax of an entire second supposes a distance from us of 206,265 times that unit, there would be required 3.224 years (or 3¼ nearly) for light to come from a star with such a parallax to us. This dimension, equivalent to about 1,000,000,000 radii of the terrestrial globe, is therefore taken for unity in the calculation of stellar distances. But no star has as yet been ascertained to have a parallax so great as one second, and hence all the stars are far beyond even this prodigious distance.

Astronomers were encouraged, by the success of Bessel, to make similar trials upon other stars, especially upon those of the superior magnitudes and those which exhibit the greater proper motions, naturally supposing these to be the least distant; but their success has been inconsiderable. The only one which seems to have yielded a certain response is α Centauri, which appears to have a parallax of nine-tenths of a second; but this has been determined only by means of meridian observations, and requires confirmation by the method of differential measurements. In the list following, we give the probable parallaxes of several of the stars; but we warn the reader at the same time that authorities by no means without weight regard the values here given with serious distrust. The successor of Bessel, Dr. Whichmann, confessed to me candidly that he looked upon no stellar parallax whatever as certainly determined, not even excepting that of 61 Cygni; because too many elements enter into the problem which may falsify the observations, made as they must be from necessity in opposite seasons, during which the instruments undergo considerable variations. Without being so sweeping as this, however, we will say, that a parallax not exceeding a quarter of a second, is a thing which the science of the present day can hardly guaranty as certain:

Parallaxes attributed to Certain Stars.

Star.	Parallax.	Authority.	Star.	Parallax.	Authority.
α Centauri	0.913″,	Henderson.	1870 Groombridge......	0.226″,	Peters.
61 Cygni...	0.348,	Bessel.	1 Ursæ Maj..	0.133,	Peters.
α Lyræ......	0.261.		Arcturus.....	0.127,	Peters.
Sirius.......	0.230,	Henderson.			

The pole-star and Capella, having less than the tenth of a second of parallax, are not included in the list. It follows, nevertheless, that, since the stars in general have no perceptible parallax at all, their distances cannot be less than ten parallactic units, or 2,062,650 times the distance of the sun; and that the time occupied by light in coming from them to us cannot be less than 32 years. This is the conclusion in regard to absolute measures, deduced from the facts up to the present time ascertained. But if we seek only relative measures, and are content to know in what proportion the stars of various magnitudes are distant from us, the case is different, and although even this problem is not without its difficulties, something more is discoverable.

* The more recent experiments made in Paris have given 300,400 kilomètres; former ones gave 298,000; we are of opinion that the number assumed in the text, which is near the mean, is preferable to either.

If the stars were all of the same absolute magnitude, their relative distances could be promptly inferred from the ratio of their observed brilliancies, since these ought to diminish in the ratio of the squares of the distances. But, as a real uniformity of magnitude is not presumable in fact, it is not reasonable to assume it. Yet, though this is quite true for a limited number of stars, for a very great number, and for the average of multitudes all equal in apparent magnitude, the case is different, and the rules of probability conduct us to the conclusion that the larger stars must be the nearer, and the smaller the more distant. This conjecture is corroborated by the fact, that the stars of the various orders of magnitude succeed each other according to a similar photometric law, so that the mean splendor of a given order is the same as would be that of a star of the superior order removed to a double distance. Upon this rule of probability has been founded a scale of relative stellar distances for all the magnitudes from the first to the most minute, which is given in the table below, and of which we have already in ¿ 2 explained the principles.

An additional aid in judging of the relative distances of the stars is derived from their proper motions. Here, again, it is evident that, if the actual proper motions of the stars in space were all equal, and all perpendicular to the observer's line of vision, the more distant would give the smaller apparent motions. But this supposition involves a twofold improbability, because, in the first place, the real velocities may be infinitely diverse; and because, secondly, the direction of movement may be such as to mask its magnitude, since when reduced to its components parallel and perpendicular to the visual ray, the last-mentioned component is only perceptible. In spite of this, however, there comes in here also the aid of the rule of probability; and, when we consider a very large number of stars, their partial movements may be mutually compensatory to such a degree that the definite resultants remaining may be esteemed to exhibit the mean proper motions—motions which will appear smaller for the more distant stars. Upon the basis of these principles, and availing himself of the numerous labors of modern astronomers upon this subject, Struve has computed a table of the stellar distances arranged in the order of their magnitudes, resting on the results already explained in ¿ 6: which table we present below in comparison with that deduced from photometry:

TABLE G.—*Table of Stellar Distances, deduced from Photometry and from Proper Motions.*

Magnitudes.	Photometric distances	From proper motions.	
		Simple stars.	Double stars.
1	1.00	1.0	1.0
2	1.55	1.3	1.4
3	2.42	2.1	2.0
4	3.76	3.6	3.2
5	5.86	6.1	5.9
6	9.11	8.5	8.2
7	14.07	12.0	11.6
8	22.01	17.9	17.8
9	34.30	33.3	31.8
10	53.36		
11	83.00		
12	129.12		
13	200.90		
14	312.50		
15	486.10		
16	756.20		

Though the two series are to some extent sensibly discordant, still it is impossible not to discover a close relationship between them; and inasmuch as they are severally deduced from elements wholly diverse, depending in the one case simply on the distance, and in the other on the square of the distance, it is out of the question to suppose the coincidence to be accidental, and we are compelled to accept it as a fact founded in nature: observing always to limit the proposition to the stars in general, and by no means pretending that it will be found true in a given particular case.

As a final result, we may state that, if we give to the stars of the 1st magnitude the parallax of one-tenth of a second, we shall have for them the time of light-travel to reach us = 32 years: for stars of the 9th magnitude, 1024 years: and for those of the 16th, the minutest visible in the Herschelian telescope, 24,192 years. All the stars, therefore, might be annihilated to-day, and nearly all of them would continue to be seen by the inhabitants of the earth, very much as they appear now, for several generations.

Since we know nothing certain of the real distances of the stars, it follows that their magnitude in respect to volume remains wholly unknown to us: and more than that, that it is not possible to compute it even for those which have parallax, since one and all are absolutely without measurable diameter. It is true that, in good instruments, the stars in general exhibit an apparent disk by which the ancient observers were deceived; but this appearance is simply an optical illusion occasioned by diffraction, and it may, in fact, be easily increased, by simply placing before the objective a diaphragm of smaller aperture. If our sun were removed to the distance of the parallactic stellar unit, it would hardly subtend a diameter of 0.0093″; that is, its apparent magnitude would be less than $\frac{1}{100}$th of a second, and would be wholly unmeasurable. The intensity of its light also would be reduced to that of a star of the sixth magnitude. As, therefore, it is impossible to know the distances of the stars in absolute measure, so likewise it is similarly impossible to know their material dimensions.

¿ 8. *Proper Motion of the Sun.*

If the stars have motions of translation in space proper to them, it is quite natural to suppose that the sun has a similar motion, and that consequently his entire attendant system is in movement with him. But though this conclusion on the part of astronomers was inevitable, the verification of the motion and the determination of its magnitude are problems demanding an inheritance of observations of a much higher degree of precision than have belonged to any which they possessed. Sir William Herschel made, nevertheless, a bold attempt to resolve it, and was successful not only in marking out the method, but even in applying it with satisfactory results. In order to understand this, it is necessary to premise that, inasmuch as all the stars are not equally distant—in other words, fixed upon the surface of a single geometrical sphere (an absurd hypothesis)—if our sun is really in motion, it must follow from that very fact that all of them will be apparently so, precisely as, to a person passing through a wood or an open country anywhere, all the trees and other objects differently distant, though actually fixed, seem to him to be moving. It might thus happen that a great part of the stellar movements of which we have spoken might be due to the translation of our sun in space, and therefore be only apparent, or, in the language of astronomy, parallactic. But, if this is the cause of some, it certainly is not of all; and, by the complication of apparent with real motions, the difficulty of the problem is considerably increased. In order to attain success in its resolution, therefore, we must analyze the conditions separately, beginning with the supposition that all the stars are motionless, though differently distant, and considering what must be the consequences resulting, on this hypothesis, from the solar movement only.

(1) In the first place, then, the apparent stellar movements will always take place in the plane passing through the star and through the line traversed by the sun, or (what, according to the known mechanical principles of relative motion, is the same thing) will be always in the plane of that great circle passing through the sun and the star which is determined in direction by the apparent movement.

(2) For any other star (the absence of real motion being still supposed) the same thing will be true; so that the two planes will intersect in the line of the sun's path, and the circumferences of the two great circles which they trace out on the celestial sphere will cut each other in a point constituting what is called the vertex of translation.

(3) If a third star be taken, regarded also as motionless, its plane must in like manner intersect the others in a line common to all: and, by thus proceeding from star to star through the whole heavens, we shall find that all will have a common intersection and a single apex or vertex of convergency, marking the point on the celestial vault toward which the sun's movement is directed.

In the second place, the apparent motions will be subject to an extremely simple law: all the stars will seem to diverge on the side toward which the sun is moving, and to converge in the opposite region, as happens to a person walking in an avenue bordered by parallel rows of trees, to whom those before him seem to separate, and those behind to approach each other. This is what ought to happen, on the assumption that the stars are all fixed, and their motions all apparent.

But if the stars are themselves in motion, the problem is complicated by the effect of their several proper velocities, and the real velocity in a particular case may be so compounded with the apparent as to mask it entirely, or even to reverse it. As this is the case with which we have practically to deal, we must resort for its solution to another principle, which is this—that, according to all the probabilities, the individual stars will have movements severally directed toward every possible point of space, and, being very numerous, will compensate and extinguish each other, leaving instead a resultant, which will bring into full evidence the single motion due to the translation of the sun.

Such is the principle by which the theoretic discussion of these movements is guided. The compounded movements which observation gives must be accurately determined, and their absolute resultant ascertained; and this may then be regarded as the definitive expression of the solar motion, the other movements being treated as accidental, and being reciprocally destructive. Modern mathematical analysis furnishes precise rules for fixing this resultant, but for the development of these we cannot here afford space.

Such a method of precision was not, however, that employed by Herschel. He simply traced in the celestial sphere the great circles apparently described by various stars having large proper motions, and saw that the intersections of their planes of movement, when taken two and two, tended to converge toward the constellation Hercules, and that the most nearly central point in the area of convergence, assumed as the vertex of the solar translation, had for co-ordinates the values A. R. = 245° 52′, Decl. N. = 49° 58′; confessing this, nevertheless, to be but a rough approximation.

The astronomer who, next after Herschel, occupied himself seriously with this problem, was Argelander. Comparing his own observations with those of Bradley, he deduced the proper motions of many stars, and from them inferred the co-ordinates of the vertex of translation to be A. R. = 257° 49′, Decl. N. = 28° 50′. And, from very elaborate investigations, Otto Struve found the values A. R. = 261° 23′, Decl. N. = 37° 35′. Connected with these labors are the later ones of W. Struve, who assigned for these co-ordinates A. R. = 259° 9′, Decl. N. = 12° 51′; making, however, corrections of quantities introduced which are not always justifiable, and showing that a very great difference in declination might be produced by slightly varying the latitude of the observatory at Greenwich. All these labors were founded on observations made in the northern hemisphere. Galloway chose to discuss those of the southern, and, comparing the observations of Lacaille with others more recent, determined for the vertex of translation the co-ordinates A. R. = 259° 46′, Decl. N = 32° 29′. Leo de Ball, from a new investigation on southern stars, finds A. R. = 269° 33′; D. = 23° 11′ N. Mean of all, and most probable values, A. R. = 261° ± 5°; D. = 27° ± 4° N. It can accordingly admit of no doubt that this result is pretty near the truth. And it is manifest, besides, that, in order to discover the direction of this movement, there is no need of knowing the distance of the stars, since the deduction is drawn from their apparent displacement only. If, however, we would assign an absolute value to the motion in space, the knowledge of this distance is necessary. Otto Struve, on the principles of stellar distances already explained in the preceding portions of this article, found that the proper motion of the sun, as observed from a star of the 5th magnitude, would amount in 70 years to 3.508″ in right ascension, to 0.800″ in declination, and to 4.597″ in a great circle of the sphere. Considering this motion as a motion in space, and founding the computation upon the hypothetic stellar distances above referred to, it would follow that it must amount to a little more than one and a half radii of the earth's orbit (1.623) per annum, or 154,000,000 of miles—a value, however, extremely uncertain, because of our ignorance of the absolute distances of the stars. Naturally, such a motion cannot be rectilinear, and its direction must vary with time: but these are points in regard to which the answers must be left to be supplied by distant posterity. Where may be the centre of this movement, or whether, indeed, there is a material centre at all, and whether the curve is not determined by the resultant action of many centres, is wholly unknown, and any attempt to define it must be regarded as at present premature.

When once the motion of the sun is established in amount, if, resuming the consideration of the stellar movements, we subtract from them what is due to parallax, the remainder will be the movement which belongs to the individual star. The motions thus found form a class of residual phenomena of observation which, after an enormous succession of ages, may possibly be reduced to law; for the present they are seemingly accidental. We may observe, nevertheless, that, as Struve and Proctor have shown, the direction of solar motion very slightly affects the apparent motions of particular stars—a fact which appears from the inspection of Table F, where the columns 8, 9, and 10 give the individual motions after the parallactic motions due to translation have been eliminated. The existence of such a multitude of movements among the stars will be less a matter of surprise, when we proceed, as we now propose to do, to show that, in those regions where we imagine rest and eternal silence to reign, there exists an almost inconceivable activity, with centres of motion and orbital velocities very much more considerable than any of which our planetary system affords examples.

§ 9. *Double Stars.*

Many stars which to the naked eye appear simple are found, when observed with instruments, to be composed of two, and occasionally of three or more, extremely close together, of magnitudes sometimes equal and sometimes very different. These are called double or multiple stars. The close approximation of the bodies in these instances may either be a simple effect of perspective, in virtue of which two stars widely distant from each other are projected upon very nearly the same point of vision, or, in the second place, may be owing to a physical connection existing between them, the consequence of some sort of force binding them together, as is true of the planets and the sun. In the first case, the objects are called optically double; in the second, physically so. To determine whether, in a particular instance, such a bond of union exists, is a work exacting delicate observation and laborious calculation. Let us take a hasty glance at the results of these studies.

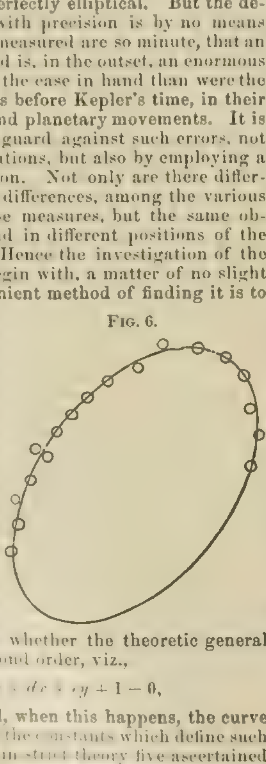
Already, more than a century ago (in 1767), Mitchell had suspected a connection of the kind here suggested, from a study of the question, how great would be the probability of the occurrence of accidental combinations involving only a few seconds of distance between the members, on the supposition that the stars had been strewn at random through space. He found that, for the case of two stars of the 2d magnitude, the chances were 500,000 to 1 against such an occurrence. Now, of such combinations, we have several examples, as α Centauri, α Geminorum, etc. But this probability does not suffice to establish the fact. A more substantial argument is derived from a consideration of the proper motions. If the stars are accidentally companions, their proper motions, whether apparent or real, ought, since the objects are usually of different magnitudes, to be different: and hence these objects, in the progress of time, should separate. Now, it happens, in point of fact, that various stars of this class, though endowed with considerable proper motions, preserve sensibly the same relative distance for very long periods of time. Such are the two companions of α Centauri, the two of Castor, γ Virginis, and ξ Ursæ Majoris, all of which are unequal, and a great multitude of others. Alpha Centauri, hardly separable in the time of Lacaille, has so great a proper motion that, were not this common to both members of the pair, they ought now to be 6 minutes apart. Even this, however, is not a criterion wholly infallible, for it is a possibility that proper motions, in spite of diversities of real amount, may so manifest themselves as to exhibit very minute differences. But the characteristic which rigorously decides the question, is the positive fact that, in many instances, one star of a pair revolves around the other in a closed curve, described according to the laws of central forces. The grand discovery of this fact is due to Sir William Herschel. When that astronomer had so perfected his instruments as to enable him to penetrate farther into the depths of space than all who had gone before him, he proposed to himself, proceeding on the principle of Galileo (§ 7), to resolve the problem of the parallax. Having selected for this purpose a number of the more brilliant stars, each of them accompanied by minute and very near neighbors separated from them only by a few seconds, he measured their distances as exactly as possible, and, by means of a micrometer of his own invention, determined the angle between the arc passing through the pair and the horary circle—an angle which is called the angle of position. If there were any annual parallax whatever, it ought to be brought to light by the variation either of the distance or of this angle. But after many and accurate measurements in all the different seasons of the year, he failed to detect anything certain, and accordingly for the time abandoned the pursuit. Having, however, in the mean time, further perfected his instruments, he returned once more to the labor with the hope of a happier result. What was his surprise to discover that some of the stars which had before appeared to him double were so no longer, and that others had notably changed both in position and in distance! If every hope of the annual parallax had thus vanished, there was nevertheless presented here an indication of a parallax of a higher order, due either to the general motion of the system, or to the motions of the individual stars. To encourage the observer in pursuing these researches, the theory of Mitchell of a bond of connection between the stars was certainly not without its relevancy; and it happened, in fact, that after several years of assiduous investigation, he was enabled, in 1802, to announce to the scientific world, that some of the stars have really luminous satellites revolving round them in periods comparatively brief: as, for example, ζ Herculis in 36 years; η Coronæ Borealis in 44 years; ζ Cancri, a triple star, of which the lesser revolves in 59 years; ξ Ursæ Majoris in 63 years, and so on. It was naturally the case that the first determinations

of these [illegible] were [illegible] from simple fractions of a revolution, [illegible] were sufficient then to establish with certainty the [illegible] character of the apparent orbits; and these with [illegible] time have gone on developing, till at length, [illegible], the bodies have completed more than [illegible]. The number of pairs discovered to be [illegible] connected, small in Herschel's first list, has [illegible] increasing, as well in consequence of the [illegible] number of newly-discovered binaries by [illegible] increase which has kept pace with the im[illegible] instruments—as through the extensive arcs [illegible] described by the smaller members of the pairs [illegible] greater. Since the time of Sir William Herschel [illegible] investigation has been prosecuted by his son, Sir John, [illegible] by South, Dawes, and many others, but especially by Struve, who, with the superb refractor of Dorpat, early constructed an exceedingly rich catalogue, embracing no fewer than 3112 double stars—a number which has continued to grow with time, and at present amounts to more than 6000, one tenth part of which at least are in motion.

But not all the very close stars are physically connected, though such, as we shall presently see, is the case with most of them. In a re-examination and re-measurement which we have made of the stars in Struve's catalogue to the number of 1082, we have found that 181 have noticeably moved with a motion presumably orbital, that in 291 other instances the variation is doubtful, and that in 606 it has not been sensible, or has not exceeded the probable errors of observation. It is to be remarked that simple displacements in angular position or in distance may possibly be the effect of proper motion, and not of central forces; on which account, whenever the successive positions of the star do not present a sensible curve, the case is doubtful; and such a case seems to be that of 61 Cygni, since the recent labors of Flammarion upon this object.

It is of the first interest, therefore, to ascertain the nature of the apparent curve described by a satellite about its primary, in order to establish the reality of any physical connection whatever. This settled, we may afterward recognize the real curve described by the satellite in space, and then, by applying the principles of mechanics, demonstrate the nature of the force. Observation has shown that the curve is usually an oval, approaching nearly to an ellipse, and in most cases perfectly elliptical. But the determination of this curve with precision is by no means easy. The distances to be measured are so minute, that an error of a fraction of a second is, in the outset, an enormous quantity—much greater for the case in hand than were the errors of the old astronomers before Kepler's time, in their rude observations of solar and planetary movements. It is indispensable, therefore, to guard against such errors, not only by multiplying observations, but also by employing a proper and cautious reduction. Not only are there differences, and even systematic differences, among the various observers in regard to these measures, but the same observer, at different times and in different positions of the star, differs from himself. Hence the investigation of the apparent orbit only is, to begin with, a matter of no slight difficulty. The most convenient method of finding it is to construct graphically, upon an arbitrary scale, the positions in angle and in distance assigned to the body by observation, and through the points thus laid down, to draw with a free hand, the curve which best represents them all, and passes among them so as to make the differences a minimum. A glance will show whether the curve has a closed or open contour—whether it is elliptic, hyperbolic, or rectilinear. In the case of a closed curve, most frequently occurring, it will be seen whether the theoretic general equation of lines of the second order, viz.,

Fig. 6.

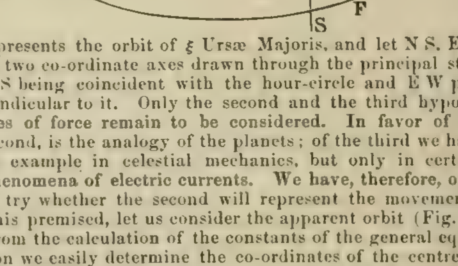


$$ax^2 + by^2 + cxy + dx + ey + 1 = 0,$$

satisfies the perimeter; and, when this happens, the curve is an ellipse. Inasmuch as the constants which define such a curve are five in number, in strict theory five ascertained points upon its contour suffice to determine it completely; but, in practice, as many points are taken as possible, and, by the method of least squares, or other modes of interpolation, the most probable values are ascertained.

The apparent curve having thus been fixed, we have next to seek the real curve; and as this part of the problem is partly indeterminate, we must introduce into it some theoretic element. The apparent orbit which we see, being only the projection of the true orbit upon the celestial sphere, it might, if elliptic, be the projection of any one of a variety of curves suitably placed in space to produce this effect by perspective. It might, for instance, be the projection of a circle, of an ellipse, or even of a curve of double curvature. But this last possibility may be dismissed if, on comparing the various sectors of the apparent orbit, we find their areas proportional to the times of describing them; since we know that, whenever this proportion is true in any projection whatever of an orbit upon a plane, the orbit must be described under the influence of a central force, and must necessarily itself be plane. Whenever, therefore, calculation from the observations assures us that this proportionality of areas to times actually exists, we may be certain that the orbit is plane. But this does not wholly remove from the problem its character of indeterminateness. The ellipse of projection may be produced by more than one species of force: (1) from a force directed toward the centre, and varying directly as the distance; (2) from a force directed toward a focus, and varying, as in the case of the planets, inversely as the square of the distance; (3) from a force directed toward any point in the interior of the ellipse, supposing it to vary jointly as the inverse square of the distance and as a function of the angle made by the radius vector with a fixed direction. In practice, however, this indeterminateness is easily settled. It suffices, indeed, to consider that the apparent orbit is the base of a cylinder, of which the observer's eye is in the axis, and which is intersected normally by the surface of the celestial sphere, which is there practically coincident with its tangent plane; the true orbit being another section of this same cylinder made by a plane otherwise inclined to the axis. But in these two sections, the axis of the cylinder determines a centre common to both ellipses; so that, if the principal star is in the centre of the true orbit, it must also be in the centre of the apparent orbit; and if the primary is out of the centre, the force cannot be of the first kind, but must be of the second. Now, in practice, this is the case usually met with; that is, the star is eccentric in the apparent orbit. Let us take, for example, Fig. 7, which

Fig. 7.



represents the orbit of ξ Ursæ Majoris, and let N S, E W be two co-ordinate axes drawn through the principal star, N S being coincident with the hour-circle and E W perpendicular to it. Only the second and the third hypotheses of force remain to be considered. In favor of the second, is the analogy of the planets; of the third we have no example in celestial mechanics, but only in certain phenomena of electric currents. We have, therefore, only to try whether the second will represent the movements. This premised, let us consider the apparent orbit (Fig. 7). From the calculation of the constants of the general equation we easily determine the co-ordinates of the centre of the apparent ellipse, which, as just observed, is also that of the real ellipse.* Then, as the principal star must occupy the focus of the true ellipse, by drawing the line C S′ and producing it to the perimeter, we obtain A B, the major axis of this same true ellipse. Now, by the theory of the ellipse, it is known that the axes of an ellipse projected on a plane oblique to it will be projected into conjugate diameters of the ellipse of projection; whence, the position of A B and its conjugate being ascertained, we determine, by means of familiar formulæ, the position of the axes of the original or projected ellipse, and also its eccentricity and its inclination to the plane of projection.

Thus, therefore, the geometric elements of the curve become known; that is to say, its dimensions and its position in space. The mechanical elements are the periodic time and the time of perihelion passage, which are calculated without difficulty from the epochs of the observations. The general idea here given of the solution of this problem will suffice for our present purpose. The results are exhibited in the following table, in which are embraced

* This calculation is explained in treatises by various authors on lines of the second order; as, for instance, by Boucharlat. It is applied in his method of computing the orbits of double stars as given by Sir John Herschel. (See *Mem. Royal Astr. Soc.*)

some of the stellar orbits most to be relied on, mostly from Chambers, but with additions from other astronomers:

TABLE II.—*Catalogue of certain Stars physically Double, with the Elements of their Orbits.*

Star.	Period.	Periastron Passage.	Semi-axis Major.	Eccentricity.	Authority.
	Years				
ζ Herculis	36.3	1830.4	1.25	0.44	Villarceau.
η Coronæ Borealis	43.6	1850.3	0.95	0.28	Winnecke.
ζ Cancri	58.9	1853.4	1.29	0.23	Madler.
ξ Ursæ Majoris	63.1	1816.3	2.45	0.39	J. Breen.
α Centauri	75.3	1858.	30	0.96	E. B. Powell.
ω Leonis	82.5	1849.7	0.85	0.64	Madler.
70 Ophiuchi	92.8	1812.7	4.19	0.44	Madler.
3062 Σ	94.7	1837.4	1.25	0.44	Madler.
γ Coronæ Australis	55.6	1882.8	2.40	0.70	Schiaparelli.
ξ Boötis	117.1	1779.8	12.56	0.59	J. Herschel.
δ Cygni	178.7	1862.8	1.18	0.60	Hind.
η Cassiopeiæ	181.	1715.0	10.33	0.77	E. B. Powell.
γ Virginis	182.1	1836.4	3.58	0.87	J. Herschel.
σ Coronæ Borealis	195.1	1831.1	2.71	0.30	Jacob.
Castor	252.6	1855.8	8.08	0.75	J. Herschel.
μ^2 Boötis	649.7	1852.5	3.21	0.84	Hind.
γ Leonis	1200.	1741.1	2.20	0.71	Doberck.
42 Comæ	25	1869.0	0.65	0.48	Dubiago.
3121 Σ	40	....	....	.....	These four are very uncertain.
Procyon	40	....	....	.....	
ξ Libræ	49	....	....	.....	
Sirius	49	....	....	.....	

TABLE K.—*Table of some Double Stars having different Colors in their Components.*

Name.	R. A. 1870.			Declin. 1870.		Mag. of components		Color of A.	Color of B.
	h.	m.	s.	°	′				
η Cassiopeiæ	0	41	15	+ 57	7.8	4	7½	Yellow	Purple.
α Piscium	1	55	18	+ 2	8.1	5	6	Pale green	Blue.
γ Andromedæ	1	55	55	+ 41	42.4	3½	5½	Orange	Sea green.
ι Cancri	8	38	49	+ 29	14.0	5½	8	Orange	Blue.
ε Boötis	14	39	18	+ 27	37.4	3	7	Pale orange	Sea-green.
ζ Coronæ	15	34	29	+ 37	3.6	5	6	White	Light purple.
α Herculis	17	8	43	+ 14	32.2	3½	5½	Orange	Emerald green.
β Cygni	19	25	28	+ 27	41.3	3	7	Yellow	Sapphire-blue.
σ Cassiopeiæ	23	52	26	+ 55	1.8	6	8	Greenish	Bright blue.

One case occurs, however, which cannot be treated in the way above described; it is the case in which the true orbit lies in the plane passing through the observer's eye, and is consequently projected into a straight line. In this case other expedients must be resorted to; and it is necessary to wait until the star, with a gradually slackening movement, reaches the limit of its course and returns in the opposite direction. Such cases as yet are rare.

But the determination of the relative orbit leaves still the question of real dimensions unsolved. To settle this we must suppose the distance of the star—that is to say, its parallax—to be known; that given, it is manifest that from the apparent diameter of the orbit in seconds, and from its inclination, the real magnitude of the true orbit can be determined, and consequently also, by means of the commonly-accepted constant for the attraction of matter, the mass of the system, and the mean motion or periodic time. But here, unfortunately, science fails. The parallaxes are so small and uncertain that none of them can be definitely stated. The star 61 Cygni, which was believed to be physically double, and which has a sensible parallax, might have given an important result, but, inasmuch as recent scrutiny of this object seems to prove that it is only double optically, we learn from it nothing certain. Up to the present time, α Centauri is the only star which gives us any indication available for this purpose. Its parallax may amount to 0.98″; and, if this is to be depended on, as the semi diameter of its orbit amounts to 20.89″, and its period to 77 years, it follows that its real orbit must be about twenty times greater than that of the earth, and that, in mass, it must be three quarters as great as the sun. The orbit in reality, therefore, must be about equal in mean diameter, though not in eccentricity, to that of Halley's comet.* The semi-axis of the comet's orbit equals seventeen semi-diameters of the earth's, and its eccentricity is 0.96. Since, furthermore, the principal star has a proper motion of 3.6″, it follows that its linear velocity of translation in space is 371,000,000 miles per annum. But Hind's latest results greatly modify these deductions.

These proper motions may possibly complicate sensibly the phenomena of the real movements. Since the propagation of light from the stars to us occupies an appreciable time, it follows that, if they are approaching or receding, the phases of apparent movement will no longer correspond to those of the true movement, but will be accelerated or retarded according to the direction which the star is taking: occasioning thus a phenomenon analogous to that of the aberration of the light of the planets in our solar system. To this we must add the perturbations to which visible satellites may be subject from the influence of others dark and invisible, or which, in triple and multiple stars, visible satellites may produce on each other, as is, for example, the case in the triple ζ Cancri (see Struve, *Comptes Rendus*, T. lxxix. p. 1167), in which, in the more distant star, a perturbation due to the nearer seems to exist in fact.

* Powell, *Mem. Astr. Soc.*, No. xxi. p. 170.

We have said elsewhere that some stars seem to be surrounded by a retinue of dark [illegible], a case illustrated in Algol. From the calculation of proper motions it has been made evident that other stars experience perturbations from the influence of such invisible bodies. Irregularities [illegible] manifesting themselves in Sirius and Procyon gave rise to the belief that they were thus disturbed, and this conjecture has been fully verified of both of them, since it has been discovered that each has really a satellite, difficult indeed of observation, because immersed in the rays of the principal, but brought to light and measured by the powerful refractors of modern times.

If we consider for a moment the physical consequences of these luminous systems and their [illegible], we cannot but experience a profound astonishment. In so eccentric a system as that of α Centauri, the planets of these primaries must at one time receive the heat of two suns, both very near, and at another, of one near and another extremely distant. Who can calculate the vicissitudes of life subject to such a periodicity? Only the wisdom of Him who with the fewest instrumentalities is able to accomplish results infinite in variety. Add to this that, in the double stars, the members of the system are often of different and complementary colors, and even the poet's fancy is powerless to paint the varying beauty of days illumined by a rosy sun and nights lighted up by a green one, or of days which two differently colored suns combine to vivify, preceded by a golden twilight and an azure dawn. (See Table K.)

The double stars of which the periods have been calculated are not very numerous, and out of these not a few are uncertain. Time only can enrich the catalogue by adding new systems, as the orbits as yet hardly sketched in rough are fully developed. Struve, however, as if in anticipation of this, has endeavored to measure the probable ratio between the total number of the apparently double stars and those which are physically double, employing a method founded on their proper motions already indicated by Mitchell. He found that, if the number of visibly double stars of his first three orders be represented by the number 693, of these, there will be 48 optically, and the rest, physically double. This proportion for the physically double has been increased by recent discovery. In these three orders we can pronounce, from our own measures only, that motions of revolution are certain in 149 stars, even without any reference to proper motions. As regards the argument from proper motion, we have this remarkable result: the probability that two close stars having the same proper motion are not physically united, is less than the probability that the sun will not rise to-morrow, in the face of all the historical experience we have of that daily recurring phenomenon. Hence, it is an admitted postulate, that any two stars which have a common proper motion are connected together by a physical bond.

In order to perceive the weight of this argument, one reflection should be premised. It is a fact already proved (§ 6) that the larger stars have greater proper motions than the smaller: whence, while it would not be difficult to find two equal stars (as in 61 Cygni) with equal or nearly equal motions, it is extremely improbable that the motion of a small star and of a large star should be the same. It follows that, for all unequal double stars, an equality of proper motion is a probability in favor of their physical connection. Observation has confirmed this higher probability. In the actual examination of the proper motions of double stars less than 4″ apart, not a single one has been found optically double. Among the higher orders, from 4″ to 16″ of distance, 60 out of 66 have been found physically, and only 6, optically double. The apparently double are found most frequently among the stars of very unequal magnitude, as is natural, since the small are so much more numerous than the large.

In the second place, it is found that orbital motions have been most frequently detected in the closest stars, and that the number diminishes with increase of separation; also, that the proper motions of the doubles of the first orders (the closest) are likewise greater. [illegible] tribute these stars into two categories [illegible] proper motions (from 1″ to 10″ in 2[illegible] years) [illegible] of motions below 10″ in the same time, we have the following results:

No. of stars.	Mean proper motions.	Double. Optically.	Physically.	Ratio.
86	0″–10″	13	73	0.177
103	10″–45″	15	88	0.184

From this table it results, that the ratio between the physically and the optically double stars remains substantially the same for the two classes of movement, which is as much as to say that this ratio is independent of distance, the proper motions being supposed, as usual, to be inversely as the distance.

We shall conclude this article by presenting some conclusions of Struve as to the number of stars physically double, in proportion to the total number visible in the celestial arch.

(1) Of 72,500 stars of the magnitudes 1 to 8½ inclusive, and distant 16″, 1973, or 1 to 36.7, were found by him to be double. Of these, 1702 are physically and 271 optically double, or 1 optical to 6 physical. This was true of his time, but recent measures have considerably increased the number of the physically doubles.

(2) For the stars from the 1st to the 4th magnitude, inclusive, the total number being 353, there are only 75 physically connected, or 1 to 4.71.

(3) The existence of a physical bond is not limited to stars of minimum distance, but there are cases where the distance is considerable, as is inferrible from the identity of proper motions, sometimes occurring even when the distance is very great. Examples of this sort are found in the minute companions of Castor, and of 40 Eridanus, in Alcor (the companion of ζ Ursæ Majoris), and along with it in all the group of β, γ, δ, ζ of this constellation; from which we conclude that *at least one-third part of the stars visible in the heavens are connected with one another by physical bonds*; and perhaps it would not be an exaggeration to say a half.*

We have to regret that the necessary limitations of this article will not permit a fuller discussion of a subject of so great importance, sufficient of itself not only to enlarge the boundaries of creation, but also to prove that in the depths of space there reign the same laws of force which regulate phenomena in our own immediate neighborhood; and, while establishing identity of laws, to add infinitely to the variety of results, showing that innumerable bodies remain still unknown to us, and that all our solar system, with its numerous cortege of planets, satellites, asteroids, and comets, is only a point in limitless space, associated with myriads of similar systems, which are all animated by the same physical principle, and are ruled by the same laws, and which constitute one entire and complete unity, even as the Great First Cause which from nothingness called them into being is one.

The spectroscope has proved to us the unity of matter; the double stars demonstrate the unity of force; geology teaches how vast a series of ages must have rolled round in order to the accomplishment of the actual state of things; and of this we shall be even more fully persuaded when we study the entire stellar mass, to the consideration of which we now proceed.

§ 10. *Of the Apparent Distribution of the Stars in the Celestial Sphere.*

There is nothing more capricious, to appearance, than the distribution of the stars in the celestial vault. It disconcerts every hypothesis, and even every conceit of the fancy. Yet there must be some kind of order in the arrangement. And just as the observer, who, from the momentary aspects of the satellites of Jupiter or Saturn observed in a single evening, should, in ignorance of their cycles, pronounce their positions to be capricious, so would he err who should imagine that the stars have no other disposition but that which we see. Their appearance is dependent on the orbits which they describe in the mighty void, in periods incalculable in length as compared with our brief generations; but to search out the intricacies of that vast system will perhaps never be conceded to the inhabitants of our little planet. There are, nevertheless, certain general forms which science has detected, and which may give us an idea of a determinate order governing the distribution of these vast masses in space. Even to the most careless glance, the enormous agglomeration of stars in certain regions, and their sparseness in others, cannot fail to be manifest. If, therefore, abandoning any pretension to unravel the intricacies of systems, we are content to investigate their general distribution, we shall gather from the study many and important results. But, in the first place, in order to arrive at any theoretic conception whatever of the real distribution, it is necessary to examine with care the apparent distribution. In spite of the impossibility of penetrating the mysterious constitution of the cosmos, we have, nevertheless, in the labors hitherto executed upon a grand scale by the astronomers, much material suited to illumine our ignorance, at least to some degree. And in this inquiry we should always keep before our eyes the admirable caution of Herschel, to avoid with equal care either of two extremes—the first, that of framing worlds according to our own fancy, by which means we shall fail for ever to understand nature, and shall waste our time vainly; the second, that of hesitating, through too great timidity, to indulge in conjecture, and of thus losing the fruit of observation, the very object of which is to arrive at the structural composition of the universe.†

That in discussing this vast subject we may proceed with method, we shall speak (1) of the apparent distribution of the greater stars; (2) of that of the minor, in treating of which we shall analyze the most important researches made recently in regard to these, not yet as well known as they deserve to be; (3) of the real distribution in space which may be conjectured to exist, comparing the results obtained from various suppositions with that which it is possible to deduce from modern investigations of a different kind.

It is commonly said that the stars of the larger magnitudes are scattered over the celestial vault so irregularly as to suggest no certain principle of arrangement. Yet it has been long since noticed that the brightest of them occupy a broad zone which embraces Taurus, Orion, and the Southern Cross. This obscure indication we have endeavored to examine a little more particularly, with the following results: If a celestial globe be so adjusted that the bright star of the Southern Fish, called Fomalhaut, be in the zenith, the horizon of the globe will mark a great circle, such that a quite narrow zone above and below its plane will embrace the larger number of the conspicuously bright stars. The course of this circle is as follows: Passing through the Hyades, it takes in α Tauri, or Aldebaran, crosses the constellation Orion in a line nearly parallel to his belt, passes between Sirius and Procyon, divides the Southern Cross, and passes between the bright stars of the Centaur and through the body of the Scorpion. Then crossing the ecliptic into the northern hemisphere, it separates the bright stars of Ophiuchus, traverses the constellation of the Lyre, nearly touching Vega, crosses Cassiopeia, and passing through α Persei, leaves at a little distance the beautiful star Capella. The southern pole of this circle, as remarked already, is near the star Fomalhaut; that is, in A. R. 10*h*. 45*m*., and Decl. S. 30°. The northern is in 22*h*. 45*m*., Decl. N. 30°, near ξ Ursæ Majoris. The circle cuts the equator in A. R. 4*h*. 45*m*. and A. R. 16*h*. 45*m*., and cuts the ecliptic in the constellation of the Bull near Aldebaran, and in that of the Scorpion near Antares, having an inclination to this circle of about 70°. From a mere inspection of the globe, it is manifest that most of the stars of the magnitudes from 1st to 4th, are found in this zone. Nevertheless, to give to this statement more of precision, the angular distance from the great circle above described has been determined for all the stars down to the 4th and 5th magnitudes for which the distances do not exceed thirty degrees. The manner of making this determination is obvious enough, consisting only in taking, upon a good celestial globe, the positions of the stars relatively to the horizon, after having first placed Fomalhaut in the zenith, and afterward in the nadir. The numbers thus obtained are certainly not very precise, but they are more than sufficiently so for the present purpose, any greater delicacy being here in fact useless. This list will be seen to embrace not only the principal stars which form the group of Orion and the Greater Dog, but even some which at first view seem to have no relation to it, as Lyra, Perseus, and Cassiopeia. It is immediately obvious that this zone is not coincident with the Milky Way, but yet is not far distant from it, and even follows for quite a stretch the preceding branch of that Way, which, after the division in Aquila, takes the direction of the Scorpion's head. The Milky Way appears commonly not to have on the side of Orion a subdivision corresponding to that in Sagittarius; but our discovery, made in 1855, that the nebula of θ′ Orionis may be traced to very remote limits—even to more than six degrees in declination and four in right ascension — demonstrates a symmetry in this celestial conformation in the two opposite hemispheres, too remarkable to be disregarded. The isolated nebulæ of Andromeda and of the Triangle may possibly belong to this system, but they are situated on the opposite side of the circle. The "sack of charcoal," or the space near the Swan in which every trace of white stellar

* See Struve, *Stellarum Duplicium, etc.*, St. Petersburg, 1852.

† Herschel, *Phil. Trans.*, 1785, p. 213—"On the Construction of the Heavens."

light is absent, does not terminate where in ordinary evenings it seems to do so; but in nights of unusual clearness its continuation may be traced, in the form of an elongated *m*, nearly to the Pole. Now, such a bifurcation corresponds exactly to that which is produced by prolonging, in the other region spoken of above, the great circle which traverses the anterior part of the Scorpion and of Orion. There are many nebulæ in this zone, and numerous groups scattered through Hercules, the Dragon, Ophiuchus, the Lyre, the Bull, the Twins, which, occurring so near to this circle, must certainly belong to the same formation. This is important, as indicating that these groups have in the process of development taken the place of a single great star. We may remark, finally, that the bright star-zone constitutes a well-defined partial system, intersecting the zone of the Milky Way under a pretty acute angle, at points from which, for long distances, the two are confounded. The few bright stars outside of this zone are those of the Lion, the Lesser Dog, and the Twins, which form a third zone, still quite distinct, passing through these constellations not far from the Great Bear in one direction, and extending to the brilliants of the Crane and the Peacock, not far from the Southern Fish, in the opposite. This new circle has its north pole not far from α Cephei, and meets the great circle before described almost at right angles, cutting also the equator near the Belt of Orion.

It would be interesting to seek the relations of these circles to that of the sun's proper motion in space. I limit myself here to the remark that the apex of translation of the solar system is in the principal circle of bright stars; or, more precisely, is near the point in Hercules where that circle intersects the third, or circle of secondary stars, passing through the Lion and the Twins. This coincidence is too singular to be accidental, and points to the existence of some great law of stellar distribution. Hence, probably, the circle first above mentioned should be regarded as the fundamental plane of the stellar system to which our sun belongs.

The distribution of the minor stars is also well marked, so long as we are careful to regard only mean results without descending to particular cases. The larger number of minute stars is evidently in the Milky Way. The course of this zone, with all its cloudlets, has been diligently traced by Heis through the northern hemisphere, in his *Novus Atlas Cœlestis*, and for the southern, by Sir John Herschel in his observations at the Cape. We also have made of it a careful study. The figures given by these authorities, and, better still, a glance at the heavens themselves, the great book open to all, are worth more than any description. The Milky Way is not properly a continuous zone, but is rather a series of luminous patches formed of stars more or less condensed. These masses are not disposed along a regular great circle running through the midst of them, nor is the Way equally broad throughout, or everywhere simple. Broadest in the Swan, it is subdivided, as is well known, in the Eagle, and its principal branch passes through Antinous, Sobieski's Shield, and Sagittarius (II. XVII.), while the other goes on to the Scorpion. Near the Scorpion the globular structure is more apparent than anywhere else. These branches recover their union in the southern hemisphere, where, in the Southern Triangle (II. XV. and XIV.), the zone is brightest, passing thence to the Southern Cross (II. XIII.). But in this constellation it presents a curious phenomenon—viz. an oval empty space called the *Coal-Sack*, beyond which it contracts greatly, becoming only three degrees in breadth, and afterward expands anew, and terminates in a fan of three principal branches (II. IX.). The important gap which the zone here presents, is in the constellation Argo, near λ and γ. Beyond this occurs a vacant interval of about 10°, on the opposite side of which the bright zone reappears, with an extremity similarly split up into the form of another fan of three branches (II. VIII.). Thence it passes over the Great Dog to the Unicorn, where it crosses the equator, and after being considerably dilated and enfeebled in intensity, it reaches our hemisphere, to become diffused over the broad space between the Bull and the Twins, and afterward contracting again, to be anew dilated in Perseus and Cassiopeia, returns finally to the Swan.

This most irregular zone presents no constant density even to the telescope; but while on the side of the Eagle and the Archer, under the most powerful instruments, there still remains a sky of impenetrable whiteness, on that of the Bull, where the breadth is greatest, it is completely resolved into stars. The middle line drawn through this labyrinth is not rigorously a great circle, but rather a small circle distant about 5° from the great circle nearest. It cuts the celestial equator by its principal branch at 108° and 288°, and by the secondary at 268°, being inclined in the mean, on the preceding side, at an angle of about 60°. The Magellanic Clouds may be regarded as detached portions of the Milky Way, isolated in the firmament.

From the slight and very imperfect sketch here given of this immense celestial formation, it is an obvious impossibility, without conveying a false conception, to reduce it to a simple geometrical representation. Nevertheless, in order to resolve certain problems, it is necessary to study its principal characteristics, contenting ourselves in doing so with such mean results as observation gives, and which, if they change the character of the phenomenon, as considered from one point of view, are yet in other respects useful and unexceptionable. Premising this with a view to forestall inopportune exceptions, we proceed with our subject.

The soundings of the stars, instituted by Herschel for the purpose of learning the apparent distribution of those bodies, have already been described. The data thus obtained were discussed by their author, and afterward by Struve, and have led to the following results: (1) The stars are more abundant the nearer we approach the Milky Way, where their density is maximum. (2) The minimum density is found at the pole of the same zone. Employing the numbers of Herschel, W. Struve* has investigated the laws of stellar condensation as referred to the Galaxy, and has obtained these results: Taking separately the soundings made in the middle of the Milky Way at the point where it crosses the equator, there are found for each field—

On the side of the 6th hour (Taurus, 49 different soundings with 4042 stars give for the mean field .... 82.5 stars.
On the side of the 18th hour (Aquila) 73 soundings in the principal branch, with 10,612 stars, and 29 in the secondary branch, with .... 5,862 "
Give for the total at the 18th hour 102 soundings and.....16,474 stars, or in mean 161.5 "

The difference is here considerable, and shows a greater accumulation of stars on the side of the 18th hour than on the opposite side. At the 6th, the maximum number found in one field was 204, and at the 17th, 557, which indicates that the Milky Way is more uniform on the side of the 6th hour than on the other. If we limit ourselves, however, to general conclusions, it is allowable to take the mean of these numbers. But on the side of the 18th hour the Milky Way is double, and this introduces another irregularity. Still, even in the space between the branches, it is quite rich, and at the point in the Eagle where it divides, it has a mean of 60 stars per field. Taking, therefore, the average of the numbers given above, we find that, in the plane of the Galaxy itself, the mean number of stars per field is 122. (3) In order to find the mean density at 15° distance from the galactic plane, the celebrated author cited has taken the sum of the Herschelian soundings falling between 10° and 20° of distance S. as well as N. of the Milky Way, as laid down in Lubbock's maps, and has found—

On the side of the 6th hour 33 soundings, with a mean density of .... 25.56 stars.
On that of the 18th, 23 soundings, with a mean density of .... 35.06 "
From which the mean density for the distance of 15° is inferred to be .... 30.30 "

(4) Proceeding in the same way for the distances between 25° and 35°, there is obtained from 35 soundings the density of 17.68 stars; and by similar successive operations is formed the following table:

Distance from plane of Galaxy	Star-density.	No. of soundings effected.
0°	122.00	151
15°	30.30	56
30°	17.68	34
45°	10.36	48
60°	6.32	18
75°	4.78	few.

The two points following, noticed by Struve, are worthy of observation: (1) A *saltus*, or noticeably sudden diminution of density, beyond two degrees of breadth, which explains why the Milky Way appears so narrow—that is, not more than 4° wide—a conclusion to which the law of continuity also leads even in telescopic observations, particular cases only excepted in which stellar groups are so sharply defined that half the field is within and half without the Galaxy; but these cases are rare. (2) The great disproportion between the two extremes, so that in the plane of the Milky Way, even taking means, the stars are thirty times more numerous than at the pole; it being understood that the disproportion between the actual numbers largely varies with the localities. Yet in no locality, not even in

* *Études d'Astronomie Stellaire.*

the openings or "coal-sacks," is the poverty ever so great as at the poles.

It may now be inquired whether a similar distribution of stars occurs in the southern hemisphere; and further, whether stars of the different magnitudes are equally condensed toward the Milky Way, or whether the minuter stars are proportionally more compact. Answers to these questions have been furnished by the labors of the younger Herschel and of Struve. Sir William Herschel, in his soundings, took no account of the magnitudes of the stars, but his son, in pursuing a similar labor for the southern hemisphere at the Cape of Good Hope, divided the stars into classes, and arrived at results similar to those above indicated, with particulars better suited to the purposes of our inquiry. Taking the soundings in a zone of 3° in breadth—that is, of 1½° in each direction from the Galaxy—he found a mean of 75.5 stars per field, and this without following the tortuous course of the Galaxy, on which account, since many of the fields fell outside of it, the number is diminished; so that, when this circumstance is taken into account, the number of stars per field is at least 90, even when those fields are omitted from the reckoning in which there are aggregations so dense as to give more than 200 each. **Starting, then, from this number, which does not** differ much from the 122 found by his father in the northern hemisphere, he found, for the zones at different distances from the Galaxy, the results following:

Distance from plane.	Middle of zone.	No. of soundings.	Total No. of stars.	Proportion.
1½° N. to 1½° S.	0°	84	6,258	74.50 to 90
0° to 15° S.	7½°	321	16,461	51.28
15° S. to 30° S.	22½°	195	4,576	23.47
30° S. to 45° S.	37½°	68	982	14.46
45° S. to 60° S.	52½°	21	161	7.41

The rate of decrease is the same as in the preceding table, though the absolute values are somewhat different, referring as they do to different mean limits; and hence the conclusion is drawn that the total number of stars visible in the southern hemisphere is about 2,665,786, and the total number in the entire heavens about 5,331,572, or five and a quarter millions at least. It follows that the southern hemisphere is less richly provided than the northern. In the following table are contained the estimated numbers of stars scattered through the zones parallel to the Galaxy, arranged according to magnitudes:

Distance from S. pole of the Galaxy.		Number of stars per 100 telescopic fields.					
		Larger than 8th mag.	From 8th to 9th.	From 9th to 10th.	From 10th to 11th.	From 11th to 12th.	12th and beyond.
0° to	15°	5	...	7	47	72	474
15	36	5	6	22	38	56	535
36	45	5	7	17	39	76	764
45	60	3	6	18	42	109	1171
60	75	3	7	23	57	161	2378
75	90	6	11	38	88	248	5515
90	105	4	9	28	70	215	4802
105	120	6	8	21	46	121	2145
120	135	3	1	21	51	130	1240
135	150	...	5	5	24	81	656

It is here easily apparent that the larger stars are pretty uniformly distributed, but that the smaller are more and more condensed, till near the Galaxy they are twelve or **thirteen times more numerous than at the pole of that** zone; and if figures be constructed in accordance with these **numbers, they will visibly illustrate the closeness and the** multitude of the stars. We shall presently see what conclusions may be drawn from this distribution.

Besides the laborious enumerations of Herschel, there are other similar monuments of industry which may possibly suggest the laws of stellar distribution in space. Some of these we shall briefly notice. The zones of Bessel, catalogued by Weisse for the limiting parallels of 15° N. and 15° S. declination, and discussed by Struve, lead to the following distribution, arranged according to right ascensions, the heavens being divided into regions of four hours each. The letters A and B indicate the magnitudes according to Argelander and Bessel respectively:

Distribution of Stars in Right Ascension.

Region.	Hour.		1st to 5th mag. (A)	[illegible]	[illegible]	[illegible] (B)	9 (B).	1st to 6th (A)	Total.
	h.	h.							
1	1 to	4	61	120	[illegible]	[illegible]	[illegible]	181	6,818
2	5	8	76	148	598	[illegible]	[illegible]	224	13,598
3	9	12	49	78	393	[illegible]	[illegible]	127	7,005
4	13	16	50	87	475	[illegible]	[illegible]	137	6,856
5	17	20	68	106	674	[illegible]	[illegible]	174	10,657
6	21	0	58	113	362	1,273	[illegible]	171	7,171
I. to VI.	0	23	362	652	2894	10,458	[illegible]	1014	52,105

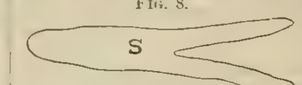
Here is seen at a glance the preponderating abundance of stars in the 2d and the 5th of the regions above defined, where, more largely than elsewhere, the zone is traversed by the Milky Way. The numbers are sensibly larger in these regions for all the stars, but for the small ones in greater proportion. Still, the distribution in these zones **has the effect to understate largely the density in the ga**lactic region, and to increase it near the pole of that belt, because the stars of the 9th magnitude, though the most abundant, cannot in the galactic belt be all recorded by the observer, while in the poor regions they are pretty completely gathered up. **Moreover, the Galaxy where it inter**sects the equator does not spread over the four hours of the region to which it belongs, which therefore includes a large **celestial space poor in stars. The poorer portions, more**over, being more than 30° distant from the galactic pole, it is evident that the real condition of things cannot be in**ferred from this enumeration. The conclusions which it** suggests are nevertheless sufficiently in harmony with those of Herschel. The zone observations of De Vico, of the American Bond, and others, conduct to the same results, **which are these: (1) That stars are more numerous near the plane of the Milky Way than in other quarters of the** heavens; (2) that the proportional increase in numbers toward this plane is greater for the small stars than for the **large. These general results are incontrovertible, but are hardly an adequate compensation for the severe toil which** this discussion has necessitated. The laws of apparent **density, however, having been thus reduced, at least ap**proximately, to formal numerical expression, the problem **henceforth loses something of its vagueness; and upon the** basis of these laws we are enabled to proceed more securely to the discussion of some of the questions which relate to **the real distribution of the stars in space.**

§ 11. *Real Distribution of the Stars in Space.*

To pass, then, to these questions, the first inquiry which presents itself is this: Is the apparently greater **density of the stars in certain regions purely an effect of perspective, or is it owing to the fact that the number of** stars in a given space is really greater in those regions than elsewhere? In other words, Does the visual ray in a given direction encounter more stars because its line of **transit through them is longer, while they are in fact uniformly distributed through space, or do they appear more** crowded because they really are so? This question, in respect to certain particular regions of the heavens—as, for **instance, the Magellanic Clouds and certain large spots of the Milky Way, apparently globular agglomerations of enormous bulk—is easily resolved. For in these cases, if we choose to assume that the component stars are, as in other regions, equally distant from each other, we are com**pelled to regard the agglomerations as cylindrical masses **with their axes pointing directly toward the observer—a condition of which the improbability is plain enough to any one. Moreover, some of these masses are composed of stars of nearly equal magnitude, and clustered together** with a density increasing toward the centre; so that it is impossible not to recognize them as special systems. Such are the numerous clusters which we find isolated in the **heavens, and very many others occurring in the Galaxy. Of these particular cases it is not our purpose here to speak.** Our present inquiry relates to the visible stellar mass in general, especially as seen in the Milky Way, and our aim is to settle which of the two hypotheses above mentioned **is to be preferred.**

Sir William Herschel, in the beginning of his stellar researches, accepted the idea of Huyghens that the stars are **uniformly distributed through space; and he consequently** regarded the number of these which in his soundings he found on the line of the visual ray, as a measure of the depth of the stratum. He was thus conducted to his famous conception of the galactic system as forming a vast stratum of relatively small thickness, bifurcated on the **side of Sagittarius, and presenting in section the appear**ance shown in the annexed figure. But this fancy was abandoned by himself in his later years, though many quote it still as his **finally-settled opinion. If it is admitted that the stel**lar density is at the same time apparent and real, **and that the stars appear** crowded not only by the effect of perspective, but because of their actually greater mutual proximity; and if on this **hypothesis the relative density of the Herschelian stratum in various planes parallel to the principal plane of the** stratum be a subject of inquiry, the following table, calculated by Struve upon the soundings of Herschel, will furnish replies:

Fig. 8.



Herschel's Stratum Theory.
S, sun's place.

Distance from plane of Galaxy.	Stellar density.	Interstellar distances.
0.00	1.000	1.00
0.05	0.480	1.27
0.10	0.330	1.45
0.20	0.239	1.61
0.30	0.180	1.77
0.40	0.086	1.97
0.50	0.014	2.26
0.80	0.005	4.14
0.86	....	5.73

From this it is apparent how rapidly the stellar distances must increase in proceeding toward the pole of the Galaxy, and how large is the excess of density in its own plane. Thus, at the distance 0.86, which corresponds to 60° of elevation above the galactic plane, the density is hardly 0.0005 of that within the plane itself; and the interstellar distances are something like six times greater near the pole than in that plane. Though such a distribution cannot be called impossible, it is supported by no argument strong enough to give it preference to the other, which supposes the stars equidistant, but arranged in longer lines. In deciding this point the following reflections may be serviceable:

If the stars seem more dense only—as Herschel's original supposition presumes—because the visual lines are longer, the proportion of stars of different magnitudes will not be the same throughout the heavens, but, in the directions of the longer visual rays, the number of small stars will predominate; and this for the reason that, to the number of those which are really small, must be added such as, being actually great, are reduced in magnitude in consequence of their distance. On the other hand, if the stars are really closer where they appear to be so, then, assuming that the different magnitudes are impartially distributed through space (for there is no reason to think otherwise), the ratio of the numbers expressing the various orders of magnitude must, within a sphere of visibility of any given radius, be the same as that which is deduced from other elements as related to their distance; as, for instance, from photometry and proper motion.

It is, however, to be remarked that the two hypotheses are not absolutely mutually exclusive, since it may happen that, in certain directions, the stars are at the same time more thickly strown and arranged on longer lines. Really, therefore, we are without any certain criterion, and it is necessary here also to resort to the criterion of probability. We know, indeed, that one of the stars nearest to us, 61 Cygni, is among the smaller. With a view to the resolution of this problem, W. Struve has calculated what should be the radius of a sphere capable of containing the stars of each order of magnitude, on the supposition, first, of a uniform distribution, and secondly, of inequalities of density. Let it be understood that we are not here discussing absolute distances, but proportional distances only, and that, in speaking of uniform distribution, we do not intend a geometrical uniformity, which in space is impossible, but merely an approximate uniformity. Resuming, then, the enumeration of the stars given in the foregoing sections, we have the following table, in which the first column gives the magnitudes, and the second the numbers of the stars according to Argelander; the third, the successive sums of the first and second, the first, second, and third, etc.; the fourth, the radius of the sphere capable of containing the stars of the several magnitudes respectively, supposing them mutually equidistant; the fifth, the results of a similar calculation according to the enumeration made by Struve upon the stars of Bessel in Weisse's catalogue; and the sixth and last, the differences between the two calculations:

Magnitudes.	Number of stars, according to Argelander.	Successive sums.	Radius of sphere to embrace these sums.	Similar computation from Bessel's numbers.	Diff.
1	20	20	1.00	1.00	
2	65	85	1.62	1.46	+ .16
3	190	275	2.39	2.13	+ .26
4	425	700	3.27	2.91	+ .36
5	1,100	1,800	4.48	3.97	.51
6	3,200	5,000	6.30	4.48	+ 1.82
7	13,000	18,000	9.65	8.58	1.07
8	40,000	58,000	13.20	13.44	— .24
9	142,000	200,000	21.55	20.38	— .17
14 H.	....	....	98.00		

The differences of the last column, though sensible, do not exceed the irregularity admissible in this matter. The greatest anomaly appears between the stars of the 6th and 7th magnitudes—that is, at the point of transition from the telescopic stars to those visible to the naked eye—a *saltus* in the scale already noticed by Struve. The total number of stars visible to the naked eye in all the heavens, down to the 6th magnitude, amounts, according to Heis, to 6800, which gives for the radius of the including sphere, 6.610; and from the Pulkova catalogue the number of stars to the 7th magnitude amounts to 26,800, which gives, for the similar radius, 11.021. These two numbers exceed those of the table above, but Heis confesses that his own sight extends to many stars below the 6th magnitude; and it is equally admitted on the part of Struve that many stars half a magnitude below the 7th are included in the Pulkova catalogue—a fact which he attributes to an uncertainty necessarily arising out of the nature of the case, but which I believe to be no less due to our natural tendency to fancy a star larger than it is whenever, without any kind of instrumental aid, we form our estimates by the eye alone.

Let us now see what must be the radii of the spheres capable of containing the same classes of stars, on supposition that their apparent density is also real. From the law of apparent density, deduced by Struve from the labors of Herschel, are computed the following distances:

Magnitudes.	Radii. Nos. and densities compounded.
1	1.00
2	1.80
3	2.76
4	3.90
5	5.45
6	9.28
7	15.78
8	23.86
9	33.40
14 H.	180.40

It now remains to be seen which of these two series most nearly represents the actual facts in the celestial expanse. To decide the question directly is impossible: but indirectly we may do it by comparing the radii of these tables with the mean distances inferred from photometry and from proper motions. For the purposes of such a comparison a *résumé* of all these values is presented in the following table:

Magnitudes.	Distances inferred. From number, distribution supposed uniform.	From number, density supposed variable.	From photometry.	From proper motions of the single stars in A. R.
1	1.00	1.00	1.00	1.0
2	1.46	1.80	1.55	1.8
3	2.13	2.76	2.42	2.8
4	2.91	3.90	3.76	3.9
5	3.98	5.45	5.86	5.6
6	5.47	9.28	9.11	9.0
7	8.58	15.78	14.17	16.0
8	13.44	23.36	22.04	18.0
9	20.38	33.40	34.30	33.0
14 H.	98.00	180.40	312.00	......

Here it is obvious that the photometric scale more nearly accords with the hypothesis of condensation than with the other, especially for the smaller stars; and the same thing is true in regard to the proper motions. We are led, therefore, to the conclusion that, not only in appearance but in fact, the stars are more dense near the Galaxy.

This, which may be called the theory of the real distribution of the stars in space, is the only result which, among the numerous speculations hitherto made as to the structure of the Milky Way considered as the principal body of the universe, deserves any confidence. Kepler, first among these speculators, regarded the Milky Way as a confused ring composed of stars, within which he conceived our sun to be eccentrically placed toward one side, and out of the mean plane. Huyghens supposed the stars to be distributed uniformly—an idea which we have seen to be untenable. Wright, Kant, and Lambert discoursed largely upon the nature of the systems which make up this immense aggregation; but all their conceptions are modelled on the type of the solar and planetary system as it was known in their time. Hence, in their speculations, we have always the inevitable great central primaries, and after these the secondaries and other attendants, of the 3d, the 4th, and even the 5th order. But as, in our day, the solar system itself has been so greatly modified, and since it presents so large an ascertained variety, it would be idle to follow in the footsteps of these. In fact, they could never escape from the conception of a sun surrounded by planets forming systems of the first order, and these surrounded by satellites forming systems of the second order, all the orbits being eccentric and only slightly inclined to the equator

of the primary. They admitted also comets with orbits largely eccentric, numerous, but without law. Now, besides these principal classes, composed of masses of great magnitude, we recognize between Mars and Jupiter a zone of little bodies whose entire mass, although their number already re[illegible] Jan. 1, 1877), scarcely equals that of the earth; where there is no ground to suppose that they have been all discovered, but rather, from the rapidity with which discovery has followed discovery, we may reasonably infer the contrary. Their orbits are considerably inclined to the ecliptic, and some of them are very eccentric—so much so, indeed, as, in view of their mutual proximity and the intricacy with which they are interwoven, while the whole are distributed over a zone no broader than the mean distance of the earth from the sun, to make their stability doubtful, and even to lend plausibility to the conjecture that the bodies themselves may sometimes come into collision. We recognize, moreover, many periodic comets, and others not periodic, some of which make part of the long parabolic currents of minute cosmical bodies—that is to say, meteorites—forming sometimes arcs of very great and sometimes of limited extent, which follow the tracks of some of the comets. These bodies, moreover, are not all solid, but in part gaseous, and on this account present so strange phenomena in their approach to the sun. In like manner, with the discovery of gaseous nebulæ—a discovery, however, already predicted by Sir William Herschel toward the close of his career—all the fancied resemblances between the nebulæ and the Milky Way fall to the ground.

In view of these discoveries in our own system, it is no longer improbable that groups of very minute stars may take the place of vast isolated bodies, and that every system may not, as Lambert would have it, possess a great preponderating centre to give it an indefinite stability. From the general vicinity of the nebulæ to the Milky Way, and considering that they are not always formed of separate stars, as used to be believed, it is impossible to say that these objects may not be parts of that great formation. Besides, the necessity of a great central mass is not absolute; it being possible to secure regularity of motion by means of an annular system, or other combination, without a central body—arrangements of which examples exist among the nebulæ, where are also spiral systems destined to other ends than perpetual circulation in orbits perfectly closed.*

From this survey must not be excluded the stellar systems, now well proved to exist, of double, triple, and multiple stars, nor the various groups found in the Milky Way, which without being globular seem to suggest the idea of partial systems, since they exhibit coronæ approximately circular, furnished with fringes or linear streams systematically diverging, analogous to the temporary positions of our planets projected around the sun. Nor should it be omitted that the central bodies of such groups may escape observation in consequence of their inferior luminosity. Some systems of this kind may be seen, especially in certain of the nebulæ of Sagittarius, and precisely in A. R. 18*h*. 10*m*. and in Decl. S. 18° 53′. The idea, moreover, of Mr. Proctor, who considers the openings in the Milky Way near the Southern Cross, and in the Swan, as evidences that the thickness of the sidereal stratum is limited, and that we see beyond the limit of its thickness, seems to be just. In fact, as a spherical aggregation, in instances like those of the Magellanic Clouds, is inferred to exist from the form alone, inasmuch as it cannot be supposed to be an indefinite cylinder with its axis directed toward the observer, so these apertures show that the bordering masses have a thickness in the direction of the visual ray bearing some proportion to their breadth; and we are not permitted to conceive them as tubular perforations of indefinite length with their axes turned precisely in our direction. The inference is therefore unavoidable that the Milky Way must be a finite system of stars, of which the depth in the visual direction cannot differ much from its breadth; at least, that this must be true on certain lines, though in others it may be impossible to say where it ends.

The earliest speculators on this subject had much to say about a ring; others talked of a disk split into two laminæ; but neither of these forms can explain, even approximately, the observed convolutions. Mr. Proctor has recently suggested the similitude of a serpent, coiled upon itself yet without closing the circle, there being in one place an interval which is seen in the constellation of the Southern Cross.† But none of these forms suffice to give even a rough idea of this great stellar mass in its entirety, and its real structure defies our every conjecture. All we can say is that it is composed principally of aggregations of unbounded magnitude, with intervening spaces where the stars are scattered with less density and more uniformity; that the series of these aggregations is longest, in respect to us, in the direction of Sagittarius; and that, diametrically opposite to this, in Perseus and Cassiopeia, it has also a great profundity: while to the right and the left of this diametrical line, where it is both narrower and nearer to us, the depth is much less; that our sun, with the neighboring stars of the group to which it belongs, is certainly not situated in the centre of the stratum, but sensibly eccentrically, as is evident from the enormous difference of stellar density between the 6th hour of right ascension and the 18th; moreover, laterally from these, the Milky Way is very singularly bifurcated, and while it is everywhere bright and in many points irresolvable, it is suddenly interrupted, terminating, as remarked above, in two large fans situated in A. R. 9*h*., nearly in front of the constellation Argo.

The sun, moreover, is a little out of the plane of the Galaxy, since this zone does not form a great circle, but a parallel to a great circle, and distant from it about 5°. More than this it is useless to conjecture. The component masses seem to be scattered groups, independent and countless in number, rather than a unit-system; and in consequence of the complication, their aspects throw no light upon the structure of this immense aggregation.

Though resolvability into stars distinguishes in general the Via Lactea from the nebulæ, yet many bits of this, examined with the spectroscope, have given indications of bright isolated spectral lines, so that it is not certain that in these points there may be nothing but stars, as we shall soon learn.

But all the visible stars do not form parts of the galactic system alone. Many groups seem independent of it—as, for instance, the Magellanic Clouds; and the same is likewise true of numerous aggregations of stars mingled with nebulæ, such as Coma Berenices and its surroundings, and other clusters of less dimensions than these. Above all, the nebulæ seem to form a system of their own, and to these we shall now turn our attention.

§ 12. *The Nebulæ.*‡

Not only in the magnificent celestial girdle of the Via Lactea, but also outside of it, there are in the heavens many spots which, even to the naked eye, seem luminous clouds, such as the Pleiades, the Beehive in Cancer, the hilt of Orion's sword, and the Hair of Berenice. These spots, from the earliest antiquity, have been called "nebulæ;" but since the time of Galileo it has been proved, by the aid even of imperfect instruments, that they are in most instances formed of aggregations of minute stars so close together that, though easily separated by instruments, the naked eye fails to distinguish them individually. The Pleiades and Præsepe produce little effect in telescopes, their component stars being so far apart; but the central portion of the group in Perseus, shown in Fig. 9, is magnificent.

Fig. 9.

A. R. = 2*h*. 7*m*.; D. N. = 56° 24′.
Portion of the Group in Perseus.

The little nubecula in the Milky Way near the star μ in Sagittarius is a surprising entanglement of curves, arches, and circles, defying all description. Its right as-

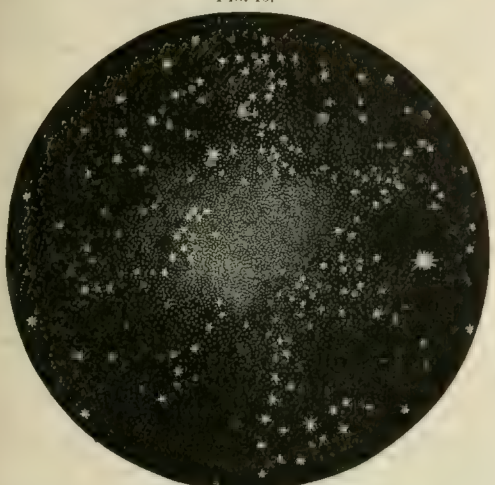
* It is no objection to this hypothesis to say that such systems could not be stable, since it is possibly true that the bodies composing them are destined by their collisions for the renovation of systems and the generation of scenes of new life.

† *Monthly Notices R. Astr. Soc.*, Dec., 1870, and *Astr. Essays*, p. 331.

‡ An article on the NEBULÆ will be found in Vol. III., but this covers only to a slight extent the ground of that, while that contains much not embraced in this. The two are mutually supplementary.

cension is $18h.\ 9m.$, and its declination 18° 50′ S. (See *Memoirs of the Observatory of the Collegio Romano*, 1852.) There is a neighboring group in A. R. $18h.\ 9m.$, Decl. 19° 6′ S., and one also in $18h.\ 10m.\ 46s.$, Decl. 19° 2′ S., where a magnificent red star, surrounded by an indescribable mesh, suggests irresistibly the idea of a system. The improvement of telescopes opened up a much more extensive field of objects of this kind, though of smaller dimensions. Messier and Lacaille in their time detected an admirable list, some separable in their instruments into stars, and others not. It was reserved for the elder Herschel to study exhaustively this branch of astronomy also, and to gather from it marvels without end. As a first result, many of the objects believed by his cotemporaries to be irresolvable, were perfectly resolved by his powerful instruments. Many also show rich aggregations of variously-colored stars—as, for example, the one near κ of the Southern Cross, which resembles a heap of gems—and many form a special category of objects called clusters, and by us groups or globular masses, made up of immense multitudes of exceedingly minute stars arranged in globular form, and so closely condensed in the centre as to present there a uniform white light. Figs. 10 and 11 give an idea of these objects. The

FIG. 10.



Globular Cluster in Aquarius.

most beautiful in our hemisphere is that of Hercules, in A. R. $16h.\ 37m.$, Decl. + 36° 42′, which is noticeable on ac-

FIG. 11.

Globular Cluster in Canes Venatici.

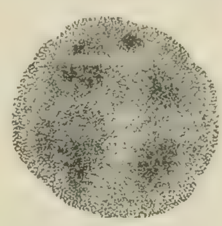
count of its curvilinear rays exterior to the arches of the spiral: it fills a field of 8′; that of Libra is not more beautiful, more extensive, or more resolvable than this. In the southern hemisphere are two others not less surprising —viz. the nebula of Toucan and that of ω Centauri, in which stars are present in thousands. The last occupies at least 20′ of space entirely covered with stars of the 12th and 13th magnitudes. The following is a list of the most beautiful objects of this kind. To give a description of them no number of figures or of pages would suffice. The only mode of acquiring any conception of these objects at all is, with an instrument of adequate power, to examine the objects themselves:

Principal Globular Groups of Stars.

Group.	Right ascension.		Declination.	
M. 5 in Libra	15h.	10m.	+ 2°	41′
M. 13 " Hercules	16	37	+ 36	43
M. 92 " "	17	13	+ 43	15
M. 10 " Ophiuchus	16	50	− 3	53
M. 9 " "	17	12	− 18	23
M. 14 " "	17	29	− 3	02
M. 2 " Aquarius	21	25	− 1	34
M. 3 " Canes Venatici	13	36	+ 29	11
—— " Crux Australis	12	44	− 59	26
H. 2322 in Toucan	0	17	− 73	2
H. 3504 " ω Centauri	13	17	− 46	35
—— " Antinous	18	44	− 6	25
M. 13 in Pegasus	22	22	+ 11	27
—— " Delphinus	20	26	+ 6	51

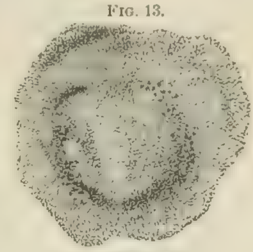
But the power of Herschel's instruments was not sufficient to resolve into stars all the objects characterized as nebulosities, and the name of nebula is now restricted to the unresolved. Of these nebulæ there are three categories: (1st) the planetary nebulæ; (2d) the elliptic nebulæ; (3d) the irregular nebulæ. The first receive their name from the fact that, in the field of the telescope, they appear as disks more or less well defined, and with a light like that of a planet, nearly uniform. Their color is greenish-blue. A beautiful series of these objects is represented in Figs. 12, 13, 14, 15, 16, 17, 18. The uniformity of light in

FIG. 12.



A. R. = $19h.\ 34m.$; D. = − 14° 32′.

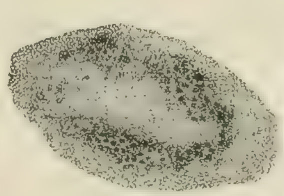
FIG. 13.



A. R. = $23h.\ 18m.$; D. = + 41° 36′.

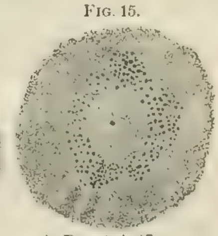
some of these is singular, as in Fig. 12. But in these also are seen spots of greater brightness, which seem to scintil-

FIG. 14.



A. R. = $20h.\ 55m.$; D. = − 12° 2′

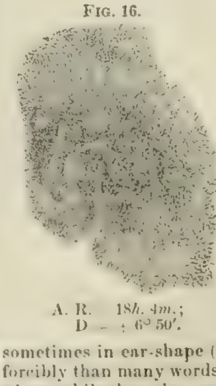
FIG. 15.



A. R. = $10h.\ 17m.$; D. = − 17° 47′.

late, and are arranged apparently in curves. These lucid masses are sometimes disposed in ring shape (Figs. 13, 17),

FIG. 16.

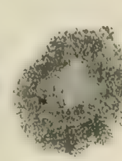


A. R. = $18h.\ 4m.$; D. = + 6° 50′.

FIG. 17.

A. R. = $7h.\ 34m.$; D. = − 14° 20′.

FIG. 18.

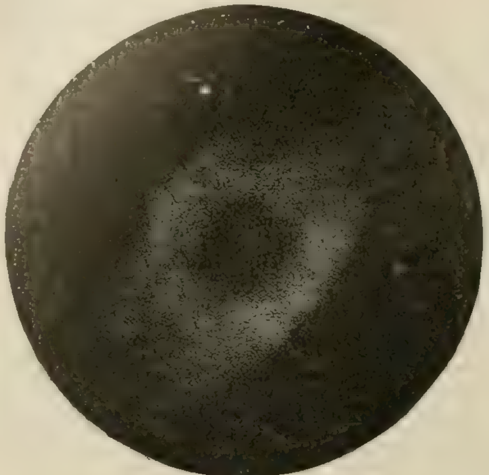


A. R. = $5h.\ 33m.$ D. = + 9° 0′.

sometimes in ear-shape (Fig. 15). The figures speak more forcibly than many words. Others, again, are cloudy on the edges, while they also present a neatly-defined central part, as in Fig. 16. These at first sight resemble somewhat Saturn with his ring—that is to say, a globe surrounded by an oval—but on closer examination exhibit the characters shown in Figs. 13, 14, and 15. Some have decidedly the aspect of a true ring, the interior being wholly vacant. Unique among these is the nebula of Lyra, A. R. $18h.$

4^{h} 8^{m}. 12^{s}., Decl. N. 32° 52′, which presents an elliptic ring, having in the centre the merest scintillation of light, which is an exceedingly minute star. (Fig. 19.)

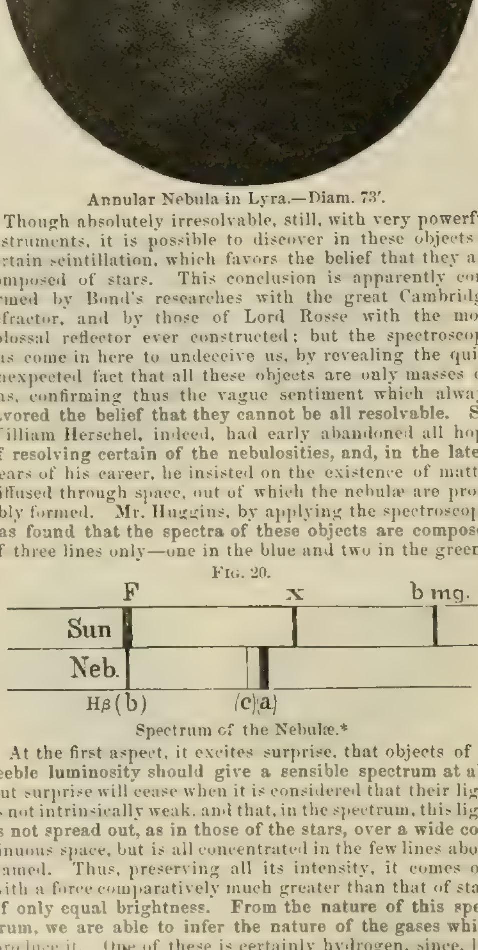
FIG. 19.



Annular Nebula in Lyra.—Diam. 73′.

Though absolutely irresolvable, still, with very powerful instruments, it is possible to discover in these objects a certain scintillation, which favors the belief that they are composed of stars. This conclusion is apparently confirmed by Bond's researches with the great Cambridge refractor, and by those of Lord Rosse with the most colossal reflector ever constructed; but the spectroscope has come in here to undeceive us, by revealing the quite unexpected fact that all these objects are only masses of gas, confirming thus the vague sentiment which always favored the belief that they cannot be all resolvable. Sir William Herschel, indeed, had early abandoned all hope of resolving certain of the nebulosities, and, in the latest years of his career, he insisted on the existence of matter diffused through space, out of which the nebulæ are probably formed. Mr. Huggins, by applying the spectroscope, has found that the spectra of these objects are composed of three lines only—one in the blue and two in the green.

FIG. 20.



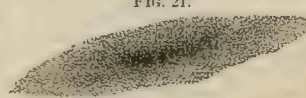
Spectrum of the Nebulæ.*

At the first aspect, it excites surprise, that objects of so feeble luminosity should give a sensible spectrum at all; but surprise will cease when it is considered that their light is not intrinsically weak, and that, in the spectrum, this light is not spread out, as in those of the stars, over a wide continuous space, but is all concentrated in the few lines above named. Thus, preserving all its intensity, it comes out with a force comparatively much greater than that of stars of only equal brightness. From the nature of this spectrum, we are able to infer the nature of the gases which produce it. One of these is certainly hydrogen, since, besides the coincidence of the line above mentioned with the solar F, the line G in the red has also been successfully identified in the brighter of the nebular spectra. As to the others, one is very near to the double line of azote, found in the spectrum of the second order of this gas; but as it is not perfectly coincident with either one of the pair, the substance producing it is unknown. Among the artificial lights which approach nearest to this, there is a line of lead, but the identity is hardly probable. The third and finer line is quite unknown.

(2) The oval nebulæ are elliptic masses, mostly faint and extremely diffuse at the borders. A remarkable example of this class is in the girdle of Andromeda, discernible to the naked eye, and resembling in appearance a light seen through a thin plate of horn: it was so described by its discoverer, Fabricius. Its extent is very remarkable, being in length a degree and a half, and in breadth a quarter of a degree. It was profoundly studied by Bond of Cambridge, who found that it is far from being continuously luminous, but has, as it were, two narrow dark stripes or channels.† Yet its spectrum is found to be continuous, whence the nature of its composition remains unknown. Still, this does not prove that it may not be gaseous, it being possible for gases at low temperature to give a continuous spectrum.

A great number of small nebulæ, of the type shown in Fig. 21, are found chiefly in the region of Coma Berenices and in the wings of the Virgin. These are in general much condensed at the centre and extremely diffuse at the borders. They pass step by step through all the possible grades of density, from the faintest cloud to such as have quite a bright central lustre. It is a remarkable fact that the elliptic nebulæ were generally characterized by Herschel as irresolvable. It is also noteworthy that while, in the globular groups, the borders are entirely formed of brilliant stars, in these, the margin is more diffuse and less bright than the centre.

FIG. 21.



Small Elliptic Nebula—type form.

The irregular nebulæ are not less numerous or celebrated than those already mentioned. The most remarkable among those visible in our hemisphere is that in the hilt of Orion's Sword, involving the multiple star θ'. The portion of the heavens which surrounds this star seems to be formed of loosely-heaped locks of cotton.‡

The form of this nebula varies greatly in details according to the power of the telescope with which it is observed; and great reflectors, like those of Rosse, Lassell, and Ellery, give to its masses an aspect of sharper definition than smaller instruments: on which account the designs we have of it are in their minor features discordant among themselves. This nebula, in its brighter parts, under strong enlargements and in favorable atmosphere, appears to scintillate and to give signs of resolution into stars. (*Bond*, *Secchi*.) But analyzed with the spectroscope, it presents, like the planetary, a linear spectrum, and therefore must be regarded as gaseous. This condition of matter does not exclude the possibility of such agglomeration as may produce masses dense enough and bright enough to take on the appearance of small stars. Hence the discovery of Bond ought not to be considered an illusion; and we ourselves can bear witness to having many times verified the fact of such scintillation in this nebula and in the planetary also; *e. g.* Figs. 12, 13, 15, 16.

The extent of this nebulous aggregation is very great, since, besides the central mass, commonly regarded as the nebula, numerous filaments have been traced by us from $-0° 50'$ to $-7\frac{1}{2}°$, comprehending the triangular area limited by the stars ζ, 49, and υ in decl., and in A. R. extending from 79° to near 84°:§ that is, through $6\frac{1}{2}°$ in declination and 5° in right ascension. Thus, all this region of the heavens appears to be occupied by a nebulous stratum, and the stars of Orion exhibit in the spectroscope an exceptional tint of green with a faint shade of red—an appearance which may be what is called accidental, or may be owing to the transmission of their light through this mass of decidedly green color. It is an interesting question whether the singular narrowness of the line F in these stars may not perhaps be owing to the superposition upon it of an equal bright line belonging to the nebulous substance. This seems extremely probable.

It is said that around the star θ', which is composed of four beautiful small stars forming the famous Trapezium, and two others exceedingly minute in the neighborhood, the nebulosity does not exist. The exactness of this statement may be doubted. There is certainly a cloudiness there, but, on account of the vivid light of the stars themselves, it is exceedingly faint. The idea that the nebula fails here because of having been condensed into stars has not a sufficiently solid foundation. A brilliant star, by eclipsing the nebula, makes it often disappear, as actually happened to the nebula in Argo when the star η was of the 1st magnitude, but now that the star has dwindled to the 9th, the nebula is well marked. It is also said that the nebula in Orion is subject to sudden changes; but as all such opinions have hitherto been founded on observations made with the imperfect instruments of other times, we can regard nothing of this as certain. Inasmuch, on the other hand, as the more recent and more powerful in-

* In order to fix the position of these lines, the following method (given in our memoir) is employed: The position of the micrometer having been fixed in the night, with the micrometer thread on the line (b) of the nebula, it is left untouched till morning, when it is found that, on the solar spectrum, (b) corresponds to F; the principal line (a) falls near a strong dark line near the middle of the interval between b and F; but the line of the nebula is a little to the left, toward b, and does not coincide with this; it is apparently a line of azote. The fine line (c) is at about one-fifth of the interval between *a* and (*b*) of the nebula.

† See Fig. 4, art. NEBULÆ, for this object.
‡ See Fig. 1, art. NEBULÆ, for this object.
§ See *Mem. Osserv. Coll. Rom.*, 1852-53.

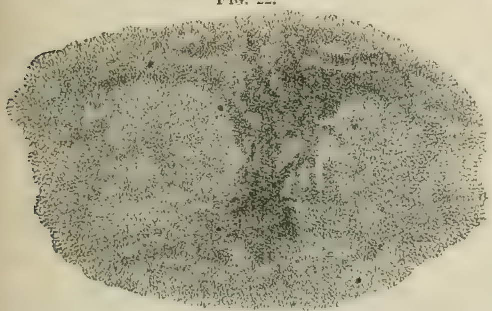
struments render visible divers features which escaped the feebler, there is in this fact a sufficient explanation of all the suspected changes. Even now the designs of Lord Rosse and of Struve very little resemble our own or that of Herschel.

Among the irregular nebulæ visible in middle northern latitude should be ranked the nebula in Sagittarius (3722 C. G. H.) in A. R. 17*h.* 54*m.*, Decl. $-24°$ 21′; this also gives the bright lines of the nebular spectrum. The same is true of many other nebulæ drawn by Herschel during his observations at the Cape; as, for instance, that in A. R. 18*h.* 11*m.*, Decl. $-16°$ 15′. Finally, many regions of the Milky Way, in Sagittarius, give all the lines of the brighter nebulæ in the same quarter.

Another nebula of not less importance is that which surrounds η Argûs in the southern hemisphere, in A. R. 10*h.* 39*m.*, Decl. $-56°$ 47′. It is very singular, having a large vacant space in form of a lemniscate, of which it is very difficult to form a theory. A change has been suspected in this nebula also, but the varying appearances supposed to have been hitherto observed, may probably have been due to the varieties of instruments employed, and, as just remarked, to the variations of the stars immersed in the nebula.

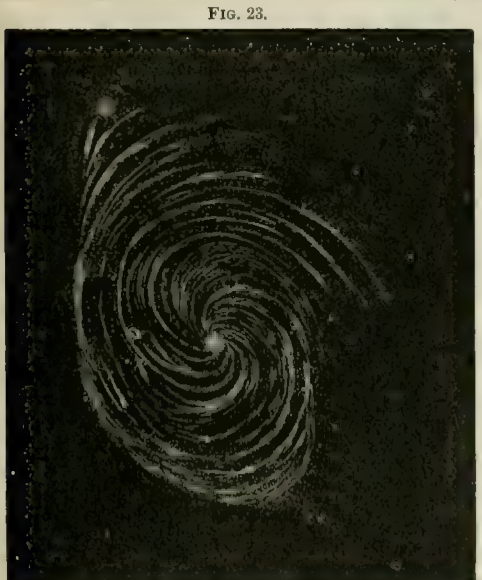
There are several other irregular nebulæ in the heavens which were designed by Herschel. One of the most important is that of Vulpecula (Fig. 22), called by the English the Dumb-bell Nebula, and another is that of Canes Venatici (Fig. 23). In this last is manifested a spiral structure; and a similar configuration has been found, under the scrutiny of the powerful instruments of Lord Rosse, to be repeated in other nebulæ also.

Fig. 22.



The Dumb-bell Nebula.
A. R. = 10*h.* 52*m.*; D. = $+2°$ 17′.

Fig. 23.

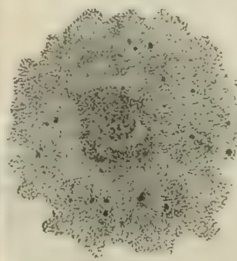


The Spiral Nebula 51 M Canum Venaticorum (*Earl of Rosse*).

This structure calls to mind the power of the central force which may tend to unite in one single stellar centre the diffused masses of gas, and may suggest ideas of cosmology analogous to those thrown out by Kant, Herschel, and Laplace, who suppose the stars to have been formed by the condensation of nebular matter. The nebula just mentioned does not show in our instruments the spectral lines of the gases. If this is not the fault of the instruments (a point which deserves verification), it would prove that the mass is at quite a low temperature.

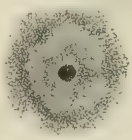
The idea of a progressive condensation receives support from the nebulous stars. This is the name given to the stars which are clothed with a nebulous atmosphere. Such is the object in A. R. 19*h.* 40*m.*, Decl. $+50°$ 6′ (Fig. 24), which gives, in addition to a spectrum consisting of a zone sensibly continuous, the bright lines proper to the nebular spectrum: the star is still surrounded by a part of the vapor of which it was formed. Another of the kind is in A. R. 7*h.* 19*m.*, Decl. $+21°$ 15′ (Fig. 25), and another still in A. R. 10*h.* 0*m.*, Decl. $-39°$ 36′ (Fig. 26). There are also double and triple nebulæ, as in Figs. 27 and 28, but it is extremely difficult to make exact measures of them.

Fig. 24.



A. R. = 19*h.* 40*m.*;
D. = $+50°$ 6′.

Fig. 25.



A. R. = 7*h.* 19*m.*;
D. = $+21°$ 15′.

Fig. 26.

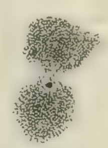
A. R. = 10*h.* 0*m.*;
D. = $-39°$ 36′.

One of the matters of greatest importance connected with this subject is the study of the distribution of the nebulæ. Herschel II., in his observations at the Cape, gave a statistical statement of the number of these objects in different parts of the heavens. From the study made by him of this distribution, he found that, in the northern hemisphere the richest region is in the Virgin, in Coma Berenices, and in Pisces. This region has its largest density near the pole of the Galaxy—so much so that, putting this zone at the horizon of the celestial globe, the swarm of nebulæ spreads out like a pavilion, having its summit in the pole and its base in the galactic circle. In the southern hemisphere, the distribution is less graphically marked, but it also continues there, and the zone of greatest abundance approaches the northern nebular region of the Fishes. In this distribution there is no trace of a decided band as in the Milky Way, but we recognize only centres of superior density. The chart below (Fig. 29), reduced from the work of Proctor, presents it to the eye.

Fig. 27.

A. R. = 7*h.* 35*m.*;
D. = $-17°$ 49′.

Fig. 28.



A. R. = 7*h.* 15*m.*;
D. = $-29°$ 49′.

It is singular that, while the elliptic nebulæ are disposed by preference around the pole of the Milky Way, the irregular nebulæ, on the other hand, are found on the border of that zone or very near it. We may also say that many regions of the Milky Way itself are positively nebulous. From this it is obvious that the elliptic nebulæ form a class independent of the Milky Way.

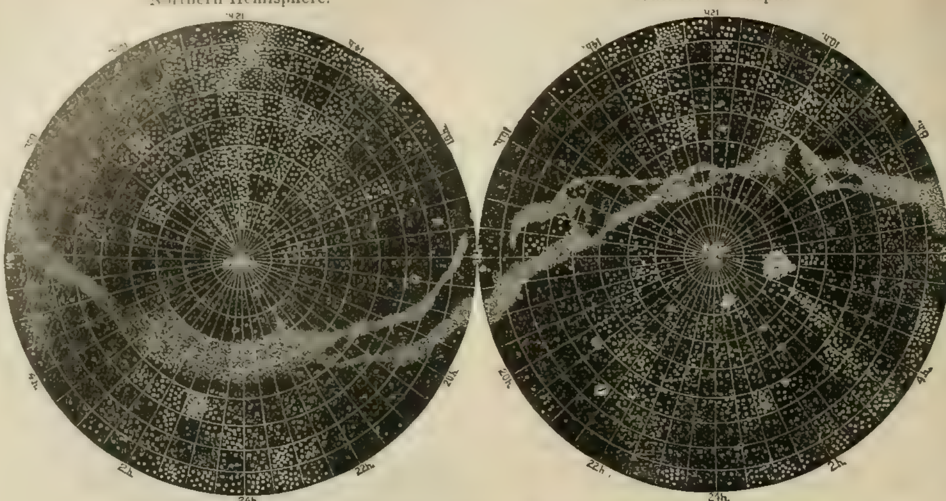
We cannot, nevertheless, place in this category the Magellanic Clouds, in which immensely vast masses are resolved into stars and into extremely minute nebulæ, forming a gigantic and marvellous group entirely isolated, and having an extent which defies our utmost conception.

It is a thing worthy of observation that, in the elliptic nebulæ, the eccentricity of the strata goes on diminishing, till nuclei are at length reached very nearly spherical. This fact is certainly connected with an important principle of theoretic mechanics wholly different from that which rules in globular systems, and makes, moreover, a contrast with the annular systems, still more striking.

It was for a long time said that the Via Lactea is only one of the nebulæ, but the gaseous nature of these and the stellar structure of the former will no longer admit so sweeping or rigorous a parallel. Still, as in many of the bright regions of this zone, analyzed by the spectroscope, we have found traces of bright lines, there are possibly here vast masses of uncondensed nebulous matter yet existing. But for studies of this difficulty an instrument such as ours is perhaps too feeble. Let us hope that these researches will be continued, as they deserve to be, with sufficient means, by others; this being the criterion so much desired by Sir John Herschel for distinguishing with certainty the gaseous nebulæ from those possibly stellar or composed of condensed matter, such as are our clouds in relation to watery vapor. The globular clusters, not exhibiting any trace of bright spectral lines, remain in the

FIG. 29.

Northern Hemisphere. Southern Hemisphere.



Distribution of the Nebulæ.—The Northern and Southern Nebulæ.

category of stars: an exception may perhaps be made of the planetary nebula of the Dolphin, in which are seen a lucid point, and a diffuse brightness which present a rudimental appearance of a monochromatic zone.

It is still a great question, as we have already intimated, whether the nebulæ have varied in aspect. The solution of this doubt is difficult. Between two observers, making sketches of the same object upon the same night, and with the same instrument, there are still very great differences. It is no marvel, therefore, that designs should fail to agree, when time and place and person and instrument all differ. Many variations may be due to variations of neighboring stars. Thus, for example, while η Argûs was most brilliant and of the first magnitude, it appeared free from nebulosity. (*J. Herschel, Cape Obs.*, pp. 36–37.) It is now, having dwindled to the 4th magnitude, seen without difficulty to be involved in such a nebulosity. (*Monthly Notices R. A. S.*, 1876.) We have seen that the Trapezium of Orion was supposed to be without a nebulous surrounding, but that the spectroscope has proved this nebula to be even brighter there than elsewhere. The unchangeability of the nebulæ shows upon what a scale in time we must measure the formations of creation, in respect to which, as to duration, geological periods are truly but days.

The distance of none of these masses is yet known, no parallax having been determined of any one of them; and hence it is impossible to assign their magnitude. It is certain that the space filled by some must be immeasurably great, embracing not merely limited localities, but vast regions in the heavens, since those of Orion, of Argo, and of Andromeda occupy several entire degrees of visible extension; but even limiting ourselves to the smallest and best defined, like the planetary nebulæ above mentioned, which, measuring but a few seconds, are better comparable with our usual scale, the magnitude is beyond conception great. A nebula of this description, though only 26″ in diameter, like that of Sagittarius, or 33″, like that in Hydra, if we allow it a parallax of one second in arc, is comparable only to the orbit of Neptune, which is thirty times greater in diameter than the orbit of the earth. But since so large a parallax as this is not probable, since, on the other hand, it is reasonable to presume that the real parallax is a very great deal smaller, we have dimensions in which our imaginations are utterly lost.

The number of the nebulæ is countless. Herschel discussed 3812 in his statistics, and in the great catalogue published by him in 1864 were included 5079. Since this epoch, not a few others have been discovered at Rome, and several hundred at Marseilles, with the great reflector of ninety centimètres diameter of that observatory. Probably the number will increase with the increasing dimensions of instruments, but all the later discoveries are of objects too faint to promise to future speculators matter of important interest.

This immense labor, due chiefly to the Herschel family, has been completed in a little less than a century.* But to the name of Herschel must be added those of Lacaille and Messier among earlier observers, and among the recent, those of Rosse, Lassell, De la Rue, Bond, D'Arrest, Huggins, and perhaps others. And from the list of these famous observers, some of whom were themselves splendid artisans, ought not to be omitted the hardly less famous names of the artisans proper, such as those of Merz, Cook, Secretan, Cauchoix, Clark, Grubb, and others similarly honorable. The work of this century remains a testimony to the activity of the generations of the present, and an incitement to the emulation of those which are to follow; for whom it is reserved to fathom all those difficult problems, which, being functions of the time, no assiduity and no skill on the part of observers, but the lapse of ages only, can suffice to resolve.

Furling now our sails after the course by no means brief which we have run through the celestial spaces, we may here sum up in conclusion the principal results. (The conclusion here referred to will be found under the title UNIVERSE later in this volume.) P. A. SECCHI.

Translated by F. A. P. Barnard.

Star'stone, a variety of sapphire, the *asteria* of Pliny and the ancients, is found in Ceylon, and presents, when cut *en cabochon*, or in a hemispherical form, and viewed in a direction perpendicular to the axis, a peculiar reflection of light in the form of a star.

Starüi-Büchow, town of Russia, government of Vilna, on the Dnieper, has six churches, several good educational and benevolent institutions, and extensive manufactures. P. 6901.

Starüi-Asskol, town of Russia, government of Koorsk, on the Asskol, has a normal school and a theological seminary. The vicinity is famous for its rich orchards. P. 7029.

Starvation. See APPENDIX.

Stass'furt, town of the Prussian province of Saxony, on the Bode, is noted for the immense layer of rock-salt in its vicinity, which was discovered in 1837 at a depth of 826 feet, and with a thickness of about 1000 feet. A shaft was finally opened, and steam-engines applied to operate the mine in 1852. The produce amounted in 1856 to 15,480 cwts.; in 1860, to 666,480; in 1864, to 2,071,880; and the mine is now one of the largest in the world. The town had 4785 inhabitants in 1864, and 10,327 in 1871. (See the descriptions by Bischof (Halle, 1864) and by Rheinwart (Dresden, 1871).)

Staszow, town of Russian Poland, government of Radom, on the Czarna, has manufactures of paper, iron goods, and copper ware. P. about 5000, of which many are Jews.

State, by PRES. T. D. WOOLSEY. See APPENDIX.

State'burg, p.-v. and tp., Sumter co., S. C., on Camden branch of Wilmington Columbia and Augusta R. R. P. 2095.

State Centre, p.-v. and tp., Marshall co., Ia., on Iowa division of Chicago and North-western R. R., in an agricultural and stock-raising region, has 1 weekly newspaper. P. of v. 559; of tp. 1076.

State Line, p.-v., Mound tp., Warren co., Ind., on Toledo Wabash and Western R. R.

State Medicine. See SANITARY SCIENCE, by PORTER C. BLISS, A. M.

*Messier published a catalogue of 45 nebulæ in 1771; his second and third, published in the *Connaissance des Temps* for 1783 and 1784, contained 103.

Stat'en Isl'and [named by the Dutch in honor of the States General], the island which constitutes nearly all of Richmond co., N. Y., is bounded on the E. by New York harbor, New York Bay, and the Narrows, N. by the Kill van Kull, W. by Staten Island Sound, and S. S. E. by Raritan Bay and the Lower Bay of New York. It is 14 miles long, and greatest breadth 8 miles. Area, 58½ sq. m. The island abounds in pleasant scenery, and has many fine residences. It is traversed by Staten Island R. R., and is connected with New York by lines of ferry-boats. (See Richmond co., N. Y.)

Stat'enville, p.-v., cap. of Echols co., Ga., on Atlantic and Gulf R. R. P. 61.

State Public School for Dependent Children, of Michigan was organized by an act (of which the writer was in the senate the author) of the legislature at its session in 1871. It is a part of the common-school system of that State, for which Michigan is so well and favorably known. It is maintained by the State. It is not a penal or reformatory institution, an orphan asylum, or an almshouse; but only for children of sound mind and body, between four and sixteen years of age, that are dependent on the public for support. It is the only one of the kind existing under any government. Others, in some respects similar, receive criminal children from the courts, thus tainting all alike with crime. This has a twofold character, uniting the humanities and economies. First, it is a home and school for the children of the poor, and poverty alone is the price of admission. Second, it is a merciful agency, by which the State becomes the guardian of its dependent children, and restores them to society and a permanent home under parental influences. Heretofore, these children, as they now are in other States, were maintained in the county poorhouses, which places were unfit for innocent children by reason of the necessary association with the adult diseased, idiotic, insane, and immoral inmates of a very low mental, physical, and moral type. There were in these poorhouses no means of classification of inmates or separation in apartments, no educational influences, and hence all the surroundings injuriously affected the impressible child, and it very early learned its first lessons in crime. This course tended to make the child, as the adults around it, also a pauper, and then a criminal, thus propagating, increasing, and perpetuating those classes. The merit of the Michigan system, aside from its humanity, lies largely in its preventive effects. Heretofore, this State had (as other governments yet do) delayed action until these children became criminal, and then erected for them extensive reformatories, workhouses, prisons disguised by the name of industrials, and in them began the always difficult and questionable work of reformation, when early preventive work would have been uniformly successful and far less expensive. All the arguments that have been given to the world as to the education of children might be repeated here, with even more forcible application in reference to these young dependents of society and wards of the State.

This institution is located just outside of the beautiful city of Coldwater, on an eminence overlooking the surrounding country. The buildings are on the cottage plan, the central being used for the superintendent's residence, employés' dormitories, offices, for school-rooms, for cooking, dining, sewing, and other industrial purposes. The cottages are for the homes of the children, there being 8 at present, with about 30 inmates each, making the capacity of the school 240. This can be increased to 400 or 500 by adding other cottages only. Over each of these homes presides a lady cottage-manager, whose duties are very similar to those of a mother with a smaller family, except that the cooking, dining, washing, etc., are done as in other large public institutions. The children attend school in the school-rooms in the wings of the main building, where they are taught the common English branches. Those of proper age are taught how to work—the boys on the farm (of 41 acres) and in the garden, to make shoes, caps, and their own clothing, etc.; the girls to make their clothing, do housework, etc. The proficiency of these children in the schools, in their work, and in their general conduct and appearance after they have been there a few months will bear very favorable comparison with that of those who attend our common schools. Their moral culture has proper attention, as required by law, and religious services are held Sunday forenoons and afternoons, conducted by the superintendent, assisted by ladies and gentlemen of the city from different denominations. The children are sent to the institution by superintendents of the poor of the several counties (a board of three members in each), who take the child claimed to be dependent to the judge of probate of the proper county, who hears the testimony, and in case he decides the child to be dependent, it is sent here with a copy of such evidence and decision, which forms the basis of the history of the child, kept on record at the school. The second prominent characteristic is that of providing homes. It is made the special duty of the board to find homes as fast as practicable, giving room in this way for others. The board has authority to appoint an agent to attend to this work. Also, there is an agent in each principal county, appointed by the governor, charged with the duty of finding homes and afterward supervising their condition. All indentures have a clause reserving the right to take back a child when in the opinion of the board it is for the interest of the child to do so. No child can be placed in any home unless the State agent certifies it to be a proper one. The whole career of the child is carefully watched over during its minority, and all of its interests jealously protected by its guardian, the State.

State Public School, Coldwater, Mich.

This new charity is in charge of a board of control of three members appointed by the governor and confirmed by the senate for a term of six years each. This board has quite full and discretionary powers. It establishes a system of government, employs all officers, managers, teachers, etc., and fixes their salaries by approval of the governor. The administration of the ordinary affairs is in the hands of the resident superintendent, who is delegated large discretionary authority by the board, and in whom is principally the responsibility of success. Most of the employés reside in the institution.

This school for the children of the poor was opened in May, 1873. It has now about 250 inmates. It has already placed over 100 dependent children in excellent homes under contracts ensuring them "good treatment as a member of the family," and three months each year in the district school, and to be taught the occupation of the guardian. So far the execution of the scheme has been satisfactorily successful in the opinion of the legislature and the people, with whom it appears to be one of our most popular State institutions; and of it our present popular governor, John J. Bagley, says in one of his messages, "This institution will in its results accomplish much, if not more real good than any other yet founded by the State."

C. D. Randall.

State Rights. See Sovereignty, by Pres. T. D. Woolsey, S. T. D., LL.D.

States'borough, p.-v., cap. of Bulloch co., Ga. P. [illegible].

State's Evidence. This phrase is not a technical term of the law, but is popularly used to describe the evi-

dence of an accomplice, generally given under an arrangement made with the officer representing the state that the witness so testifying shall not himself be prosecuted for the crime of which he confesses himself to be guilty while he is disclosing the guilt of the party on trial. Hence comes the very common but very inaccurate expression as applied to a person, "to turn state's evidence," or "he turned state's evidence." One who is *particeps criminis* with another in the commission of a crime, either as a principal or as an accessory, is an accomplice, although this designation is usually given to such a confederate when he is permitted to appear and testify on behalf of the state against his associates. It is often necessary, in order that the ends of justice may not be defeated, that one of several criminals, whether indicted jointly with the others, or indicted separately, or perhaps not indicted at all, should be procured or suffered by the prosecution to become a witness for the state, and to testify on the trial of his fellows, although his evidence may show himself to be guilty of the same offence or of some other one. When this is done, there is generally a tacit understanding or an express agreement with the prosecuting officer that the person whose disclosures are thus used on behalf of the public shall not be brought to trial and conviction. When and with whom such an arrangement shall be made rests on the sound discretion of the officer who represents the people, and largely depends upon the exigencies of each particular case. The evidence given under such circumstances is of course very suspicious, and it has even been said that as a matter of law no conviction can be had upon the uncorroborated testimony of an accomplice. The better doctrine, however, is, that this is a rule not of the law, but of practice and of expediency. A jury has the power to convict upon such evidence, and their verdict could not be set aside as illegal. The judge should always instruct the jury that the testimony of an accomplice is to be most carefully scrutinized, and that, unless confirmed in material points by other and reliable evidence, a conviction upon it is inexpedient—that the corroboration should extend not merely to the circumstances of the crime itself, but also to the participation therein by the accused who is on trial. Still, such instructions are rather in the nature of advice than of direction or command, and they may therefore be disregarded. JOHN NORTON POMEROY.

States General. See ESTATES, THE THREE.

States of the Church. See PAPAL STATES.

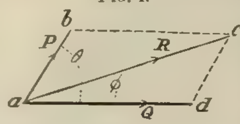
States'ville, p.-v. and tp., cap. of Iredell co., N. C., on Western North Carolina R. R., at N. terminus of Atlantic Tennessee and Ohio R. R., has an active trade and 2 weekly newspapers. P. of v. 644; of tp. 1656.

Statice. See MARSH ROSEMARY.

Statics [Gr. στατική] is that branch of mechanics which treats of the properties and relations of forces in equilibrium: and by equilibrium it is meant that the forces are in perfect balance, so that the body upon which they act is in a state of rest. According to the classification presented in most textbooks on the subject, and which, in fact, is now employed by many English writers, the word "statics" is used in opposition to "dynamics," the former being the science of equilibrium or rest, the latter of motion, and both together constituting mechanics. The influence of French literature has, however, produced among recent writers a tendency to a stricter and better use of these words. In this new classification the word "mechanics" is used in a more extended sense, as expressing not only the theory of force and motion, but its applications to the arts; the portion of this which may be regarded as pure science is then divided into kinematics and dynamics, the former being the pure geometrical theory of motion independent of notions of force and matter, and the latter the theory of forces as acting upon and producing either the rest or motion of bodies. The word "dynamics" is thus employed nearly in its etymological sense, as expressing the science which treats of the laws of force or power (corresponding closely to the old use of the word "mechanics"), and it is divided into statics and kinetics, the one being the science which treats of forces considered as producing rest, and the other as producing motion.

In statics, forces are measured by the pressures that they will produce, and for convenience the unit of pressure is a certain effect of the force of gravitation as indicated by a spring balance (not by a steelyard or scales) acted upon at London or some other assigned place by a definite quantity of matter. Thus, the unit may be the pressure called an ounce, a pound, or a kilogram, as may be agreed upon beforehand. In the discussions of statics it is convenient to represent forces by lines, the lengths of the lines being proportional to the intensities of the forces, their directions parallel to the directions of the forces, and their ends denoting the points of application of the forces. By such a representation we form a geometrical figure, and by reasoning upon the properties of its lines we arrive at the properties and relations of the forces themselves. The resultant of two or more forces is a single force, which produces the same effect as the several forces acting together.

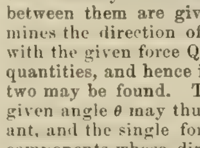
FIG. 1.



The components of a single force are forces whose united action produces the same effect as the single one. The process of combining forces into a resultant is called composition, and that of separating a single force into components is called resolution. These processes are effected by means of the principle of the parallelogram of forces, which is thus stated: If two forces P and Q acting upon the material point a are represented in intensity and direction by the lines $a\,b$ and $a\,d$, their resultant R will be represented in intensity and direction by the diagonal $a\,c$ of the parallelogram $a\,b\,c\,d$ constructed upon the two given sides. Since the relations between the forces P, Q, and R are the same as between the corresponding lines in the parallelogram, we have the equations $R^2 = P^2 + Q^2 + 2PQ\cos\theta$ and $\cos\phi = \dfrac{R^2 + Q^2 - P^2}{2\,P\,Q}$; the first of which determines the intensity of R when P, Q, and the angle θ included between them are given, and the second of which determines the direction of R, or the angle ϕ which it makes with the given force Q. These two equations contain five quantities, and hence if three of them are given, the other two may be found. The two forces P and Q acting at a given angle θ may thus be compounded into their resultant, and the single force R may be resolved into any two components whose directions are given. If the resultant R act as represented in the figure from a toward c, it will replace the two forces P and Q; if it be taken as acting from c toward a, it will hold them in equilibrium.

Another fundamental law of the greatest importance, and upon which, indeed, the whole science may be based, is the principle of moments. By the moment of a force with reference to a point is meant the product of the intensity of the force by the perpendicular distance from the point to the direction of the force; which distance is usually called the lever-arm of the force. The moment of a force, or the product of the force and its lever-arm, is thus a measure of the tendency of the force to cause rotation around the given point or centre of moments. Now, the principle of moments is, that if any number of forces are in equilibrium, the algebraic sum of the moments of all the forces with reference to *any* point must be equal to zero. Thus, if three forces P, Q, and R acting at the point O be in equilibrium or balance, and if from any point c the perpendiculars p, q, and r be drawn to the lines of direction of P, Q, and R, we must have $P_p + Q_q + R_r = 0$, which is

FIG. 2.



merely the expression of the condition implied in the word equilibrium—viz. that the three forces have no tendency to cause rotation about the point c. It must here be understood that a moment may be positive or negative according as its force tends to turn the system in a right- or left-handed direction around the chosen centre. Bearing in mind the meaning of the word "resultant," it follows that the moment of a resultant is equal to the sum of the moments of its components. The principle of moments furnishes, then, also a means for the composition and resolution of forces and the discussion of statical problems.

The conditions of equilibrium of any number of forces acting upon a body are now evident. If the body is at rest, and the forces in perfect balance, there will be no tendency to a motion of translation or to one of rotation. The condition necessary for the first is that the resultant of all the forces shall be zero, and for the second that the algebraic sum of the moments of all the forces about any point shall be zero. These, together, are the necessary and sufficient conditions of equilibrium; the first alone is not sufficient, for a couple may result; and the second alone is not sufficient, for the centre of moments may be chosen on the line of direction of the resultant.

The whole science of statics is but little more than the development and exemplification of the consequences of the above principles. The common textbooks on the subject, after having established and illustrated these fundamental principles, proceed to the consideration of parallel forces and to the determination of centres of gravity and moments of inertia of bodies, after which the equilibrium of forces acting through the cord, lever, pulley, inclined plane, and screw, of which all machines are compounded, is discussed, both in its simplest theoretic conception and as

modified by the forces of friction and cohesion. The laws of the equilibrium of gases (aërostatics) and of liquids (hydrostatics), with their applications to the barometer, pump, and hydrostatic press, are then developed and illustrated. The treatment of these questions in the elementary textbooks exhibits, however, only the first principles, and forms merely the introduction to the science, whose complete development in its several departments must be sought for in special and technical treatises. Among these, where experiment lends its aid to theory by determining the necessary constants for the full discussion and application of the laws of friction, elasticity, and tension, we may mention the theory of the equilibrium of arches and bridges, the theory of the flexure of elastic bodies, the theory of the strength of materials subject to forces of tension, compression, shearing, or torsion, the theory of the tension of fluids and the statics of molecules, each of which may indeed be considered as a science in itself. Within the limits of such an article as this a specific account of even one of the least extended departments of statics would be in fact impossible.

The forces which come under consideration in statical investigations are all the forces of nature which can be measured by pressures. As to their origin, they may be forces of gravitation, of molecular attraction and repulsion, of friction, or of muscular strength. If the equilibrium of a system of forces is disturbed, motion ensues, and statics passes into kinetics. The very disturbance of equilibrium calls, however, into action the resistance of inertia. And we take occasion here to remark that by the consideration of this resistance as a force the laws of statics become applicable, even though the body be not at rest. For by the principle of D'Alembert (which is nothing more than a particular case of Newton's third law of motion) the resistance of the inertia of a body at any instant of its motion is equal and opposite to the resultant of all the exterior forces acting upon it. Hence, regarding inertia as a force, all the forces acting upon a moving body at any instant are in equilibrium, and the principles of statics suffice for their discussion. It thus appears that statics is but a special case of kinetics, and that the law of D'Alembert furnishes the means of passing from one to the other.

With reference to the mode of reasoning and the character of the processes involved, we may distinguish analytical statics and synthetical statics, belonging to the latter of which is graphical statics, a young and growing science of particular value to the civil engineering profession.

Analytical Statics is the method of treating the subject by analytical or deductive reasoning, in which the mind seeks to refer complicated phenomena to their fundamental laws, and then from those general laws and conditions to deduce special properties and results. This kind of reasoning is usually best pursued by the use of algebraic symbols and processes, although it must be distinctly borne in mind that these do not form an indispensable part of the method itself. The following example, taken from the theory of flexure, will serve to illustrate the analytical mode of reasoning: Let a straight plank or beam of uniform thickness throughout be laid upon three supports in the same horizontal plane, one of them being at its centre and the others at its ends. What portion of its weight is borne by each support? The weight borne by each support must, from the fundamental conditions of equilibrium, be opposed by the equal and opposite reactions of the supports; and of these the two end ones are equal, and the centre one equal to the difference between their sum and the total load. The solution of the problem begins by the consideration of the consequences of the fundamental conditions of statical equilibrium. Regarding one of the end supports, those conditions affirm that the upward reaction is equal and opposite to the molecular shearing force in a section directly over that support. And, generally, at any section the algebraic sum of the vertical forces must vanish. Hence, taking the end support as an origin, we have for any section, distant x from it, $dS = wdx$, S being the shearing force at the section, and w the weight of the beam per linear unit. To apply this to our problem, we seek the value of S, which we determine in terms of the moment M at the same section, or $Sdx = dM$. Again, we have to find M; and this we do by considering the curve of deflection formed by the bent beam, which depends upon its form or moment of inertia I, and the properties of its material as expressed by the coefficient of elasticity E. Upon the hypothesis that the deflection is slight, the curvature at any point whose co-ordinates are x and y is $\frac{d^2y}{dx^2}$, and we find $\mathrm{EI}\frac{d^2y}{dx^2} = \mathrm{M}$. Substituting this in the previous expressions, there result the following equations:

$$\mathrm{EI}\frac{d^4y}{dx^4} = w = \text{uniform load per linear unit;}$$

$$\mathrm{EI}\frac{d^3y}{dx^3} = \mathrm{S} = \text{shearing force at section } x.$$

We have not given the details of the reasoning leading to these results, as we wish not to give an exposition of the theory of flexure, but to exhibit the general character of analytical processes. Starting from the fundamental conditions of equilibrium, we found first $dS = wdx$ for the particular case of beams uniformly loaded, but as this included an unknown element S, we had to determine it also; and this led to the differential equation expressing the dependence of the moment upon the curvature of the beam, its form, and its material. We have thus arrived at the general laws given above, which are applicable to all beams uniformly loaded, whatever be the number of supports. Integrating the first expression four times successively, we obtain

$$\mathrm{EI}y = \frac{wx^4}{24} + \frac{\mathrm{C}x^3}{6} + \frac{\mathrm{C}'x^2}{2} + \mathrm{C}''x + \mathrm{C}''',$$

in which C, C′, C″, and C‴ are the constants of integration which determine the curve of deflection for any particular case. For the beam under consideration these are found by the conditions that for $x = 0$, $\frac{d^2y}{dx^2} = 0$; and that for $x = l$ (l being the distance between the supports) $\frac{dy}{dx} = 0$, which gives $\mathrm{C} = -\frac{3}{8}wl$, $\mathrm{C}' = 0$, $\mathrm{C}'' = \frac{wl^3}{48}$, and $\mathrm{C}''' = 0$. Accordingly, for the shearing force at any section x—

$$\mathrm{S} = \mathrm{EI}\frac{d^3y}{dx^3} = wx + \mathrm{C} = wx - \tfrac{3}{8}wl;$$

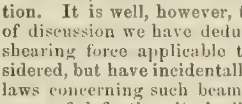
and when $x = 0$, this becomes $\mathrm{S} = -\frac{3}{8}wl$, which is equal and opposite to the reaction at the end support. Hence, the three reactions are $\frac{3}{8}wl$, $\frac{10}{8}wl$, and $\frac{3}{8}wl$, whose sum is $2wl$, the total weight of the beam. Thus, having referred our special problem back to the general laws of flexure, we have by a discussion of those laws arrived at its solution. It is well, however, to remark that by this method of discussion we have deduced not only a general law of shearing force applicable to all beams of the class considered, but have incidentally determined a variety of other laws concerning such beams, such as the equation of the curve of deflection, its inclination to the line joining the two supports, its curvature, and the moment of flexure at any point.

Even with questions involving merely numerical data the analytical mode of reasoning is usually followed in a general form. The particular question in hand is solved; and not only this, but the fundamental laws governing all problems of the same class are discovered. It is in the generality of its conclusions, rather than in the generality of its methods, that the power of analysis lies.

Graphical Statics.—The synthetical mode of reasoning is that in which the mind starts from the simplest of admitted truths, and from these ascends by comparison and composition to complex relations and properties. Graphical statics, which uses mainly this kind of reasoning for the establishment of its processes, is a method of solving statical problems by means of simple geometric constructions. The forces are represented by lines drawn to scale, and by operating upon them the draftsman deduces other lines which furnish the solution of the particular problem before him.

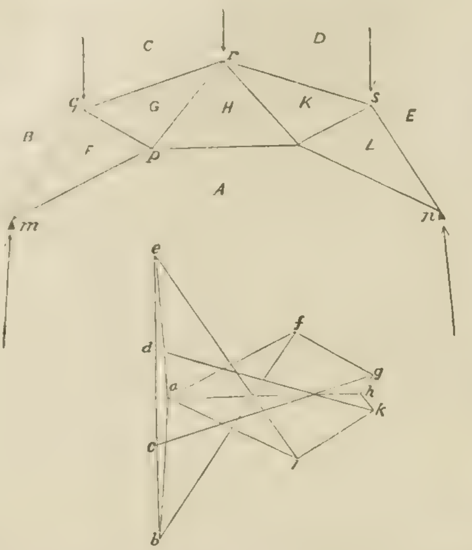
The principle of the parallelogram of forces forms the starting-point of the science. The resultant R of the forces P and Q being represented in direction and intensity by the diagonal $a\,c$ of the parallelogram $a\,b\,c\,d$, it is evident that the directions and intensities of the three forces are shown by the sides of the triangle $a\,b\,c$, $a\,b$ being equal and parallel to P, $b\,c$ to Q, and $a\,c$ to R; and if we follow around that triangle in the direction from a to b, b to c, and c to a, the direction of each force thus obtained is that necessary for equilibrium. Hence arises the principle of the triangle of forces, which is readily extended to include any number under the name of the polygon of forces, and which may be thus stated: If any number of forces are in equilibrium, a closed polygon may be formed whose sides are parallel and equal to the several forces; and if, starting with any force, we follow around this polygon, the direction thus obtained for each of the others will be the direction required for equilibrium. By this principle we may readily perform the graphical resolution and composition of forces, and

Fig. 3.



solve a great variety of practical statical problems. For example, in the annexed sketch there is given a framed roof truss, held at rest by five external forces—viz. three

FIG. 4.



equal weights acting downward at the points q, r, and s, and two equal reactions acting upward at the supports m and n. These forces, being in equilibrium, can only preserve that equilibrium by means of other forces or strains transmitted along the various pieces of the truss. It is required to determine these strains. The weight acting at q we designate by B C, that at r by C D, the reaction at m by A B, and so on, each force receiving a name corresponding to the two letters placed on opposite sides of it; in the same way, the pieces of the truss are named, B F being that joining the points m and q, F G that from q to p, and so on. We first proceed to form the force polygon for the weights and reactions by drawing $b\,a$ equal and parallel to B A, $a\,e$ to A E, $e\,d$ to E D, $d\,c$ to D C, and $c\,b$ to C B, thus obtaining the closed figure $a\,e\,d\,c\,b\,a$ to represent the equilibrium of the given exterior forces. The process for finding the strains is then as follows: Beginning at the point m, we have three forces in equilibrium, the reaction $a\,b$ and the unknown strains in A F and B F, whose directions, however, are given; and these, being in equilibrium, will be represented by the sides of a triangle formed by drawing $a\,f$ parallel to A F and $b\,f$ parallel to B F, which with $a\,b$ constitute the force triangle $a\,b\,f$. Measuring, then, $a\,f$ and $b\,f$ by the same scale with which $a\,b$ was laid off, we have the intensities of the two forces in A F and B F; and following around the triangle in the direction indicated by the given reaction, we find the first to be tension and the second compression. Passing next to the point q, we have there acting four forces, of which B F and B C are known and represented in the strain diagram by $b\,f$ and $b\,c$; hence, drawing from c and f lines parallel to C G and F G, we form the force polygon $c\,b\,f\,g\,c$ for the forces meeting at q, and thus determine the strains $c\,g$ and $f\,g$. Again passing to q, we find two known forces $a\,f$ and $f\,g$, and by drawing parallels to A H and G H, we determine the polygon $a\,f\,g\,h\,a$, in which $a\,h$ and $g\,h$ are the two unknown forces or strains. Then passing to r, we construct in like manner the force polygon $d\,c\,g\,h\,k\,d$ for that point, and thus continuing produce a diagram in which every line is parallel to its corresponding one in the truss. The two figures are, as will be noticed, reciprocal ones, the strains represented by the lines meeting at any point, as k, being those which exist in the pieces surrounding the space K. The relations of the various forces are thus clearly shown to the eye, the strains are readily found by measurement, their character determined by following around the polygons as noticed above, while the symmetry of the figure furnishes checks upon the accuracy of the work.

The system of diagramming thus briefly indicated for a roof-truss is entirely general, and may be applied to all framed structures acted upon by known exterior forces. It furnishes a system or routine by which the designer may readily, with drawing board and tools, determine the strains arising in any particular case. Another principle of great importance is that of the equilibrium polygon, which is the polygon or curve that a cord will assume when solicited by forces acting at various angles, a particular case of which is the catenary curve of a suspension cable. The properties of this polygon furnish numerous elegant graphical methods for the determination of centres of gravity and moments of inertia of bodies, as also the discussion of the stability of arches, beams, and bridges. For these it furnishes general methods applicable alike to all problems of the same class, however great be the variation in size or shape of the bodies or in magnitude and direction of the forces.

By analytical methods we not only deduce general laws and relations concerning the objects of our investigation, but also arrive at general solutions—solutions which formulate laws concerning all problems of the same class. Graphical methods, on the other hand, furnish no general laws or solutions, but for the investigation of a certain class of problems afford general processes or systems. Thus, the above question concerning the reactions of the continuous beam whose length is $2l$, and load per linear unit w, cannot be graphically investigated unless there be assigned to l and w numerical values. These being given, they may be laid off to scale upon paper, and the numerical values of the reactions be found by established graphical routines; but these routines do not deduce a single one of the general laws or relations which the analytical process has developed. While the processes of analysis are special, the results derived are general; while the graphical method furnishes general processes, they can only be applied for the deduction of special numerical results. The two methods have, then, but little in common; and the fact that a particular problem, or even that a particular class of problems, may be more easily treated and solved by one than by the other, justifies no attempt to weigh their relative merits. Each is indeed a supplement to the other, and he who is acquainted with both will use the one or the other, or a combination of the two, as the requirements of the special problem in hand, as to generality, accuracy, or quickness, may demand.

The history of the science of statics would in itself require a volume, while our space allows only a brief and imperfect sketch. The first general principle which we find recorded is that of the equilibrium of weights on a lever, which is a special case of the principle of moments. This was discovered by Archimedes (B. C. 287–212), as also its application to the determination of the centres of gravity of plane figures; in his writings also appear the first investigations concerning the equilibrium of bodies floating or immersed in liquids. For 1800 years after his time there was no further advance. The next step was made by Stevinus (1548–1603), who represented the intensity and direction of forces by straight lines, deduced the principle of the resolution of forces in rectangular directions, and investigated the equilibrium of a body resting upon an inclined plane. Next followed the principle of the parallelogram of forces, which, partially implied by the methods of Stevinus, was only completely established by the labors of Galileo (1564–1642), Varignon (1654–1722), and Newton (1642–1727). To Varignon is also due the development of the simpler properties of the force and equilibrium polygons. About the same time the statics of fluids began to receive attention, the first true explanation of their equilibrium being due to Torricelli (1608–47), the inventor of the barometer. The application of these principles has since those days occupied the attention of a host of writers, and in the present century the science has grown to such a vast extent that a mere enumeration of the titles of meritorious works would in itself occupy many pages. The new branch of graphical statics may be said to have been entirely developed since the year 1866, and is due mostly to the labors of Culmann. (For detailed information concerning the early history of the subject the reader may consult the section on mechanics in Whewell's *History of the Inductive Sciences* (London, 1847, and New York, 1859).) MANSFIELD MERRIMAN.

Stations of the Cross, a series of figures or pictures, usually fifteen in number, representing the various stages of the *Via Calvaria*, or of our Lord's Passion on the way to Calvary. They abound in Italy and other Roman Catholic countries, and are arranged along the line of approach to a calvary or central shrine. They are visited in succession for the performance of devotional exercises. This devotion was at first a substitute for the pilgrimage to the Holy Sepulchre.

Statistical Congress, International, a conference of eminent statists representing the statistical departments of most of the European governments, the U. S., Egypt, and various statistical and learned associations, was held at Brussels in 1853. The main purpose of this conference was to effect a uniformity and harmony in the statistical work of nations, so that the results obtained by separate and independent workers in this field might

be easily comparable, and thus made to serve a wider sphere of usefulness. In addition to this, the benefits to be derived from the personal intercourse and exchange of views among the most eminent statists of all countries was not overlooked. The importance of the object to be attained was too apparent not to have been suggested to many minds, but the practical initiation of the movement and its successful accomplishment are undoubtedly due to a few leading statists. The U. S. may justly claim a share of the credit attached to this important work. In May, 1851, Mr. J. C. G. Kennedy, then superintendent of the census, received from the interior department, at his own suggestion, approved by the President and cabinet, a commission to visit the principal governments of Europe for the purpose of recommending to the constituted authorities in charge of statistical work the propriety of adopting, in common with each other and with the U. S., such a system of inquiry and publication as would enable each government to institute comparisons with the others readily and accurately. During the summer of 1851, Mr. Kennedy presented his views to the statistical departments of England, France, Belgium, and Prussia, and sought their co-operation in the work. At the London International Exhibition of that year the need of such harmonizing effort was forcibly illustrated. Some of the leading statists there present, including Quetelet and Visschers of Belgium, Farr, Porter, and Fletcher of England, and Kennedy of the U. S., strongly impressed with the possibility of international co-operation, held numerous conferences in London and Brussels upon the subject. In Sept., 1851, Mr. Adolph Quetelet announced by letter to Mr. Kennedy that they had decided positively on holding a statistical congress after a consideration of his (Kennedy's) ideas and the concurring opinions of the principal statists of different countries. It was to have been held at Brussels in the autumn of 1852, but was postponed to 1853. The intention was to hold these congresses at intervals of two years. They have been held less frequently, principally on account of political disturbances in Europe. To M. Quetelet is due preeminently the credit of executing the project and successfully organizing these congresses. Being a man of liberal views, a scientist as well as statist, occupying the official position of director of the royal observatory and president of the central statistical commission for Belgium, he was enabled to obtain the support and co-operation of the Belgian government, which assumed the initiative and invited other nations to send delegates to the congress. Eight congresses have been held, respectively in Brussels, Paris, Vienna, London, Berlin, Florence, the Hague, and St. Petersburg; the ninth to meet in 1876 at Buda-Pesth, Hungary. Much has been done to systematize and harmonize the statistical work of different nations, and valuable contributions have been made to the general fund of administrative and scientific statistics. The proceedings of each congress, including the discussions of the delegates, the results arrived at, and the papers read, have been published by the respective governments where these congresses have been held. The principal publications are comprised in large quarto volumes of the proceedings, containing from 260 to 800 pages each. Those of the St. Petersburg congress fill three immense volumes. They are usually published in two languages. Besides the regular volumes of proceedings, a volume has been published entitled *International Statistics (Population)*, 4to, 406 pp. (Brussels, 1865); also a volume containing the principal transactions of the first four congresses, 4to, 273 pp. (Berlin, 1863, French), and a similar volume of the first five congresses, 4to, 325 pp. (Florence, 1866, French). The U. S. have been represented in each of these congresses except the third and sixth, and official delegates have been accredited by the government to the fourth, fifth, seventh, and eighth. Judge Longstreet represented the government at the fourth congress, and Mr. Samuel B. Ruggles at the fifth and seventh. Mr. Ruggles's report for the seventh is published in *Ex. Doc. No. 7, Senate, 1871*. In the eighth congress the government was represented by Dr. Edward Young of the treasury department, William Barnes, and Edwin M. Snow, M. D. Their report was published at the government printing-office (1875). Besides the contributions from the official delegates, valuable papers have been furnished by Americans representing scientific and statistical associations, notably those of Mr. E. B. Elliot on "Military Statistics," contained in the Berlin proceedings, of Dr. Jarvis on "Vital Statistics," contained in the London proceedings, and of Mr. Kennedy on the "U. S. Census," in the Paris proceedings.

1st Congress.—Compte-rendu des Travaux du Congrès général de Statistique, réuni à Bruxelles 1853 (4to, Bruxelles, 1853, 260 pp.). *2d Congress.—Compte-rendu de la Deuxième Session du Congrès international de Statistique réuni à Paris 1855* (4to, Paris, 1856, 542 pp.). *3d Congress.—Rechenschafts-bericht über die dritte Versammlung des Internationalen Congresses für Statistique abgehalten zu Wien 1857* (4to, Wien, 1858, 576 pp.); also, an edition published in French (4to, Vienne, 1858, 556 pp.). *4th Congress.—Report of the Proceedings of the Fourth Session of the International Statistical Congress held in London 1860* (in English, with French syllabus, 4to, London, 1861, 548 pp.). *5th Congress.—Rechenschafts-bericht über die fünfte Sitzungsperiod des Internationalen Congresses für Statistik abgehalten zu Berlin 1863*, and *Statistischen Congresses in Berlin* (2 vols. 4to, Berlin, 1865, 250 and 800 pp.). *6th Congress.—Programme* (Florence, 1867, 121 pp.); *Compte-rendu des Travaux de la VIe Session du Congrès international de Statistique réuni à Florence 1867* (4to, Florence, 1868, 650 pp.). *7th Congress.—Projet du Programme* (small 4to, 18 pp.). *8th Congress.—Compte-rendu des Travaux de la VIIIe Session du Congrès international de Statistique réuni à St. Petersbourg 1872* (3 vols., St. Petersburg, 1874, 600, 470, and 603 pp.).—*Compte-rendu général des Travaux du Congrès international de Statistique dans les Séances tenues à Bruxelles 1853, Paris 1855, Vienne 1857, et Londres 1860* (4to, Berlin, 1863, 273 pp.); *Compte-rendu général des Travaux du Congrès international de Statistique dans les Séances tenues à Bruxelles 1853, Paris 1855, Vienne 1857, Londres 1860, et Berlin 1863* (4to, Florence, 1866, 325 pp.); *Statistique internationale (Population)*, (4to, Brussels, 1865, 406 pp.). ALBERT W. PAINE.

Statis'tics, a branch of political science having for its object the collection and classification of facts illustrative of the social, moral, and industrial condition of a people. As a basis for the operations of government, attempts more or less rude to obtain such information have been made in every civilized country from time immemorial, the censuses of the Egyptians, Jews, Greeks, and Romans having been rudimentary efforts in this direction. It is, however, only in comparatively modern times that the great importance of the subject has been appreciated, it having first been recognized as a science by Gottfried Achenwall (1719–72), professor of philosophy at Göttingen, who lectured upon the subject and proposed the name. The fundamental principle enunciated by him was that the laws which govern nature, and especially those affecting the moral and physical condition of mankind, are constant, and may be discovered by the collection and comparison of large masses of data, the accidental diversities neutralizing each other. This principle was still more fully grasped and developed by Von Schlözer at the close of the eighteenth century. The rise of political economy supplied a motive for increased interest in statistics, and from the close of the wars of the French revolution all the leading countries of Europe began to organize statistical bureaus, departments, or commissions. It was from the first correctly recognized that it is the province of government to supply the data for the new science, they being for the most part of such a character as to be inaccessible to private research. The province of the statistician, therefore, consists in deducing from known data their more important results. In England the vigorous growth of the science may be reckoned from the passage of the Reform bill, which was immediately followed by the creation of the statistical department of the board of trade (1832), the formation of a statistical section in the British Association (1833), and of the London Statistical Society (1834). The little kingdom of Belgium, formed in 1830, was fortunate in numbering among its citizens the most distinguished statistician of the century, Lambert Quetelet (1796–1874), who from this time devoted himself almost exclusively to this subject, and the Belgian statistical department, organized in 1841, has ever since been the model for similar offices in other countries. Parliamentary reports embodying vast masses of statistics are now annually published in England, and monthly reports are issued in the U. S. by the bureau of statistics of the treasury department. Societies devoted either wholly or in part to statistics now exist in all the chief European capitals, in New York, Mexico, and Rio de Janeiro; international congresses of statisticians have been held biennially or triennially since the first congress, formed at Brussels in 1853; several periodicals are devoted exclusively to this subject; a statistical seminary was established in Berlin in 1862, and a professorship of statistics founded in the University of Berlin 1874. The most important branch of the subject, VITAL STATISTICS, will be treated in a separate article. The remarkable results deduced from statistics by some non-professional writers, such as the late H. T. Buckle, are well known, but must be received with considerable qualification as to the correctness of the data, which is the weak point in all inquiries in this science. (See STATISTICAL CONGRESS.)

Statius (CÆCILIUS). See CÆCILIUS STATIUS.

Sta'tius (PUBLIUS PAPINIUS), b. about 61 A. D., seems to have acquired early and rapidly a great fame by his

victories in the Alban contests, and then to have lost it again as rapidly after his defeat in the quinquennial contest; but very little is known of his personal life. He lived at one time in Rome and enjoyed the favor of Domitian, but d. about 96 A. D., in retirement at Naples. Juvenal is the only contemporary author who mentions him. For the story that Domitian stabbed him in a fit of anger there is no foundation. Of his works are still extant *Silvarum Libri V.*, a collection of miscellaneous poems; *Thebaidos Libri XII.*, translated into English, the first book by Pope, the first five books by Thomas Stephens (1648), the whole poem by W. L. Lewis (1767); *Achilleidos Libri II.*, unfinished, translated into English by Howard (1660); best editions by Amar and Lemaire (Paris, 4 vols.) and by O. Müller (1870).

Statuary. See SCULPTURE, by CLARENCE COOK. See also ROMAN ARCHÆOLOGY.

Sta′tus [Lat.], a term of the Roman law, borrowed thence by the jurisprudence of continental Europe, denoting the legal condition of a person, or the sum of his capacities and incapacities to hold legal rights or to be subjected to legal duties. The word does not belong to the technical nomenclature of the American and English law, although it is used by some modern text writers in the same general sense in which it was employed by the Roman jurists. In the Roman law there were three grades of status or legal condition, the lower and more general of which might exist without the others, while the higher and more special always presupposed the lesser. The first and most general was that of liberty (*status libertatis*), by virtue of which a person was either a freeman (*liberus*) or a slave (*servus*). The second was that of citizenship (*status civitatis*), by virtue of which a person was either a citizen (*civis*) or a stranger (*peregrinus*). The highest was that of the family (*status familiæ*), by virtue of which a person might be the head of a household (*paterfamilias*) and his own master (*sui juris*), or under the control of another (*alieni juris*), as a son, daughter, wife, ward, and the like. An individual might be a freeman without being a citizen or the head of a household, but he could not be the head of a household without being at the same time a freeman and a citizen. It was possible that a person might lose a higher status, and yet remain in a lower condition; he might cease to be *sui juris*, and still be a citizen; he might forfeit his citizenship, and yet remain free; finally, in the earlier periods of Roman history at least, he might sink from freedom into slavery. Although we have not in our law the technical term *status*, it is plain that to a certain extent we have the facts denoted by it. It is true that at birth a person becomes clothed with the great mass of rights conferred by the law of the U. S., but he may be subjected to certain special capacities or incapacities depending upon the existence of particular circumstances. Among these incapacities are those resulting from infancy, lunacy, marriage in case of the wife, conviction or imprisonment for crime, public pauperism, and the like. Among the special capacities the most important are those pertaining to citizenship and to the electoral franchise. In the U. S. the differences of legal condition or status belonging to class, rank, profession, or trade have no existence, for every person—at least every sane person—is clothed with the same *capacity* in respect to these subjects.

JOHN NORTON POMEROY.

Statute of Frauds. See FRAUDS, STATUTE OF, by PROF. GEORGE CHASE.

Stat′utes [Lat. *statutus*]. A statute is a law in a written form enacted by the supreme legislative authority of a nation or commonwealth, as contradistinguished from the law established by judicial decision. In its generic sense the term includes all legislative as opposed to judicial creations of the law, whatever be the nature and organization of the body—persons or person—which exercises the creative function.

Their Sources.—The sources from which statutes have emanated or may emanate, according to the varying political constitutions of different states, are the general or partial assemblies of the citizens, the emperors, kings, or other single heads of despotic governments, and the representative assemblies, either hereditary or elective. The *leges* and *plebiscita* of the Roman citizens during the Republic were produced by the first class of legislators; the "constitutions" of the Roman emperors by the second; while the parliaments of Great Britain and of many other European nations, the U. S. Congress, and the State legislatures are the modern forms of the third. The extent of the powers held by these bodies is determined by the organic law of each country. The British Parliament is said to be omnipotent; which simply means that the restrictions under which it ordinarily acts are self-imposed. In the U. S. the most remarkable feature of the political organization is the express, positive, and extensive limitation of the legislative function contained in all the written constitutions, which are themselves fundamental statutes adopted by the people in their sovereign capacity. With every new revision of the State constitutions this limitation in reference to the forms and modes of legislation, as well as its subject-matter, is made more far-reaching, minute, and prohibitory.

Their Kinds.—Statutes may be classified according to their external form and according to their subject-matter and effects. With respect to form three classes exist: (1) The first class comprises those single, separate enactments which are passed from time to time as occasion demands relating to one subject or class of subjects, and therefore comparatively short. Nearly all the acts of the British Parliament, of the U. S. Congress, and of the State legislatures until a period quite recent belong to this division. Where this form exclusively prevails, the legislation of a country is made up of almost innumerable fragments collected into the statute-books without system or order, and the resulting confusion necessarily affects the entire law with uncertainty. Of these enactments, some are intended to be permanent, and remain unaltered until, through a change in governmental policy, they are modified or repealed. Others, like the supply and appropriation bills, are renewed annually or at other short intervals. (2) The second division embraces those statutes which are digested and arranged into the form of complete national codes. The most remarkable instances of this class in ancient times were the XII. Tables (B. C. 451), with which the authentic history of the Roman law began, and the Digests of Justinian (A. D. 529–534), with which the spontaneous growth of that jurisprudence was closed. At the present time the private law has been fully codified in France, Austria, Prussia, and several other European countries, in British East India, and in the States of Louisiana and California. Among modern theoretical jurists and scientific legislators the tendency in favor of this form is very strong and nearly universal. (3) The third class consists in the revisions of the most important and general statutes which have been made by almost all the American States, and recently by the national Congress, and which are, in fact, partial codes, differing from those referred to in the preceding division only in their extent and completeness. With regard to their subject-matter, the classes into which the American and English statutes have been separated are numerous. The following are the most important of these subdivisions. Statutes are *public* and *general* when they affect all persons within the commonwealth, relate to matters of common interest, and apply to all parts of the territory—*private* or *local*, when they affect some particular class of persons, relate solely to matters of a local interest, or are confined in their operation to a specified portion of the territory; they are *declaratory* when they simply re-enact a rule of law already existing—*innovating*, when they introduce a new rule; they are *mandatory* when their command is enforced by some sanction—*directory*, when they are merely permissive, so that obedience is voluntary; they are *remedial* when they supply defects in the existing law, either by abrogating old or by enacting new rules; they are *penal* when they prescribe or forbid certain acts and impose a penalty or forfeiture in case of a violation; and *criminal* if the act prohibited is made a crime and the penalty a punishment; they are *prospective* when their operation is confined to matters occurring after their passage; *retrospective*, when they relate back and affect relations and acts which existed or took place prior to their passage; they are *repealing* when they annul other statutory provisions. It is plain from these definitions that the same enactment may belong to several of the foregoing classes; it may, for example, be at once public, mandatory, remedial, criminal, and prospective.

Their Parts.—The common form of English and American statutes may, and sometimes does, comprise the following distinct parts: the title, the commencement, the preamble, and the purview. The "title" is a brief preliminary description—*e. g.* "An act for the amendment of the law." It has become of great importance in the law of this country, since most of the State constitutions prescribe in substance that every statute shall contain but one subject, and that this shall be properly expressed in the title, although in two or three States this requirement is confined to private and local laws. By the "commencement" is meant the formal enacting clause—namely, "Be it enacted by the Senate and House of Representatives of the U. S. of America, in Congress assembled," and, "Be it enacted by the queen's most excellent majesty, by and with the advice and consent of the Lords spiritual and temporal and Commons in this present Parliament assembled, and by the authority of the same." The "preamble" is a preface setting forth the reasons and motives for the act. Once very

common, it is now generally omitted. The "purview" is the main body, the effective portion of the statute, which contains a statement of the legislative will, and declares its object and purpose. Among the special clauses or subdivisions which may be found in it are the "interpretation clause," the "saving clause," the "repealing clause," the "provisoes," the "exceptions," and the "schedules," the objects of which are sufficiently indicated by their names. In codes, whether complete or partial, a more orderly and scientific arrangement of parts is always made, and a division, according to some general plan, into books, titles, chapters, sections, and the like is universal.

Their Passage.—The practice which prevails in the U. S. Congress and in the State legislatures is the same in all its substantial features, and differs widely from that which is pursued in the Parliament of Great Britain or in the legislative assemblies of other European nations. A bill may be prepared and offered by a committee, or it may be first presented by any private member, in which case it is referred to the appropriate committee for examination and report. In its course through the house it is read three times, but the first two of these readings are merely formal, and the controversy, if any, is connected with the third reading. After passing both houses, it is engrossed with its amendments, is then signed by the presiding officer of each body, and transmitted to the President or governor for his approval. Upon receiving the assent of the executive it becomes an "act," and is filed in the office of the secretary of state. Many State constitutions contain minute regulations concerning the necessary number of votes, the manner in which they shall be given, and their record in the minutes. No provision, however, is made for any official preparation of proposed measures, nor for ensuring the use of language which shall accurately express the legislative intent. In this respect our methods are in striking contrast with those pursued in certain continental states of Europe, where the most careful attention is paid in the preliminary stages of legislation to the proper drafting of the statutes and to the statement of the reasons and motives upon which they are based. The time when statutes take effect is fixed in most of the American States either by a constitutional provision or by a general law. In some they become operative at the expiration of a specified number of days after the close of the session, in others at a specified period after the day of their passage; but the legislature may in the body of a statute prescribe a different time, as, for example, that it shall take effect immediately. The common law made an act operative from the first day of the session at which it was passed, but this absurd doctrine was abolished in the thirty-third year of George III., and all laws were declared to be binding from the time when they received the royal assent. The repeal of a statute may be either express or by implication. It is express when effected by a clause inserted for that specific purpose in a subsequent act; it is by implication when the provisions of a later enactment are wholly and irreconcilably inconsistent with those contained in an earlier one. Repeal by implication is not favored. If the two statutes concerning the same subject-matter can possibly be harmonized, both will stand; if the contradiction is absolute, the prior one gives way. There remain two most important topics connected with the general theory of statutes—the rules which govern their interpretation and construction, and the peculiarly American doctrine of their validity as affected by the national and State constitutions. The discussion of these topics will be found in the articles on INTERPRETATION and CONSTITUTION. (See also CODE and RETROSPECTIVE LAWS.) JOHN NORTON POMEROY.

Statutes of Limitation. See LIMITATION, STATUTES OF, by PROF. GEORGE CHASE.

Staub'bach ["dust-stream"], a celebrated waterfall of Switzerland, in the canton of Berne, has a descent of between 800 and 900 feet, but long before the water reaches the bottom it is dissolved into spray and carried away by the wind, which gives the phenomenon a singularly beautiful resemblance to a lace curtain floating in the air.

Stäud'lin (KARL FRIEDRICH), b. at Stuttgart July 25, 1761; studied theology at Tübingen 1779–84; travelled in Switzerland, France, and England, and was appointed in 1790 professor of theology at Göttingen, where he d. July 3, 1826. His numerous writings relate mostly to church history, such as *Universalgeschichte der christlichen Kirche* (1806; often reprinted), *Kirchliche Geographie und Statistik* (2 vols., 1804), *Allgemeine Kirchengeschichte von Grossbritannien* (1819), or to the history of special theological disciplines, such as *Geschichte der Sittenlehre Jesu* (2 vols., 1799–1823), *Geschichte der christlichen Moral seit dem Wiederaufleben der Wissenschaften* (1808), *Geschichte der Moral philosophie* (1822), etc. His first work, strongly impregnated by the reigning rationalism, was *Geschichte und Geist des Skepticismus* (2 vols., 1794).

Staugh'ton (WILLIAM), D. D., b. in Coventry, England, Jan. 4, 1770; emigrated to America 1793, and became pastor of a Baptist church in Georgetown, S. C.; preached subsequently in Philadelphia (1805–23) teaching at the same time, and acting as secretary of the Baptist Board of Foreign Missions; from 1823 to 1827 president of Columbian College. D. Dec. 12, 1829.

Staun'ton, p.-v., Macoupin co., Ill., on St. Louis division of Toledo Wabash and Western R. R.

Staunton, p.-v., Posey tp., Clay co., Ind., on Terre Haute and Indianapolis R. R. P. 589.

Staunton, tp., Miami co., O. P. 1317.

Staunton, p.-v., cap. of Augusta co., Va., at the junction of Great Valley and Chesapeake and Ohio R. Rs., 136 miles from Richmond, has 12 churches, 4 female seminaries, a graded free school, State institutions for the insane and the deaf, dumb, and blind, 3 newspapers, 3 banks, and 2 iron-foundries and machine-shops. It has fine facilities for transportation. P. 5120.

R. MAUZY & CO., EDS. "SPECTATOR."

Staunton, tp., Bedford co., Va. P. 3251.

Staunton, tp., Halifax co., Va. P. 3915.

Staunton, tp., Pittsylvania co., Va. P. 3270.

Staunton, a river of Southern Virginia, rising in the Alleghany Mountains in Montgomery co., flowing E. and S. E. through a pass in the Blue Mountains, and uniting with the Dan at Clarksville, Mecklenburg co., forms the Roanoke. In the first 20 miles of its course it descends 1000 feet; its entire length is about 200 miles.

Staunton (Sir GEORGE LEONARD), BART., D. C. L., b. at Cargin, Galway, Ireland, Apr. 19, 1737; educated at Dublin and at Montpellier, France, where he graduated in medicine; returned to England 1760; wrote for London periodicals, acquiring the friendship of Dr. Johnson and other eminent men of letters; settled in 1762 as a physician in the island of Grenada in the West Indies, where he held several official positions, including that of attorney-general, for which he had qualified himself by legal study, and acquired a considerable fortune, which he invested in landed estates; formed in 1774 an intimate friendship with Lord Macartney, the new governor of the island, with whom he was sent prisoner to France on the capture of Grenada in 1779, and whom he accompanied as secretary during his governorship in Madras (1781–84) and his celebrated embassy to China (1792), of which he published in 1797 an interesting narrative. D. in London Jan. 14, 1801. He was made a baronet 1784 in reward for his success in negotiating a treaty with Tippoo Sahib.—His son, SIR GEORGE THOMAS, b. at Milford, England, May 26, 1781, accompanied his father to China 1792; learned the Chinese language; was many years in the service of the East India Company in China, rising to the highest posts; was a member of the Amherst embassy 1816; returned to England 1817, and was a member of Parliament with short intervals from 1818 to 1852. D. Aug. 10, 1859. He wrote a *Memoir* of his father (1823), an autobiography (1856), and published various works, original and translated, upon China.

Staunton (HOWARD), b. in England in 1810; educated at Oxford; travelled extensively; settled in London; became noted as one of the most skilful of chess-players and as an eminent Shakspearian scholar; edited for many years the *Chess-Player's Chronicle* and the chess column of the *Illustrated London News*; published several manuals of the game of chess, including the *Handbook* (1847), the *Companion* (1849), the *Chess Tournament* (1851), and *Chess Praxis* (1860). He published an edition of Shakspeare's *Plays and Poems* (3 vols., 1857–60, and library ed., 4 vols., 1863) preceded by a *Life*, a photo lithographic fac-simile of the celebrated "first folio" of 1623 (1865); *Memorials of Shakspeare, his Will, Indentures of Conveyance, etc.*, photographed (Apr., 1864), and projected a new edition of Shakspeare, which he did not live to execute, though a portion of its materials were published in an interesting series of articles in the *Athenæum* for 1874, entitled *Unsuspected Corruptions of Shakspeare's Text*. He was extremely familiar with the dramatic literature of the Elizabethan age, and sometimes appeared upon the stage, chiefly in Shakspearian dramas. D. in London June 22, 1874. Author of *The Great Schools of England* (1865; 2d ed. 1869).

Staunton (WILLIAM), D. D., b. at Chester, England, Apr. 20, 1803; came to the U. S. at the age of fifteen years; acquired a good education, chiefly by private study; was ordained deacon in the Protestant Episcopal Church June 9, 1833, and priest Sept. 7, 1834; was a missionary preacher at Palmyra and Lyons, N. Y., 1834–35; rector of St. James's

church, Roxbury, Mass., 1835-40, of St. Peter's church, Morristown, N. J., 1840-47; founded and became first rector of St. Peter's church, Brooklyn, N. Y., 1848; was subsequently for seven years rector of Trinity church, Potsdam, N. Y., and has since been a resident of the city of New York. Author of *A Dictionary of the Church* (New York, 12mo, 1844), republished, much enlarged, as *An Ecclesiastical Dictionary* (New York, 8vo, 1861), *The Book of [illegible], Songs, and Prayers for the Family Altar* (1860), *The Book of Common Praise* (1866), *Voluntaries for the Organ*, a prize *Te Deum*, and of articles in this CYCLOPÆDIA.

Stau'pitz, von (JOHANN), descended from a noble family in Meissen, but his parentage and birth-date are unknown; studied theology at Tübingen, but turned entirely from the barren method of the Schoolmen, and found in the writings of Augustine and the mediaeval mystics his spiritual models; took a very active part in the foundation of the University of Wittenberg, and was appointed its first professor of theology; became, as vicar-general of the Augustine order in Germany, acquainted with the young Luther, for whom he conceived a warm friendship, and on whom he exercised considerable influence; procured his appointment as professor in Wittenberg, approved fully of his theses against the sale of indulgences, and gave him, during the first stage of his contest with the Roman Catholic Church, his valuable and effective support. Subsequently, however, when the controversy became too violent, and an open breach with the Church took place, he retired from Wittenberg, and lived after 1519 at Salzburg as court preacher to the archbishop and abbey of a Benedictine monastery. D. here Dec. 28, 1524. But his friendship for Luther remained unabated to his death; all the Reformer's writings were found in his library, and his own works, *De Amore Dei* and *De Fide Christiana*, show the spiritual sympathy he felt for the Reformation. Roman Catholic writers have not disdained to explain the support he gave Luther as an act of jealousy, because the sale of indulgences was given to the Dominican and not to the Augustine order.

Stavang'er, an old town of Norway, at the head of Bukkefjörd, about 100 miles S. of Bergen. It exports timber and salt herrings. P. 17,058.

Stave, or **Staff,** in music, the lines and spaces on which the notes are placed. (See NOTATION.)

Stavro'pol, government of Russia, bordering on the Caspian Sea, comprises an area of 28,800 sq. m. with 437,118 inhabitants. It is mostly low and flat. In the south-western part agriculture is the principal occupation; wheat, millet, wine, and mulberries are cultivated. In the north-eastern part the inhabitants are nomads, and immense herds of cattle, horses, and sheep are reared.

Stavropol, town of Russia, capital of the government of Stavropol, trades in cattle, horses, sheep, skins, wool, jars, and honey, and has 20,927 inhabitants.

Stay'ner, p.-v., Nottawasaga tp., Simcoe co., Ontario, Can., on Northern R. R., 86 miles from Toronto, has several hotels, flour, saw, and woollen mills, and factories. P. about 1000.

Stead'y Run, tp., Keokuk co., Ia. P. 1038.

Steam [Ang.-Sax. *stêm*]. The substance which in the solid condition is known as ice, and in the liquid condition as water, assumes under certain circumstances of heat and pressure the vaporous condition known as *steam*. Water exposed continuously to a temperature below 32° F., or 0° Centigrade, becomes converted into ice. At temperatures above 32° F., or freezing-point, and between this temperature—called the melting-point—and 212° F., and under a pressure of one atmosphere, the liquid state is exhibited. If the temperature be increased to 212° F. under a pressure of one atmosphere, the liquid rapidly disappears, and is dissipated in the form of steam or vapor. This transformation, which is rapid at the temperature of 212° F., takes place *slowly* at all temperatures above the freezing-point when the liquid is freely exposed to the atmosphere, the change being more rapid as the temperature rises, until the limiting temperature, 212°, is reached, above which, under a pressure of one atmosphere, the substance can no longer retain its liquid form. The ordinary "boiling-point" of water, 212° F., is thus a limiting temperature, above which it assumes the vaporous condition under a pressure of one atmosphere.

This formation of vapor at lower temperatures in the atmosphere is a phenomenon of great importance in the economy of nature, the slow evaporation from the surface of the sea, from lakes, and from rivers forming a part of the cycle of changes by which rainfall and dew supply moisture to the dry land. The laws of this natural *evaporation* are not well known, the quantity of water converted into vapor in a given time from a given surface of a lake or river being an almost indeterminate quantity, depending as it does on the removal of the vapor already formed by winds, the temperature of the water, the pressure of the atmosphere, and the quantity of vapor already existing in the air brought from other regions. When water is confined in a close vessel, however, a part of the enclosed space being left free or vacant, the effects of heat may be more definitely determined. If under these circumstances the water be heated to 212°, the space above the water will become filled with steam or vapor with an elastic force of one atmosphere, or 14.7 pounds per square inch. If more heat be applied to the mixture of water and steam, the volume of the vessel remaining constant, an additional quantity of steam will be formed, the quantity of liquid water being correspondingly diminished, an increase of elastic force or pressure will be observed, and these new relations will remain fixed and permanent for any given higher temperature as long as that temperature is constant. If the vessel be then cooled, reverse phenomena will occur; a certain portion of the steam will be condensed to a liquid form, and the elastic force will be diminished. If the steam-space be enlarged, the temperature remaining constant, an additional quantity of vapor will be formed, and the elastic force will remain constant. If the space be contracted, the temperature remaining constant, condensation of vapor will occur, the pressure still remaining constant.

It is thus observed that for every temperature there is a corresponding elastic force or tension, which cannot be changed without causing either evaporation or condensation. Steam in this condition is said to be saturated. If the quantity of water in the vessel be small relatively to the size of the vessel, and heat be continuously applied, the last element of liquid will finally be converted into vapor. At this instant the vessel will contain saturated steam only, unmixed with liquid water. If, now, additional heat be applied, or if the space be enlarged, the temperature remaining constant, the steam will assume what is termed the *superheated* condition. If the volume of the vessel be increased, the temperature remaining constant, the pressure will diminish, but it will no longer be solely proportional to the temperature, as in the case of saturation; it will depend also upon the volume, and the vapor begins to partake of the properties of the permanent gases. Superheated vapor has thus always an elastic force inferior to that which belongs to saturated vapor of the same temperature; and if a quantity of saturated steam and another quantity of superheated steam exist under the *same pressure*, the temperature of the superheated steam will be the greatest.

Steam unmixed with particles of water is transparent and colorless, its ordinary cloudy appearance as it issues from vessels containing it arising from suspended particles of water. Its uses as a medium for the transfer of heat in heating buildings or heating other bodies, and also as a medium for the transformation of heat into useful work in the steam-engine, have become almost universal, and render it one of the most important agents in modern civilization. Its properties have accordingly been carefully studied. In its superheated condition it obeys the general laws of the permanent gases; but saturated steam, as well as the saturated vapors of other liquids, possesses peculiar properties which have been determined mainly by experimental investigations.

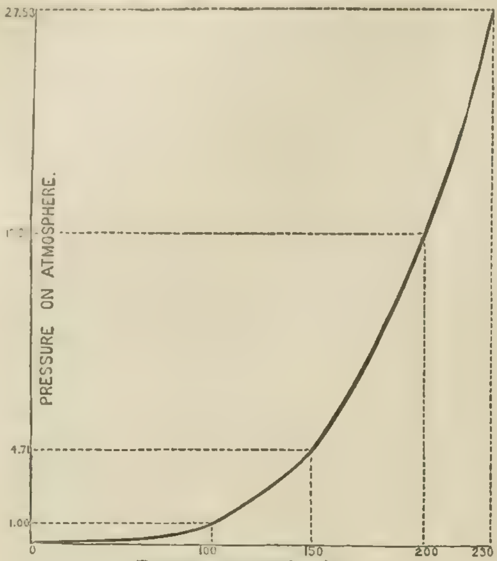
The condition of any body in regard to heat being determined by the pressure, volume, and temperature, the first subject of investigation is to ascertain the relation between these quantities, without reference to the quantities of heat involved in a change of state or condition, the pressure or elastic force being expressed in pounds per square inch, the volume being expressed in cubic feet, and the temperature in degrees Fahr. The first question is to determine the relation between these quantities. For the ordinary permanent gases this relation takes the form $pv = \mathrm{R}\mathrm{T}$, in which equation p represents the pressure, v the volume of unit of weight, T the *absolute* temperature, and R a constant quantity having a special value for each particular gas. This expression shows that for perfect gases the product of the pressure by the volume is proportional to the temperature. For saturated vapors a law still more simple holds true—viz. that the pressure or elastic force depends only on the temperature, and not on the volume of the mixture of liquid and vapor, the pressure of saturated vapors being independent of the proportion of these two elements.

No *theoretical* mode of ascertaining the relation between the pressure and temperature in the case of saturated vapors is at present known, but for some of the most common, and especially for steam, the celebrated experiments of Regnault furnish the most reliable means of calculating by *empirical* formulas this relation for a wide range of pressures. The diagram below exhibits graphically the law of

Table of Pressures of the Saturated Vapor of Water, from 32° to 446° F., from the Experiments of Regnault.

Temp. Fahr.	Pressures in atmospheres.	Pressures in lbs. per sq. in.	Differences.	Temp. Fahr.	Pressures in atmospheres.	Pressures in lbs. per sq. in.	Differences.	Temp. Fahr.	Pressures in atmospheres.	Pressures in lbs. per sq. in.	Differences.	Temp. Fahr.	Pressures in atmospheres.	Pressures in lbs. per sq. in.	Differences.
32	0.006	0.09	0.00	136	0.175	2.57	0.09	240	1.700	24.99	0.45	344	8.500	124.95	1.65
33	0.006	0.09	0.00	137	0.181	2.66	0.03	241	1.731	25.45	0.45	345	8.612	126.60	1.64
34	0.006	0.09	0.01	138	0.183	2.69	0.12	242	1.762	25.90	0.47	346	8.724	128.24	1.68
35	0.007	0.10	0.00	139	0.191	2.81	0.07	243	1.794	26.37	0.47	347	8.838	129.92	1.69
36	0.007	0.10	0.01	140	0.196	2.88	0.06	244	1.826	26.84	0.49	348	8.953	131.61	1.72
37	0.007	0.11	0.01	141	0.200	2.94	0.07	245	1.859	27.33	0.50	349	9.070	133.33	1.75
38	0.008	0.12	0.00	142	0.205	3.01	0.08	246	1.893	27.83	0.51	350	9.189	135.08	1.78
39	0.008	0.12	0.01	143	0.210	3.09	0.10	247	1.928	28.34	0.50	351	9.310	136.86	1.81
40	0.009	0.13	0.00	144	0.217	3.19	0.04	248	1.962	28.84	0.52	352	9.433	138.67	1.80
41	0.009	0.13	0.01	145	0.220	3.23	0.09	249	1.997	29.36	0.51	353	9.556	140.47	1.83
42	0.009	0.14	0.00	146	0.226	3.32	0.08	250	2.032	29.87	0.53	354	9.680	142.30	1.82
43	0.009	0.14	0.01	147	0.231	3.40	0.10	251	2.068	30.40	0.53	355	9.804	144.12	1.84
44	0.010	0.15	0.00	148	0.238	3.50	0.10	252	2.104	30.93	0.54	356	9.929	145.96	1.85
45	0.010	0.15	0.01	149	0.245	3.60	0.09	253	2.141	31.47	0.56	357	10.055	147.81	1.87
46	0.011	0.16	0.00	150	0.251	3.69	0.12	254	2.179	32.03	0.57	358	10.182	149.68	1.89
47	0.011	0.16	0.01	151	0.259	3.81	0.09	255	2.217	32.60	0.56	359	10.311	151.57	1.93
48	0.011	0.17	0.00	152	0.265	3.90	0.08	256	2.256	33.16	0.56	360	10.442	153.50	1.95
49	0.011	0.17	0.01	153	0.271	3.98	0.11	257	2.294	33.72	0.59	361	10.575	155.45	1.99
50	0.012	0.18	0.00	154	0.278	4.09	0.10	258	2.334	34.31	0.59	362	10.710	157.44	2.01
51	0.012	0.18	0.01	155	0.285	4.19	0.06	259	2.374	34.90	0.60	363	10.847	159.45	2.03
52	0.013	0.19	0.01	156	0.289	4.25	0.16	260	2.415	35.50	0.60	364	10.985	161.48	2.03
53	0.013	0.20	0.01	157	0.300	4.41	0.09	261	2.456	36.10	0.62	365	11.123	163.51	2.04
54	0.014	0.21	0.00	158	0.306	4.50	0.03	262	2.498	36.72	0.63	366	11.262	165.55	2.04
55	0.014	0.21	0.01	159	0.308	4.53	0.14	263	2.541	37.35	0.63	367	11.401	167.59	2.08
56	0.015	0.22	0.02	160	0.318	4.67	0.11	264	2.584	37.98	0.64	368	11.542	169.67	2.08
57	0.016	0.24	0.00	161	0.325	4.78	0.19	265	2.627	38.62	0.64	369	11.684	171.75	2.14
58	0.016	0.24	0.01	162	0.338	4.97	0.10	266	2.671	39.26	0.67	370	11.829	173.89	2.16
59	0.017	0.25	0.01	163	0.345	5.07	0.12	267	2.716	39.93	0.66	371	11.976	176.05	2.19
60	0.018	0.26	0.00	164	0.353	5.19	0.12	268	2.761	40.59	0.67	372	12.125	178.24	2.19
61	0.018	0.26	0.00	165	0.361	5.31	0.14	269	2.807	41.26	0.69	373	12.274	180.43	2.22
62	0.018	0.26	0.02	166	0.371	5.45	0.12	270	2.854	41.95	0.69	374	12.425	182.65	2.22
63	0.019	0.28	0.01	167	0.379	5.57	0.12	271	2.901	42.64	0.71	375	12.576	184.87	2.23
64	0.020	0.29	0.00	168	0.387	5.69	0.13	272	2.949	43.35	0.71	376	12.728	187.10	2.25
65	0.020	0.29	0.02	169	0.396	5.82	0.13	273	2.997	44.06	0.72	377	12.881	189.35	2.26
66	0.021	0.31	0.01	170	0.405	5.95	0.15	274	3.046	44.78	0.75	378	13.035	191.61	2.28
67	0.022	0.32	0.02	171	0.415	6.10	0.15	275	3.097	45.53	0.73	379	13.190	193.89	2.31
68	0.023	0.34	0.00	172	0.425	6.25	0.16	276	3.147	46.26	0.75	380	13.347	196.20	2.35
69	0.023	0.34	0.01	173	0.436	6.41	0.13	277	3.198	47.01	0.77	381	13.507	198.55	2.40
70	0.024	0.35	0.00	174	0.445	6.54	0.15	278	3.250	47.78	0.77	382	13.670	200.95	2.44
71	0.024	0.35	0.02	175	0.455	6.69	0.16	279	3.303	48.55	0.80	383	13.836	203.39	2.45
72	0.025	0.37	0.01	176	0.466	6.85	0.15	280	3.357	49.35	0.79	384	14.003	205.84	2.47
73	0.026	0.38	0.02	177	0.476	7.00	0.15	281	3.411	50.14	0.81	385	14.171	208.31	2.49
74	0.027	0.40	0.01	178	0.488	7.15	0.21	282	3.466	50.95	0.81	386	14.340	210.80	2.50
75	0.028	0.41	0.02	179	0.501	7.36	0.18	283	3.521	51.76	0.81	387	14.510	213.30	2.51
76	0.029	0.43	0.03	180	0.513	7.54	0.12	284	3.576	52.57	0.82	388	14.681	215.81	2.54
77	0.031	0.46	0.00	181	0.521	7.66	0.15	285	3.632	53.39	0.84	389	14.854	218.35	2.58
78	0.031	0.46	0.01	182	0.531	7.81	0.17	286	3.689	54.23	0.85	390	15.029	220.93	2.60
79	0.032	0.47	0.00	183	0.543	7.98	0.19	287	3.747	55.08	0.87	391	15.206	223.53	2.56
80	0.032	0.47	0.02	184	0.556	8.17	0.19	288	3.806	55.95	0.88	392	15.380	226.09	1.13
81	0.033	0.49	0.01	185	0.569	8.36	0.18	289	3.866	56.83	0.88	393	15.457	227.22	2.64
82	0.034	0.50	0.03	186	0.581	8.54	0.18	290	3.926	57.71	0.90	394	15.637	229.86	2.69
83	0.036	0.53	0.01	187	0.593	8.72	0.17	291	3.987	58.61	0.91	395	15.820	232.55	2.65
84	0.037	0.54	0.03	188	0.605	8.89	0.19	292	4.049	59.52	0.93	396	16.000	235.20	2.79
85	0.039	0.57	0.03	189	0.618	9.08	0.21	293	4.112	60.45	0.92	397	16.190	237.99	2.87
86	0.041	0.60	0.02	190	0.632	9.29	0.21	294	4.175	61.37	0.94	398	16.385	240.86	2.90
87	0.042	0.62	0.01	191	0.646	9.50	0.22	295	4.239	62.31	0.96	399	16.582	243.76	2.94
88	0.043	0.63	0.02	192	0.661	9.72	0.22	296	4.304	63.27	0.97	400	16.782	246.70	3.04
89	0.044	0.65	0.03	193	0.676	9.94	0.22	297	4.370	64.24	0.98	401	16.989	249.74	3.47
90	0.046	0.68	0.03	194	0.691	10.16	0.20	298	4.437	65.22	1.00	402	17.225	253.21	3.03
91	0.048	0.71	0.01	195	0.705	10.36	0.21	299	4.505	66.22	1.02	403	17.431	256.24	3.04
92	0.049	0.72	0.02	196	0.719	10.57	0.22	300	4.574	67.24	1.01	404	17.638	259.28	3.07
93	0.050	0.74	0.02	197	0.734	10.79	0.22	301	4.643	68.25	1.02	405	17.847	262.35	3.04
94	0.052	0.76	0.05	198	0.749	11.01	0.22	302	4.712	69.27	1.03	406	18.054	265.39	3.05
95	0.055	0.81	0.03	199	0.764	11.23	0.22	303	4.782	70.30	1.04	407	18.261	268.44	3.04
96	0.057	0.84	0.01	200	0.770	11.45	0.12	304	4.853	71.34	1.06	408	18.468	271.48	3.04
97	0.058	0.85	0.05	201	0.787	11.57	0.25	305	4.925	72.40	1.07	409	18.675	274.52	2.55
98	0.061	0.90	0.00	202	0.804	11.82	0.43	306	4.998	73.47	1.09	410	18.848	277.07	3.16
99	0.061	0.90	0.03	203	0.833	12.25	0.25	307	5.072	74.56	1.10	411	19.063	280.23	3.19
100	0.063	0.93	0.04	204	0.850	12.50	0.24	308	5.147	75.66	1.12	412	19.280	283.42	3.19
101	0.066	0.97	0.01	205	0.867	12.74	0.27	309	5.223	76.78	1.13	413	19.497	286.61	3.19
102	0.067	0.98	0.03	206	0.885	13.01	0.28	310	5.300	77.91	1.16	414	19.714	289.80	3.19
103	0.069	1.01	0.05	207	0.904	13.29	0.28	311	5.379	79.07	1.16	415	19.931	292.99	3.19
104	0.072	1.06	0.03	208	0.923	13.57	0.28	312	5.458	80.23	1.18	416	20.148	296.18	3.19
105	0.074	1.09	0.06	209	0.942	13.85	0.28	313	5.538	81.41	1.19	417	20.365	299.37	3.19
106	0.078	1.15	0.01	210	0.961	14.13	0.29	314	5.619	82.60	1.20	418	20.582	302.56	3.07
107	0.079	1.16	0.02	211	0.981	14.42	0.28	315	5.701	83.80	1.22	419	20.791	305.63	3.38
108	0.080	1.18	0.04	212	1.000	14.70	0.30	316	5.784	85.02	1.22	420	21.021	309.01	3.38
109	0.083	1.22	0.04	213	1.020	15.00	0.29	317	5.867	86.24	1.24	421	21.251	312.39	3.38
110	0.086	1.26	0.03	214	1.040	15.29	0.31	318	5.951	87.48	1.23	422	21.481	315.77	3.38
111	0.088	1.29	0.05	215	1.061	15.60	0.32	319	6.035	88.71	1.27	423	21.711	319.15	3.44
112	0.091	1.34	0.03	216	1.083	15.92	0.31	320	6.121	89.98	1.28	424	21.945	322.59	3.32
113	0.093	1.37	0.03	217	1.104	16.23	0.31	321	6.208	91.26	1.29	425	22.171	325.91	3.38
114	0.095	1.40	0.07	218	1.125	16.54	0.32	322	6.296	92.55	1.31	426	22.401	329.29	3.39
115	0.100	1.47	0.03	219	1.147	16.86	0.32	323	6.385	93.86	1.32	427	22.631	332.68	3.83
116	0.102	1.50	0.04	220	1.169	17.18	0.33	324	6.475	95.18	1.34	428	22.892	336.51	3.53
117	0.105	1.54	0.03	221	1.191	17.51	0.35	325	6.566	96.52	1.35	429	23.132	340.04	3.53
118	0.107	1.57	0.08	222	1.215	17.86	0.34	326	6.658	97.87	1.37	430	23.372	343.57	3.53
119	0.112	1.65	0.03	223	1.238	18.20	0.34	327	6.751	99.24	1.40	431	23.612	347.10	3.52
120	0.114	1.68	0.04	224	1.261	18.54	0.35	328	6.846	100.64	1.45	432	23.852	350.62	3.68
121	0.117	1.72	0.06	225	1.285	18.89	0.35	329	6.945	102.09	1.44	433	24.102	354.30	3.67
122	0.121	1.78	0.04	226	1.309	19.24	0.37	330	7.043	103.53	1.44	434	24.352	357.97	3.68
123	0.124	1.82	0.05	227	1.334	19.61	0.37	331	7.141	104.97	1.44	435	24.602	361.65	3.67
124	0.127	1.87	0.04	228	1.359	19.98	0.38	332	7.239	106.41	1.46	436	24.852	365.32	3.91
125	0.130	1.91	0.09	229	1.385	20.36	0.44	333	7.338	107.87	1.45	437	25.118	369.23	3.83
126	0.136	2.00	0.04	230	1.415	20.80	0.40	334	7.437	109.32	1.46	438	25.378	373.06	3.82
127	0.139	2.04	0.05	231	1.442	21.20	0.39	335	7.536	110.78	1.50	439	25.638	376.88	3.82
128	0.142	2.09	0.06	232	1.469	21.59	0.42	336	7.638	112.28	1.51	440	25.898	380.70	3.90
129	0.146	2.15	0.05	233	1.497	22.01	0.41	337	7.741	113.79	1.55	441	26.163	384.60	3.97
130	0.150	2.20	0.06	234	1.525	22.42	0.41	338	7.846	115.34	1.55	442	26.433	388.57	4.11
131	0.154	2.26	0.06	235	1.553	22.83	0.43	339	7.952	116.89	1.59	443	26.713	392.68	4.12
132	0.158	2.32	0.06	236	1.582	23.26	0.44	340	8.060	118.48	1.60	444	26.993	396.80	4.11
133	0.162	2.38	0.06	237	1.612	23.70	0.42	341	8.169	120.08	1.62	445	27.273	400.91	4.12
134	0.166	2.44	0.09	238	1.641	24.12	0.43	342	8.279	121.70	1.62	446	27.553	405.03	
135	0.172	2.53	0.04	239	1.670	24.55	0.44	343	8.389	123.32	1.63				

pressures and temperatures as determined by Regnault for saturated steam, from 0° to 230° C.:



Temperature, Centigrade.

The above curve is a representation of that drawn by Regnault to exhibit the results of his experiments. The law of the curve was expressed *analytically* by him by the empirical formula—

$$\operatorname{Log} p = a + b\alpha^{\tau} + c\beta^{\tau},$$

in which $\tau = t - t_0$, t being the temperature of the experiment, and t_0 a lower temperature arbitrarily chosen; the quantities a, b, c, α, β are constants which were experimentally determined. From this formula, which gave results in correspondence with the experimental curve, a table was constructed which, reduced to English units and temperatures Fahrenheit, is given on p. 468.

The experiments of Regnault were subsequently verified by Magnus, and form the only reliable basis at the present day for the applications of the dynamic theory of heat to steam and the steam-engine. Regnault's experiments comprised also various other vapors, for reference to which see the article HEAT.

In the preceding table the first column gives the temperature Fahrenheit; the second the pressure or tension of the vapor in atmospheres; and the third the same pressure in pounds per square inch. The fourth column gives the differences in the pressures for one degree. An inspection of this column of differences will show at once one of the most remarkable features of the results—viz. the increase of the variation of pressure for one degree of temperature as the temperature rises.

The second important question to be considered is in reference to the *quantity of heat* which must be communicated to a given quantity of water at any temperature to convert it into saturated steam at any other temperature. Another series of experiments by Regnault furnishes the basis for the determination of these quantities of heat under given conditions. In the process of evaporation water must first be heated from a given initial temperature to the temperature of evaporation, or the "boiling point due to the pressure." The quantity of heat required for this purpose depends on the specific heat of water; and as the specific heat is variable with the temperature, if we designate the specific heat by c, the quantity of heat required for an elevation of temperature dt will be given by the expression $dq = c\,dt$, q representing the quantity of heat required for a given finite change of temperature. Expressed analytically, its value is $q = \int_0^t c.dt$. Regnault deduces from his experiments the empirical formula $q = t + 0.0000t^2 + 0.0000003t^3$, which gave the quantity of heat q in calories required to heat water from 0° to any temperature (t) C. In this determination it is supposed that the volume of the *liquid* subjected to the active heat remains constant. For water the expansion of the liquid by heat is so small that the variations due to external pressure from this cause are regarded as insignificant.

In another series of experiments Regnault deduced the quantity of heat necessary for the *evaporation* of the liquid. The results were obtained by observing the quantity of heat by a suitable calorimeter, which becomes free when the vapor is liquefied under constant pressure, this quantity of heat being the same as that which must be applied to the liquid to convert it into vapor at the same constant pressure. The pressure being constant during the liquefaction or vaporization, the temperature also remains constant. This quantity of heat is usually called the *latent heat of vaporization*, or *heat of vaporization*, while the quantity q is called the *heat of the liquid*. Calling the heat of vaporization r, the total heat required to raise water from 0° to the temperature t, and evaporate it at that temperature, will be $L = q + r$. From this equation the value of r is $r = L - q$. Regnault found from his experiments that the value of L in calories may be represented by the formula $L = 606.50 + 0.305t$, the temperature being expresed in centigrade degrees. Subtracting from this the value of q found above, and there results $r = 606.50 - 0.695t - 0.0000t^2 - 0.000000t^3$ for the latent heat of vaporization of water in calories. The equivalent formula in English units of heat and temperature Fahrenheit is, neglecting the last two terms, which are small, $L = 1091.7 - 0.695.(t - 32°)$, or for technical applications, $L = 1092. - 0.7\,(t - 32°)$ approximately, or $L = 966. - 0.7\,(t - 212°)$. The latent heat of evaporation of one pound of water, according to this last formula, at atmospheric pressure, is found by substituting for t, 212°, and amounts to 966 units of heat, approximately. The value of q in the formula $q = \int_0^t c.dt$, when c, the specific heat of water, is taken as unity (which for technical applications is often admissible), is $q = t$; and thus the number of units of heat necessary to heat one pound of water from the melting-point of ice to any temperature is often estimated by the number of degrees of temperature. By this approximate method the quantity of heat necessary to raise a pound of water from any temperature t to 212°, and evaporate it at that temperature, is $q = (212° - t) + 966$, t being the lower initial temperature. The total heat of evaporation, or the heat L required to raise one unit of weight of water from the melting-point of ice to any temperature t, and evaporate it at that temperature, being for French units and centigrade degrees, $L = 606.50 + 0.305t$, and for English units and Fahrenheit degrees, $L = 1091.7 + 0.305.(t - 32°)$, if the heat required to raise one unit of weight of water from the melting-point of ice to any temperature t_1, such as the temperature of the feed-water of a boiler, be subtracted from this quantity, and the specific heat of water be taken as unity, the following formula, for English units and Fahrenheit degrees, will give approximately the total heat required to raise water from such temperature (feed-water temperature) to the temperature of evaporation, and evaporate it at that temperature: $q = 1091.7 + 0.305\,(t - 32°) - (t_1 - 32°)$.

The heat of evaporation r is composed of two parts, one of which is the heat required to overcome the work of the molecular attractions, and the other the external work exerted by the vapor in expanding against the constant pressure p from the volume of the water to the volume of the water and vapor which it produces under the given pressure. Calling the first quantity of heat ρ, and the increase of volume of the water in expanding to the vaporous form u, the external work will be in English units of heat $\frac{1}{772} \times p\,u$, or $A\,p\,u$, A being put for $\frac{1}{772}$. The value of r will then be $r = \rho + A\,p\,u$. The value of $A\,p\,u$ may be calculated by the aid of the dynamic theory of heat, employing also the quantities derived from the experiments of Regnault, already referred to, on the elastic force of vapors.

Having found the value of $A\,p\,u$ for various pressures or temperatures, and knowing r, the value of ρ may be found. Prof. Zeuner gives in his work on the mechanical theory of heat empirical formulas, established in this manner for the value of ρ and $A\,p\,u$, which serve for the calculation of tables of their values for different pressures or temperatures. From the values of $A\,p\,u$, calculated as above indicated, the value of u for any pressure p may be calculated. The value of u being found for steam, the volume of unit of weight of steam may be ascertained from the formula $v = u + s$, s being the volume of unit of weight of the liquid, and v the volume of unit of weight of the vapor. The value of s is generally so small compared with u for vapors under ordinary temperatures that it may often be neglected, and the value of u in the table taken as the volume of unit of weight of the vapor.

The density of the vapor of water is found from the formula $D = \frac{1}{v} = \frac{1}{u + s}$. The last column of the table gives the densities of saturated steam—*i. e.* the weight of one cubic foot for the pressures given. The value of u, or the volume of unit of weight, being found, the density or weight of unit of volume may be determined by the formula $D = \frac{1}{u}$. Values of the density are given in the last column of the table.

Giving the Heat of the Liquid, the Internal Latent Heat, the External Latent Heat, the Specific Volume, and Specific Weight of 1 pound of Saturated Steam at different pressures.

Pressure in atmospheres.	Pressure in pounds per sq. in.	Temp. in degrees Fahr.	Heat of liquids in units of heat. q.	Latent internal heat of vapor in units of heat. ρ	External latent heat in units of heat. Apu.	Values of cubic feet.	Specific weight in pounds. D.
0.1	1.47	115.0	83.308	969.926	65.835	233.0879	.0043
0.2	2.94	141.0	109.060	949.651	66.175	120.8162	.0083
0.3	4.41	157.0	125.437	936.779	67.633	82.3180	.0121
0.4	5.88	169.4	137.698	927.155	68.708	62.7204	.0159
0.5	7.35	178.9	147.631	919.381	69.547	50.7880	.0197
0.6	8.82	187.6	155.992	912.818	70.281	42.7705	.0234
0.7	10.29	194.6	163.267	907.123	70.897	36.9812	.0270
0.8	11.76	201.8	169.747	902.054	71.438	32.6065	.0307
0.9	13.23	206.8	175.577	897.198	71.923	29.1800	.0343
1.0	14.70	212.0	180.900	893.340	72.360	26.4216	.0378
1.1	16.17	216.8	185.789	889.524	72.758	24.1517	.0414
1.2	17.64	221.4	190.332	885.978	73.127	22.2519	.0449
1.3	19.11	225.6	194.587	882.661	73.469	20.6356	.0484
1.4	20.58	229.5	198.569	879.557	73.787	19.2451	.0519
1.5	22.05	233.1	202.334	876.625	74.086	18.0341	.0554
1.6	23.52	236.6	205.900	873.848	74.367	16.9720	.0589
1.7	24.99	240.0	209.284	871.214	74.633	16.0301	.0623
1.8	26.46	243.2	212.506	868.709	74.884	15.1907	.0658
1.9	27.93	246.2	215.602	866.302	75.121	14.4362	.0692
2.0	29.40	249.1	218.551	864.009	75.350	13.7570	.0726
2.1	30.87	251.9	221.391	861.802	75.566	13.1387	.0760
2.2	32.34	254.5	224.123	859.682	75.773	12.5764	.0794
2.3	33.81	257.1	226.746	857.646	75.973	12.0606	.0828
2.4	35.28	259.6	229.295	855.666	76.165	11.5881	.0862
2.5	36.75	262.0	231.755	853.758	76.349	11.1508	.0896
2.6	38.22	264.4	234.142	851.908	76.527	10.7471	.0929
2.7	39.69	266.6	236.437	850.127	76.698	10.3722	.0963
2.8	41.16	268.8	238.678	848.390	76.864	10.0230	.0996
2.9	42.63	271.0	240.865	846.697	77.024	9.6978	.1029
3.0	44.10	273.1	242.980	845.052	77.177	9.3935	.1063
3.1	45.57	275.0	245.039	843.464	77.328	9.1084	.1096
3.2	47.04	277.0	247 045	841.912	77.472	8.8392	.1129
3.3	48.51	278.9	249.014	840.389	77.614	8.5877	.1162
3.4	49.98	280.8	250.927	838.908	77.753	8.3507	.1195
3.5	51.45	282.6	252.788	837.470	77.884	8.1248	.1228
3.6	52.92	284.4	254.610	836.060	78.016	7.9133	.1261
3.7	54.39	286.2	256.415	834.665	78.143	7.7115	.1294
3.8	55.86	287.9	258.149	833.326	78.264	7.5209	.1327
3.9	57.33	289.6	259.862	832.003	78.386	7.3383	.1360
4.0	58.80	291.2	261.558	830.693	78.505	7.1669	.1392
4.1	60.27	292.8	263.200	829.426	78.619	7.0019	.1425
4.2	61.74	294.4	264.895	828.187	78.730	6.8449	.1458
4.3	63.21	295.9	266.373	826.976	78.838	6.6943	.1490
4.4	64.68	297.4	267.943	825.766	78.946	6.5517	.1523
4.5	66.15	298.9	269.474	824.583	79.052	6.4140	.1555
4.6	67.62	300.4	270.970	823.432	79.155	6.2826	.1587
4.7	69.09	301.8	272.448	822.292	79.254	6.1577	.1620
4.8	70.56	303.2	273.908	821.167	79.353	6.0359	.1652
4.9	72.03	304.6	275.330	820.071	79.450	5.9206	.1685
5.0	73.50	306.0	276.734	818.989	79.546	5.8085	.1717
5.1	74.97	307.4	278.122	817.922	79.637	5.7011	.1749
5.2	76.44	308.7	279.472	816.881	79.727	5.8986	.1781
5.3	77.91	310.0	280.822	815.843	79.817	5.4993	.1813
5.4	79.38	311.3	282.134	814.831	79.905	5.4032	.1845
5.5	80.85	312.5	283.448	813.821	79.994	5.3103	.1877
5.6	82.32	313.8	284.726	812.839	80.077	5.1725	.1909
5.7	83.79	315.0	285.984	811.870	80.159	5.1341	.1941
5.8	85.26	316.2	287.242	810.902	80.242	5.0508	.1973
5.9	86.73	317.4	288.466	809.962	80.321	4.9707	.2005
6.0	88.20	318.6	289.688	809.023	80.401	4.8922	.2037
6.1	89.67	319.8	290.893	808.997	80.478	4.8169	.2069
6.2	91.14	320.9	292.059	807.199	80.555	4.7448	.2101
6.3	92.61	322.0	293.247	806.288	80.629	4.6727	.2133
6.4	94.08	323.2	294.395	805.406	80.705	4.6038	.2164
6.5	95.55	324.3	295.526	804.537	80.777	4.5382	.2196
6.6	97.02	325.4	296.658	803.669	80.849	4.4725	.2228
6.7	98.49	326.4	297.770	802.814	80.921	4.4100	.2259
6.8	99.96	327.5	298.885	801.961	80.989	4.3491	.2291
6.9	101.43	328.5	299.951	801.135	81.058	4.2899	.2323
7.0	102.90	329.6	301.037	800.309	81.126	4.2322	.2354
7.25	106.575	332.1	303.692	798.273	81.292	4.0944	.2433
7.50	110.250	334.6	306.255	796.307	81.450	3.9647	.2512
7.75	113.925	337.1	308.763	794.385	81.607	3.8445	.2590
8.00	117.600	339.4	311.198	792.520	81.756	3.7308	.2668
8.25	121.275	341.7	313.598	790.684	81.902	3.6251	.2747
8.50	124 950	344.0	315.925	788.904	82.040	3.5242	.2825
8.75	128.625	346.2	318.195	787.167	82.177	3.4296	.2903
9.00	132.300	348.4	320.431	785.459	82.309	3.3399	.2980
9.25	135.975	350.5	322.610	783.792	82.436	3.2534	.3058
9.50	139.650	352.5	324.731	782.170	82.562	3.1733	.3135
9.75	143.325	354.6	326.842	780.561	82.683	3.0965	.3213
10.00	147.000	356.6	328.894	778.995	82.802	3.0228	.3290
10.25	150.675	358.5	330 890	777.470	82.915	2.9539	.3367
10.50	154.350	360.4	332.869	775 962	83.029	2.8866	.3444
10.75	158.025	362.3	334.809	774 481	83.140	2.8241	.3521
11.00	161.700	364.1	336.717	773.028	83.245	2.7633	.3598
11.25	165.375	365.9	338.603	771 590	83.351	2.7056	.3675
11.50	169.050	367.7	340.436	770.195	83.452	2.6495	.3751
11.75	172.725	369.4	342.250	768.814	83.551	2.5967	.3828
12.00	176.400	371.2	344.027	767.462	83.648	2.5454	.3904
12.25	180.075	372.8	345.787	766.123	83.743	2.4957	.3981
12.50	183.750	374.5	347.508	764.813	83.837	2.4493	.4057
12.75	187.425	376.1	349.213	763.555	83.927	2.4028	.4133
13.00	191.100	377.8	350.899	762.237	84.017	2.3596	.4209
13.25	194.775	379.4	352.548	760.984	84.103	2.3179	.4285
13.50	198.450	380.9	354.179	759 744	84.190	2.2763	.4361
13.75	202.125	382.5	355.792	758.520	84.272	2.2378	.4437
14.00	205.800	484.0	357.367	757.325	84.355	2.1994	.4512

In the foregoing table the quantities refer to one pound of saturated steam, English units of heat, and Fahrenheit degrees of temperature. The first column gives the pressure in atmospheres; the second in pounds per square inch; the third the corresponding temperatures; the fourth the value of q, or heat required to raise one pound of water from 32° to the temperature given; the fifth column gives the value of ρ, the heat required to overcome the molecular attractions in the evaporation; the sixth column, the value of $A\,p\,u$, the external latent heat, or external work in units of heat required to expand the vapor against the pressure p given in the first column from the volume of one pound of water to the volume of one pound of the mixture of steam and water produced; the seventh column gives the values of u at the given pressure; and the eighth column the weight of one pound of steam at the given pressure, or specific weight. The total heat of evaporation—*i. e.* the heat required to raise one pound of water from 32° to the temperature of evaporation, and evaporate it at that temperature—may be found for any temperature and pressure by adding together the quantities opposite that temperature in columns 4, 5, and 6. Thus, to find the total heat of evaporation of one pound of water from 32° at 212°, the table gives—

$$
\begin{aligned}
q &= 180.900 \\
\rho &= 893.340 \\
A\,p\,u &= \underline{72.360} \\
\text{Total} &= 1146.600
\end{aligned}
$$

The corresponding quantities for 356.6°, or 10 atmospheres, are—

$$
\begin{array}{r}
328.894 \\
778.995 \\
\underline{82.802} \\
1190.691 \\
\underline{1146.600} \\
\text{Difference,}\quad 44.091
\end{array}
$$

showing that it requires 44.091 more units of heat in the second case. If from the first quantity, 1146.600, we subtract 180, the approximate number of units of heat required to heat water from 32° to 212°, we obtain 966.6, the latent heat of evaporation of one pound of water at 212°. The weight of a cubic foot of water being 62.5 pounds, the volume of one pound will be $\frac{1}{62.5}$ cubic feet = 0.016 cubic feet. This quantity added to any value of u given in the table will give the specific volume of steam at the corresponding temperature, or the volume of *one pound* of steam at that temperature. This constant quantity to be added is so small that it is evident that for approximate estimates the quantities u in the table may be taken directly as the volumes of one pound of steam. At eight atmospheres, for instance, the value of u is 3.7308 cubic feet; adding 0.016, the exact specific volume is 3.747 cubic feet; the difference being in all cases $\frac{16}{1000}$ths of a cubic foot.

W. P. Trowbridge.

Steamboat. See Steam Vessels.

Steam'boat Rock, p.-v., Clay tp., Hardin co., Ia., on Central Iowa R. R.

Steam'burg, p.-v., Cold Spring tp., Cattaraugus co., N. Y., on Atlantic and Great Western R. R., near Alleghany River.

Steam-Carriage. See Locomotive, by P. Barnes, and Railroads, by Col. J. W. Adams, C. E.

Steam'-Engine. The steam-engine may be defined to be a prime mover or motor in which the force of heat is caused to perform useful work through the medium of steam. The most simple form of the apparatus possible embraces at least two distinct organs—one for the production and supply of the steam, called the *boiler*, and the other for the utilization of the steam, called the *engine*. These two organs are in one sense inseparable: there can be no steam-engine without a boiler of some form, and any mechanical device by which steam is made to perform work continuously must be connected with the source of supply, the boiler. These two organs are nevertheless so different in their functions that in a theoretical or scientific point of view they are constructed on quite different principles, and, practically, the only necessary physical or material connection between them consists of a pipe or conduit for the supply of the steam to the engine. The boiler and engine may each have different forms independently of the other, and they may be set up or established separately on different foundations, or they may be combined in one structure. They may therefore be described separately. It is only when the action of the heat of the steam is to be investigated, from the moment that water is injected into the boiler until it has passed through its various transformations, that it is necessary to consider the two as forming one apparatus.

The engine consists of two essential, and to some extent independent, combinations of mechanism—the *cylinder*, with its *piston* and *piston-rod*, its *connecting-rod* and *crank*, by means of which the elastic force of the steam is caused to produce a motion against the useful resistances to be overcome; and the *valve-gearing*, by which the proper distribution of the steam is made to and from the cylinder at certain periods of the motion of the piston. A third organ is often attached to the engine or connected with it by a pipe, called the *condenser*, which performs a special and important office when it is employed, its introduction giving rise to a general classification of engines into *non-condensing* and *condensing* engines, the distinction in the action of the engines as far as the steam is concerned being that in non-condensing engines the steam after having performed its work in the cylinder is ejected from the cylinder into the atmosphere, and is there dissipated; while in condensing engines the steam is exhausted into the condenser, where the condensation is effected by cold water supplied to the condenser, and the condensed steam may be resupplied to the boiler. In such an arrangement, where the condenser is of the kind called a surface condenser, the cooling water does not become mixed with the condensed steam, and the latter may be pumped directly back to the boiler. In such cases the same mass of water may be employed continuously without the introduction of water from an external source. The steam-engine as a whole will then consist of the following parts: the *boiler*, with its *attachments*; the *cylinder*, with its *valve-gear*; the *condenser*, and the necessary *feed* and *circulating pumps*. There are also often combined with the apparatus certain regulators of the motion, such as fly-wheels in stationary engines for regulating the momentary resistances against which the elastic force acts; and governors, for controlling the flow of steam to the cylinder, and thus regulating the average pressure of the steam on the piston. The fly-wheel in such cases is often made in the form of a band-pulley for transmitting the power of the engine to other machines. These various parts may be considered separately, and afterward in various combinations; and finally there will remain to be considered the application of the theory of heat to the steam as it passes through the engine, and the mode of estimating the power.

The Boiler.—To whatever use heat is to be applied through the medium of steam, the apparatus for generating and retaining the steam is constructed on the same general principles for all purposes, and is popularly termed a *boiler*. It may be described in general terms as a closed metallic vessel, kept partly filled with water, with arrangements for imparting heat to the water by means of the combustion of fuel. The steam generated is confined in the vessel above the water until it is required for use, when it is drawn off through pipes. This metallic vessel, with its compartments and openings, takes the name of "boiler" in the shops where it is manufactured. But in many classes or forms of boilers the steam-generating apparatus is not complete until the boiler is set up in brickwork, with an external furnace constructed for the combustion of the fuel, and external flues made for conducting the heated gases to the chimney along the sides of the boiler. In others the boiler is ready for use as it comes from the manufacturer, having within its external shell all these necessary arrangements for combustion and draught. In all cases certain adjuncts and appurtenances are necessary, such as the feed-pump or other means of supplying water, with the necessary pipes and attachments, the safety-valve, the steam and water-gauges, and grate bars for the furnace. So that a complete steam-generating apparatus requires something more than the simple vessel which constitutes its principal and important feature. For the mere exhibition of the principal phenomena connected with the generation of steam such a vessel of the most simple form and construction might be sufficient.

But connected with its uses as an instrument of industrial economy it has become an object deserving and requiring the most thorough and critical study. The primary conditions which steam generators should fulfil are—(1) strength to sustain the internal pressures to which they will be subjected; (2) durability; (3) economy or efficiency in evaporating qualities; (4) economy of construction in materials and workmanship; (5) adaptation to the particular circumstances of their use. (6) To these conditions must be added safety, which depends on form, construction, strength, and qualities of materials, as well as upon management.

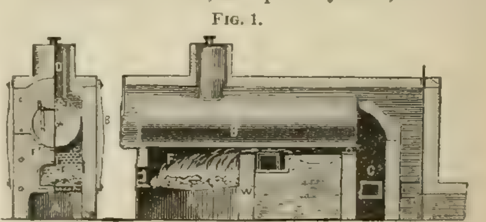
The first condition—strength to sustain the internal pressures—requires the consideration of the materials to be employed, the statical pressures or strains to which these materials will be subjected, and the proper forms and devices to resist those strains. The condition of durability involves the action of these materials, and their preservation under the varying influences of heat, pressure, and the chemical reactions to which they will be subjected in use. Economy in evaporative qualities calls for such arrangements for the combustion of fuel and the transfer of heat as shall utilize the greatest possible proportion of the heat which is evolved by the combustion of the fuel. Economy in materials and construction requires the employment of the least amount of costly materials, and the least labor in the construction, that shall be consistent with the other conditions. Adaptation to various uses gives rise to various forms, in which the special use controls or modifies to some extent some of the other conditions; while safety of life and property demands that strength of parts, quality of materials, excellence of workmanship, and skilful management shall not only meet the requirements of economy, durability, and adaptation, but shall place beyond contingencies, as far as possible, the occurrence of explosions. As far as they relate to construction alone, the conditions of *economy* and *safety* stand, to a certain extent, in constant antagonism, the least amount of material that will bear the internal pressures being the extreme limit of economy of construction, while a near approach to this limit is always attended by excessive risk. But as true economy includes permanence and durability under continuous use, it may be said that all the essential conditions are involved in *strength, economy of construction and use, durability*, and *adaptation*.

In regard to forms and adaptation to various uses, boilers may be classified under a few types, which serve to illustrate not only general principles of construction, but the adaptability of the various forms to particular circumstances of use. Considered merely in reference to strength and internal capacity, combined with the least weight of material, the spherical form is that which fulfils the theoretical requirements of strength and safety. A vessel of this form possesses the advantage, in regard to strength, that every point of the shell or external envelope is exposed to a strain of extension. No cross-strain is produced in any part of the material, and no distortion can occur from the internal pressures. The spherical form is not, however, the best adapted for the application of heat externally, nor is it the form of cheapest construction. Those conditions are obtained by modifying this form and extending it to the cylindrical shape, which gives the same advantages in transforming all the strains into tangential strains, while it permits of the most extensive variety of arrangements for the application of heat. The cylinder, whether it be used for the exterior shell of the boiler, in which it is subjected to internal pressures, or for the flues or tubes required for the flow of the gases to the chimney, or for the liquid circulation, is the form best adapted for cheapness of construction, strength, permanence of shape under both internal and external pressures, and for the flow of fluids; and it thus forms a basis for nearly all constructions, modifications or departures from this form being adopted only in exceptional cases, such as the boilers of steam-vessels, where the figure of the external shell is often adapted to the position and space available.

The most common types of steam-generators may be arranged under the following designations: (1) The plain cylinder boiler; (2) the cylinder-flue boiler; (3) the cylinder-tubular boiler; (4) the return-flue boiler; (5) the return-tubular boiler; (6) the water-tube boiler; (7) the locomotive boiler; (8) the sectional boiler. Each of these types appears under various forms, and the modifications often present such peculiar and distinct characteristics that they would scarcely be classed with either of the above-named types. But for a general discussion these forms comprehend the largest proportion of boilers at present in use, or which have been in use during the last quarter of a century.

The plain cylinder boiler (B, Fig. 1), as it comes from the manufacturer's hands, is a plain cylinder, formed of

Fig. 1.



Plain Cylinder Boiler set in brickwork.

wrought-iron plates of $\frac{3}{16}$ to $\frac{1}{2}$ inch thickness, according to the size of the boiler, the ends of the cylinder being closed by cast-iron heads or by wrought-iron plates hammered into the form of a segment of a sphere. The plates forming the body of the cylinder are shaped to a cylindrical form in a

cold state by rollers, the sections thus formed being riveted together longitudinally, and afterward joined end to end. The cylinder is surmounted at some point by a cylindrical chamber, called the *steam-dome* or steam-drum, which is closed at the top by a cast- or wrought-iron head, on which the castings for attaching the steam-pipes and the safety-valve are usually fitted. This cylindrical structure is called in the shops a boiler, but the complete apparatus to which this term appropriately belongs requires other parts, which, for this class of boilers, is usually supplied by the brick-work setting in which it is mounted. Fig. 1 represents a cylinder boiler set in brickwork. The front end of the cylinder rests upon a cast-iron frame, called the *front*, shown in section and partly in the end elevation of the figure. The rear end of the cylinder rests upon a brick wall, a roller being placed under this end to permit a slight movement when the cylinder expands or contracts, the object being to prevent the shattering or breaking of the walls by the expansions and contractions when the boiler is alternately heated and cooled.

The setting of a boiler of this character consists usually of a chamber formed by the iron *boiler-front*, two side walls, and a rear closing wall of brick. The side walls are built up parallel to each other, as shown in the longitudinal section and end view, at a distance from each other a little greater than the diameter of the shell of the boiler. These walls are held together by clamps, connected at the top and bottom by long bolts, as shown at B in the end view. The space underneath the boiler-shell is divided into two portions by a wall called the *bridge-wall* W. The chamber in front of the bridge-wall is devoted to the combustion of the fuel, and is called the *furnace-chamber*. This chamber is divided by the grate into two chambers, the upper being the *furnace* and the lower the *ash-pit*. The upper part of the bridge-wall extends nearly to the shell of the boiler, the top being finished in a cylindrical form, as shown at F in the end view. This upper portion is called the *bridge*. It is usually made of fire-bricks, and its office is twofold—to furnish a rear wall to the furnace, and to contract the entrance to the flue to the area proper or suitable for the most efficient draught. The chamber in rear of the bridge-wall is contracted into a flue by solid filling up nearly to the surface of the cylinder. The furnace F extends from the front back to the bridge-wall. In this class of boilers the width of the furnace is generally equal to the distance between the side walls, and the depth or distance from the front to the bridge is determined by the conveniences of firing, being usually from 4 to 7 feet. The main flue underneath the boiler terminates in a chamber C, which is connected with the bottom of the chimney. This chamber takes the general name of connection, or smoke-connection. The chimney may be connected with the smoke-connection or chamber directly, or it may be isolated and connected through another flue or conduit. The chimney is a vertical flue, the object of which is usually twofold—viz. (1) to cause a draught or supply of air through the furnace, in which its functions are those of a machine operated by the heat of the gases; and (2) to carry off the products of combustion beyond hurtful or disagreeable proximity.

The principal parts of the plain cylinder boiler, which are also represented wholly or in part in nearly all boilers under the same names, are: (1) The *shell*, or external envelope. (2) The *furnace*, F, the chamber in which combustion takes place. (3) The *flue* or flues, the passages for the heated gases to the chimney. (4) The *bridge*, or rear wall of the furnace, which forms, with the shell of the boiler above it, the boundary of the *draught-area*. (5) The *ash-pit*, the bottom part of the furnace-chamber, which serves as a receptacle for the ashes and cinders, and also as an entrance for air underneath the grate. (6) The *grate*, which is composed of *grate-bars* or *fire-bars*, forming the bottom of the furnace on which the fuel is laid. (7) The *furnace door*. (8) The *ash-pit door*. (9) The *combustion-chamber*. This is an enlargement of the main flue in rear of the bridge, formed by dropping the bottom of this flue a few inches. This part of the main flue is often called the *combustion*-chamber, under the assumption that the combustion of the volatile portions of the fuel is not completed in the furnace, and that an enlargement of this flue into a sort of chamber favors a more thorough mixing of the air and the volatile or combustible gases, and thus produces complete combustion. This is perhaps true where air is admitted by a special arrangement behind the bridge or through holes in the furnace door. When bituminous coal, or fuel containing a large quantity of volatile matter, is used, some such arrangement for burning the volatile matters should be made. (10) The *smoke-box* or smoke-connection is more important in some other classes of boilers than in the plain cylinder boiler, as will appear in the description of those boilers. (11) The *steam-dome* is a vertical chamber set upon the upper surface of the shell, and communicating with it freely through holes in the shell or through a single large aperture, the object of which is to furnish a chamber for the steam above the steam-space, in which the steam, being removed as far as possible from the liquid water in the boiler, and being in a quiescent state, any particles of water which are carried up with the steam may be separated by precipitation. In some boilers, especially those for marine purposes, this dome takes the form of an annular space, which is traversed by the smoke-stack or chimney, and is then called the *steam-chimney*. (12) *Water-room* and *steam-room*. The interior of the shell of the boiler is divided by the surface of the water into two spaces, called the *water-room* and *steam-room*, or water-space and steam-space; all the space occupied by water below the water-level being water-space, and the space or spaces above the water-level, including the *steam-dome*, being steam-room. The water-room of a plain cylinder boiler occupies about three-fourths of the whole space, and generally in other boilers about three-fourths of the internal capacity of the shell when the water is at its mean level. (13) *Man-holes, hand-holes*. It is important in the management of boilers to examine all accessible parts frequently, and accessibility to every part is a fundamental principle of construction, not only for cleaning, but for facilitating repairs. *Man-holes* are apertures left in the shell, and closed by strong plates which can be removed at will, the opening being large enough to admit a man. *Hand-holes* are smaller openings, generally near the bottom, which answer the purpose of cleaning by means of tools. (14) *Heating-surface*. In all boilers portions of the iron plates which form the shell, flues, or tubes are exposed on one side to the heat of the furnace, or the heat of the gases in their course to the chimney, and on the other side to the contact of the water or steam, the transfer of heat being from the furnace and flues to the water through these portions of the iron structure. A heating-surface in a steam-generator may therefore be defined to be any surface which acts as a medium for the transfer of heat from the furnace or gases to the water or steam within the boiler. The *efficiency* of such a surface depends on the difference between the temperatures of the furnace or gases and the water, and the thorough and rapid circulation of the fluids and gases in contact with the surfaces.

Several adjuncts or appurtenances are needed to give efficiency and safety to the boiler—viz.:

(15) The *feed apparatus*, which is composed of a pump, an injector or other device, with the necessary pipes for supplying water to the boiler. (16) The *safety-valve*, a valve opening outward, and so adjusted and arranged that it will be opened by the internal pressure of the steam when that pressure exceeds a given amount per square inch. (17) The *steam-gauge*, an instrument which exhibits at all times to the eye of the engineer or stoker the pressure of the steam in the boiler. (18) *Water-gauges* and *gauge-cocks*, which are intended to show at any instant the level of the water within the boiler. (19) The *low-water detector*, an instrument attached to many boilers, by means of which an alarm is given if the water falls below a given point. To these "fittings," as they are sometimes called, may be added also the necessary stoker's tools for feeding and managing the furnace, cleaning the flues and tubes, and removing ashes and clinker.

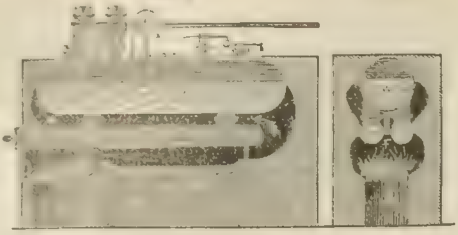
These descriptions of the various parts are applicable to all steam-generators, and, though variously modified, perform the same offices in all. A repetition of the descriptions will therefore be unnecessary in referring to other kinds of boilers, a reference to the plates being sufficient to show the special combinations in each case.

The plain cylinder boiler which has been described is the most simple in construction of all boilers, and for this reason it is often employed where economy of first cost is desirable, and where economy of fuel is a secondary matter. The furnaces and flues are external to the shell. The heating-surface comprises all of the lower part of the cylindrical shell which is exposed to the heat of the furnaces and gases. Its advantages are cheapness of construction, facility of access for repairs, and general simplicity.

The French Boiler (Figs. 2 and 3).—A modification of the plain cylinder boiler, called in England the *French boiler*, and also the *elephant boiler*, and in France the *chaudière à bouilleurs*, is much used on the continent of Europe and also to some extent in England. It is seldom seen in this country, although a boiler involving the same principal features is often constructed here for shipment to the West India sugar-plantations. Fig. 2 represents a longitudinal and Fig. 3 a cross-section of this boiler.

Cylinder-flue Boiler.—This modification of the cylinder boiler is characterized by an arrangement of one or more internal flues of large diameter running longitudinally within the shell in such a manner that the heated gases pass once through these flues, and once through one or more

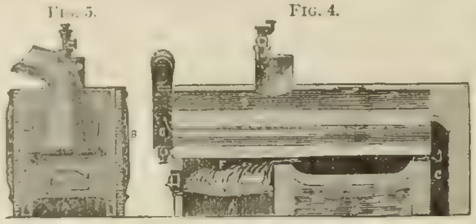
FIG. 2. FIG. 3.



French Boiler.

flues external to the shell. Figs. 4 and 5 give a longitudinal section and an end elevation of a single cylinder-flue boiler, mounted in brickwork.

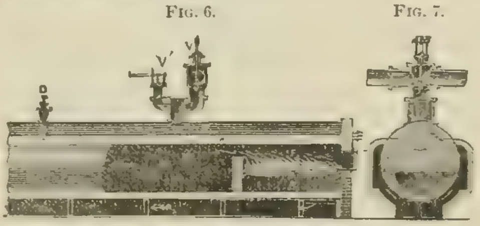
FIG. 5. FIG. 4.



Cylinder-flue Boiler.

The Cornish Boiler.—This is a variety of the cylinder-flue boiler which has been long in use in England for stationary engines. It differs from the American boiler of the same class in having an *internal furnace*. The furnace or furnaces are placed within the front end of a large flue,

FIG. 6. FIG. 7.

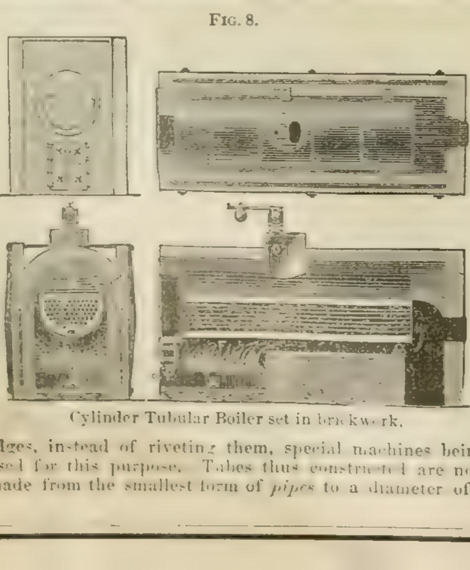


The Cornish Boiler.

which extends through the boiler from the front to the rear end. Figs. 6 and 7 represent a longitudinal section and sectional elevation of the Cornish boiler.

Cylinder-tubular Boiler.—Boilers of this class differ so little from the common cylinder-flue boiler described above that they might with propriety be classed with them. They form, however, the basis of a variety of modified forms, and in practice there is a difference between flues and tubes, not only in mechanical construction, but also in the modes of connecting the flues and tubes with the end-plates of the boilers, of which they form parts. Flues differ from tubes in being generally of larger dimensions. They are usually constructed of metallic plates rolled into the cylindrical form and then riveted together, as in the construction of the shell of the plain cylinder boiler. Tubes, on the other hand, are usually constructed by lapping and *welding* the

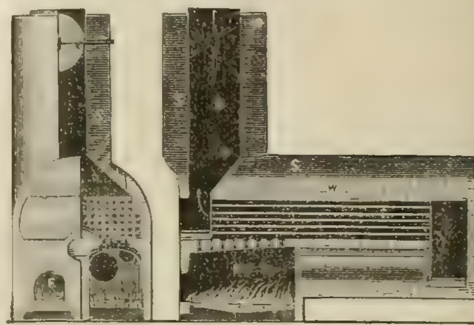
FIG. 8.



Cylinder Tubular Boiler set in brickwork.

edges, instead of riveting them, special machines being used for this purpose. Tubes thus constructed are now made from the smallest form of *pipes* to a diameter of 6 and 8 inches. This form of boiler, with its various modifications, is probably in more universal use at the present day than any other form of cylinder boiler. It constitutes the basis of all *marine tubular* boilers, even where the shell is not cylindrical, and for stationary engines is very extensively used. Fig. 8 represents one of these boilers set in brickwork. Fig. 9 represents varieties of a class of boilers

FIG. 9.

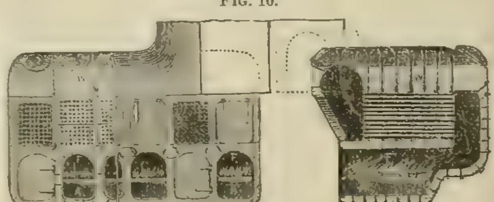


Return-flue Boiler.

which are known as *return-flue boilers*. They were at one time in very general use in steamboats and steamships in this country, and are still employed to some extent. They are characterized by having internal furnaces and internal flues, no external furnaces or brickwork being attached to the boilers. Constructed in this manner, they are ready for use as they come from the hands of the manufacturer. The shell in these boilers is made sufficiently large to receive within it the direct flues from the furnace, from front to rear, and also the return flues, the arrangements being as exhibited in the plate. These boilers having large diameters, it is necessary to strengthen the various parts by stays, as shown in Fig. 11. Around the furnaces the plates are stayed and kept in position by *sockets* and bolts, the sockets acting as struts and the bolts as stays.

Marine Tubular Boiler.—Fig. 10 represents a modification of the return-tubular boiler suited to marine purposes.

FIG. 10.



The limitation of space in the hold of a ship renders it necessary to contract the boiler-space as much as possible, and the form of boiler adopted generally is that illustrated in this figure. The arrangement of the furnaces, flues, tubes, and smoke-connections is as shown in the figure. In boilers of this character each boiler contains several

FIG. 11. FIG. 12.

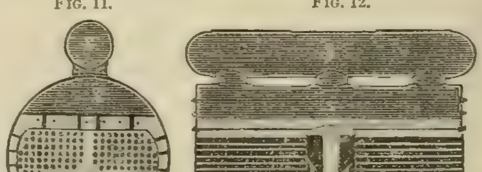
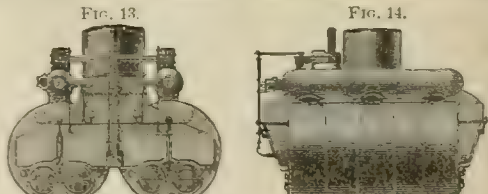


FIG. 13. FIG. 14.



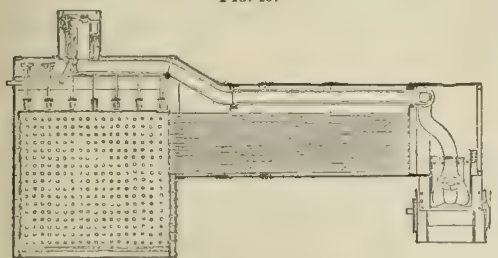
English Marine Tubular Boilers, with cylindrical shells.

furnaces, and two or more boilers are usually set together on opposite sides of the hold of the vessel, in such a man-

ner as to have a common chimney. The peculiar form of the shell is adapted to the space allotted to the boiler along the side of the ship's hold, as is usual in such cases. This form not being cylindrical, it is necessary to brace all flat surfaces which receive pressure. The manner in which this is accomplished is exhibited in the drawing. Figs. 11, 12, 13, and 14 represent a pair of boilers made by English manufacturers for a large steamship furnished with compound engines, the shells being 11 feet in diameter, and the iron of the shell $\frac{7}{8}$ths of an inch thick. These are becoming common in marine constructions, having the advantage of the greatest strength combined with the least material.

The Locomotive Boiler.—The railroad locomotive boiler (Fig. 15) presents features peculiar to its adaptation to a

FIG. 15.

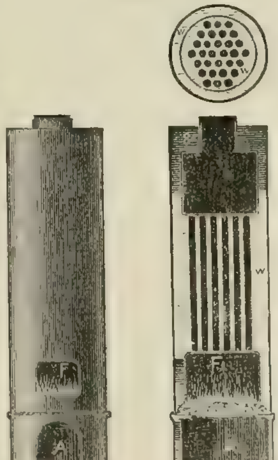


Locomotive-engine Boiler.

particular purpose, but the essential parts of all such boilers are exhibited in the plate. The fire-box is rectangular in cross-section, and the tubes pass directly from the fire-box to the smoke-connection or smoke-box. It will be seen from the construction that the fire-box is an isolated chamber, separated entirely from the sides of the boiler and surrounded by water. The sides and top being flat, and being subjected to external pressure, require to be strongly stayed to the shell. The crown-plate is stayed to the upper part of the shell, and the side plates and shell are connected by sockets and bolts, the stays acting as struts as well as ties. The shell, dome, and tubes are constructed on the same principles as are applicable to the cylinder-tubular boiler. The heating-surface comprises the interior surface of the fire-box and the interior surfaces of the tubes. The locomotive boiler is the type of a large class of boilers, the distinctive feature of which is that the tubes pass directly from the furnace or fire-box. For railroad engines various modifications are used, each establishment usually having a special form of construction.

A modification of the locomotive boiler, much used for portable and stationary engines, is known as the *upright boiler*, an illustration of which is given in Fig. 16. The simplicity of construction, convenience of access, and small space occupied by these boilers, combined with their evaporative qualities and strength, and combining, as they do, the chimney with natural draught with the upright shell, render them peculiarly adaptable for some conditions of use.

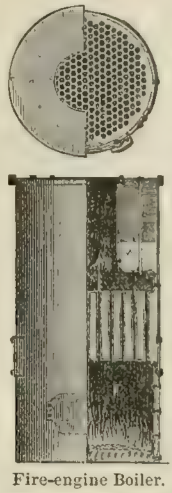
FIG. 16.



Upright Boiler.

A form of this boiler which demands special interest and attention is found in the *fire-engine boiler* represented in Fig. 17. This is essentially an upright boiler of the locomotive type, but its peculiarity consists in the great number of tubes and the great extent of heating-surface, compared with the cubic dimensions and the water space. To facilitate the sudden and quick raising of steam, the tubes are comparatively thin (usually made of brass or copper). This permits not only the introduction of a larger number in a given space, but the thinness of the tubes lessens the time for the first development of steam. The cut exhibited (Fig. 17) is from a drawing furnished by the Amoskeag Manufacturing Co. of Manchester, N. H. The dimensions of the boiler are as follows: Total height, 5 feet 4 inches; outside diameter, $31\frac{3}{4}$ inches; number of brass tubes, 301; diameter of tubes, $1\frac{1}{4}$ inches; length of tubes, 16 inches; distance from centre to centre of tubes, $1\frac{7}{32}$ inches; heating surface, 157 square feet.

FIG. 17.

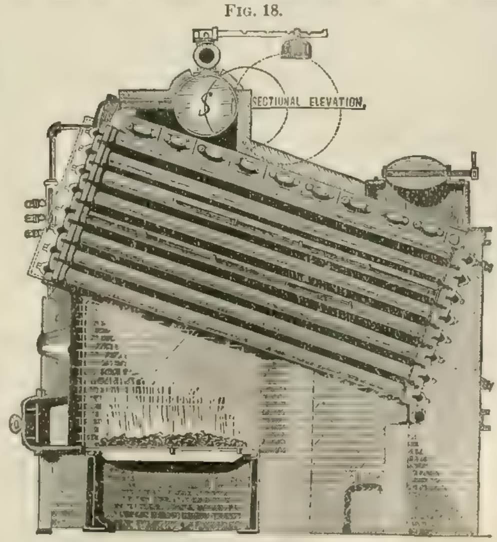


Fire-engine Boiler.

Sectional Boilers.—In all types of boilers thus far considered the water- and steam-space is either a single chamber, as in the plain cylinder boiler, or a chamber traversed by tubes, through which, in some cases, the heated gases find their way to the chimney, and in others the circulating water finds its way from one part of the water space to another, the heated gases passing around the outside of the tubes. The volume of the water is large in proportion to the heating-surface, and the circulation of the water is not confined to prescribed channels. Moreover, an external shell is necessary, which must contain the water and steam, and generally also the system of tubes, this shell being subjected to the whole effect of the steam pressure.

A system of construction which has come largely into use of late years, and which is becoming more and more advanced toward perfection in its mechanical details, is known in this country by the name of *sectional boilers*, and in France boilers with *rapid circulation* or *water-circulating boilers*. This system may be said to have originated with Mr. Jacob Perkins, who in 1831 obtained a patent in England for improvements in generating steam, in which he insisted on the advantages to be gained by causing the water to circulate rapidly over the heating-surfaces exposed to the direct action of the fire. In 1839, Perkins obtained a patent for a more complete apparatus involving this idea, under the title "apparatus for transmitting heat by circulating water." Steam-generators constructed with special reference to this idea were extensively tried, but were finally abandoned for the reason that, owing to practical difficulties in their construction, the high pressures employed, and the difficulty of keeping them in repair, they soon became unfit for use, and it is only from a comparatively recent date that they have again come into use under more favorable auspices. The *sectional boiler* consists essentially of a system of tubes so arranged that a continuous circulation of the water is maintained through the tubes from the mechanical action arising from some portions of the tubes being maintained at a higher temperature than others, the heated and lighter water ascending and the cooler and heavier water descending. The shell is dispensed with, and the heat applied directly by both radiation and contact to the exterior surfaces of the tubes. The steam-space is usually a large tube or a system of tubes with which the various *sections* of tubes are connected, and the various devices which are found in practical use for connecting and arranging the tubes, so that

FIG. 18.



The Root Boiler.

they shall form a compact arrangement with all the necessary conditions for applying heat, for accessibility, and for

promoting circulation, constitute the *sectional boilers* of the present day, which usually take their names from the inventors or manufacturers. An illustration of one of these boilers, the Root boiler, is given in Fig. 18.

Whatever may be the type of steam-generator selected for a special purpose, the following fundamental considerations are involved in its design and construction: I. Proportion of parts; II. Actual dimensions; III. Kind, quality, and strength of the materials employed, and the mechanical conditions of the structure.

The proper proportions of the parts determine the economy or efficiency of the apparatus; on the actual dimensions depends the capacity for producing steam, or, as it is sometimes expressed, the *power* of the boiler; and on the kind, quality, and strength of the materials employed, and the mechanical perfection of the structure, depend not only the first cost, but also the strength of the structure and its durability. The parts of which the relative proportions require special consideration are those which determine the *combustion of the fuel* and the *transfer of heat*. It is obvious that the first object to be attained is the thorough and complete combustion of the fuel. If any combustible gases or any portion of the fuel in the form of smoke escape from the chimney, a direct loss occurs, which should be prevented if possible. The combustion depends on the means of supplying the draught, and the quantity and disposal of the fuel with which the air comes in contact.

Chimneys.—The chimney, in all cases in which the draught is produced by a simple "chimney draught," performs the functions of a machine, and its dimensions (its height and cross-section), taken in connection with the area of the grate and the surface of contact of the fuel exposed to the action of the air, are the principal elements on which not only complete or perfect combustion, but the quantity of fuel burned in a given time, depend. In boilers provided with any other means of draught, such as the steam-jet or the blower, the dimensions of the chimney are not so important. In almost all stationary, and in nearly all marine boilers, the draught is produced solely by a chimney, which forms an indispensable and important part of the apparatus. The determination of the proper proportions between the heating-surface and the grate surface depends on the initial temperature of the gases; and as the initial temperature varies with the rate of combustion or the height of the chimney, the height of the chimney indirectly enters into the consideration of this proportion. It is well known that the draught of a chimney is caused by a difference of pressure at the base of the chimney acting in an upward direction, due to the difference between the weight of the heated gases in the chimney and a column of equal height and cross-section of the external air. This difference of pressure is easily found. If we take a unit of area of the cross-section—one square foot, for instance—the weight of the column of external air will be the height of the chimney multiplied by the density of the external air, and the weight of the column of heated gases of equal height will be equal to the height of the chimney multiplied by the density of the *heated gases*. If H be the height of the chimney, D the density of the external air, and D′ the density of the heated gases, the difference of pressure referred to will therefore be, in algebraic symbols, $p = \mathrm{H\,D} - \mathrm{H\,D'} = \mathrm{H(D - D')}$. This unbalanced pressure acts as a motive force to drive the heated gases through the chimney and out at the top. In order to find what height of column of the external air would produce this pressure, acting simply by its weight, we have to divide the pressure by the density of the external air, and will have—

$$\frac{p}{\mathrm{D}} = \mathrm{H}\left(\frac{\mathrm{D - D'}}{\mathrm{D}}\right).$$

It is a well-known law of dynamics that the theoretical velocity with which the air would enter the chimney if there were no resistance would be found by the equation

$$\mathrm{H}\left(\frac{\mathrm{D - D'}}{\mathrm{D}}\right) = \frac{v^2}{2g},$$

from which the theoretical velocity of access of external air would be

$$v = \sqrt{2g\mathrm{H} \times \left(\frac{\mathrm{D - D'}}{\mathrm{D}}\right)}.$$

The values of D and D′ may be readily found. If $\mathrm{D_0}$ represent the density or weight of a cubic foot of air at 32° and at atmospheric pressure, the weight at any other temperature will be $\mathrm{D = D_0} \times \frac{\mathrm{T_0}}{\mathrm{T_1}}$, $\mathrm{T_1}$ being the absolute temperature of the external air generally higher than $\mathrm{T_0}$, the absolute temperature of melting ice. For the weight of a column of the heated gases of the chimney having a base of one square foot, a similar process is to be followed. The results of experiments indicate that the weight of one cubic foot of the chimney gases—composed principally of carbonic acid, nitrogen, and oxygen—is at 32° F. and one atmosphere, 0.08424 pounds. Then $\mathrm{D'} = 0.08424 \times \frac{\mathrm{T_0}}{\mathrm{T_2}}$, $\mathrm{T_0}$ being the absolute temperature of melting ice, and $\mathrm{T_2}$ that of the chimney gases.

The velocity v determined from this formula is not, however, that with which the external air will enter the chimney. Resistance is offered to the passage of air through the grate, through the bed of fuel, and through the flues and chimney. These resistances do not admit of theoretical determination, and can only be found by direct experiment. They are proportional to the square of the actual velocity, and depend on the diameter and length of the flues and chimney, the thickness of the bed of fuel, and the state of division of the fuel. The experiments of Peclèt led him to propose the formula for the actual velocity essentially as given below:

$$v' = \sqrt{2gh\left(\frac{\mathrm{D - D'}}{\mathrm{D}}\right)} \cdot \sqrt{\frac{1}{1 + \mathrm{A} + \frac{\mathrm{K\,L}}{d}\left(\frac{\mathrm{T_2}}{\mathrm{T_1}}\right)^2}}.$$

In Peclèt's formula K represents a coefficient of friction, L and d the length and diameter of the chimney and flues, and A a coefficient of resistance of the grate.

The values of the velocity of access of air found by Peclèt for heights of 10, 20, and 30 mètres, or 32.8 feet, 65.6 feet, and 98.4 feet, were 5.1 feet, 8 feet, and 9.18 feet per second, or 18,360, 28,800, and 32,948 feet per hour. These velocities, divided by the number of cubic feet of air required to burn one pound of fuel, will give the quantity of fuel burned per hour for each square foot of section of the chimney, the section of the chimney being supposed equal to the free surface of the grate. In the ordinary process of combustion in a grate it is apparent that some of the air which enters must escape contact with the fuel and enter the chimney as air. The quantity which thus escapes has been usually assumed equal to the quantity which is required for combustion; or, in other words, the quantity which enters the furnace has been estimated to be double the quantity required for combustion. An ordinary estimate is, however, 250 cubic feet of air for the combustion of one pound of fuel. The consumption of fuel per square foot of section of the chimney will then be, for the heights above given—

Heights	32.8	65.6	98.4
Pounds	73.4	115.1	137.8

If it be assumed that each square foot of section of the chimney corresponds to 8 square feet of grate-surface, the above figures will give for the rate of combustion on each square foot of grate surface—

Pounds	9.2	14.8	17.2

These results seem to be the nearest that can be attained by combining theoretical considerations with experimental deductions. The conditions which exist in different chimneys and furnaces in regard to the resistances are so complex and various that no *theoretical* formula will give results which can be considered even approximately correct.

Showing Heights of Chimneys for producing certain Rates of Combustion per square foot of area of section of the Chimney.

Heights in feet.	Pounds of coal burned per hour per square foot of section of chimney.	Pounds of coal burned per hour per square foot of grate, the ratio of grate to section of chimney being 8 to 1.
20	60	7.5
25	68	8.5
30	76	9.5
35	84	10.5
40	93	11.6
45	99	12.4
50	105	13.1
55	111	13.8
60	116	14.5
65	121	15.1
70	126	15.8
75	131	16.4
80	135	16.9
85	139	17.4
90	144	18.0
95	148	18.5
100	152	19.0
105	156	19.5
110	160	20.0

A comparison of the results obtained by the partly empirical formula of Peclèt, applied to ordinary conditions of practice, with numerous examples in which the quantity of fuel burned and the dimensions of the chimneys are

given, has led the writer of this article to the suggestion of the preceding practical table of heights and quantities of fuel burned per square foot of section of the chimney per hour. This table is intended only to give approximate quantities; and although instances are given which differ from the table considerably, it is to be borne in mind that in constructing a chimney an excess of height should be chosen, since the draught may be afterward regulated by a damper, and no serious error in choice is likely to occur. It appears from the table that a difference of height of 6 to 8 feet corresponds to a difference in rate of combustion of about one pound per square foot of grate-surface, the ratio of the grate to the chimney section being 8 to 1. The quantities given in the table refer to the average conditions of chimneys of steam-generators.

Grate-Surface.—The height of the chimney, taken in connection with the temperature of the heated gases, determines the rate of combustion.

Heating-Surfaces.—The heating-surfaces of a boiler have already been defined to be all those surfaces or *plates* of the boiler which serve to transmit heat from the furnace or heated gases to the water or steam within the boiler. From the laws of transfer of heat it appears that the quantity of heat transmitted by any surface depends on the extent of the surface and the difference of temperature between the source of heat and the absorbent; or, in the case of steam-generators, the difference in temperature of the incandescent fuel or heated gases and the water in the boiler. The extent or amount of heating-surface is fixed with reference to the initial temperatures of the furnace and gases; or, since these temperatures are proportional to the rate of combustion, the extent of heating-surface will depend on the *rate of combustion* to be employed. The extent of heating-surface must evidently also be in proportion to the absolute quantity of fuel burned in a given time; or, what is the same thing, it must have a direct relation to the grate-surface.

The following results are taken from the published records of experiments made for the U. S. navy under the direction of Mr. B. F. Isherwood. The first horizontal line represents the quantities of anthracite coal, in pounds, burned on each square foot of grate-surface in a marine tubular boiler, the heating-surface remaining constant and having a ratio of 25 to 1 to the grate-surface. The second horizontal line represents the pounds of water evaporated under atmospheric pressure from 212° F. by one pound of coal:

Pounds of coal burned per hour.

6,	8,	10,	12,	14,	16,	18,	20,	22,	24.
10.5,	10.4,	10.1,	9.5,	8.9,	8.2,	7.7,	7.3,	7.0,	6.8.

Pounds of water evaporated.

A second series of experiments is furnished by Mr. D. K. Clark in his excellent work on *Railway Machinery*, in which he gives the amounts of evaporation for different *boilers* with varying rates of combustion and varying proportions of heating-surface. The following results are extracted from his work: The first horizontal line of figures gives the quantities of coke burned per hour on each square foot of grate-surface. The second gives the quantities of heating-surface in square feet required to preserve the evaporation constant for each pound of coke, and equal to 9 pounds of water for each pound of coke burned:

Pounds of coke burned on each square foot of grate.

14,	19,	25,	31,	38,	47,	56,	65,	76,	87,	98,	110,	125,	139,	153.
30,	35,	40,	45,	50,	55,	60,	65,	70,	75,	80,	85,	90,	95,	100.

Heating-surface for each square foot of grate.

These two sets of experimental results serve to show how, in the first place, the economic evaporation varies with the rate of combustion, the heating-surface remaining the same; and in the second, how the heating-surface must vary if the rate of evaporation remains constant.

Inasmuch, however, as it is impossible to vary the heating-surface at will, after a steam-generator is constructed, it is customary to fix the extent of this surface according to average conditions of use, taking into account average rates of combustion. The following proportions represent as near as can be ascertained the usual rules of practice. The grate-surface being 1, the heating-surfaces are for—

Plain cylinder boilers	10 to 15,	average	12.
Cornish boilers	30 to 40,	"	35.
French cylinder boilers	25 to 40,	"	33.
Cylinder-flue boilers	17 to 25,	"	21.
Cylinder-tubular boilers (chimney draught)	25 to 30,	"	28.
Traction-engine boilers		"	32.
Marine tubular and flue boilers—French, English, and American practice		"	25.
Locomotive boilers	40 to 100,	"	75.

The rates of combustion per hour and per square foot of grate, in ordinary practice, are, according to Rankine—

Slowest rate in Cornish boilers	4 lbs. per hour.
Ordinary rate	10 " "
Ordinary rate in factory boilers	12 to 16 lbs. per hour.
Ordinary rate in marine boilers	16 to 24 " "
Locomotive boilers	40 to 120 " "

The amount of heating-surface required to evaporate one cubic foot of water per hour at 212° is for—

Plain cylinder boilers	8.8 square feet.
Galloway multitubular boiler (water-tube boiler)	8.5 "
Marine tubular boiler	14 "
Double-flue Cornish	11.7 "

For these the rate of combustion is such that the total heating-surfaces are sufficient to evaporate 9 pounds of water for 1 pound of coal.

The following conclusions are deduced from Mr. Isherwood's experiments. The boilers of various steamships on which experiments were made, with the results, are indicated by the names of the vessels:

Jacob Bell	marine tubular	19	12	11
Mt. Vernon	"	19	10.5	10.5
Valley City	"	16	11.2	9.16
Crusader	"	16.8	11.8	9.3
Wyandotte	vert. water-tubes	20	12.4	10
Underwriter	hor. flue boilers	15.6	11.2	9.9
Young America	" " "	15	10.4	9.3
Boston, of N. Y.	marine tubular	18	11.1	11.5
				82.1
				10.2

1st column, Heating-surface required per indicated H. P.; 2d column, water evaporated per hour per pound of combustible; 3d column, combustible in pounds burned per hour per square foot of grate.

The practice of the navy department is to allow 8 pounds of anthracite coal per hour to evaporate 1 cubic foot of water at 212°, under a pressure of 30 pounds per square inch, which requires two-thirds square foot of grate and 16⅔ square feet of heating-surface.

The quantity of water evaporated per pound of coal for the plain cylinder boiler, the cylinder-flue boiler, and the cylinder-tubular boiler, in the order given, is, under the most favorable circumstances, 7, 8, and 9 pounds of water for each pound of coal burned. The railroad locomotive is the only boiler in which the rates of combustion are frequently and greatly varied while in use; and in these boilers it is necessary to provide for very high rates of combustion by giving an extreme amount of heating-surface. The locomotive boiler, with ordinary rates of combustion, corresponds, in evaporative efficiency, to the ordinary marine tubular boiler.

Causes which affect the Efficiency of Evaporation.—These are, 1st, those which influence the *rate of combustion*; and, 2d, those which influence the *rate of transfer of heat*. Among the causes which influence the rate of combustion may be mentioned the temperature of the external air, the temperature of the chimney gases, the presence of moisture in the air, the management of the fires, the quality of the fuel, and defective combustion. The principal causes which affect the transfer of heat are the rate of combustion, which determines the initial temperatures in the boiler; the temperature of the water in the boiler; the accumulations of incrustations and dust in the tubes; and generally all those circumstances which impair the qualities of the heating-surfaces. The management of the fires and the quality of coal are most important influences on the rate of combustion and economy of fuel.

Horse-power of Boilers.—The term *horse-power* can hardly be applied with propriety to steam-generators, inasmuch as it implies a *rate of work*, and a boiler ordinarily does no work, but merely supplies the means of work to a machine. The amount or rate of work is thus dependent on the utilization of the steam, and must vary with the variations of the machine which utilizes it. Moreover, the application of this term to boilers is especially inappropriate when it is determined solely by the dimensions of the boiler, as is usually the case; a boiler of certain dimensions being spoken of as a boiler of 10-horse power, another of larger dimensions as one of 20-horse power, etc. In reality, a boiler called a 10-horse-power boiler may, according to any rational rule which can be adopted, be made a 20-horse-power boiler by simply increasing the rate of combustion or the pressure of the steam, or both combined. This becomes a matter of some importance when boilers are bought and sold according to their *horse-power*, because in case of dispute it is impossible to attach definite ideas to the terms employed, unless it be at the same time specified what is to be the rate of combustion and the pressure. The rate of combustion is subject to such variable conditions that it is difficult to establish it precisely, and the custom of describing the capacity of boilers by the term *horse-power* is therefore liable to lead to difficulty. In regard to the use of the term, it must be admitted, however, that it is a convenient mode of designating the capacity of land boilers, where *average*

conditions of pressure and rate of evaporation are understood. There is, however, a want of uniformity among manufacturers in regard to what amount of heating-surface should constitute a horse-power with chimney-draughts, the amounts ranging from 12 to 18 square feet.

Kinds and Quality of Materials.—The materials employed in the construction of boilers consist of plates rolled or shaped into the forms necessary for the shell, tube-sheets, and heads, tubes or flues formed by drawing or by lap-welding, rivets for the joints; rods acting as stays; plates or castings for the fronts and doors; and bars for the grates. When boilers are set in brickwork, it is to be understood that the external work is to be of a character such as will resist the action of heat, as well as prevent its dissipation through radiation and conduction. The materials now universally used for the shell are wrought iron and steel. Cast iron is sometimes employed for the heads of small cylinder boilers and for steam domes or steam-chambers, but owing to its rapid deterioration under the action of heat it is not a suitable material for heating-surfaces. It is, however, employed largely in the fronts, grate-bars, for attachments for valves and pipes, and for man-hole and hand-hole plates.

Theory of Stress in Boilers.—By the term "stress" in applied mechanics is meant the force which acts directly upon the particles of any material to separate them. In boiler construction the adoption of the cylindrical form for the shell and flues or tubes causes this stress to be always a tensile stress on the shell, on flues subjected to internal pressure, and on the stays. The stress is a compressive one on flues or tubes subjected to external pressure, and a shearing stress on rivets. Bending moments are carefully avoided in all parts of the structure. The tensile stress upon the material of a cylindrical shell tending to rupture it longitudinally is found as follows: Let p denote the elastic force of the steam in pounds per square inch, d the diameter of the cylinder, t the thickness of the shell. If we consider unity of length of the cylinder, the total force tending to produce rupture will be pd, d being expressed in inches. The total resistance of the material will be $2t \times f$, f being the resistance to tension of the material; and the conditions of equilibrium require that

$$pd = 2tf,$$

from which the thickness of the shell is obtained—

$$t = \frac{pd}{2f}.$$

For the same internal pressure and the same material the thickness for different diameters will be proportional to the diameter. For the stress in the direction of the axis of the cylinder, the total pressure in this direction will be $p \times \frac{1}{4}\pi d^2$, and the resistance of the material in the cross-section will be $f \times \pi dt$. Placing these quantities equal to each other, we have—

$$p \times \tfrac{1}{4}\pi d_2 = f\pi dt;$$

or,

$$p\tfrac{1}{4}d = ft,$$

$$t = \frac{p}{4}\frac{d}{f}.$$

This result shows that the area of resistance to rupture in the direction of the axis, *relatively to the total area of pressure*, is double that in the first case; or, in other words, the stress *per square inch* of material in the direction of the axis is only half that which tends to rupture the boiler along a longitudinal plane through the axis. The tenacity f may be taken for the *bursting tension*, the *proof tension*, or the *working tension*. Mr. Fairbairn gives the values of f for wrought iron: bursting tension, 34,000; proof tension, 17,000; working tension, 4250 pounds per square inch. This is equivalent to making the factor of safety 8, which, however, is greater than that usually adopted in practice. It is assumed that the working pressure, multiplied by the factor of safety, will produce rupture. If the working pressure be 60 pounds per square inch, for example, a pressure of 480 pounds per square inch will produce rupture. Ordinary boilers constructed for a working pressure of 60 pounds will hardly bear, before rupture, 480 pounds. Proof-tests of double the working pressure are allowed, although these tests are generally limited to one and a half times the working pressure.

In the construction of boilers the junction of the plates requires special care and attention, inasmuch as the resistance of the joints determines the total resistance. Riveted joints are made in several different modes, the principal of which are the *lap joint single riveted*, the *lap-joint double riveted*, the *butt joint single riveted*, and the *butt-joint double riveted*. The stress upon the rivets is a shearing stress. The butt joint is formed by adjusting the edges of two plates and covering the joint on both sides by covering-plates, riveted with either one or two rows of rivets on each side of the joint.

The order of strength of these joints, in terms of the strength of the original plate, according to Clark, are for plates $\frac{3}{8}$ inch thick and less—

		Working strength.
Original strength of plate*......	100	11,000 lbs. per square inch.
Single-riveted lap-joint............	60	6,700 " " " "
Double-riveted lap-joint............	72	8,000 " " " "
Double-riveted butt-joint.........	80	9,000 " " " "

The above figures are given for the best English Yorkshire plates. Fairbairn estimates the strength of joints to be, in terms of the strength of the plate—

Strength of plate..................	100	Bursting tension.......	34,000 lbs.
Double-riveted joint.....	70	Proof tension...........	17,000 "
Single-riveted joint.............	56	Working tension......	4,250 "

the working tension being one eighth of the bursting tension. For cast-iron pipes the working tension may be estimated at one-sixth the bursting tension, and the values of the tenacity in practice may be estimated at

16,500 lbs. per square inch for bursting tension.
5,500 " " " " " proof tension.
2,750 " " " " " working tension.

Welded joints for boilers have been found to possess the same strength as the original plate, but practical difficulties prevent the adoption of this process for ordinary work. The thickness of boiler-plates is practically limited in both directions. Very thin plates cannot be caulked, and very thick plates cannot be riveted. The limits are practically about one-fourth of an inch for the lower limit and three-fourths of an inch for the higher limit. The riveting-machine is essential for very thick plates, a thickness of half an inch being near the limit of hand-riveting. The usual thicknesses for boilers are $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$.

The ordinary feed-pump of boilers needs no special description, as it is constructed on the principle of the force-pump described under the article PUMP.

The Giffard injector, used also for this purpose, requires a special notice. It is represented in Figs. 19 and 20,

FIG. 19.

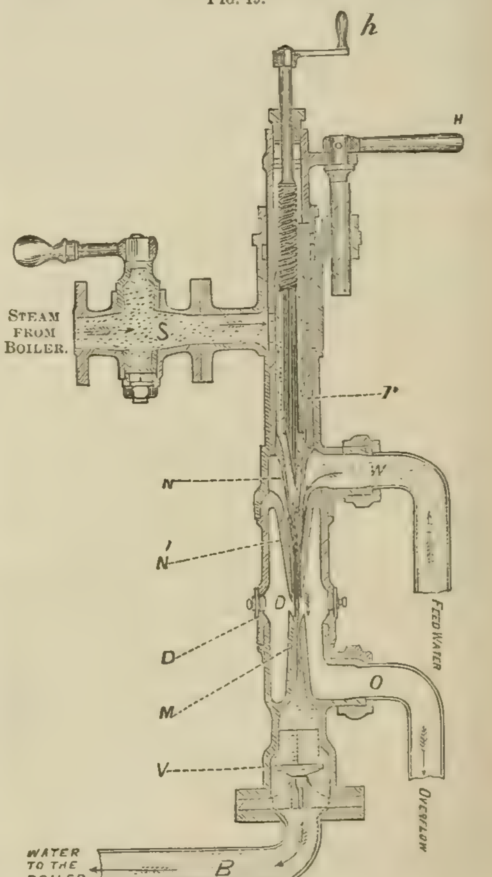
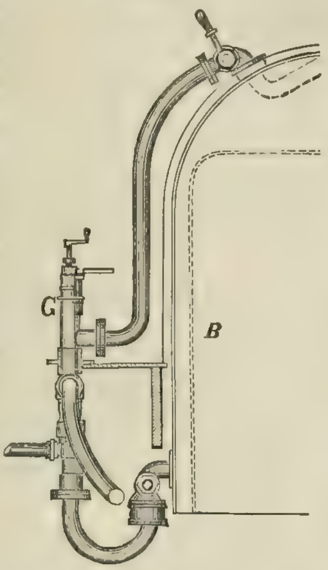


Fig. 19 representing a section longitudinally, showing the internal structure, and Fig. 20 exhibiting the injector in place attached to a boiler. In Fig. 19, S represents a cock through which steam is let into the injector from the boiler: the steam flows down through the hollow casing of the instrument to a conical nozzle N. This nozzle is sur-

*Holley.

rounded, when the instrument is in action, by the feed-water, which enters through the pipe W. The nozzle N is adjustable longitudinally by the screw and handle H, so that it may be set more or less within or toward the fixed cone N′, and thus act as a regulator of the water-supply. A spindle *r*, adjustable by a screw with a handle *h*, regulates the steam-supply as it is set more or less into the cone N. M is an inverted fixed cone or nozzle below N′, the two fixed nozzles N and N′ standing opposite each other, but not meeting. A pipe B, fitted with a check-valve V, leads from the nozzle M back to the boiler. The action of the injector is as follows: Steam from the boiler is let on by the cock S; it flows with great velocity through the cone N and through the fixed cone N′. In its motion it draws water along with it from the feed-pipe W, partly by contact and partly by a condensation which causes a partial vacuum in the space at the mouth of the nozzle N. The result is a stream of hot or warm water issuing from the fixed nozzle D with a high velocity; the stream crosses the short space at D, and impinges upon the mouth of the inverted cone M, which is soon filled, and then the steam exerts a pressure equal to its *momentum* upon the water in this space, and forces open the check-valve V; the current of warm water then continues in an uninterrupted stream into the boiler through the pipe B. It will be observed that all parts of this apparatus are fixed except the cock S, the valve V, and the adjusting parts attached to the handles H and *h*, the first of which regulates the supply of water, and the second the supply of steam. O is an overflow by which any surplus of water entering the space D is carried back to the feed-tank. This overflow practically ceases as soon as the adjustments of the feed of steam and water are made.

Fig. 20.



In regard to this instrument, it has been determined theoretically that it is quite as economical, as far as expenditure of heat is concerned, as the force-pump, and has the advantage over the force-pump in having no moving parts when in action, and hence the work lost by friction of mechanism is nothing. The quantity of heat expended depends only on the quantity of water which is introduced into the boiler, and not on the quantity of steam which the injector uses, nor the temperature at which the feed-water is introduced into the boiler. Water may by this instrument be introduced into a boiler at high pressure by steam from a boiler at low pressure, but the injector ceases to act when the *feed-water* has a high temperature, because the vacuum formed at the outlet of the nozzle N is impaired, and water ceases to flow with sufficient rapidity from the feed-pipe W. The principle on which the injector works is the same as that which determines the action of the steam-jet pump, the difference between the two being that in a jet-pump, which forces water into the atmosphere, all the heat which is imparted to the feed-water is lost, while in the injector this heat goes back into the boiler; the jet-pump for ordinary pumping purposes is therefore excessively wasteful of heat, while the injector employs no more heat, practically, than that which is equivalent to the work of the common feed-pump.

It has been found by experiments made in England that for pressures of 10, 20, 30, 40, 50, and 100 pounds per square inch in the boiler, the temperature of the feed-water should not exceed 148°, 138°, 130°, 124°, 120°, 110°, respectively, the quantity of water forced into a boiler per hour by the same injector increasing with the pressure of steam.

Supply of Feed-Water.—The supply of water to a boiler is of course indispensable to its performance. It is usually accomplished by an independent apparatus, a pump or an injector being employed. The capacity of the feeding apparatus should be such as to supply sufficient water not only for the highest rate of evaporation likely to be attained, but to supply all losses from priming, leakage, blowing off, etc. Care should be taken that the feed-water does not impinge on the plates or flues, as the sudden cooling at one point is liable to fracture the plates. Such fractures cannot always be discovered when the boilers are inspected, and are always a source of danger. For land engines a capacity of two and a half times the net feed-water required by the engine is the rule given by Rankine. Proper arrangements for regulating the supply to the boiler are required. Where steam is used for heating purposes, the condensed steam is returned to the boiler by the action of gravity, the waste being supplied from time to time by the attendant through a cock operated by hand.

Feed-water heaters are devices by which the exhaust-steam from engines is caused to pass through pipes, through which the feed-water also flows in contact with these pipes. A part of the waste heat of the engine is thus utilized in raising the temperature of the feed-water before it reaches the boiler. The saving effected, in units of heat, is the quantity of heat, nearly, required to raise the temperature of the feed-water from its natural temperature to the temperature at which it is supplied to the boiler.

The risk of life and property which attends the use of the steam-boiler has always been a source of constant anxiety to the engineer and to the public. Explosions continually take place under circumstances of the utmost apparent security: as they occur without warning and occupy but an instant of time, it is generally impossible, except in rare instances, to ascertain with certainty their true cause, and there is seldom a unanimous opinion on the part of experts who examine into the causes after the event. The loss of life and damage to property often produce great public excitement and private distress, and are sometimes followed by suits for damages or indictments for manslaughter. It becomes, then, a matter of serious importance not only to ascertain how far explosions may be prevented, but also the degree of individual responsibility to be attached to them.

It has been remarked that the conditions of safety and economy in the case of steam generators, as in nearly all other structures, are in direct antagonism—economy of construction demanding the least amount of costly materials, and safety requiring such an excess of strength as shall place accidents beyond all contingencies of use and management. In the forms of boilers which are most exposed to explosions it is customary to provide theoretically for a factor of safety of 6 to 8; that is, an internal pressure of six or eight times the working pressure is supposed to be sufficient to produce rupture. This theoretical factor is, however, seldom realized. It is doubtful whether boilers of the common forms are ever manufactured so strong that four times the working pressure, if applied, would not cause permanent injury or rupture, and proof-tests of three times the working pressure would be objected to by any manufacturer, on the ground that it would permanently injure the structure.

There are evidently numerous possible causes of explosion, some of which may be subjected to exact analysis, and means of preventing such causes may be provided; while there are supposed to be other causes not yet fully understood. In a great majority of cases it is safe to say, however, that explosions arise from defects or other causes simple enough in themselves, but which, at the moment, are either hidden from observation or are unavoidable accidents. Excellence in material and workmanship, and intelligence and watchfulness on the part of the attendant, are the surest guaranties of safety. Where such narrow limits exist, although it may not be possible to state positively all the causes of explosions, yet some of the more evident sources of danger may be pointed out. It may be asserted, for instance, as a self-evident truth, that the real or remote causes of all explosions may be reduced to two proximate causes. *First*, insufficient strength of the structure to resist the ordinary working pressure. Such a deficiency in strength may arise from an original defect in the materials or workmanship at the time of construction, or it may be due to deterioration from use, from ordinary wear and tear, or from injuries occurring from mismanagement, want of attention and repairs, etc. Manufacturers and engineers are supposed to comprehend fully these causes of danger, and it is the object of good engineering and good management to avoid them. The *second* cause of danger arises from an accumulation of pressure within the boiler to a dangerous degree above that which the structure is designed to resist. When the limits of safe *working pressure* are exceeded, the danger begins, and beyond a safe *proof-tension* it becomes imminent. The accumulation of pressure may be *gradual*, and due simply to the increase which accompanies a continued evaporation when there is not sufficient outlet for the steam constantly formed, or it

may, according to prevailing ideas, arise from a *sudden* evolution of steam in amounts too great for any ordinary means of efflux, extraordinary stresses being brought to bear from the expansive forces thus generated.

First, in regard to *gradually-increasing pressure*, to what extent may the engineer or stoker be held responsible, or what degree of watchfulness is necessary on his part? One question to be solved is, At *what rate in time* will the pressure in any given boiler increase if there is a constant rate of ordinary evaporation, and no outlet for the steam? and another, To what extent can the engineer trust the ordinary safety-valve to prevent this gradual increase or to furnish an outlet for the steam?

The rate of increase of pressure may be found theoretically by means of a formula given by Prof. Zeuner in his work on the *Mechanical Theory of Heat*. Let T be the time, in minutes, which must elapse from the instant that all efflux of steam is prevented in a boiler to the instant when a dangerous or bursting pressure must follow: let W represent the weight of water in the boiler; t_1 the temperature of the water due to a dangerous pressure; t the temperature due to the working pressure; Q the quantity of heat, in British units, transferred to the water per minute; then

$$T = \frac{W(t_1 - t)}{Q}$$

will give, with a sufficient degree of approximation, the time in minutes, the mean specific heat of water being taken as unity. This formula shows that the time will be proportional *directly* to the *amount of water* in the boiler, to the *difference of temperatures* t_1 and t, and *inversely* proportional to the quantity Q. The fluctuations of pressure will be less rapid in boilers which contain large quantities of water and have at the same time a low rate of evaporation. Such conditions are found especially in marine boilers, while the reverse is true for boilers containing small quantities of water and having rapid rates of evaporation, such as locomotive and fire-engine boilers. The fluctuations will also evidently be more rapid at high pressures than at low pressures, since at high pressures a greater change of pressure occurs with an equal difference of temperatures than at low pressures. The following example will exhibit the applications of the formula:

Example 1.—A marine tubular boiler of the largest size W = 79,000 pounds of water. Suppose the working pressure to be $2\frac{1}{4}$ atmospheres, and the dangerous pressure to be 4 atmospheres. The boiler contains 5000 square feet of heating surface; and supposing the evaporation to be 3 pounds of water per hour for each square foot of heating-surface, we shall have, taking as a sufficient approximation in round numbers, 1000 units of heat as the thermal equivalent of the evaporation of 1 pound of water.

$$t_1 - t = 29° \text{ F.}$$

$$Q = \frac{5000 \times 3 \times 1000}{60},$$

$$T = \frac{79000 \times 29}{\frac{5000 \times 3 \times 1000}{60}} = 9.1 \text{ minutes.}$$

Example 2.—The Steam Fire-Engine.—Taking an actual case: The boiler contains 338 pounds of water and has 157 square feet of heating-surface. Supposing each square foot of heating-surface to generate only one pound of steam in one hour, the pressure will rise from 100 to 200 pounds in T = 7 minutes.

Safety-Valves.—It is supposed that the gradual increase of pressure above discussed can never take place if the safety-valve is in good working order and if it have proper proportions. It should be observed, however, that engineers do not, in practice, place their trust in the safety-valve alone, and that to their watchfulness and attention the public are more indebted for safety than to the apparatus which is designed to regulate the pressure.

The theoretical area of orifice O′ for the efflux of a given quantity of steam from a boiler into the atmosphere, supposing this orifice to be a circular area, may be determined by first ascertaining the theoretical velocity of efflux, and multiplying this by a coefficient ascertained by experiments. It has been customary to fix the cross-section of the efflux-pipe or the area of the conical safety-valve by empirical formulas, resulting from actual experience. The experiments made by Mr. R. D. Napier on the efflux of steam at different pressures and with different orifices have not only furnished the means of determining the coefficients of efflux, but for determining empirical formulas for the area required for the discharge of a given weight of steam per second. An approximate formula given by Rankine is as follows: When the pressure in the boiler is equal to or greater than five-thirds the external pressure, the weight of steam discharged from an orifice of unit of area in one second is $W = \frac{p_2}{70}$, p_2 being the boiler-pressure in unit of weight on unit of surface. The number of pounds of steam discharged per square inch of area per second, the boiler-pressure being p_2 pounds per square inch, will be $W = \frac{p_2}{70}$, and for an orifice O it will be $O W = \frac{p_2}{70} \times O = W$, then $O = \frac{70\,W}{p_2}$.

Example.—Suppose a boiler to evaporate 1800 pounds of water per hour, what area of orifice (supposed to have the form of a cone of the shape of the contracted vein) will be sufficient for the discharge of all the steam, the pressure in the boiler being 4 atmospheres, or 58.8 pounds per square inch? We shall have

$$A = \frac{70}{58.8} \times \frac{1800}{3600} = \frac{70}{58.8} \times 0.5 = 0.60 \text{ square inches.}$$

It is thus seen how small an area of orifice is sufficient to discharge all the steam in the example given.

The ordinary safety-valve is a disk with a bevelled edge, resting on a corresponding seat. The disk is kept down against the boiler-pressure by external pressure variously applied, either by a weight acting with a leverage or by a spring. The opening for the efflux of steam, created by the rise of the valve, is thus an annular opening, the area of which may be approximately found by multiplying the mean circumference of the disk by the rise of the valve measured perpendicularly to the bevelled edge. Representing the orifice by O, the height of rise by l, and the mean circumference by c, the opening or *orifice* will be approximately $O = l \times c$. In the above example we should have $O = 0.60$ square inch $= l \times c$. If the diameter of the disk of the valve is 6 inches, the circumference will be, approximately, 18 inches, and $l = \frac{0.60}{18} = \frac{1}{30}$; the rise of the valve will be $\frac{1}{30}$th of an inch. As the rise l is a result of forces the magnitudes of which are not easily determined, there is a difficulty in applying theoretical rules to the subject. One English empirical rule is that the safety-valve *area* shall have half a square inch for each square foot of fire-grate, or .025 of a square inch for each square foot of heating-surface. Others, quoted by Rankine, are as follows: Let A be the area of the piston, V its velocity in feet per minute, P the excess of pressure in the boiler above that of the atmosphere in pounds on the square inch; then the area will be

$$a = A \frac{V}{300\,P}, \text{ nearly.}$$

Another quoted by the same author is: "a = area in square inches = from $\frac{1}{25}$th to $\frac{1}{30}$th of the number of pounds of coal burned per hour, or a the area in square inches = $\frac{1}{150}$th to $\frac{1}{180}$th of the water evaporated per hour."

The French rule for the diameter of the valve, as given by Peclèt, is—

$$D = 2.6\sqrt{\frac{S}{n - 0.412}},$$

or,

$$S' = 5.30\,\frac{S}{n - 0.412}.$$

(In these formulas D, the diameter of the disk, is given in centimètres; S is the heating-surface in square mètres; S′, the area of the disk in square centimètres; and n the pressure in atmospheres.) In Germany the laws require that the area of the *disk* of the valve shall be determined by a rule which may be stated as follows: P being the absolute internal pressure, the area of the disk in square inches *for each square foot of heating-surface* is to be determined by the formula

$$A = \frac{1.2}{P + 15}.$$

In all cases it is not only a matter of observation, but a theoretical law, that as soon as efflux begins there is a considerable diminution of pressure underneath the valve; and numerous devices have been proposed by which the opening of the valve shall not be influenced by the pressure in the orifice, but by the action of the pressure at a point remote from the orifice. The equilibrium between the full internal pressure of the boiler and the external forces acting upon the valve is then not disturbed by the actual pressure in the orifice. This seems to be the only principle that can render the safety-valve a perfect regulator of pressure.

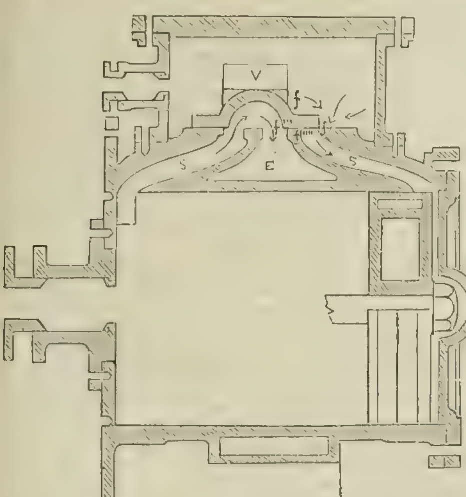
There are supposed to be, under some circumstances, sudden evolutions of steam in such quantities that no relief is *possible* through the medium of safety-valves, however perfect they may be in their action, and under circumstances in which no warning occurs. In regard to such

causes there is much diversity of opinion, but they are supposed to be connected with a deficiency of water in the boiler, and it is considered of vital importance to keep up the supply under all circumstances.

As long as it is necessary to construct steam-boilers with large shells, put together in pieces, fastened by seams, the factor of safety being only 4 or 5, it must happen that of the large number in daily use some must yield to the heavy internal pressures, and explode. The sectional boiler is gaining popularity continually, not so much from its evaporative powers, as from the fact that it has a very large factor of safety, probably as high as 20. Mr. Perkins of London, grandson of the inventor Jacob Perkins, uses steam in several small boats at pressures of 250 and 500 pounds per square inch, the boilers being of the class called sectional boilers. The actual risk with these boilers at this high pressure is probably not as great as that with ordinary shell boilers carrying 80 to 100 pounds pressure.

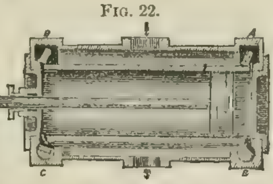
The cylinder, as applied to the steam-engine, comprises all forms of the chamber or working space in which the steam, by acting upon a movable surface, produces motion against a resistance. This working chamber is almost universally cylindrical, and the movable surface is usually

Fig. 21.



the end of a piston of a cylindrical form accurately fitted to the interior of the cylinder, and moving in the direction of the axis of the cylinder. This most common form of a cylinder is shown in Fig. 21, which represents a longitudinal section of a cylinder, with its piston and piston-rod. Fig. 22 represents a section of the cylinder of the Corliss engine. It shows a different arrangement of openings for the entrance and exhaust of steam. Fig. 23 represents the piston with its packing-rings; these rings serve to prevent the escape of steam past the piston.

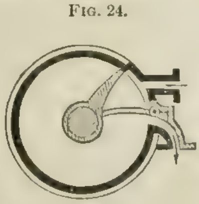
Fig. 22.



Figs. 24 and 25 are sketches illustrating the rotary forms of engine as invented by Watt and Bramah respectively. In these engines the cylinders are truly cylindrical, but the pistons revolve about the axes of the cylinders. The action of the steam in each of these may be seen by inspection. Of

Fig. 23.

Fig. 24.



many hundreds of devices of rotary engines these are the principal types. In the compound engine the steam performs its work in two or three cylinders successively. These devices need not be here described in detail, as they are introduced merely to exhibit a few of the various forms of cylinders or working chambers which have been employed.

The following cut (Fig. 26) exhibits the mechanism of the ordinary non-condensing stationary steam-engine, by which the reciprocating rectilineal motion of the piston and piston-rod is converted into continuous rotary motion. In this cut, C represents the cylinder, C′ the cross-head moving in guides, C″ the crank, C‴ the connecting-rod, F the fly or band-wheel, *s* the steam-pipe. Fig. 27 represents generally the corresponding features of the Corliss engine, and Fig. 28 the mechanism of the American beam engine, as designed for large steamships and river boats. In this sketch C represents the cylinder, C″ the condenser, B the working- (or "walking-") beam, C‴ the connecting-rod, C'''' the crank, A the air-pump, V valve-gearing.

Fig. 25.

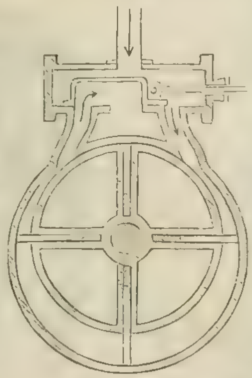
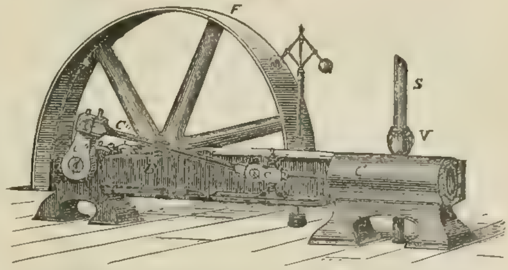


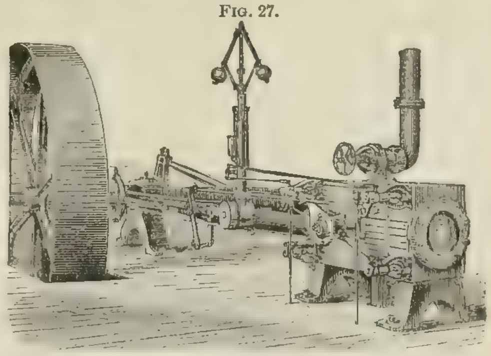
Fig. 26.



Babcock and Wilcox Horizontal Stationary Engine.

Fig. 29 exhibits an arrangement of mechanism of a compound engine for a propeller.

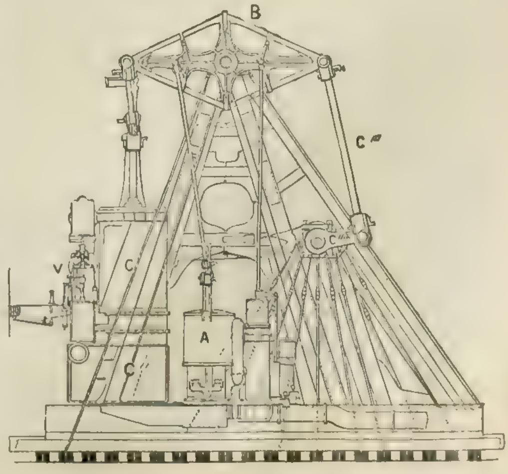
Fig. 27.



The Corliss Steam-engine.

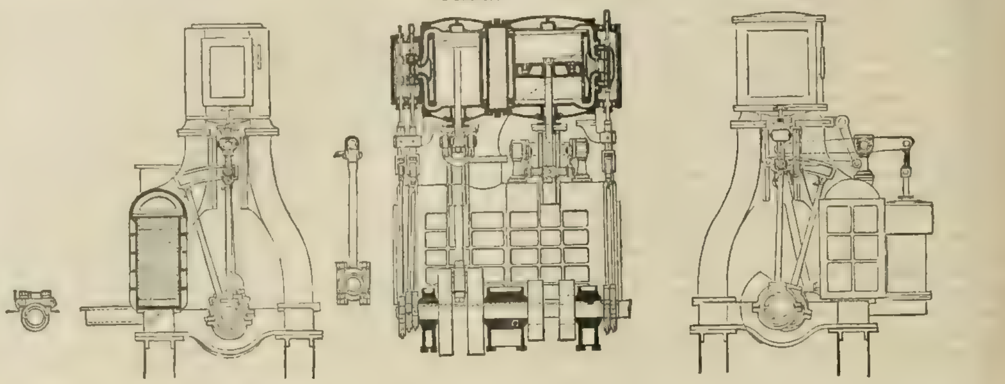
These illustrations exhibit a few of the forms of combination which the mechanism of the engine takes under

Fig. 28.



different circumstances, but it is impossible in a brief sketch to describe minutely even these general forms, much less to mention all the various combinations which the mechanism assumes. A few general classifications only can be given. A *single-acting* engine (*e. g.* the Cornish pumping engine) is one in which the steam acts upon one

Fig. 29.



side of the piston only, the opposite end of the cylinder being open. A *double-acting* engine is one in which the steam acts on both sides of the piston alternately. A *direct-acting* engine is one in which the connecting-rod extends beyond the cross-head, away from the cylinder, and a *back-acting* engine one in which the connecting-rod is brought from the cross head back toward the cylinder or beyond it. Engines are also classed as *vertical* or *horizontal*, according as the cylinder is vertical or horizontal. An *oscillating* engine is one in which the cylinder is mounted on trunnions, the steam being received and discharged through the trunnions. Such engines have no connecting-rod, the piston-rod being directly connected with the crank.

Nearly all marine engines, except the beam engine, have two cylinders, connecting with cranks at right angles to each other (see Fig. 29), in order to equalize the action of the power.

Another mode of descriptive designation of engines relates to the general nature of the machine and kind of work which it performs; for example, *marine engine, stationary engine, portable engine, locomotive engine, hoisting engine, pumping engine*, etc., each of these varieties having its characteristic mechanism and connections. In the rotary engine the motion of the piston or its equivalent is circular and continuous in one direction, and what is the crank-shaft in other engines is in this the shaft on which the piston revolves. No piston-rod, connecting-rod, or crank is required; and thus, as far as these parts are concerned, the mechanism is the most simple and compact of all engines. The difficulty of providing a perfectly steam-tight working-space for the steam in this class of engines, with freedom from excessive friction, and the existence of other defects which no inventor has yet remedied, render this form very inefficient, notwithstanding its compactness.

The *cylinder* and *common piston*, with the *piston-rod, connecting-rod*, and *crank*, may therefore be regarded as the elements of the mechanism in universal use, whatever may be the other parts of any particular combination. To this form we shall refer in discussing the subject of *valve-gearing*. The term *valve-gearing* comprises all the special mechanism attached to the cylinder, which, deriving its motion indirectly from the motion of the piston, acts in such a manner as to open and close, at proper times, the passages by which the steam enters and is discharged from the cylinder. Those pieces of this mechanism which act directly to close the passages are called valves. The mechanism by which they are moved is properly the *valve-gearing*. A full description of the common slide-valve, with the principles of mechanism involved in its use, will illustrate the subject: other kinds of valves and their special mechanisms will then need only a passing notice.

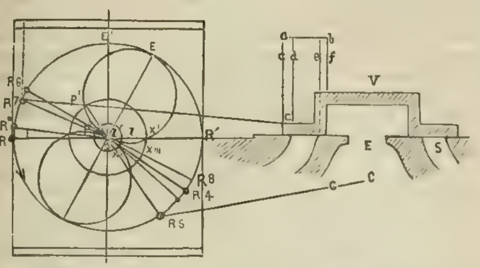
Fig. 21, already given, shows a section of a cylinder by which the action of the common D slide-valve (so called from the shape of its section) may be explained. In this section V represents the valve, situated in a rectangular box or casing, which is in full communication with the boiler when the engine is running. This box, called the *steam-chest*, situated on the side of the cylinder and forming part of it, is constantly full of steam at nearly the boiler-pressure when the engine is in motion. S S are passages called steam-passages leading from this chest to the ends of the cylinder: E, a passage called the exhaust port leading to the open air or to the condenser. The *ports* are long rectangular openings in a plane surface on the side of the cylinder. The valve V has such form and dimensions that it covers all these ports when in its neutral or middle position, and is caused to slide back and forth just enough to uncover alternately the steam-ports S S, the amount of this sliding, even in the largest engines, in which the valve may have a superficial area of several square feet, being only 3 or 4 inches. In small engines the extent of sliding in one direction may be only a fraction of an inch. This movement of the valve to the right and left is produced by means of an eccentric or small crank and a special connected rod attached to the valve, by which its motions are made to correspond in point of time with the motions of the piston: but the eccentric and main crank being keyed to the shaft in different positions, these motions, although taking place in the same times, will not at each moment correspond in direction or velocity.

It will be seen from the figure that the piston is at the end of its stroke, and its return to the opposite end depends on its receiving the impulse of steam admitted from the steam-chest just at this moment to drive it back. It will be observed, also, that the valve has been moved from its central position, covering all the ports, already sufficiently far to open the steam-port on the right a small amount, and steam is already admitted and fills the narrow space to the right of the piston. Thus, the full boiler-pressure, or nearly so, is already acting on the right of the piston to drive it back. The condition of things on the left of the piston at this moment is quite different. The steam which has been confined in that part of the cylinder to the left, and which by its expansive action has driven the piston toward the right, is now free to pass from this space into the atmosphere back through the steam-port S through which it came, but not into the steam-chest—the port S now leading through the hollow of the valve to the *exhaust-port*; and this opening is by the movement of the valve already larger than the opening for admission on the right. The phenomena which now take place while the piston moves from the right to the left are as follows: The valve completes its excursion to the left, and returns, so as to shut off the supply of steam on the right of the cylinder, while the piston is still in motion to the left. After the supply is cut off, the confined steam continues to act by its expansion alone, no more being admitted. The point at which this occurs is called the point of *cut-off*. The fraction of the stroke at which this occurs depends on the dimensions of the valve and the arrangement of the mechanism by which it is moved. It may happen, also, that by the same movement of the valve on its return to the right, and while the piston is still moving to the left, the exhaust-passage is closed so as to confine a portion of the steam in the left-hand part of the chamber, to act as a sort of cushion. This will occur at the moment the inner edge of the hollow part of the valve on the left reaches the inner edge of the steam-port. These phenomena may be illustrated by a larger sketch of the valve and the ports.

Fig. 30 represents on a larger scale a section of a simple slide-valve and the cylinder ports, the valve being in its middle or neutral position, covering all the ports. It will be observed that the outer edges of the valve project beyond the edges of the steam-ports, so that in this position of the valve the ports are more than covered by the valve. This projection beyond the edges of the port is called the *outside lap*. It exercises an important influence on the distribution of the steam. The inside edges of the hollow part of the valve also project over the inner edges of the steam-ports. This projection is called the *inside lap*; it is always relatively small, and often does not exist to an appreciable amount. Now, suppose the valve to begin to

move to the right. The first phenomenon that occurs will be the opening of the communication on the right between

FIG. 30.

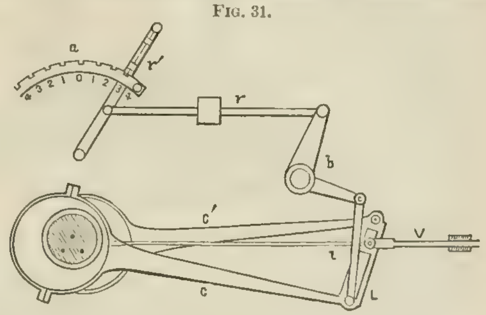


the steam-port S and the exhaust E. This movement is generally only a fraction of an inch. The piston is now on its way to the left, and near the end of its stroke; and, as the sketch shows, the corresponding communication on the left with the exhaust is already closed; the piston is already acting against a cushion of partially-exhausted steam on its left. As the valve continues to move to the right, the outer edge of the valve C on the left approaches the edge of the steam-port, and at a certain instant opens that port, letting new or "live" steam from the boiler into this end of the cylinder, which mingles with the exhaust steam already confined there as a cushion. This phenomenon usually takes place but an instant before the piston reaches the end of its stroke, in order that it may meet not only a cushion of exhausted steam, but of steam at full pressure from the boiler. The action of the inside lap is of some importance, as far as the cushioning is concerned, and it also acts to prolong the expansion to a limited extent, as may be made evident if the motion of the closing and opening of the left-hand steam-port is considered for a moment.

Fig. 30 represents not only the slide-valve and the openings in the cylinder, but also, by the circular diagram on the left, a graphical method of determining the phenomena of the distribution of steam, and of adjusting the parts of the valve-gearing. In this diagram O represents the centre of the crank-shaft; O E the eccentric radius or crank-arm of the eccentric which drives the valve; E′ O E the *angle of advance—i. e.* the angle which the eccentric crank makes with the perpendicular to line of motion of the end of the eccentric rod. A circle described on O E as a diameter is called the *valve-circle*; it furnishes a scale of distances travelled by the *valve* in its movement to the right and back to its central position. In this diagram, which may be enlarged in scale for distinctness, O E represents the eccentricity; *a b*, the throw of the valve; O *l* represents *c d*, the outside lap, and O *l′* represents *e f*, the inside lap. The two small circles drawn about the centre O are called lap-circles. The circle drawn with O R as a radius represents the crank-pin circle of the engine. It should be drawn to a larger scale. For want of space in this diagram it is taken the same as that described by the eccentric radius. If we suppose the crank of the engine to be on its dead-point at R, and to move in the direction of the arrow, the property of the valve-circle O p' E is this—that for any position of the crank, such as R^5, if a line be drawn through O and prolonged to meet the valve-circle, the distance O p' will give the true distance of the valve to the right of its middle or neutral position. In the position of the valve shown in the sketch the crank is at R^6, and the valve is ready to begin its movement to the right. When the crank arrives at R, the dead-point, the valve has moved a distance O X′, which is a little greater than the outside lap O *l* or *c d*, and hence steam is already admitted to the piston. The point of admission is found by taking the intersection X‴ of the valve-circle with the outside lap-circle, and drawing through O the line O R″. This gives the *angle of lead*, and the distance *l x′* is the *lead* of the valve. The point of cut-off is found by taking the second intersection p' of the valve-circle with the outside lap-circle; this shows the angle R O R^5 through which the crank has revolved to the time when the valve has completed its movement to the right, and has come back to the point at which its outer edge C closes the steam-port again, cutting off the steam. The intersections of the inside lap-circle will determine the points of release or exhaust and compression. In this diagram four quantities are represented: the eccentricity, O E = *r*; the angle of advance, E′ O E = *d*; the outside lap, = *l*; and the inside lap, = *l′*. The adjustment of these quantities, which can be graphically made, will determine the degree of expansion, the lead, the point of release, and the compression, and the proper arrangement of the mechanism for any degree of expansion. This mode of determining these quantities is due to Dr. Zeuner. With a crank pin circle and cylinder drawn to the same scale, the position of the piston for any portion of the crank may be determined by taking the length of the connecting-rod as a radius, and laying off this length from the position of the crank to the central line of motion of the cross-head.

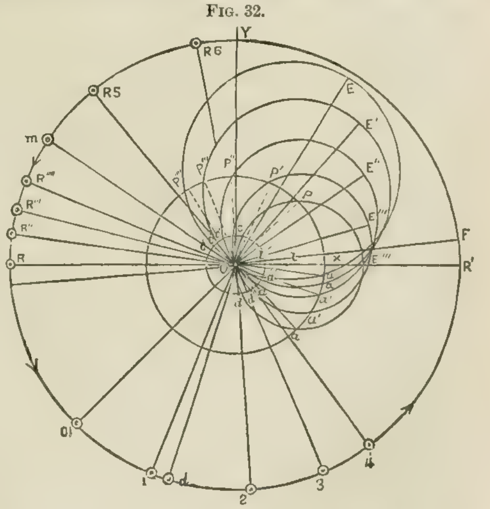
The adjustment of the single slide-valve with a single eccentric, when once made, cannot be easily changed while the engine is running. Where this is desirable in order to change the degree of expansion, and by that means the power of the engine, the link-motion is generally used.

FIG. 31.



This is a device shown in Fig. 31, by means of which the angle of advance and the eccentricity are simultaneously altered; and it is accomplished by means of two eccentrics C C′ and a link L, the effect of the two, with the link, being to make one *virtual* eccentric. The arrangement shown in Fig. 31 is that commonly used in locomotives, and is known as Stephenson's link-motion. It is arranged with a reversing lever *r′*, by which either the eccentrics C and C′ can be caused to move the valve quite independently of each other, but one giving a forward motion and the other a backward motion to the engine. At positions of the link intermediate between these the virtual eccentric, which is the resultant of the two, controls the movements of the valve, and varies the degree of expansion. The notches in the arc (*a*) determine certain positions of the link with

FIG. 32.



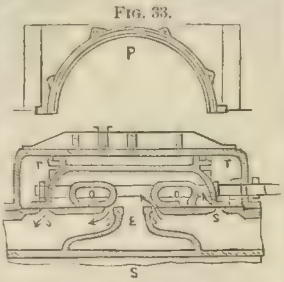
reference to the valve-stem V. Applying Zeuner's valve-circle diagram to the Stephenson link with open rods, as in Fig. 32, O E is the eccentric and Y O E angle of advance for full forward gear (Notch 4). For the 3d notch, O E′ gives the corresponding eccentric and angle of advance, and so on to mid gear (Notch 0), in which the eccentricity is O E⁗ and the angle of advance 90°. The points of admission *a*, *a′*, *a″*, *a‴* on the left, from mid-gear to full-gear, the corresponding angles of lead, the points of cut-off, *p*, *p′*, *p″*, *p‴*, *p⁗*, the points of release, *d*, *d′*, *d″*, *d‴*, on the right of the piston, and the points of compression, *c*, *c′*, *c″*, *c‴*, on the right, are all shown for the different grades of expansion; and the study of the diagram will also show the variations of lead, *l x*, for these different grades.

It is not practicable to enter here into a discussion of this valve-gear, nor to describe the various other link-motions which have been proposed, but simply to illustrate

the most common device for altering the degree of expansion and for reversing by the double eccentric and link. The subject is fully discussed in Zeuner's work on valve-gearing.

The extent of sliding movement of the valve is a consideration of importance, since the hurtful work of its friction depends directly on the extent of its motion. When slide valves are very large, this useless work becomes an important item of expense. There are two means of reducing it: first, by reducing the travel or space passed over at each stroke; and, second, by relieving the back of the valve from a portion of the pressure of the steam in the valve chest. Fig. 33 represents a valve in which both these methods are used. P is a plan of one half the valve, and S a section. There are two steam-ports *s s* on each side of the exhaust port. When the valve moves from left to right, for instance, both ports *s s* on the left are uncovered simultaneously; steam enters the *outer* port directly from the steam-chest, and the *inner* port indirectly through the arched opening in the valve O, the exhaust taking place on the opposite side, into the hollow of the valve and into the exhaust port E. A partial vacuum is maintained on the back of the valve by means of a packing-ring *r r*, which slides against the lower surface of the steam-chest cover, the space enclosed between this and the valve being connected with the condenser. This kind of valve is called an equilibrium double ported slide-valve. The valve of which this is a representation had a total length of over 5 feet and a width of over 4 feet, the diameter of the packing-ring being about 1 feet; the extreme travel of the valve in one direction being only 5 inches, the outside laps less than 3 inches, and the inside laps only $\frac{1}{32}$d of an inch. It formed a part of the mechanism of a large marine engine.

Fig. 33.



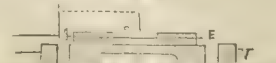
Double-ported Equilibrium Slide-valve.

To avoid long steam-passages, which are disadvantageous, two slide-valves are often connected by a bar and attached to the same valve-stem within the chest, these separate valves being then placed near the ends of the cylinder and having a common exhaust.

Expansion-Valves and *Cut-Offs* designate special combinations of valve-mechanism by means of which the steam may be suddenly cut off at any point of the stroke independently of any other phenomena of the distribution of steam. The simple slide-valve, moved by a single eccentric, cannot be arranged to cut off the steam at less than one-half the stroke advantageously, because, as will be evident from the inspection of the valve-diagrams for the link motion, where the higher grades of expansion are used, the compression and *release* begin so much earlier that the power of the engine exerted in each stroke is diminished, and the efficiency—*i. e.* the economy—of the power is also diminished. To preserve the efficiency of the steam undiminished, and to place in the hands of the engine-driver the means of adapting the power of the engine to the work to be performed, two systems of construction are employed—one in which the variation in the expansion may be adjusted or controlled by the engine-driver by hand; for instance, when for a considerable period of time the engine is not required to perform its full amount of work, and a single adjustment for the given time is all that is required; and second, when a momentary variation of power may be advisable, so that the speed of the engine may remain invariable. The first system is an arrangement of *expansion-valves*, operated as required by the engine-driver; and the second system the "cut-off" system, in which the degree of expansion or the supply of steam at each stroke is regulated by the governor.

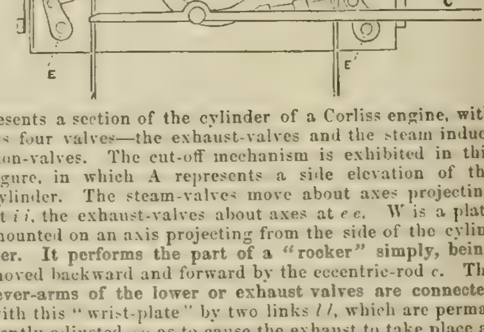
A great variety of expansion valves, as well as variable cut offs, are employed in practice, and we will give such examples only as will illustrate the systems. The most common, and perhaps the most simple and perfect, expansion-valve is exhibited in Fig. 34. In this figure the upper surface of the D valve is made plane, and it is extended some distance beyond the outside laps, a mortise or rectangular aperture, nearly equal in area to the steam-port, being made in the ends. The valve is in other respects precisely like all other D slide-valves, and is moved by an eccentric, sometimes by two eccentrics, with a link for reversing the engine. The expansion-valve consists of two plates E sliding on the top of the D-valve (which is called in this combination the *distribution-valve*). These two plates are on the same valve-stem S, which passes through both, and is supplied with screw-threads, right and left hand, so that when the stem is turned on its axis the two plates will approach or recede from each other. On *their distance apart* depends the period of cut-off, and a device may be attached to the valve-stem outside of the steam-chest by means of which this distance can be made greater or less by turning a hand-wheel even while the engine is running. The degree of expansion is thus controllable by hand. The expansion-valve is moved by a separate eccentric.

Fig. 34.



Governor Cut-Offs.—Devices for cut-offs adjustable by the governor are very numerous, and it is impracticable to describe even a few of the best in detail; all that can here be attempted is to illustrate the principles of their action by reference to one or two examples. The old combination of the governor and throttle-valve is not a cut-off. Its action is to diminish or increase the pressure in the cylinder as the speed of the engine is increased or lessened, and thus diminish or increase the work per stroke; but a diminution of the initial pressure in the cylinder and the pressure throughout the stroke entails waste of heat and power, and is therefore only admissible where these considerations are not regarded as important. In stationary engines employed for many purposes it is not only important in point of economy that this waste should be avoided, but the character of the work may be such that variations of speed, to any considerable degree, are to be avoided. The action of the governor in causing a complete cut-off of the steam at any point of the stroke depends primarily upon the speed of the engine by which it is moved (see GOVERNOR), and secondarily upon its connection with the valves which close the steam-ports. The power of the governor is not sufficient, generally, to move these valves directly, and hence its action consists in nearly all cases in throwing into or out of gear mechanism driven by the engine itself; by which the requisite movement of the valve is produced. One mode consists in a sudden disconnection of the mechanism which moves the valve, which is then driven back so as to cover the steam-port by means of a weight or spring. The closing of the valve is thus almost instantaneous—a matter of importance both in the opening and closing of the valves. The Corliss engine furnishes an instance of this kind of cut-off. Fig. 35 represents a section of the cylinder of a Corliss engine, with its four valves—the exhaust-valves and the steam induction-valves. The cut-off mechanism is exhibited in this figure, in which A represents a side elevation of the cylinder. The steam-valves move about axes projecting at *i i*, the exhaust-valves about axes at *e e*. W is a plate mounted on an axis projecting from the side of the cylinder. It performs the part of a "rocker" simply, being moved backward and forward by the eccentric-rod *c*. The lever-arms of the lower or exhaust valves are connected with this "wrist-plate" by two links *l l*, which are permanently adjusted, so as to cause the exhaust to take place at the proper moment. The upper corresponding lever-arms for the induction-valves have the form of bell-cranks, to one arm of which a weight is attached by a long vertical rod, shown in the drawing. The links *r r* attached to the wrist-plate are not permanently jointed to the bell-cranks, but the ends of these links or bars slide along the ends of the bell-crank; a notch in the sliding end catches the arm on the return motion and draws it back, opening the valve. The disengagement of this notch is effected by a bent piece, shown at *b*, which, as the link *r* is drawn back, strikes a small protuberance *p*. The position of this small protuberance depends only on the governor. The governor-rods *g g* are attached to the ends of levers which move

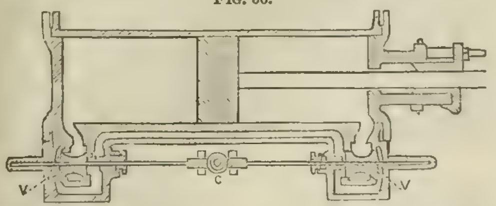
Fig. 35.



plates or rings embracing the axes *i i*, and on these plates the protuberances are made. When the hook or bent piece strikes the protuberance, the notch is disengaged, and the weight, acting on the valve, closes it. The cutting off of the steam is thus instantaneously effected.

Another example, the Wright engine, may be given to illustrate the use of a cam-motion controlled by the governor. Fig. 36 represents a section of the cylinder of the Wright engine; V V the valves, which are balanced *poppet-*

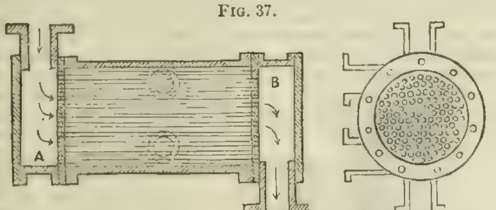
FIG. 36.



valves. These valves are double—that is, they have two conical seats—and when they are closed, the steam-pressure acting on both sides of the valve, it is nearly balanced. The stems of these valves extend to a position near the middle of the cylinder, and are there actuated by a cam C, being alternately opened by the cam. When the cam in its revolution releases either valve, it is carried back promptly by a spring. The cam slides vertically on a rod, the vertical motion bringing a new arc of the cam into action. This vertical motion is controlled by the governor. Other efficient devices might be mentioned which are deservedly popular, but these are sufficient to illustrate the principle. The Stevens cut-off, so common on our river-steamers, has poppet-valves, the vertical valve-stems having strong toes or projections attached to them which are lifted by corresponding toes or arms attached to the rock-shaft. This cut-off is not controlled by the governor, but is adjustable by the engine-driver. The Ryder cut-off is one in which by an ingenious device the governor performs the work of moving the expansion-valve, unassisted by the engine.

Condensers.—The condenser in steam-engines is an organ which characterizes a certain class of engines called condensing engines. It consists of a chamber of any convenient form, and placed in any convenient position with reference to the cylinder, into which the exhaust steam is carried at each stroke of the engine. In this chamber the steam is condensed, either by actual contact with particles of cold water thrown into the chamber by an injection-pump, or by contact with the surfaces of tubes, the opposite surfaces of which are kept cooled by contact with cold running water, the circulation of the water being produced by a circulating pump. The first form is called the *jet condenser*, and the second the *surface condenser*. In the jet condenser cold water is injected by a force-pump into a chamber into which the exhaust steam is discharged. The condensing water and the condensed steam thus become mingled, and, together with the air disengaged, are removed by the air-pump. A portion of this hot water is conveyed to the boiler, and the surplus discharged as waste. The surface condenser usually takes the form of a cham-

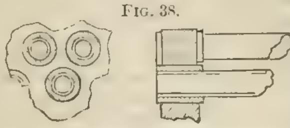
FIG. 37.



ber traversed by hollow tubes through which cold water is kept circulating, while the steam is admitted to the chamber around the exterior surfaces of the tubes. Fig. 37 represents a surface condenser of a cylindrical form. The condensing water enters the tubes at one end, as shown by the arrows, and is discharged at the other, while the steam is admitted around the tubes. A mode of packing the ends of the tubes by ferules of compressed pine wood is shown in Fig. 38. This device, the invention of Mr. Horatio Allen, has contributed, at least in this country, more than anything else to render the surface condenser perfect in its operations.

The chief difference between the surface and jet condensers consists in this—that in the surface condenser the condensed steam does not become mixed with the condensing water, and hence the *same mass* of water may be kept continually circulating from the condenser to the boiler and cylinder, and back to the condenser; the boiler is thus supplied with distilled water, and is much more durable under these circumstances; while indirectly the surface condenser is economically more advantageous than the jet condenser. The employment of either, especially at low pressures, results in a saving of fuel as compared with the non-condensing engine.

FIG. 38.



The disadvantages are the increased cost and the necessity for a large amount of cold water for condensation, which for stationary, locomotive, and many other engines cannot be obtained or practically applied.

Fly-Wheel.—The fly-wheel is an important and essential appendage to the steam-engine under many conditions of use.

A stationary engine with a single cylinder requires a moving mass between the piston and the working point, which by its alternate accelerations and retardations will store up and give out energy in such a manner as to keep the power, reduced to or at the working point, nearly constant. As an example, the rolling-mill is perhaps the most striking. The useful work to be performed is in this case the driving of a heavy plastic bar or plate of iron or other metal between rolls—an operation not continuous, but occurring only at intervals. With a single-cylinder engine of the ordinary type the pressure of the steam on the piston at any instant is not usually sufficient to overcome the great resistance offered; by the interposition of a heavy fly-wheel, however, the action of the engine produces gradually a high velocity of revolution in the fly-wheel, causing an accumulation of living force. When the metal enters the rolls, this accumulated energy is given out; and even if the steam were suddenly shut off, the fly-wheel would carry the metal through the rolls. This is accomplished, however, only at the cost of a loss of velocity in the fly-wheel, which loss must again be restored by the engine. Again, when the resistance is sensibly constant, as when an engine is driving a shop or factory, the power of the engine is nothing at the dead-points, and is a maximum at nearly mid-stroke. If there were no moving mass to store up and give out power, the engine must cease working at the first dead-point; for at that point the piston, which is the working point, comes to a stop and begins to return on its course. When, in addition to the above considerations, the action of the steam on the piston is not constant, but diminishes gradually from the time it is cut off, the necessity for the fly-wheel to keep up a uniform or nearly uniform motion in the shaft is still greater; or, rather, the conditions on which its dimensions depend become more complicated. In cases where the living force of the fly-wheel is required for a short period of time to perform nearly the whole useful work, as in the case of a rolling-mill, its dimensions cannot be theoretically estimated with certainty, owing to the fact that it is in such cases impossible to ascertain theoretically the amount of the useful work to be performed during the period. Precedents and experience must then be the chief guides to the engineer. The dimensions suitable for a given engine, in which the resistances are supposed constant, may, however, be determined from theoretical considerations, at least with the aid of experiments made to determine certain constants which enter the formulas.

It is impossible to establish a perfect uniformity of motion in the crank-shaft of an engine, because the mass, which by alternately gaining and losing living force preserves a uniform velocity during certain *periods* of motion, can only act by itself gaining or losing velocity momentarily at intervals of those periods. But under given conditions the variations of velocity may be made as small as is desirable. The moment of inertia of the rim of the fly-wheel is represented approximately by $W r^2$, W being the weight of the rim, and r its mean radius. The dimensions for any engine are determined by the formula

$$W r^2 = \frac{m g E}{v^2},$$

in which m is a number such that $\frac{1}{m}$ is the desired limit of fluctuation of speed, usually $\frac{1}{50}$th to $\frac{1}{60}$th for fine machinery, and $\frac{1}{30}$th for ordinary work; g representing the acceleration due to gravity 32.2: E representing the energy stored up and given out at each revolution—a quantity to be determined experimentally, and depending on the fluctuations of velocity of the driving point or piston, and the variations of pressure of the steam at each stroke. Experiments made by Gen. Morin and others furnish values of E for different non-condensing and condensing engines. The variations in the velocity of the piston at different points of the stroke when the motion of the crank is uniform depend on the

length of the connecting-rod. The fluctuations of energy E. depending as they do on this variable velocity, are quantities which must be established for certain lengths of connecting rods and certain points of cut-off. The experiments made by Gen. Morin place the average value of E at about $\frac{2}{10}$ths of the whole energy exerted by the steam on the piston in one revolution, so that, having found this quantity in foot pounds, the value of E may be approximately ascertained by consulting the results of experiments. Two tenths of this value will give a near approximation: the value of $\frac{1}{m}$ being $\frac{1}{30}$th for common engines, and $\frac{1}{50}$th to $\frac{1}{60}$th for engines driving fine machinery, the value of $W v^2$ becomes known. The radius r is chosen, so that the tangential velocity v of the rim of the wheel shall be what is required. If the wheel acts as a band-wheel, this velocity will depend on the necessary velocity of the countershaft to perform the work required. If the velocity may be arbitrarily chosen, it is taken at 20 to 40 feet a second.

Theory of the Action of the Steam in the Steam-Engine.—In designing a steam-engine to accomplish a particular quantity of work in a given time, or of a determinate *horse-power*, although in practice very simple formulas are employed, yet the constructor is supposed to have a knowledge of the principles on which such formulas are based. It has been found especially necessary, at least in the efforts which have been made to improve the economic working of steam-engines, to ascertain the theoretical principles which are applicable to the problem. This will at once be appreciated when it is considered that the *moving force* of the steam must first be produced or generated at the cost of the fuel burned. In the cycle of changes which water undergoes from the boiler to the condenser, and back again to the boiler, it passes through a series of transformations, each of which has its equivalent in a certain quantity of heat required to produce the change; and it is necessary to ascertain those influences which are effective and those which are inefficient in order to introduce conditions to render the first most effective, and to reduce the losses to the least possible amount. This is accomplished mainly by the disposition of the mechanism and the arrangement of the details of the apparatus.

It is first necessary to investigate the action of the fluid in its passage through the cycle of transformations. The water is first evaporated in the boiler at a temperature and corresponding tension which are decided upon as convenient or desirable. The quantity of heat required for this purpose is determined as described in the article STEAM, and the efficacy of the steam-generator as described in that part of this article relating to the boiler.

A certain quantity of steam enters the cylinder at each stroke of the piston, depending on the cut-off or degree of expansion. During this period the piston is actuated by the full pressure of the steam in the cylinder, generally a little less than that in the boiler, and performs a quantity of work represented in foot-pounds by the product of the pressure multiplied by the volume traversed during the period of full pressure, or $p_1 V_1$. After the steam is cut off, it continues to act on the piston by its expansive force, but with a constantly-diminishing pressure, to the end of the stroke. It is usually assumed in practice that the diminution of pressure takes place during this part of the stroke, according to the law, that the pressure is inversely proportional to the volume; and on this supposition the mean pressure throughout the whole stroke is determined by the formula—

$$p_m = p_1 \frac{(1 + \text{hyp. log. } r)}{r},$$

p_m being the *mean* pressure, r the ratio of expansion; the logarithms being taken in the Napierian system. As the piston returns, a certain back or negative pressure is unavoidable, due to the resistance offered by the steam that is being expelled from the cylinder. That pressure cannot be determined from theoretical considerations, but it is approximately known from experience. Calling this back-pressure p_2, the negative work of this pressure during the return of the piston may be determined. The work of the steam on one side of the piston during *one revolution* will then be represented by

$$A \times S \times (p_m - p_2),$$

A being the area of the piston and S the length of stroke in feet. This must be doubled in cases where the engine is double-acting, the usual case. If, now, the engine makes n revolutions per minute, the total work in foot-pounds per minute will be

$$n \times 2A.S\,(p_m - p_2).$$

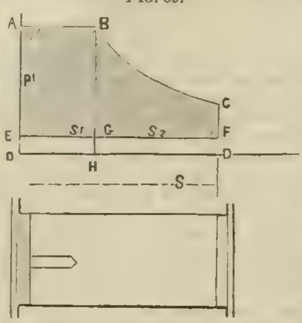
If A is expressed in square feet, p_m and p_2 must be given in pounds per square foot. This expression divided by 33,000, the number of foot-pounds per minute in a horse-power, the power of the engine will be

$$\text{H.P.} = \frac{n.2.A.S.\,(p_m - p_2)}{33{,}000}.$$

In this expression the mean pressure p_m depends on the degree of expansion; and hence the power is given by the above formula for one grade of expansion.

In engines in which the grade of expansion may be varied at will, the power of the engine will correspondingly vary. The engine making n revolutions per minute, the distance passed over by the piston per minute will be $n.2.S.$, which varies in practice from 200 to 800 feet. The formula is evidently a purely mechanical one—*i.e.* the force of the steam is treated as though it were any other force subjected to like variations, and acting upon the area of the piston. Questions of the quantities of heat do not enter. The action of this force is usually illustrated by a diagram as follows (Fig. 39): Let O D = S represent the length of stroke of the piston; A B = S_1 the distance passed over by the piston before the steam is cut off. The ratio of expansion will be $\frac{S}{S_1} = r$, and that will be equal to the ratio of the volumes $\frac{V}{V_1}$ of the steam at point of cut-off and at the end of the stroke. Let O A = p_1 represent the initial pressure of the steam in pounds per square inch: then p_1 A $\times$ 144 will represent the total force on the piston = P. The work performed during the travel from O to H or A to B will be represented by P S_1 or A $\times p_1$ $S_1 \times$ 144. The area of the rectangle O A B H will then represent this work. The work performed during the travel from H to D will in the same manner be represented by the area H B C D, on the assumption that the curve B C is an equilateral hyperbola. This area will be equivalent to P S_1 hyp. log. r, and the sum of these two areas representing the whole work of the steam during one stroke,

FIG. 39.

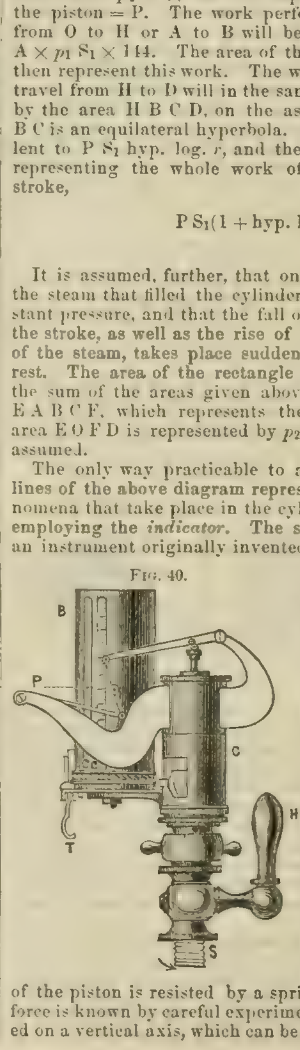


$$P\,S_1(1 + \text{hyp. log. } r).$$

It is assumed, further, that on the return of the piston the steam that filled the cylinder is discharged at a constant pressure, and that the fall of pressure at the end of the stroke, as well as the rise of pressure on the entrance of the steam, takes place suddenly while the piston is at rest. The area of the rectangle O E D F, subtracted from the sum of the areas given above, will then give an area E A B C F, which represents the work performed. The area E O F D is represented by $p_2 V_2$, the value of p_2 being assumed.

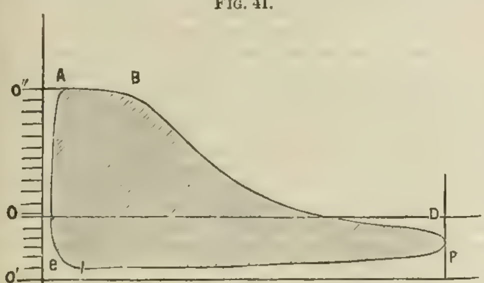
The only way practicable to ascertain how nearly the lines of the above diagram represent truly the actual phenomena that take place in the cylinder of an engine is by employing the *indicator*. The steam-engine indicator is an instrument originally invented by Watt, but improved in modern times, the object of which is to show the actual pressure of the steam on the cylinder at each point of the stroke. The instrument as improved by Richards is exhibited in Fig. 40. In this figure C represents a small cylinder fitted with a piston working without sensible friction; S is a pipe fitted with a screw, by means of which the cylinder can be put in communication with the steam-space of the cylinder, the steam being turned on or off by the cock H. The motion of the piston is resisted by a spring, of which the elastic force is known by careful experiments. B is a barrel mounted on a vertical axis, which can be turned around by pulling

FIG. 40.



on the spring T, a spring carrying the barrel back when the pulling force is withdrawn. Paper is wrapped around the barrel, and a pencil P attached to a parallel motion is caused to move up and down with the piston on the cylinder, the motion of the pencil being magnified by the lever-arm of the parallel-motion bar to which the piston is attached. The pencil will thus rise and fall as the pressure in the cylinder is increased or diminished. The spring T is attached to some moving part of the engine in such a manner that the parts of a revolution forward and back of the barrel H shall correspond truly with the corresponding motions of the piston in the cylinder of the engine. Before steam is turned on the indicator, if the barrel be revolved the pencil will describe a line which, when the paper is unwrapped, is a straight line. This is the line of no pressure, or base line from which pressures are laid off, the piston of the indicator being then subjected to the pressure of the atmosphere above and below. If now the steam be turned on by the cock H, the pencil will make a quick movement up and down, corresponding to the full pressure, expansion, and exhaust in the engine-cylinder; and the barrel having made at the same time nearly a whole rotation forward and back, when the paper is unwrapped it will be found that the pencil has described a closed curve on the paper, corresponding to Fig. 41. This diagram is from a condensing engine, and the atmospheric line

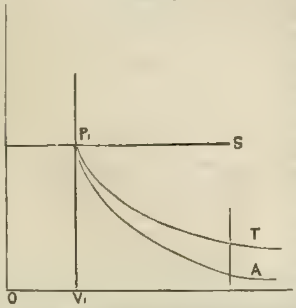
FIG. 41.



is marked O, the lower base line O′, corresponding to a perfect vacuum in the condenser; the distance O O′ will then usually represent about 15 pounds in the vertical scale of pressures. It will be seen that the diagram differs from the theoretical diagram. If the pressure O O″ is measured on the scale, it will be found that this pressure is always less than the boiler-pressure; the line A B is not usually a straight line; the angle at B is rounded; the end of the diagram at D is not the same as in the assumed diagram. The same is true in regard to the curve at E, and the line E A may be a curved line. In truth, real diagrams sometimes differ so much from the assumed theoretical diagram that they would scarcely be recognized as relating to the same phenomena, the upper curve representing the expansion curve, and the lower the back pressures on the return of the piston. In all cases these lines give a true indication of the pressures in the cylinder at different points of the stroke; and by measurements of the pressures on vertical scales, drawn at equal intervals, the mean forward and mean backward pressures p_m and p_2 may be determined.

The "efficiency" of a machine is a term used to designate the ratio of the disposable or theoretical work to the useful work. This is the usual mode of estimating the loss of effect in employing any machine. If the disposable work is estimated in the cylinder of the steam-engine in the theoretical manner above indicated, calling W the disposable work and W′ the real work, the efficiency will be $\frac{W'}{W}$, a fraction always less than unity, because, on account of friction, there is always in any machine a certain amount of useless or ineffective work. There are generally also other causes of loss, so that the efficiency of a machine becomes still less. The efficiency of machines can be determined, therefore, only when the disposable work W can be properly determined, and when also the useful work W′ can be determined. The theoretical diagram which has been given does not truly give the disposable work of a given engine for two reasons: First, the expansion curve may not be—and is not usually—a part of an equilateral hyperbola. The equilateral hyperbola is a curve which represents the expansion of a perfect gas under *constant temperature*. The equation P V = R T for perfect gases (and approximately for the permanent gases) becomes, when the temperature is constant during expansion, P V = const.; that is, the product of the pressure and volume during expansion is constant, and the pressure is inversely proportional to the volume—a law which, when the pressures and volumes represent the ordinate and abscissa of a curve, gives the equilateral hyperbola. When steam in contact with water expands at constant temperature, the *pressures are constant*, and such an expansion curve is a straight line parallel to the line of abscissas. When air, for instance, expands without accessory heat, it no longer follows the simple law of Mariotte, but the relation between the pressures and volumes is $P V^{1.41} =$ const., giving a curve different from the isothermal curve. The two curves for permanent gases represented by the equations $P V = P_1 V_1$ and $P V^k = P_1 V_1^k$

FIG. 42.



(k being the exponent of V for the adiabatic curve) have the relation shown above at Fig. 42. Starting from the same initial point p_1, the isothermal curve p_1 T lies always above the adiabatic curve p_1 A. The pressures diminishing more rapidly for the latter, the *isothermal* curve for steam in contact with liquid water would be the straight line p_1 s.

The *adiabatic curve* for saturated steam—that is, the curve of expansion when no heat is furnished to or abstracted from the steam during the expansion—differs from both of these, but approaches the isothermal for permanent gases in form. The probable equation of the curve has the same form as that for the permanent gases, but with a different exponent k. This exponent, first determined by Rankine empirically, is shown by Dr. Zeuner to depend on the quantity of water mixed with the steam at the beginning of the expansion. For dry saturated steam Dr. Zeuner's determinations gave $k = 1.135$. When the steam is mixed with 20 per cent. of water—that is, when in one pound of the mixture, divided into 100 parts, 20 are water and 80 steam—then $k = 1.115$, and the relation between the pressures and volumes becomes

$$P V^{1.115} = P_1 V_1^{1.115} = \text{constant}.$$

When the quantity of steam is 30 and the quantity of water 70—a condition never allowed in engines—the adiabatic curve for steam becomes almost coincident with the equilateral hyperbola, or k becomes equal to 1, nearly.

The formula for determining the mean pressure on the supposition that steam expands by the adiabatic curve, the exponent k being 1.111, or $\frac{10}{9}$, as assumed by Rankine, is, $p_m = p_1\left(10.\frac{1}{r} - \frac{9}{r^{1.111}}\right)$, r being the ratio of expansion. This formula may be used for calculating the mean pressure in cases in which the steam receives no heat during expansion; *i. e.* in which the cylinders are unprovided with steam or hot-air jackets.

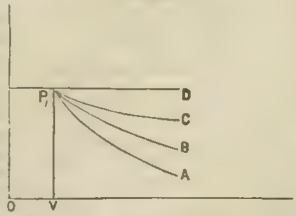
The characteristics of the adiabatic curve of expansion for steam, and the action of the fluid in regard to heat, are—that if the steam is originally dry saturated steam, there will be a condensation of vapor during expansion and a superheating during compression. Taking the other extreme case, in which there is no vapor, but only liquid water under a high pressure, the liquid will be vaporized during the expansion according to the adiabatic curve. Between these extremes there is a point at which for the same initial and final pressures the quantity of vapor will be the same at the *end* of the expansion as at the *beginning*, though not constant during the expansion. Liquid is first vaporized, and afterward vapor is partially condensed. This occurs when the weight of the liquid and vapor at the beginning of the expansion are about equal.

There are two other forms of curve of expansion which may be examined theoretically for steam, and which may be partially realized in practice. If we suppose the steam to receive heat during expansion from some external source, such as a steam jacket or a hot-air jacket around the cylinder, the adiabatic curve no longer represents the law of expansion, that curve being, conditionally, that in which no heat is received or abstracted during expansion and compression. In one case it is supposed that just enough heat is imparted to the steam to prevent liquefaction or condensation when the steam is originally *dry* and *saturated*, or just enough to preserve the quantity of vapor constant if the steam is mixed with water at the beginning of the expansion. This curve of expansion, starting from the same initial point, will lie above the adiabatic curve. The form of the curve of expansion in this case is similar to that of the adiabatic curve. Another is that in which the *interior work* of the vapor and water remains constant—*i. e.* there is neither evaporation nor condensa-

tion, and the *temperature* remains constant. This curve of expansion for the same initial point lies above both the adiabatic curve and the curve of quantity of vapor constant.

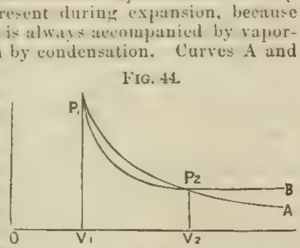
Starting from the same initial point with the same relative volumes of vapor and liquid, the relative position of these curves is shown in Fig. 43. A is the adiabatic curve, B the curve of quantity of vapor constant, C the isodynamic curve, and D the isothermal curve. The straight line D represents the expansion or *compression* of steam at constant temperature when it is in contact always with its liquid.

FIG. 43.



The second curve C is possible as an *expansion* curve only when liquid water is present during expansion, because expansion by this curve is always accompanied by vaporization, and compression by condensation. Curves A and B are possible expansion curves for either dry saturated steam or for mixed water and steam, and hence they are the curves of most interest in connection with the steam-engine. When there is at the beginning of the expansion as much water by weight as vapor, the two curves coincide at two points. In the curve B the quantity of vapor is constant, and in the adiabatic curve there is first an evaporation and then a condensation until the specific volumes become equal; if the expansion is continued, the adiabatic curve (Fig. 44) falls below the curve B.

FIG. 44.



In estimating theoretically the power of an engine furnished with a steam-jacket, it is impossible to assume with certainty the actual conditions of the problem. It is not known, for instance, precisely what quantity of heat will be furnished by the steam-jacket, nor what relative quantities of vapor and water will be found in the cylinder at the beginning of the expansion. It is usually assumed that enough heat enters the cylinder from the jacket during the expansion to prevent the condensation which would occur if no heat were added—*i. e.* if there were no steam-jacket; that the curve of expansion is the curve of quantity of vapor constant, and that the steam is saturated and dry at the beginning of the expansion. The curve of expansion is then represented by Rankine by the formula

$$P\,V^{1\cdot06} = P_1V_1^{1\cdot06} \text{ or } P = C_1\frac{1}{V^{1\cdot06}} = C\,\frac{1}{V^{\frac{17}{16}}},$$

and the mean forward pressure is given by the formula

$$p_m = p_1\left(17\,\frac{1}{r} - 16\,\frac{1}{r^{\frac{17}{16}}}\right),$$

r being the ratio of expansion. The mean effective pressure $(p_m - p_2)$ is then known when p_2 is assumed.

It will be seen by the preceding discussion that the equilateral hyperbola is not a *theoretical curve* of expansion for steam except under one particular and (for steam-engines) an almost unsupposable case—viz. when the relative quantities of vapor and of water are to each other in the proportion of 3 to 7, the water being in excess, and the expansion taking place according to the adiabatic curve, no steam-jacket being employed, but that the curve last described given by the equation $P = c.\frac{1}{V^{1\cdot06}}$, c being a constant (heat being supplied by hot steam from the boiler circulating in a jacket around the cylinder), gives a close approximation. Under these conditions the exact curve is in all cases dependent on the relative quantities of steam and water present at the beginning of the expansion. The steam-engine indicator traces, however, a curve which takes very nearly the form of the equilateral hyperbola, and the latter is almost universally applied to indicator "cards" as a test or basis for estimating the action of the steam during expansion. In calculating the dimensions of an engine to be constructed with a given grade of expansion, the equilateral hyperbola may be assumed as the expansion curve.

The application of purely theoretical rules to the expansion is complicated by an important secondary phenomenon which cannot well be submitted to analytical investigation. The cylinders of ordinary engines are made of cast iron, which takes up and gives out heat as a sponge takes up and gives out water. The expansion line of actual engines, on this account, differs from *any* theoretical line that can be drawn, so much that it is only from experiments with the indicator that the effect of this interchange of temperature between the iron cylinder and the mixed steam and water can be determined.

The adiabatic expansion curve for superheated steam is a curve of which, according to the best authorities, the equation is PV^k = const., k being equal to $\frac{4}{3}$, or, 1.333. Superheated steam in expanding acts, then, like the permanent gases, the exponent k only being different. The isodynamic curve for superheated steam, or the curve for which the interior work (temperature and state of aggregation) is constant, is an equilateral hyperbola. The theoretical work during the expansion by the adiabatic curve for gas, saturated steam, or superheated steam is found by either of the following expressions:

$$L = \frac{p_1V_1}{k-1}\left[1 - \left(\frac{V_1}{V_2}\right)^{k-1}\right];$$

$$L = \frac{p_1V_1}{k-1}\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{k-1}{1}}\right].$$

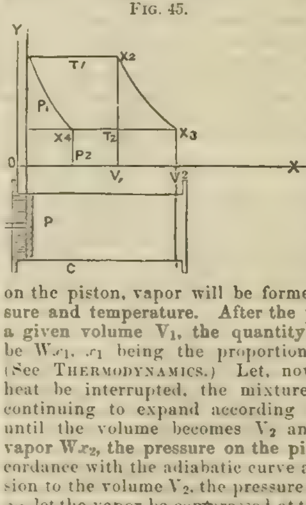
p_1 and V_1 are the initial pressure and volume, k the exponent of V in the equation of the curve, V_2 and p_2 the final volume and pressure. V_1 may be taken to represent the volume of one pound, and then p will represent the exterior work of expansion of one pound of the gas or vapor.

The use of the steam-jacket, or annular casing enveloping the cylinder with hot steam from the boiler, is an economizer of heat, not because condensation during expansion by the adiabatic curve is in itself a loss of heat, but the presence of liquid water in the form of cloud, or in any other form, in the cylinder, facilitates and renders more rapid the interchanges of heat with the metal of the cylinder and the hot entering steam from the boiler, lowering the initial pressure and increasing the final pressure in a way that cannot be estimated theoretically. As nearly all engines work expansively, it is therefore generally impracticable to ascertain *theoretically*, except as a mere approximation, the quantity of work which an actual engine under given conditions is actually exerting. The only true resource is the *indicator*.

Notwithstanding the difficulties of estimating theoretically the action of a real engine—difficulties which arise not only from the causes which have been mentioned, but from various others also—it is important to ascertain the disposable work of a theoretically-perfect engine in order to ascertain not only the relation which the actual work of the engine bears to that which is placed at our disposal, but to find out where the imperfections of real engines lie, with a view to their correction as far as the nature of the machine will allow.

The first question, then, is, What is the work put at our disposal when a given weight of water at the ordinary temperature of the atmosphere is heated to any temperature, evaporated, and then recondensed to the state of water at the lowest temperature? This is the cycle through which water passes in the boiler and engine, and we have only to seek the conditions in which during this cycle the maximum amount of external work will be performed. We may suppose, in illustrating the problem, that there is no boiler really, but that a certain quantity of water rests in the bottom of a cylinder (see Fig. 45), the weight of the water being W and the temperature t_1. To prevent the formation of vapor it will be necessary that a pressure p_1 on unit of area should be applied to the piston. If we now suppose heat to be applied to the water, the constant pressure p_1 remaining on the piston, vapor will be formed under constant pressure and temperature. After the piston has passed over a given volume V_1, the quantity of vapor formed will be Wx_1, x_1 being the proportion by weight of vapor. (See THERMODYNAMICS.) Let, now, the introduction of heat be interrupted, the mixture of vapor and liquid continuing to expand according to the adiabatic curve until the volume becomes V_2 and the quantity of the vapor Wx_2, the pressure on the piston diminishing in accordance with the adiabatic curve at the end of the expansion to the volume V_2, the pressure having been reduced to p_2, let the vapor be compressed at the constant pressure p_2. It will be necessary to abstract heat from the water and vapor during this compression. Finally, suppose the abstraction of heat to be arrested, and the compression to be

FIG. 45.



continued without the introduction or abstraction of heat until the water is again reduced to the liquid state, the cycle of operations being such as are represented in Fig. 45. The quantity of heat furnished to the water during the expansion at constant pressure p_1 will be given by the formula $Q = W r_1 x_1$, r_1 being the latent heat of evaporation at the temperature t_1, and the external work performed during the cycle will be

$$L = \frac{W r_1 x_1}{A}\left(\frac{T_1 - T_2}{T_1}\right),$$

T_1 and T_2 being the highest and lowest absolute temperatures which the water has attained during the cycle, and A the reciprocal of the dynamical equivalent of heat. (See THERMODYNAMICS.) The work L is the maximum work which the vapor can perform between the absolute temperatures T_1 and T_2. This work L may be reduced to horse-power per hour for a perfect engine of this character by finding the quantity of vapor produced in an hour ($W x_1$ being supposed that produced in one second), and dividing the quantity L by the number of units of work in a horse-power.

The temperatures T_1 and T_2 available for actual engines may be readily assumed. The higher temperature T_1 will depend on the initial pressure, and the lower, for non-condensing engines, will be the temperature corresponding to $p_2 = 1$ atmosphere, and for condensing engines corresponding to $p_2 = \frac{1}{10}$ of atmosphere nearly.

The following table gives the quantity of vapor required per horse-power per hour for such a perfect engine:

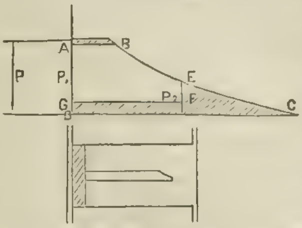
Pressure in atmospheres.	Pounds of water or vapor per horse-power per hour.	
	Non-condensing engines.	Condensing engines.
$1\frac{1}{2}$	73.9	15.6
3	33.3	12.9
4	26.7	12.0
5	23.2	11.5
6	21.0	11.0
8	18.3	10.4
10	16.7	10.0

The efficiency of a steam-engine in actual use may be ascertained by comparing the quantity of steam *actually used* to give one horse-power per hour with the quantity given by the above table for the same initial and terminal pressures of the steam. For instance, a non-condensing engine may give a horse-power per hour with a consumption of 35 pounds of water or steam at a pressure of 6 atmospheres—a common performance. The theoretical quantity required in a *perfect* engine, according to the preceding table, for the same initial pressure, is 21 pounds. The efficiency of the engine under these circumstances, measured by the standard of steam required, is $\frac{21}{35} = 0.6$. Ordinary boilers of the best type may evaporate 9 pounds of water for 1 pound of coal burned, the maximum of evaporation of the boiler being about 13.5 pounds of water per pound of coal. The efficiency of the boiler is then $\frac{9}{13.5} = 0.6$. Multiplying these efficiencies together, we have the efficiency of the boiler and engine equal to $.0.6. \times 0.6. = 0.36$.

The efficiency of the apparatus, measured by the ratio of the work in foot-pounds accomplished to the number of foot-pounds of work, which are equivalent to the heat evolved in the combustion of fuel, gives quite a different result. A non-condensing engine that requires 35 pounds of water per horse-power per hour will require a consumption of about 4 pounds of coal per horse-power per hour, of which only about six-tenths are available, the other four-tenths being waste heat of the boiler, heat required to produce the draught, etc. One horse-power per hour is equivalent to 1,980,000 foot-pounds per hour of actual work. The *available* heat of combustion of 1 pound of coal is about six-tenths of 10,000,000 foot-pounds, or 6,000,000 foot-pounds; and the available heat of combustion of 4 pounds of coal is about 24,000,000 foot-pounds. The efficiency of the whole apparatus on the basis of the heat which is imparted to the water by the combustion of the fuel will be $\frac{1,980,000}{24,000,000} = .08$, approximately. In condensing engines a corresponding calculation will give a higher efficiency, amounting to .17, a horse-power per hour being produced by 2 pounds of coal in some instances. The efficiency of the non-condensing and condensing engines approach each other as the initial pressure increases.

Some of the inherent deficiencies of the steam-engine, which can in no way be wholly avoided, may be illustrated by the following diagram. If we suppose steam to enter the cylinder with a pressure p_1 above an absolute vacuum, and to follow the piston at this full pressure through a part of its course as A B (Fig. 46), then to expand by the adiabatic curve B c, and to be discharged with a constant pressure p_2, the ordinate of the line $f\,g$, the diagram A B $c\,f\,g$ will represent theoretically that of an actual engine. In this

FIG. 46.



it will be observed that the initial pressure p_1 is less than *the boiler pressure p*; the expansion is *not complete*, and the back pressure is not zero. Those parts of the diagram covered by shaded lines represent such losses; and it may be added that even with a perfect diagram, as represented at A B C D, the *cycle* is not a complete one, such as has been given in Fig. 45. If to these defects are added others, such as arise from wire-drawing of the steam at the cut-off, hurtful or dead space at the end of the stroke, the causes of losses of efficiency in actual engines become apparent. If to these losses of efficiency the friction of the engine be added—a quantity dependent on the useful work performed—the total losses of efficiency of the machine may be estimated.

It may be remarked that the *engine itself*, with all modern improvements, approaches the turbine-wheel in efficiency. The efficiency of the latter may be estimated at eight-tenths, while the best engines will approach an efficiency of six-tenths to seven tenths. The cost of the power is another question. In the turbine-wheel nature performs the important part of elevating the water to a higher level without cost. In the steam-engine the elevation of the heat of the water to the higher degree from which it must fall to produce work is accomplished only at the cost of labor, beginning with that of the miner who excavates the coal. If the efficiency is estimated by the number of foot-pounds of energy evolved in the combustion of the coal, we have seen that it is a very small fraction.

It is impossible to enter into the details of constructions which have been proposed and executed, having for their object improvement in the efficiency of the steam-engine. The use of the condenser and the steam-jacket has been alluded to. It only remains to notice briefly the *compound engine*. This is an engine in which there are two (or more) cylinders (see Fig. 38), each with its own piston and piston-rod, but all acting upon the same shaft. One of the cylinders is called the high-pressure cylinder, and the other the low-pressure cylinder. Steam is admitted to the high-pressure cylinder, and is cut off before accomplishing the full stroke, but the expansion in the cylinder is not carried to a high degree. The steam is exhausted on the return stroke, not into the condenser directly, but into the second and larger cylinder. In this cylinder the steam continues to expand until the limit of expansion is reached, and it is then exhausted into the condenser. This style of engine has become almost universal for ocean steamships, a substantial proof of its value. The arrangement of the cylinders, whether superposed or side by side or separated from each other, and whether the pistons act on the same crank and move simultaneously in the same direction, or on different cranks having an angle with each other, does not alter the general principles of action, but constitute details which are adapted to different circumstances according to the judgment of the engineer. If the cylinders of steam-engines could be made of a material which would not absorb and give out heat, there would not be theoretically any economic gain in the expansion of the steam in several cylinders as compared with expansion in one, and the only gain which could arise would be the equalization of pressure on the crank-pin during its revolution. But the action of the metal of the cylinders in absorbing and giving out heat modifies, as has already been explained, in a remarkable degree, the action of the engine upon the steam. The less the *change of temperature* in a cylinder from this cause, the more nearly will the action of the steam correspond to that which is indicated by the mechanical theory of heat, uninfluenced by the cylinder. The effect of two cylinders is to diminish the range of temperature in each, and hence the injurious effect of these secondary causes is diminished.

It has been shown by the estimated quantity of steam required per horse-power per hour in a perfect engine that an increase of pressure is accompanied by an increase in economy. Experiments have invariably confirmed this result. In the compound engine, as now employed so generally for marine purposes, there has been with their introduction an advance in practice also in using steam at high pressures. This would in itself account largely for the increased economy in such engines; and it is contended by

many practical engineers that this is the chief, if not the sole, cause of such economy—that the use of a single cylinder with a steam jacket may be made to exhibit a corresponding degree of economy. Nevertheless, the widely-extended use of the system shows that it has important advantages. An instance is given of an engine with two cylinders on the Woolf system in Normandy, which has been in continual use for fifty years; and this is quoted as an evidence of durability of the mechanism where this system is applied.

It may be stated, as general conclusions, that the use of a steam-jacket with a single cylinder under ordinary circumstances results in an important saving of fuel, especially for high degrees of expansion; that in the compound engine, with the larger cylinder jacketed, there is a saving in economy over a single cylinder jacketed, even with the same steam-pressures and degree of expansion in both. This last conclusion, although derived from what appear to be conclusive and satisfactory experiments, is perhaps not universally accepted by engineers, the subject being one about which there is still considerable discussion. Large cylinders are more economical in expenditure of fuel for a unit of power than small ones, and slow-speed engines generally less economical than high-speed engines. An engine using steam at high pressures, other things being equal, is more economical than one using steam at low pressure. In regard to the *degree of expansion* to be allowed in designing an engine, it is to be observed that the point of cut-off with a given pressure determines the mean pressure in the cylinder from which the requisite power is to be obtained; and if the speed of the piston per minute be fixed, the size of the cylinder is determined.

There is still a want of precise and definite rules for ascertaining the most economical degree of expansion in every given case; and hence it is apparent that a theoretical calculation of the dimensions of the cylinder of an engine to be constructed is a problem which involves some degree of indetermination as far as regards maximum economy. In a paper presented to the American Society of Civil Engineers by Mr. C. E. Emery, M. E., in 1874, giving an account of experiments made by him for the U. S. navy department, the following empirical formula is given, based on the experimental data for the most economical ratio of expansion:

$$r = \frac{p + 37}{22},$$

in which r is the ratio of expansion, p the initial pressure above the atmosphere. For example, taking p equal to 5, 10, 25, 40, 60, 80, 100, the values of r will be 1.9, 2.1, 2.8, 3.5, 4.4, 5.3, 6.2, respectively. Mr. Emery states that these ratios are "nearly correct for single engines of large size, with details of good design, too small for single engines of ordinary construction, and too small for the better class of compound engines." The final performance of an engine can only be satisfactorily tested by the use of the indicator.

The adaptation of the steam-engine to special purposes, such as the locomotive, the marine engine, the stationary engine, the steam-pump, the pumping-engine, the traction-engine, etc., gives rise to details of mechanism which may be found described in works specially devoted to these subjects. W. P. TROWBRIDGE.

Steam Fire-Engine. See FIRE-ENGINE, by PROF. J. A. WHITNEY.

Steam'-Hammer. This name has been given to hammers which are raised by the direct action of steam on a piston in a steam-cylinder, and is not understood as applying to hammers which are raised by other mechanical means receiving their power from a steam-engine through the intervention of belts and pulleys or gearing. The direct-acting steam-hammer has been said to have contributed more than any other modern mechanical invention in developing the resources of the iron trade. It is certainly the outgrowth of the needs of the trade in its advancement, and has very considerably aided that advance.

Long before steam-hammers were thought of, iron forgings of considerable size were wrought under heavy hammers operated indirectly by steam or water. These primitive forge-hammers were either known as trip-hammers or tilt-hammers. The latter, and probably the most familiar form, has been much improved, and still continues in use for light forgings. This style of hammer consists of a metal hammer-head mounted on the end of a heavy timber, answering in purpose to the handle of a hand-hammer. This timber is, at some distance from the hammer-head, provided with trunnions, and a prolongation of timber back of the trunnions is operated upon by tappets on a revolving wheel. The tappets, striking the end of the beam or helve, depress it, and thus raise the hammer-head in an arc of a circle, the trunnions being the centre of the circle. The trip-hammer is the same, so far as the hammer-helve and trunnions are concerned, but the tappet-wheel is placed in front of the hammer-head, and lifts the head, acting from beneath upward. The trip-hammer in the forge and rolling-mill is used for rudely forging the puddled balls of iron into blooms. Both of these hammers deliver their blows in an arc of a circle, and are limited in their capacity of regulation as to force and intensity of the blow. The tilt-hammer, when arranged with a spring above the hammer-head or a spring below the tail end of the helve where it is driven down by the tappets, is capable of being operated at a much higher speed than when its blow is the result of gravity alone, for the hammer, recoiling from the action of the spring against which it has been driven in ascending, has a more rapid descent, and can be run at a very high rate of speed. The tilt-hammer, or helve-hammer as it is sometimes called, maintains its place in the workshop, and is largely used for light forgings for cutlery and the like.

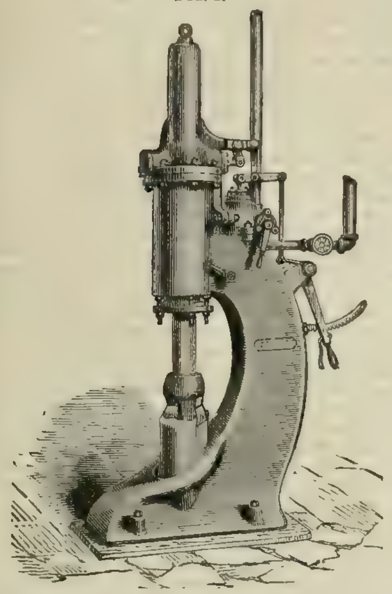
To Mr. James Nasmyth of the Bridgewater Foundry, Patricroft, near Manchester, England, is due the honor of the invention and practical construction of the first steam-hammer. Mr. James Watt in 1784 patented a steam-hammer; one William Deverell also took out a patent for one in 1806, but there is no reason to believe that these patents were ever worked. Mr. Nasmyth proposed the steam-hammer to the engineer of the Great Western Steamship Co. in 1837 as of advantage in forging the paddle-wheel shafts of the Great Britain steamship, then building, but no hammer of this kind was constructed until the years 1842 and 1843. Mr. Nasmyth's steam-hammer was constructed with parts common to all steam-hammers made afterward—viz. a heavy mass of iron which constitutes the hammer, or "tup" as it is called. This "tup" slides freely in guides or ways in the frame or upright of the hammer. On top of this frame is placed a cylinder fitted with piston, piston-rod, and valve, after the manner of a steam-engine. The piston-rod, extending downward through a stuffing-box in the brass cylinder-head, terminates in its attachment to the tup or hammer. Steam admitted under the piston raises it, and thus lifts the hammer; upon the opening of the exhaust, and consequent escape of the steam, the hammer falls with a force due to its weight and the distance fallen through, less the friction of the piston, piston-rod, and escaping steam. This form of hammer was at first made single-acting only, and its essential features are the same as nearly all the steam-hammers made by various makers since then. All direct-acting steam-hammers are, properly speaking, Nasmyth's hammers, but his name has been almost lost in the rival claims of those who have introduced distinguishing improvements on his invention. His hammer, single-acting only, was worked by hand, and no very good valve-motion was added to it to render its action automatic until his engineering manager, Mr. Robert Wilson, hit upon a plan of operating the valve automatically; and he also, it is believed, first applied the balance principle of valve to the steam-hammer. This latter improvement was of great importance, inasmuch as it permitted large valves to be readily raised by hand. The use of this valve has continued, but the cumbersome but ingenious valve-motion of Mr. Wilson has been replaced by more simple if not more efficient devices. During the continuance of Mr. Nasmyth's patent, engineers had but little chance to improve the original invention. Some radical changes were proposed which did not meet with much success, the most radical having been proposed by Mr. Conde. His invention, which bore his name, consisted in suspending the piston by its rod from the top of the hammer-frame, and making the steam-cylinder the hammer proper. Steam to this cylinder passed through the piston-rod, which was hollow. Then the steam-cylinder was made to rise and fall, and a die or hammer-face at its lower end struck the metal to be forged.

Steam-hammers have more cause to deteriorate in use than almost any other machine tool, inasmuch as the severe shocks to which they are submitted while in use tend to destroy their parts. This can be readily understood when it is considered that a mass of metal, perhaps weighing many tons, is lifted by the steam-piston and piston-rod, and either allowed to fall or is driven down by steam-pressure acting above the piston, and the motion of this heavy mass is suddenly arrested when it strikes the metal being forged. If the point of contact in striking be out of plumb with the centre of gravity of the falling mass, a side vibration is given to the mass, resulting in a severe side-strain in the guides or ways. The piston-rod, arrested in its downward motion at the end of the stroke, becomes itself a hammer, acting upon the mass of the hammer proper, or "tup," as on an anvil. This in time destroys the piston-rod. The destruction of the piston-rod from this cause was considered so serious a matter in the early

hammers as to induce Mr. Nasmyth to resort to many ingenious devices to provide an elastic cushion between the piston-rod and the "tup."

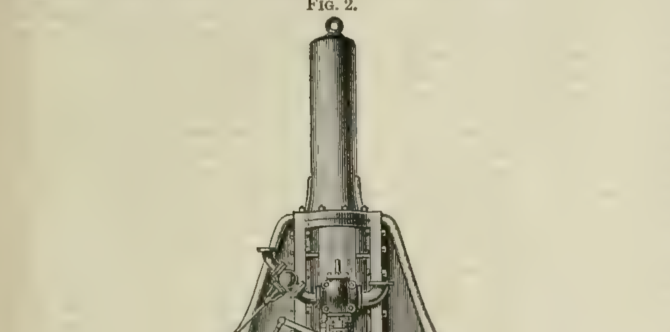
Mr. Robert Morrison of Newcastle-on-the-Tyne in the year 1853, patented a steam-hammer in which the piston-rod was the hammer, and the blow was imparted by the end of

FIG. 1.



the piston-rod properly protected by a shoe or hammer-face. He of necessity made the piston-rod very large and of wrought iron, welding the piston to the middle of this

FIG. 2.



long rod, and guiding it by stuffing-boxes in the upper and lower cylinder-heads. In other words, he extended the rod through both heads of the cylinder, and made it sufficiently large to weigh the number of pounds required. Thus, as an example, a rod weighing 5 tons be made 13 inches in diameter; its piston-head, 31 inches in diameter, working in a cylinder long enough to allow a stroke of 6 feet. His idea was to do away with the many parts which in the Nasmyth steam-hammer tend to beat themselves to pieces, one on the other, and substitute for them one single bar of wrought iron, striking endways on the forging in the manner of a battering-ram. To prevent the bar from turning, he cut a flat on the rod above the piston-head, and guided it by a corresponding shape in the top cylinder-head. This form of steam-hammer proved to be very efficient, but in time developed a weakness where the piston-rod was enlarged at its lower end to receive the hammer-die. Repeated blows caused a fracture immediately above this enlargement. In 1872, Mr. William Sellers of Philadelphia improved the Morrison hammer by enlarging the rod below the piston-head, and continuing the enlarged size down to the hammer-face, then attaching the hammer-face by means of a loose collar surrounding the lower end of the bar, this collar being held in place by means of a tapered wedge-ring driven down between the bar and collar, the collar being provided with proper dovetails to receive the hammer-face. This arrangement brought the greatest part of the weight nearer to the hammer-face, strengthened that part, and did away entirely with the weak point in the hammer-bar of Mr. Morrison. His improvement obviated all trouble from breakage of the hammer-bar, and rendered it practically indestructible. It was found advantageous to increase the weight of the hammer-bars in hammers of any given length of stroke, so that the lower part of the hammer-bar being increased, the 5-ton hammer of Mr. Morrison's bar came to weigh 7 tons. Hammers for heavy forgings are constructed with double uprights, large-sized hammers, with a long stroke, having a wide spread of base between the legs of the upright to give room for the workmen to handle the iron being forged. The anvil-face is usually set at 18 inches above the floor-level. Fig. 2 shows a double upright hammer of the Morrison type. These large hammers are not made self-acting, it having been found advantageous to work them by hand only. In light work, such as tilting or drawing out bars of steel, an automatic valve-motion is of the utmost importance. Fig. 1 shows the form of a single upright hammer as used for light forging or for tilting steel. A hammer weighing 300 pounds—*i. e.* the hammer-bar, or part which strikes the blow, weighing 300 pounds—should make at least 300 blows per minute to work economically in light forging. An important improvement recently introduced in these rapid-running steam-hammers is the separation of the exhaust-passages in the slide-valve, so that the exhaust from the space below the piston escapes through a passage which does not communicate with the exhaust-passage from the space above the piston. In the exhaust-passage from below the piston, is arranged a throttle-valve, which when partially closed chokes the exhaust escape, and thus, suspending the escape of steam as the hammer descends, materially diminishes the force of the blow, and yet, inasmuch as the upper exhaust-passage is open, the hammer rises as quickly as when working with full exhaust. This is of great advantage in working steel, as the force of the blow can be lessened without materially slowing the speed or rapidity of blows. If steel is hammered with too heavy and too rapid blows, the metal becomes overheated; in fact, cold steel so hardened will become intensely heated. As the steel in tilting is brought near to size, it is of importance that it should be worked cooler to give the requisite finish and to improve the quality of the steel. This requirement is admirably accomplished by the devices above alluded to.

In setting steam-hammers it is of the utmost importance that the foundations should be of the most substantial character. It is usual—and in fact is considered the best practice—to make the anvil-block entirely separate from the hammer—to place it too on a separate foundation, and to underlay it with some thicknesses of wood, say with two layers of closely-fitted timbers at least 24″ in thickness. This gives a degree of elasticity to the

anvil and preserves the foundation. It is customary also to place wooden beams between the foundation-stones and the bed plate of the hammer itself: the slight elasticity of the timbers relieve the frame from strains incident to the jar of the repeated blows. The anvil for iron forging hammers should not be less than five times the weight of the hammer. Thus, a 2 ton hammer should have not less than 10 tons of iron put into its anvil block. This is not enough for hammers used in forging steel, for eight to ten times the weight of the hammer should be put in their anvils. A 10 ton hammer for forging steel ingots ought to have from 90 to 100 tons weight of anvil. These very large blocks cannot readily be made in one mass, but are advantageously built up in sections, one resting on another. Such sectional blocks can be more readily handled when put in place, and can also be conveniently raised to pack under when repeated blows have caused the anvil to settle. In setting anvil-blocks they should be placed a half inch or more, according to their size, above their proper height, to allow for settling, which is sure to occur, no matter how well the foundation may have been put in.

Mr. Ramsbottom of England has devised a form of steam-hammer which in his hands at the works at Crew has given satisfaction. His steam-hammer is duplicated, and the blows are given horizontally, on opposite sides of the forging. The iron being forged rests on a bed-plate, which need not be very massive, the duplex principle doing away with the anvil-block entirely. Mr. Ramsbottom's two hammers are operated through a system of levers by one steam-cylinder, the blows from either side being simultaneous.

The steam-cylinder has been added to helve-hammers operating with a short stroke near the fulcrum, and some ingenious contrivances have been introduced to so operate a light helve-hammer as to make it take the place of a "striker" for a blacksmith, the blow being adjustable in direction as well as in force. The introduction of hydraulic machines for forging has taken some work from the steam hammer and widened the possible use of wrought iron in engineering works. The steam-hammer forges the metal into the required shape with repeated blows and well-directed skill on the part of the workman. In hydraulic forging the red-hot metal is made to flow in a solid state into metal moulds, and driven into them by plungers operated by hydraulic presses. This method of forging is yet in its infancy; its ultimate extension in use depends on the introduction of improvements in the machinery used—in machinery containing great strength with ready adaptability to the uses it has to perform, and, above all, in the utmost possible durability in constant use. The first cost of the hydraulic machinery and the constant expense of dies will for a time limit the uses to which hydraulic forging may be applied, and yet necessitate the improvement in the modes of working steam-hammers to compete with it. Die forging under steam-hammers is a step in this direction capable of extension. COLEMAN SELLERS.

Steam Navigation. See NAVIGATION, OCEAN STEAM, by W. S. W. VAUX, A. M., F. R. S.

Steam-Presses. See PRINTING, by W. S. PATERSON.

Steam-Pumps. See PUMPING-ENGINES, by J. P. FRIZELL.

Steam Type-founding. See PRINTING, by W. S. PATERSON.

Steam Vessels. The idea of the possible adaptation of steam for the propulsion of vessels was suggested at a very early period; it seems to have occurred to Roger Bacon, who lived in the thirteenth century. It has been generally stated that Blasco de Garay of Spain, in 1543, propelled a vessel by steam. As a fact, La Fuente, the Spanish historian, visited the archives of Simancas, and, examining the documents relating thereto, found that Blasco de Garay made (1540–43) several trials with paddles on ships furnished by the emperor Charles V.; but in every case these paddles were moved by companies of men. Suggestions as to the use of steam, none of which were attempted to be carried out practically, were made by Salomon de Caus (*Les Raisons des Forces mouvantes, avec diverses Machines, tant utiles que plaisantes*, Paris, 1615) and the marquis of Worcester (*Century of Inventions*, London, 1663). But the earliest practical effort appears to be that of Papin, who in 1707 applied his steam-engine to the propulsion of a model vessel on the Fulda River at Cassel. Newcomen had in the mean time brought the steam engine itself to a working condition; and in 1736, Jonathan Hulls patented a marine steam-engine which he proposed to employ in a vessel to be used as a tugboat. About 1763, William Henry of Pennsylvania built a small model steamboat, which he tried with flattering success on the Conestoga River: this experiment is specially notable as having furnished the hint to the successful efforts made forty years later by Robert Fulton. During the last quarter of the eighteenth century the problem of steam navigation had begun to engage many minds in Europe and America. In France we find the count d'Auxiron and M. Perier making experiments in 1774 and 1775, and the marquis de Jouffroy, upon a larger scale and with better success, in 1776–83. In America, James Rumsey of Maryland was engaged in similar experiments, and as early as 1786 built a boat which was propelled upon the Potomac by steam at the rate of 4 miles an hour by means of a jet of water forced out at the stern; a society was formed to aid him in his project, of which Dr. Franklin was a member, and he went to London, where he built a boat with which a successful experiment was made on the Thames in 1792; but he died before any thorough success was attained. In the mean while, John Fitch had been also trying experiments in steam navigation upon the Delaware River. His first boat, built in 1786, was propelled by paddles moved by a steam-engine; at first a speed of only 3 miles an hour was attained, but improvements were shortly added by which 8 miles were gained. After an unsuccessful visit to Europe to introduce his invention, he returned to America, and resumed his experiments with a small vessel upon the "Collect," a pond which occupied the spot where now stands the "Tombs" prison. It is noticeable that in this boat he employed side wheels, with a screw-propeller at the stern. (See FITCH, JOHN.) Simultaneous experiments were also carried on in Great Britain. In 1788, Miller, Taylor, and Symington built a boat which consisted of two connected hulls driven by a single paddle-wheel between them, which obtained a speed of 5 miles an hour on Dalswinton Loch. Next year they built a larger vessel, with a steam-engine of 12 horse-power, which attained a speed of 7 miles an hour. In 1801, Symington built a boat for towing on a canal, which drew vessels of 140 tons at the rate of $3\frac{1}{2}$ miles an hour, but was soon abandoned, as the swell raised injured the banks of the canal. About 1790, Robert Fulton left America for England to study his profession of a painter, but he soon turned his attention to mechanics, and especially to steam navigation. He made some experiments in France, which were only partially successful, but he secured the confidence and aid of Robert R. Livingston, the American ambassador, and in 1806 returned to New York, bringing with him a powerful Boulton & Watt steam-engine, for which a hull was built. The vessel, named the Clermont, after Livingston's manor on the Hudson, made a successful trial-trip to Albany, Aug. 7–9, 1807, returning on the two following days, her average running speed being 5 miles an hour. The Clermont was 130 feet long, 18 feet beam, 7 feet deep, with a burden of 160 tons. She soon commenced making regular trips between New York and Albany, and for all practical purposes must be considered the first steamboat adapted for the conveyance of passengers and freight, all previous ones having been experimental models, or at most only designed as tugs. Fulton and Livingston obtained from the State of New York the monopoly for using steam vessels in the waters of the State. (See FULTON, ROBERT.) John Stevens of New York was even earlier than Fulton as an experimenter in steam navigation, and narrowly missed anticipating him in practical success. As early as 1789 he had perfected his plans for a steam vessel, and in 1804 and 1805 built small vessels which evinced that his plans were sound. The Phœnix, his first steamboat, properly so called, was completed in 1807, following hard upon Fulton's Clermont. Prevented by the monopoly of Fulton and Livingston from navigating the Hudson, he sent his boat by sea to the Delaware, upon which she was afterward employed, and in this voyage incidentally demonstrated the problem of the possibility of the use of steam vessels upon the ocean, no one as yet having, apparently, imagined that they could be used except in smooth water. (See STEVENS, JOHN.) Steam vessels in America were now an assured success. Fulton and his coadjutors soon placed a fleet of them upon the Hudson River and Long Island Sound, while Stevens and his sons placed their steamers upon the Delaware and the Connecticut, and upon the Hudson after Fulton's monopoly had expired. The first steamboat in Great Britain was the Comet, 40 feet long, built in 1812 for the navigation of the Clyde; but before this time Fulton and Livingston had begun to build steamers at Pittsburg, Pa. Upon all navigable rivers and smooth waters of the civilized world steamboats were rapidly introduced, but their use upon the ocean was long held practically impossible, although as early as 1819 a little steamer, the Savannah, made the voyage from Savannah, Ga., to England, and thence to Russia. (For the further progress and present condition of this branch of the subject see NAVIGATION, OCEAN STEAM.)

A. H. GUERNSEY.

Stear′ic Acid [Fr. *acide stéarique*; Ger. *Talgsäure*], $C_{18}H_{36}O_2$. Stearic acid, discovered by Chevreul in 1811 (*Ann. de Chim. et de Phys.* (2), t. ii. 354, and xxiii. 19;

Recherches sur les Corps gras), is the most abundant of the solid fat-acids, and is obtained in the saponification of all the fats containing stearine, and especially of beef's tallow, mutton suet, hog's lard, etc. All the hard fats contain two solid fat-acids, which it is extremely difficult to separate completely from each other. Hence, many fat-acids described under other names are probably only stearic acid imperfectly purified; *e. g.* bassic acid, from oil of bassia; anthropic acid, from human fat (*Heintz*); palmitonic acid, from palm oil (*Schwarz*), etc. Many vegetal fats contain stearic acid, as shea-butter of Mungo Park, cacao-butter, olive oil, oil of black mustard, oil of ben, oil of madia, Chinese wax, and the oil of *Bassia latifolia*, just named (illupei tree of the Himalayan Mountains), which afforded Hardwick the purest stearic acid (his bassic acid).

The so-called stearic acid (or stearine) of commerce, which is found in "star candles," is a mixture of stearic, palmitic, and margaric (and often also oleic) acids. This commercial stearic acid is produced by the saponification of neutral fats by methods already mentioned under SOAP. But this acid is never pure, and consists of a mixture of several acids, from which it is obtained in a state of purity by one of the following methods: (1) The commercial stearic acid is dissolved in hot alcohol, which on cooling deposits the greater part of the acid; the excess of alcohol is poured off; the acid is dried by blotting-paper; and this process is repeated until the melting-point of the stearic acid is steady at 160° F. (2) The acid also may be obtained pure by fractional precipitation. For this purpose the soap obtained by the saponification of the fat by an alkali is decomposed by hydrochloric acid; the fat-acids thrown down are dissolved in a great excess of alcohol, and the boiling alcohol solution is, *in part only*, precipitated by a concentrated solution of acetate of barium, lead, or manganese; the alcoholic liquor deposits, after a time, the metallic stearate, which is then decomposed by weak hydrochloric acid; the stearic acid is then crystallized; and this process is repeated, again and again, on the product of these partial precipitations until the acid has a constant melting-point. This last method of Heintz is a modification, with much saving of time, of the original process of Chevreul. But with every possible care it is difficult to obtain stearic acid quite free from all admixture. Mutton suet saponified with one-fourth to one-third its weight of potash most readily furnishes pure stearic acid.

Pure stearic acid is colorless, and without odor or taste, and insoluble in water. It reddens blue litmus when warm and in its cold alcoholic solution, but water, which precipitates the acid, also restores the blue color. It melts at 157°–159°, and solidifies at 150° F.; Chevreul says it melts at 167°, and solidifies at 158° F. By cooling it crystallizes in brilliant needles, greasy to the touch, and after fusion it is very friable. It is insoluble in water, but dissolves in boiling alcohol in all proportions, the cooling solution depositing nacreous crystals. It is very soluble in ether. It burns with a clear and white flame. Stearic acid is the least soluble in different solvents of all the fatty acids. H. Kopp has shown that stearic acid in the act of fusion undergoes an increase of 11 per cent. in volume. The volume at 32° being 1, becomes 1.0169 at 68°, 1.0278 at 104°, 1.0539 at 140°, 1.0793 at 158°, and 1.1980 at complete fluidity. Melted stearic acid has a density of 0.854; at 39.2° its density is 1.01, and between 48° and 50° it has the same density as water. The formula $C_{18}H_{36}O_2$ is deduced from the analyses of Chevreul, Hardwick, and others, and requires C76.06, H12.68, O11.26 = 100, to which the analyses very closely correspond. It boils and distils in a vacuum and in small quantities apparently without change, and at even 572° F. in a sealed tube when heated for several hours, it neither gives off gas or water, nor alters its melting-point or appearance (*Berthelot*).

Decomposition.—When larger quantities of stearic acid are subjected to dry distillation, not *in vacuo*, the greater part passes over unchanged, while a small portion is resolved into carbon-dioxide, water, and STEARONE (which see). The distillate contains also acetic and butyric acids, and an acid of lower melting-point than stearic acid; also hydrocarbons of the formula C_nH_n, and ketones richer in carbon than stearone, resulting probably from the further decomposition of the stearone. The black-brown residue in the retort still contains stearone, but scarcely any fatty acids (*Heintz*). If sebacic acid is found in the empyreumatic residue, it is regarded as evidence of the presence of oleic acid in the stearic acid—*i. e.* of the impurity of the latter (*Redtenbacher, Smith*). Chevreul obtained 96 per cent. of this acid unaltered in the distillate from stearic acid. Chlorine and bromine both attack melted stearic acid, replacing hydrogen and producing chlorinated and brominated species, substitution-products; they are mono- and di-brominated stearine $C_{18}H_{35}BrO_{28}$, $C_{18}H_{34}Br_2O_2$, and $C_{18}H_{35}ClO_2$. Concentrated sulphuric acid at a gentle heat dissolves in stearic acid without coloration; the addition of water throws down the fatty acid in white flocks. When the sulphuric acid solution is heated, sulphurous oxide is evolved, and a new fatty acid is formed, resembling elaïdic acid = $C_{18}H_{34}O_2$, and fusible at 111° F. Iodine forms no compound with stearic acid. Boiling nitric acid attacks stearic acid, and transforms it successively into suberic, pimetic, adipic, succinic, capric, and œnanthic acids (*Bromeis*). Cold nitric acid changes stearic acid after some days into margaric acid, and if crude stearic acid is used, suberic and succinic acids are produced. With phosphoric oxide (anhydrous phosphoric acid) stearic acid yields the elements of water, and is transformed to a yellowish brittle mass, which melts between 130° and 140° F. With platinum-black, stearic acid, in an atmosphere of oxygen, at a temperature of 212° F., evolves carbon-dioxide, and at 392° F. is converted entirely into water and carbon-dioxide. Permanganate of potassium converts stearic acid completely into stearate and carbonate of potassium. Distilled with aniline, stearic acid yields phenyl stearamid = stearanilide (*Pebal*). With methylic, ethylic, and homologous alcohols, with carbohydrates, with glycerine, meconine, and cholesterine, stearic acid yields with heat ethereal compounds, formed from the acid and the other body, with elimination of water. Stearate of lime subjected to dry distillation gives off marsh-gas, olefiant gas, or other olefines, and the distillate contains abundance of stearone and other ketones in smaller quantity, calcic carbonate being the residuum.

Stearates.—Stearic acid combines with many metallic bases, forming bodies of the consistence of hard soaps and plasters which are mostly insoluble in water, the alkaline salts alone being soluble. The stearates are mostly decomposed by other acids, the stearic acid floating as an oil on the surface of the warm liquid. Stearic acid displaces carbon-dioxide from a mono-carbonate of sodium or potassium only at 212°, and it dissolves in a cold solution of alkaline carbonate, forming bicarbonate. The neutral stearates of the alkalies dissolve without dregs in 10 to 12 parts of warm water, but are decomposed by a large quantity of water, with separation of an acid salt, and the liquid becomes alkaline. This peculiarity was mentioned under SOAP as the cause of the detergent power and opaline appearance of soap-suds. The alkaline stearates are soluble in alcohol, better if warm. Ether does not dissolve the stearates, but extracts the excess of acid from the bi-stearates and transforms them into neutral salts. Saline waters dissolve only a trifling quantity of alkaline stearates—a property utilized in the manufacture of soap, as already described. The neutral salts of other metallic oxides decompose the alkaline stearates, forming insoluble stearates of the other metals. Dilute mineral acids also decompose the alkaline stearates, with separation of stearic acid.

There are three stearates of potassium—mono-, bi-, and tri-acid salts, and a mono- and bi-acid stearate of sodium, all more or less soluble salts. (See SOAP.) A soluble neutral salt of ammonia with stearic acid also exists. The history of these salts may be found in the larger treatises, as in Gmelin, xvii. 107 *seq.* The stearates of baryta, strontia, lime, magnesia, lead (bi-plumbic and mono plumbic), copper, mercury (mercurous and mercuric stearates), and silver are all insoluble salts, generally amorphous fusible powders, the stearates of the heavy metals alone being colored, the metals replacing one or more atoms of hydrogen in the constitution of the acid. The lead-salt is familiar in surgery as *diachylon*, while the lime salt is one of the products of the lime-saponification of fats in the stearic-acid candle industry. The mixture of stearic acid with lauric, myristic, palmitic, and margaric acid gives bodies varying in their melting-points and other relations, as has been already referred to under OLEIC ACID (which see), and carefully studied by Heintz (Gmelin, xvii. 113, and xvi. 214).

Stearic Ethers.—Methylic, ethylic, amylic, octylic, and cetylic stearates have been produced as conjugate compounds of the primary nucleus $C_{18}H_{36}$, *plus* the corresponding alcohol radicals. Ethylic stearate ($C_{18}H_{35}O_2.C_2H_5$) is obtained by saturating an alcoholic solution of stearic acid by hydrochloric acid gas, heating the mixture, and agitating with water. Or it may also be obtained by boiling together for half an hour a mixture of stearic acid, alcohol, and concentrated sulphuric acid. This ether forms also instantly if an ethereal solution of stearine is shaken up with an alcoholic solution of potassa insufficient for complete saponification. (*Bouis.*) Ethylic stearate is a transparent, odorless solid; melts at 88° to 93°; distills at 435° F., with decomposition. It crystallizes from the alcoholic solution in white silken needles. Its ethereal solution gives no crystals. It is partially decomposed by boiling water, and completely by chlorhydric acid and alcoholic potassa, but not by watery solution of potassa. It is not necessary to follow the history of the other stearic ethers or of the corresponding mannite compounds, or the derivatives of glu-

cose, which have been so well investigated by Berthelot (*Ann. de Chim. et Phys.* (3), xlvi. 70, and xlvii. 297, 324). (For the relations of stearic, palmitic, and oleic acids see OLEIC ACID and under.)

STEARIC-ACID INDUSTRY.—*Star Candles, Bougies.*—Chevreul, by his well known researches on the constitution of the fats, commenced in 1811, opened the way for the industrial use of the fatty acids, but it was not until Jan., 1825, that Messrs. Gay Lussac and Chevreul applied for a patent for utilizing these acids as illuminants. In this patent they proposed to use potassa or soda to saponify the fats, preferably with pressure, and alcohol for the separation of the acids from glycerine. This process was impracticable on an industrial scale, and was never put into use. Moses Poole in June, 1825, took out another patent for Gay Lussac in England, in which it was contemplated to distill the fatty acids after an alkaline saponification, and to separate the liquid acids after distillation by pressure. This was a step in the right direction, but this patent appears to have been no more fruitful of results than its predecessor of the same year. At that time, also, the use of properly prepared wicks was unknown, and the common wicks produced very imperfect combustion of the fatty acids. The patents of Cambacérès in 1825 and 1826 were mainly directed to the preparation of wicks, and to the use of pressure while exposing the products to various degrees of temperature. The candles produced by this inventor were greasy to the touch, yellow in color, offensive in odor, and gave a smoky flame; they were unsalable, and the undertaking was quickly abandoned. But the plaited wicks which Cambacérès first introduced have remained in testimony of his useful labors, without substantial change to this day. The method of producing stearic and palmitic acids on a manufacturing scale yet remained to be discovered, and the industry slumbered until 1831, when it was developed by the researches of two young medical students, Messrs. de Milly and Motard, who had taken up the study of illumination by the fatty acids in 1829, and after numerous experiments discovered a method of saponification of the fats by *lime*—a thing which had never before been accomplished on a working scale. The stearic-acid industry dates, in fact, from the year 1831, when the first manufactory by lime-saponification was opened in Paris near the Barrière de l'Étoile; hence the name, now accepted the world over, of *bougies de l'Étoile*, or *star candles*. From that date the development of this important industry was very rapid and assumed great importance—not in France alone, but all over Europe and in the U. S. In 1873, in France alone, official returns show a production of over 30,000,000 kilogrammes (more than 30,000 gross tons) of stearic acid, and a proportionate quantity of glycerine and oleic acid (*red oil*) for soap. This product was furnished by 156 manufactories, employing nearly 3000 workmen and 1200 horse-power. The money-value of the product, taking the price of the quintal (220.46 pounds) at 173.05 francs, was, in gross, 52,326,685 francs. Of this production, which extends over 43 departments in France, one-fourth part was the product of the department of the Seine alone; and the export of stearic products from France in 1873 was a little more than one seventh of her total product (7,067,291 francs), showing the very extended use of star candles in that country. For the remainder of Europe, including Great Britain, the annual product of stearine in 1873 was stated as not under 100,000,000 kilos, or, in round numbers, about 100,000 gross tons. In the U. S. this industry has also attained great importance, especially in the interior cities of the continent, where the product of hog's fat furnishes the raw material on a great scale. Cincinnati, it is said, produces over one-half of the total make of stearine candles for the U. S., but we are without exact data for the total product, which has fallen off somewhat since petroleum has become so abundant and cheap a source of illumination. The silver and gold mines of Nevada, etc., consume very large quantities of star candles, oil being inadmissible in view of the mischief it works in the amalgamation process.

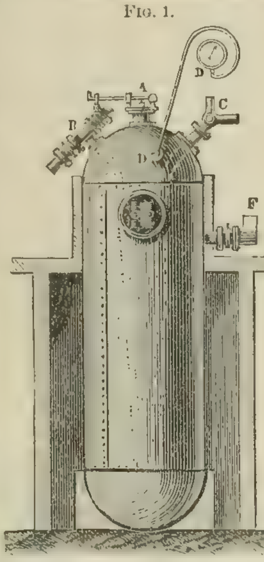
The stearic-acid industry is naturally divided into two quite distinct sections—(1) the *chemical*, and (2) the *mechanical*. The chemical part commences with the saponification of the fats by one of several methods which have already been or will be mentioned, and the separation of the fatty acids from the insoluble lime-soap produced in that mode of saponification; the mechanical processes apply to the non chemical methods of separating the liquid from the solid acids, their clarification, and the transformation, by moulding and other means, of the solid acids into finished candles. We repeat here what has elsewhere been stated, that in commercial and manufacturing use the term *stearine* means the impure stearic acid, the product of saponification of the fats, containing always more or less palmitic acid, with traces of oleic acid, etc. (See STEARINE.) The transformation of the neutral fats into fatty acids and glycerine, although spoken of in general terms as saponification, and correctly within proper limitations, means in a broader sense the dissociation of glycerine from its associated acids, whether this result is accomplished by alkalies, by acids, by hot water, by superheated steam, or by a combination of these agencies. The production of a soap in the so-called saponification of the fats for obtaining stearic acid is by no means essential, or even general, since the original lime-saponification of De Milly and Motard has been essentially modified by the later improvements of De Milly, presently to be described, while by the method of Tilghman and of Wright and Fouché superheated steam or hot water, alone or with the presence of a very small dose of lime, is the agent of decomposition, and sulphuric acid under several modifications is very extensively employed to effect the separation of the fatty acids from glycerine. We shall therefore consider the subject in the order named, commencing with—

1. THE CHEMICAL PROCESSES.—*Lime-saponification* was first proposed by Messrs. de Milly and Motard, under atmospheric pressure and in open vessels. As this process is now used chiefly by small manufacturers or in isolated situations where skilled labor and good apparatus are of difficult procurement, its interest is chiefly historical as the starting-point of the successful application of the principles discovered so long previously by Chevreul respecting the true constitution of the fats. The fat is melted in wooden tanks provided with steam-pipes perforated with holes and coiled on the bottom of the tank. Water, about equal to the weight of the fat, is added before the steam is turned on. When the fat is melted, milk of lime is turned in, equal in weight of quicklime to about 15 per cent. of the fat employed. The lime is previously slaked, and the cream passed through a sieve to separate foreign matters. The chemical action of the calcic hydrate is slow and gradual under the continued action of the steam heat, and with only the common atmospheric pressure. The mass is constantly stirred, either by hand with a rabble, a rake of wood, or by an agitator turned by machinery. In about eight or ten hours the transformation is complete, with the production of a pasty, granulated soap, which when cold is a hard, white, solid cake, breaking with a brilliant fracture and floating on a yellowish watery solution of glycerine. The impure glycerine solution is drawn off from the cold lime-soap by a cock at the bottom of the tank, and the product is washed with water to remove the last traces of glycerine. No use is made by this process of the glycerine, thousands of tons of which were discharged into the Ohio River and its affluents in former years, before the demand for nitro-glycerine led to the adoption of better methods. The lumps and masses of insoluble lime-soap are then broken up by hand or crushed by wooden rolls to a coarse powder; or more usually the acid-water is brought in immediate contact with the lumps in a tank lined with lead, and cut by the blade of a spade. The sulphuric acid used is reduced to mark on the Baumé hydrometer 20°–25°. Theoretically, 86 parts of lime require 98 of real acid of 1.840 sp. gr. for complete neutralization, or 175 parts of acid to 100 of lime. But in practice a slight excess of acid is used, making the acid double the weight of the lime to be neutralized. The acid-water is then heated by steam in contact with the lime-soap, with continued agitation and at a temperature somewhat below 212°, to avoid charring the oleic acid and stearine, etc. The gypsum, or calcic sulphate, as it forms by the action of the sulphuric acid on the lime of the soap, granulates and falls to the bottom, while the liberated fatty acids float to the top as soon as the flow of steam is arrested after the decomposition is complete. The fatty acids are then drawn off at successive heights into a wash-tank lined with lead, when the first washing is performed with fresh acid-water of about 20° B. and at a temperature of about 175° F., to avoid injury to the color. A second and third washing are made with water alone heated to boiling, by which means the last traces of sulphuric acid are removed, with some sulphate of lime and more or less fatty acids, which rise after standing some days to the surface of the wash-water, and are preserved, but not without loss in spite of all precaution. The acid liquors are preserved to dilute fresh acid for successive operations. The crude stearine and oleic acids are now ready for the press and the successive steps of mechanical treatment for making candles, which are briefly treated beyond.

Theoretically, only 9½ per cent. of lime is required to saponify 100 parts of fat; consequently, the use of 15 to 17 per cent. of lime, which in practice is found necessary for complete lime-saponification in open vessels, involves a proportionate loss of sulphuric acid for the neutralization of 6 or 7 per cent. of free lime. Messrs. de Milly and Motard in 1834 attempted to avoid this loss by saponifying under

pressure in a digester, but using at first a temperature of only about 277° F., the process was not successful, and the attempt was abandoned. In 1852, M. J. Bouis repeated the experiment with a Papin's digester at the Conservatoire des Arts et Métiers at Paris, and had partial success in resolving the neutral fats into their factors by the use of water alone at a high temperature. This was two years before Tilghman's patent of 1854. De Milly then suggested to M. Bouis the use of a certain quantity of lime in the digester, less than that required by theory. During two years many experiments were made to perfect this process, and in 1855, De Milly published the method now in general use, by which saponification was complete in a digester, called by him an *autoclave*, with only 4 to 5 per cent. of lime; and with a pressure of eight atmospheres this proportion was reduced to 2 or 3 per cent. *De Milly's Digester* (or autoclave), for lime-saponification at high temperatures, is seen in Fig. 1. It is a copper cylindrical boiler with hemispherical heads, about 16½ feet high (5 mètres) and nearly 40 inches in diameter (1 mètre). The metal is 15 to 16 m. m. thick (0.6 to 0.7 inch). This apparatus is planted two-thirds its length below the surface, and is encased in a surrounding structure of bricks, which also rise to the level of the upper cap. Its lower end rests in a step of masonry. The void space about the digester is sufficient to permit access for repairs. On its head are seen F, the charging-tube, provided with a stopcock admitting water, fat, and milk of lime; C, the pipe of discharge, drawing from near the bottom; B, the steam-pipe, having an interior diameter of 1.2 inch (= 0.030 m.), and reaching within 2 inches (= 0.05 m.) of the bottom of the digester. The steam is delivered upon a copper plate, forming a shield, to distribute it and save action on the boiler. Exteriorly, this inlet-pipe has two branches furnished with steam-cocks, one connected with the low-pressure boilers, and the other with the high-pressure system. A is a safety-valve; D, a manometer. The man-hole is seen at front. In use, this digester is charged with 2000 kilos (= 2 gross tons, nearly) of melted fat, and 1000 litres (= 1 gross ton, nearly) of water charged with 60 kilos (= 3 per cent. of the fat to be treated) of lime. Steam from the low-pressure boilers is then turned on until the manometer indicates nearly four atmospheres (290° F.); the high-pressure steam is then turned on from a boiler situated at some distance from the digester, safe for ten to twelve atmospheres, and actually used to about nine atmospheres, or so that the manometer on the digester shall mark eight atmospheres (= 340° F.) for four hours. If the pressure on the generator falls, it is needful to cut off the communicating cocks to avoid the recoil of the fat into the steam-boiler. The generator is cut off from all access to fire, to avoid danger from combustion. During the entire tour of eight hours a small opening in the stopcock permits the constant escape of a little jet of steam.

Fig. 1.



The process being complete, and the temperature fallen to about 266° F., the 3-way cock C is opened to permit the discharge of the glycerine and water into a tank until the arrival of the fatty acids commences, when the 3-way cock is turned to the other branch of C, communicating with another tank lined with lead, into which the pasty mass of saponified fat is driven to be treated with diluted sulphuric acid for the saturation of the lime. This very acid lime-soap may be regarded as composed of a small portion of neutral lime-soap diffused in a mass of fat-acids; consequently, the mass reaches the decomposing tank in a state of very fine division, and the decomposition by sulphuric acid is almost instantaneous. M. Bouis enumerates the following advantages of this process over the older lime-saponification: (1) there is no need to pulverize the lime-soap; (2) the proportion of sulphuric acid used is considerably less; (3) the quantity of gypsum produced is small, and the loss of fat acids retained in it therefore less; (4) the glycerine is obtained easily and without loss; (5) a single workman can look after many digesters at the same time, having only to manage the valves or stopcocks; (6) the whole process is complete in less time.

Many explanations of this process have been offered. For example, considering the neutral fats or tri-stearine as subject to the action of a quantity of lime not sufficient for complete saponification, it might be supposed that stearate of lime should be formed, with the production of mono- or di-stearine, without the separation of glycerine. M. Bouis says this cannot be the case, since in numerous experiments they have always found glycerine free at every stage of the process, and tri-stearine unmodified. The saponification is therefore complete, and to this end the water intervenes at the same time as the fixed base, and forms stearate of lime and free stearic acid. So true is this, that if the water is replaced by alcohol—or, in other words, if stearine is saponified by a quantity of alcoholic potassa insufficient to saturate the stearic acid—stearate of potassium and stearate of ethyl are formed simultaneously, with separation of glycerine; this action is instantaneous. Thus, when acting on stearine by 1 molecule of potassic alcohol, stearate of potassium is formed, and 2 molecules of stearic ether. (*Compt. rend. de l'Acad. des Sci.*, xlv.) We may suppose that when tri-stearine is saponified simultaneously by such a base as lime and by water, the fixed base, reacting first, forms the corresponding stearate and glyceride; then water in excess, acting on the stearate of lime, sets at liberty the stearic acid and regenerates the basic hydrate, which can then attack a new quantity of tri-stearine; and this circle of reactions continues until the saponification of the tri-stearine is complete. This view is sustained by an analogous statement of Stas and Pelouze, who admit that the saponification begins by the formation of a soap in the first stage of the process—that water decomposes this neutral soap, as fast and in proportion as it is formed, into an acid soap and a basic soap, which act on the neutral fat remaining unchanged as the lime itself had acted. Finally, they suppose water alone to be capable of producing saponification—that lime accelerates the process by weakening the affinity which manifests itself between the free fatty acids and glycerine, with a tendency to reproduce neutral fats. This view is sustained by the fact that hot water alone under pressure suffices to hydrate the glyceride and set free the fatty acids, as is seen in the processes of Tilghman and Fouché, mentioned more particularly beyond. The saponification with a diminished quantity of lime requires a corresponding increase in the temperature of the digester; thus, for 5 to 6 per cent. of lime a pressure of six atmospheres suffices, but if only 2 or 3 per cent. of lime is used, a pressure of eight atmospheres is required and a temperature of about 340° F.

Saponification of fats by water alone, at a high temperature, was patented by R. A. Tilghman of Philadelphia, Jan. 9, 1854, and about the same time (Apr., 1854) by Berthelot, who announced that he had resolved the neutral fats with water in closed vessels at a temperature of 428° F. Tilghman specified the preferred temperature of melting lead, 625° F., but names also the melting of bismuth, 518° F., and to promote the reaction caused the mixture of water and fat to traverse small tubes of wrought iron heated in a fire to a pressure of 90 or 100 atmospheres. Tilghman's process, as originally set forth in his patent, was never introduced in practice. The very high temperature employed destroyed the glycerine and contaminated the stearic acid. As subsequently modified, it has been used with success, but, as the courts have decided, not within the limits of the patent. Melsens of Brussels almost at the same time with Tilghman took out in Belgium a patent for the use of water slightly acidified by sulphuric acid to act on fats under pressure at a temperature of 356°–392° F. The presence of a small quantity of sulphuric acid—1 to 10 per cent. of the fat used—favors in a remarkable degree the evolution of the fatty acids. Melsens' method was put into successful operation at Antwerp almost immediately, using a peculiar form of digester, lined with lead, holding a ton of tallow, to which was added 50 per cent. of water, and in six hours the decomposition was complete at a temperature of 356° F. (ten atmospheres), and the fatty acids obtained were very satisfactory.

The possibility of decomposing the fats by water under high pressure was distinctly recognized by Chevreul, who pointed out the perfect analogy between the fats and the compound ethers, which are decomposed when heated in close vessels in contact with water. Faraday in 1823 records in the English *Quarterly Journal of Science* (vol. xvi. p. 172) an observation of his on the action of Perkins's steam engine, by which he shows that fat is changed by hot water under pressure into Chevreul's fat-acids; but this observation, so suggestive of fruitful results, seems to have remained without practical results for more than thirty years.

George Wilson in 1852 revived the method of decomposing

fats at a high temperature, and subsequently distilling off the acids and glycerine separately by a current of superheated steam, originally conceived by Chevreul and attempted by Messrs. Bussy and Le Canu in July, 1825, and more successfully by Dubrunfaut in 1841. In 1855, Wilson exhibited to the jury of the Paris Exposition of that year the results of his method on palm oil by means of water and steam, and distilling off both glycerine and fatty acids in a way to obtain all the products in a state of chemical purity. For this end the oil is heated in a still to the temperature of 550°–600° F., and then a stream of subdivided, superheated steam passes through it of a temperature of 600° F. Below 550° F. the saponification and distillation of the products is slight: at about 600° F. the distillation is more rapid, but is then accompanied with the production of acroleines. It is by this process that the famous "Price's glycerine" is produced. This process works well only on palm oil, and is in fact only a slight modification of the previous process of Dubrunfaut. The complete success of the hot-water process was achieved only in 1857 by Messrs. Wright and Fouché—French patent of 1857, American in 1859. This requires particular mention.

Wright and Fouché's apparatus by hot water alone produces complete decomposition of fats into fat-acids and glycerine by a continuous and automatic commingling of water and steam with the fat at a pressure and temperature of ten to twenty atmospheres for a period of twelve to twenty hours. No lime is used; water at the temperature named is the sole chemical agent: and the glycerine produced is of excellent quality: the stearic and palmitic acids (after expressing the oleic acid) are white, fine-grained, hard, and free of odor. I have examined this apparatus in the factory of R. G. Mitchell in New York, who has used it continuously since 1860 with uniformly excellent results. These inventors "do not claim the application of superheated water for decomposing fatty bodies, nor the form of apparatus described, which may vary somewhat according to conditions and circumstances; but they claim producing a continuous automatic circulation of highly-heated water, in a very finely divided state, through the bodies under treatment," etc. This process is of the more interest since it has been the subject of a protracted legal controversy, in which Mr. R. A. Tilghman sought to establish the priority of his method, patented in 1854, and already alluded to. The case was finally carried up to the Supreme Court of the U. S. by appeal from the decision of the lower courts, and in this upper tribunal it was decided adversely to the plaintiff. In tho course of this investigation, and of a like controversy in Cincinnati in which Michael Work was defendant, conducted also by Mr. Tilghman, the literature of the whole subject received a careful scrutiny, and it clearly appeared that, from the date of Chevreul's experiments in 1817 to this day, the action of water as a base to decompose the fats and hydrate the products has been recognized and recorded both when acting alone at moderate and high temperatures or when aided by the presence of metallic oxides, with and without heat. The earliest record of an invention of this sort is found in the London patent of 1826 (No. 5345) issued to N. H. Manicler, who treated 400 pounds of tallow or fat with ten or fifteen gallons of water in a digester or strong boiler provided with a safety-valve, with active ebullition for about six hours, at a pressure of two atmospheres. His method was imperfect, but he obtained fat-acids by the use of hot water and pressure alone, without alkalies or acids.

FIG. 2.

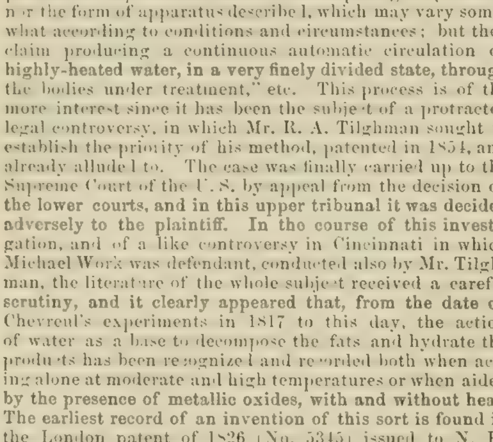


Fig. 2 is copied from Wright and Fouché's patent, and is substantially the apparatus yet in use, the chief difference being that the upper boiler *h* is now made about double the height of the lower one. The boilers *a* and *h* are of copper ⅝ inch thick; the heads are 1 inch thick, and very strongly riveted. The lower boiler *a* is 6 feet high by 2 feet diameter, set in a furnace where it is protected by a brick chamber from the direct action of air and of sulphur from the coal (an arrangement not seen in the drawing). A tube *f* connects the bottom of *a* with the bottom of the cylinder *h*; the ascending tube *g* conducts the superheated water from the boiler *a* to the upper part of the cylinder *h*, where it terminates in a rose-jet, or distributor, pierced with holes to distribute the water uniformly in the cylinder *h*, and to ensure a molecular or finely-subdivided contact between the superheated water and the substance submitted to the operation. The cylinder *h* receives the substances to be treated, which may be introduced by the funnel *i*, or in actual routine by a pipe leading to each cylinder from the reservoirs of melted fat in an upper story, controlled by a cock. A safety-valve *l*, and manometer *m*, serve to regulate and measure the pressure, which at Mr. Mitchell's is kept at eleven atmospheres for fifteen hours. To decompose fatty substances into fat-acids and glycerine, the boiler *a* is completely filled with water; the cylinder *h* is filled to one-third its height with water, and then it is filled to the level of the upper cock *n* with fat; and then the lower boiler is gradually heated until a pressure of about eleven atmospheres is indicated on the gauge (varying with the nature of the substances treated up to twenty atmospheres). It will be readily seen, from the arrangement of this apparatus, that the difference of temperature between *a* and *h* compels and maintains a continuous circulation, the superheated water being driven out of and through the rose on pipe *g* into the fatty bodies, descending again by the tube *f* to the bottom of the lower boiler, to be again heated and sent on its way in a continuous and automatic circulation. The inventors say: "We are aware that the decomposition of fatty bodies by water under the influence of heat and pressure is a well-known scientific fact; . . . that as this chemical action takes place under the influence of a weak affinity, it is necessary, in addition to the physical and chemical conditions named, to ensure a perfect molecular agitation of the whole mass; and that we claim as our invention all apparatus wherein the water and the fatty matters are heated separately in two different boilers; the first boiler heated by the source of heat, and the second boiler heated by the first. . . . The characteristics of our apparatus are that it produces agitation by a continuous and automatic circulation by the pressure of water, and the apparatus effects its chemical action in a continuous manner, without the aid of any manual or other" (external) "assistance."

The capacity of a battery of six of these double autoclaves, each 2 feet in diameter and respectively 6 and 12 feet high, is about 7000 pounds of tallow daily, producing in round numbers 8 to 9 per cent. of glycerine, 33 per cent. of *red oil* (oleic acid), and about 46 to 50 per cent. of stearic, palmitic, etc. acids; feculence, foreign bodies, and loss 8 per cent. more. The glycerine has a density of about 3½° B. as it comes from the autoclave milky with diffused stearic acid. It is evaporated by steam to a density of about 25° B., in which state it is sold to manufacturers of chemically pure glycerine. No lime or acid being used in this process, the glycerine is of a very superior quality to that produced from processes where even a very small dose of lime is used. At the temperature of eleven atmospheres (= 364.2° F.) the glycerine suffers no change, and no acroleine or empyreumatic products are formed. Even at twenty atmospheres, the highest pressure contemplated by this invention, the temperature is only 415.4° F., or 100° under the melting-point of bismuth, the lowest temperature named in Tilghman's patent.

Sulphuric-Acid Saponification.—Chevreul, in his original researches on the fatty bodies, discovered the fact that neutral fats were resolved by sulphuric acid into their factors, and he specifies this as one mode of saponification in his patent of 1825, and speaks of distilling off the products. The earlier researches of H. Braconnot (*Ann. de Ch.*, xciii. 250, 1815) first made known the peculiar action of sulphuric acid on the fats; and the coupled acids, sulpho-glyceric, sulpho-stearic, etc., were studied in 1836 by Frémy (*Ann. de Ch. et de Ph.*, 1837, lxv. 113–149), who showed that by the action of water, especially if boiling, these coupled acids were resolved into fatty acids, glycerine, and sulphuric acid, the fatty acids swimming on the surface of a watery solution of glycerine and sulphuric acid. This research first completely explained the real nature of the so-called *sulphuric-acid saponification.*

Incipient decomposition precedes and attends the action of sulphuric acid on the fats, evolving sulphurous oxide, carbon di-oxide, and free carbon, which blackens the mass, producing also a certain proportion of a pitch-like tar,

which remains behind after the distillation. The process was first successfully applied in England by Messrs. Wilson, Gwynne, and Jones in the establishment of Price & Co. in London in 1842. This process is especially available for palm oil, cocoanut oil, the fat of bones, and kitchen-drippings. It is, however, applicable in one form or another to any kind of fat. Numerous forms of apparatus have been devised for the practical use of this process, and various modifications of the process itself, the full history of which would transcend our present limits. For example, the apparatus of Messrs. Masse & Tribouillet at Neuilly, near Paris, is seen in Fig. 3. The action of sulphuric acid on the fats occurs in the lead-lined boiler A, heated by steam introduced by the pipe I into the jacket C. A lead-lined metallic chamber B surmounts the boiler, provided with windows F, and a discharge-pipe G G to carry the heavy offensive vapors evolved to the space H beneath the boilers. The water of condensation escapes by the outlet E, and the contents of the boiler are constantly stirred by the crank J K. After mingling the fat with acid, the contents of the boiler rested for twenty-four hours, the quantity of acid now being from 35 per cent. down, finally, to 10 or 12 per cent. according to the character of the fat. The temperatures ranged from 195° to 212° or 240° F. But this, with many other modified forms of apparatus, has given place to a combination of the sulphuric saponification with distillation by a current of superheated steam under the ordinary atmospheric pressure. This process is conducted in an apparatus shown in Fig. 4, which

Fig. 3.

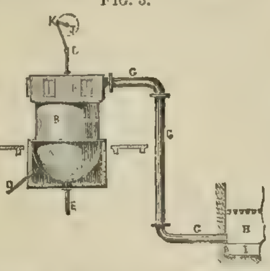
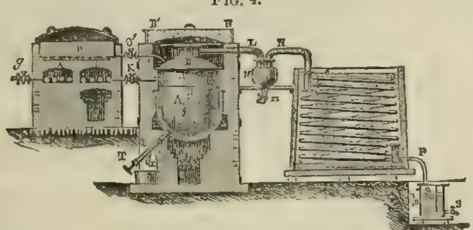


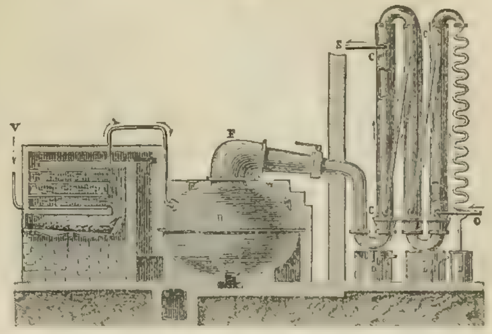
Fig. 4.



Apparatus for the distillation of fatty acids by superheated steam.

combines the results of the scientific researches of Chevreul, Frémy, and Dubrunfaut on sulphuric saponification with those of the inventive genius of Messrs. Jones, Wilson, and Gwynne in the distillation of the fatty acids and glycerine. This process, known as the *dry way*, consists in distilling off by superheated steam the fatty acids obtained from the decomposition of neutral fats by sulphuric acid. Its important advantage is in the facility it affords of obtaining excellent products from almost any kind of refuse fat, as well as from good stock. Gwynne and Wilson, in their patent of 1843, proposed to treat the fats for this process with 5 to 9 per cent. of concentrated sulphuric acid in place of 25 per cent., as formerly employed. This mixture was heated at 212° F. for two hours, and then successively for one hour each at 248°, 280°, 309°, and 350° F. This is substantially the process now in use in nearly all stearine-factories which use the sulphuric-acid saponification, and it is applicable to all kinds of fat. The black mass of fat-acids thus obtained is washed with successive doses of hot water for the removal of the sulphuric acid and glycerine, dried and fused by steam or waste heat, and placed in a boiler, where it can be distilled by a current of superheated steam. In Fig. 4, D is a flat boiler where the fat-acids are dried and melted by the waste heat from the furnace *j*, in the arches of which (*h t*) is a steam-coil, of which *g* is the inlet-cock, and *k* controls the delivery of the superheated steam upon the charge of fat-acids in the still A, the rose *f* effecting the distribution evenly. The cover B′ B is filled with ashes to keep in the heat, which may be enforced by an auxiliary fire below. The delivery-pipe L R is provided with a trap M to catch matters mechanically carried forward in the condensation-water, etc. The double worm O O communicates by the outlet Q with a florentine receiver, where the fatty acids are separated from the water. The tarry residues are drawn off by the outlet-cock T *x*. This apparatus is seen in a more recently modified form in Fig. 5, where a large elliptical or globular boiler of cast iron B is heated by the escape heat from the superheated furnace A A. The vapors of water and fat-acids discharged by the dome F are carried through vertical condensers of copper cooled by water-jackets C C, through which a stream of water passes from O to S in the course of the arrows. The

Fig. 5.



condensed products reach the receptacles D D D. The temperature of the escaping water for condensation should be about 122° F., to avoid the freezing of the condensed stearine, and the velocity of the current of water must be regulated accordingly. This apparatus may be used continuously or otherwise, as may be desired. In the former case, the still is made of a size to hold from 5 to 6 gross tons of crude acids; in the latter case, charges of about 2500 to 3000 pounds of acids are employed at a temperature of about 390° F., with superheated steam, the operation lasting about twelve hours. A second charge is then introduced, and so on several times before draining off the residual tar. As the sulphuric-acid saponification is seldom complete, it happens that rarely over four-fifths of the charge in the still can be distilled; the residue has then to be put aside to be treated afresh with sulphuric acid and redistilled. The heavy irritating vapors of acroleine are always perceived in the still-room where the sulphuric saponification is employed, mingled with gaseous hydrocarbons. The condensed liquid hydrocarbons which gather at the end of the condenser are called "blue liquors," and are found to contain solid bodies analogous to paraffine. From these by-products by treatment with sodic carbonate many amylic hydrates of the American petroleum series may be obtained—*e. g.* hexyl, heptyl, octyl, nonyl, etc.—in a state of purity. These bodies have been studied by Cahours and Demarçay.

One or two matters of interest remain to be mentioned which have been gleaned from the practical experience of those with whom the writer has consulted on this art. Mr. Florence Verdin, who was long in charge of the digesters of Wright and Fouché at R. G. Mitchell's factory in New York, insisted that after a certain time the decomposition of fats by hot water into glycerine and fat-acids not only ceased, but that if the conditions of temperature and pressure were continued, these factors again reunited, forming fats anew. This shrewd observation is in harmony with independent researches in synthetic chemistry.

Mr. S. F. Pease of Buffalo, N. Y., a well-known manufacturer of oils and candles, whose products have been rewarded by numerous medals and testimonials at home and abroad, has given me samples of stearine made by him from hog's lard in 1840, which after more than thirty-six years remain colorless, perfectly hard, and free from greasy odor, with broad brilliant crystalline laminæ. Mr. Pease asserts that no stearine has such large crystalline planes as that from hog's lard. I find the melting-point of this old stearine to be 132° F. It is curious to note that Mr. Pease's process for the production of stearine from hog's lard closely resembles the original process of Chevreul and Gay-Lussac of 1825. After expressing about 50 per cent. of lard oil (summer pressing) by hydrostatic press, he saponifies by caustic soda-ley; by salt removes the curd, which he decomposes by dilute sulphuric acid, and then removes the red oil by two pressings—first, at a pressure of 150 tons, which expels about three-fifths of the red oil, and then by a higher pressure of 700 to 800 tons for the remaining two-fifths. The candles made from this stearine are quite white, and remain so, requiring no bleaching. He exhibited to me very hard and white candles made by this method forty years ago. A portion of alcohol is added to the melted stock just before pouring into the moulds—about one quart to a box of candles—to improve the burning of the candle. The economical results of this process are—lard oil, 50 parts; red oil, 25 parts; stearine, 25 parts. No use is made of the glycerine, which involves a loss of about 4 per cent. on the origi-

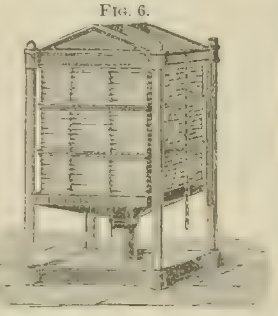
nal quantity of lard, about the same quantity remaining with the lard oil. As compared with the lime-saponification, this is not an economical process, but it is claimed that the candles produced are superior in hardness and burning without deformation. In winter the lard yields only 10 to 20 per cent. of lard oil; in summer it gives 50 per cent. The stearine obtained from tallow by the hot-water process is from 30 to 40 per cent. of the crude tallow.

2. MECHANICAL PROCESSES.—The manufacture of candles from stearic acid, however produced, requires (1) the casting of the acids into convenient forms for pressing; (2) pressing out the oleic acid, cold and hot; (3) the preparation of the wicks; (4) the moulding; (5) the bleaching, cooling, trimming, polishing, etc. A very brief notice of these mechanical processes must suffice.

The casting of the mixed acids into a convenient form for pressing out the "red oil" or crude oleic acid is performed in a simple way by setting the metallic pans (which are rectangular, with sloping sides, and about three inches deep, usually of copper, sometimes of tin plate or iron) on a terraced framework, one series over another, in such a manner that the melted acids, running first into the upper tiers, fill the successive terraces by overflow in progressive order until all are full.

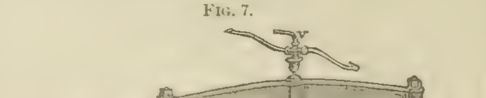
Pressing out the Oleic Acid.—After cooling to the point of crystallization—the time varies with the season, from ten to twenty hours—these cakes of crude acid are pressed in strong sacks in a vertical hydrostatic press (Fig. 6) for the removal of the red oil. This process demands care and experience to avoid the loss of more or less stearic acid dissolved in the liquid oleic acid. To this end, the mass is hardened by the addition in the pans of the waste trimmings from the hot press or from the calcareous saponification process. The red oil runs away into vats prepared for its reception on a lower story. The shrinkage of the sacks from the escape of the red oil permits the addition of relays of fresh sacks by reversing the motions of the press. The mass is kept in position by plates of sheet iron or zinc, which also carry the oleic acid to the gutters which lead it to the reservoirs below. The pressure is gradually carried to its full measure of about 400 tons, by which the cakes are reduced from 2 or 2½ inches to about one-half their original thickness, with the removal of about 45 per cent. of the oleic acid contained in the mixed mass. About 10 per cent. of oleic acid is retained in the cold cake, which requires for its removal the hot press. The limit of atmospheric temperature at which the cold pressure can be advantageously carried on is set at about 60° F., so that in this country the summer is a season of rest for this industry unless artificial refrigeration is resorted to.

FIG. 6.



The residual oleic acid remaining from the cold press dissolves the stearic acid and renders it soft. For its complete removal a horizontal hydraulic press is employed, in which the cakes of stearic acid are again pressed in hair-cloth held between heated iron plates at a well-regulated temperature. As this could not be obtained with uniformity by the method first used of heating the iron plates in a bath of steam, and successively packing them, a better method was devised, which is seen in Fig. 7. This apparatus provides a series of twelve or more flat cells of iron, seen in section at I, and supplied with steam from the valve V and by the rubber tubes *ttt*. When the temperature has fallen to about 100° F., the interspaces are rapidly packed with the hair-cloth and stearic-acid cakes, and a pressure of about 500 tons is applied for about an hour. This is a difficult operation, and requires care and experience for its proper management. At best, a considerable quantity of stearine is carried off by the oleic acid, from which it is, in part, recrystallized in the vats provided for that purpose. As its separation from the oleic acid is difficult, it is found in practice a good plan to pump off the supernatant oleic acid, and to use the residue containing the stearine to hasten the crystallization of the fatty acids in the pans prior to the cold pressing.

FIG. 7.



The thin cakes of stearic acid, on removal from between the crinolines of hair-cloth, are trimmed at the edges to remove the margin colored yellowish by oleic acid. These parings are used in charging a second hot press. The prepared cakes of stearine are still more or less contaminated by stains of iron, copper, etc. from the press, and by the entanglement of filaments of crinoline, etc., and by lime, if the acid is the product of lime-saponification. To free it from these accidental impurities it is again melted in a bath of water slightly acidulated with sulphuric acid (about 3° B.), and heated by steam. The metallic oxides, lime, etc., are thus removed, and on standing the foreign substances subside after a brief time, and the last traces of sulphuric acid are washed out in another tank containing pure water. Sometimes the white of eggs is used to clarify the melted stearine, and the lime is then precipitated by a little oxalic acid. The stearine is thus obtained perfectly colorless and limpid, floating above the water-bath, and may be then cast in blocks for sale or turned into the candle-moulds.

Melting-Point of Stearine.—Stearine from tallow melts at about 130°–132°; Price's candles from palm oil fuse at 122° to 124°; while those made from Chinese tallow (product of *Stillingia sebifera*), by Wilson and Gwynne's patent of 1845, fuse at 136° F. Mitchell's stearine, from the Wright and Fouché hot-water process, by my determination, fuses at 132° F., and Pierce's, from hog's lard by soda-saponification, at 131° F. Pure stearic acid fuses at 158° F., and palmitic acid at 140° F. The mixture of the two acids, therefore, in stearine fuses at a lower degree than either factor—a fact supported by other examples of like mixtures.

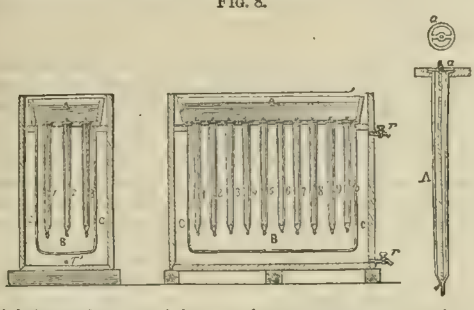
Wicks.—Candle-wicks are made of plaited cotton woven by a machine which lays up the 80 or 90 strands in such a manner as to secure the proper deflection of the free end of the burning wick, bringing it in contact with the air, so that it is consumed without a cinder falling into the cup of the candle. This end was not reached without much study and invention. Cambacérès, as already mentioned, in 1825 devised the system of twisted and plaited wicks which is still in use. But it was not until 1836 that De Milly discovered that by impregnating the wick with a weak solution of boracic acid the formation of a "thief," or mushroom of carbon on the wick, could be prevented. "Snuffers," which were an indispensable article of domestic economy in the days of our grandmothers, are now unknown except in the cabinets of *bric-à-brac*, thanks to De Milly's invention; which was, as Stas has remarked in the report of the Exposition of 1855, the finishing touch of the stearic-acid industry. The wicks are prepared by soaking them for two or three hours in a bath holding in solution 1½ per cent. of boracic acid and ½ per cent. of ammonic sulphate. The excess of solution is drained off, and the wicking dried in a hydro-extractor or by the heat of an oven. The use of phosphate of ammonia, ammonic chloride, and bismuth nitrate has also been proposed, as was dilute sulphuric acid, also earlier by Cambacérès. The latter destroyed the wick, and nothing has been found so valuable as De Milly's treatment by boric acid. After treatment the wicks should be singed by a gas-flame to remove the little filaments of cotton, which might impair the perfect combustion of the candle. There is a nice point to determine the proper size of wick for a given weight of candle, that the reservoir of molten acid in the cup be not too rapidly or too slowly drawn up by the capillary action of the wick. The candle burns most satisfactorily when in a pure still atmosphere the melted acid is drawn up at such a rate that the cup preserves its symmetry. If it is too full because the wick is too small, the delicate edge breaks down and the candle "gutters." If the wick is too large, the draught on the reservoir of melted acid exhausts the supply, the flame droops, and an irregular illumination, with a too rapid consumption of the candle, results.

The moulding of candles is in theory an extremely sim-

ple operation; practically, it is attended with some difficulties which require skilful manipulation to avoid. Especially was the crystallization of the stearine for a long time a source of trouble, and many expedients were devised before the very simple one was hit on which proves quite sufficient. This is to permit the melted stearine to become almost pasty before pouring into the moulds, which are also gently warmed beforehand. In this way the tendency to crystallize is arrested and a fine granulation results. Wax (of bees) and paraffine, added in small quantity, also prevent the crystallization. Arsenic (arsenious acid) was at one time used with success for this purpose, but was speedily abandoned because of the risks to public health it involved. It was De Milly again who hit upon the very simple expedient of pouring the candles with stearine in the milky state which precedes solidification, and thus solved a difficulty which was wellnigh proving fatal to the stearic industry.

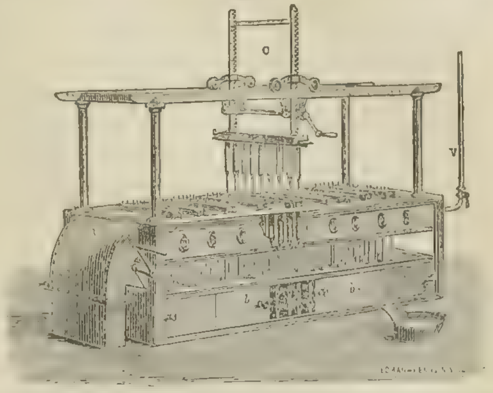
The candle-moulds are slightly tapering tubes cast of an alloy of lead 2 parts and tin 1 part, the size and length varying of course with the denomination of the candle. For convenience, the moulds are arranged in groups of ten, twenty, thirty, or more in a basin or tank, which acts as a reservoir for holding the fluid acids when the moulds are filled, and for furnishing the needful reserve to supply the shrinkage, as the candles contract in cooling. This reservoir or feeder also furnishes a firm support for the withdrawal of the candles from the moulds, for which purpose a suitable handle or grapple of tin is plunged in the feeder while the acids are yet fluid. The wicks, prepared as already described, are introduced by a long and slender crochet-needle while the moulds are laid horizontally. The

Fig. 8.



wick is made central by attachment to an eye seen in the single figure *a* (Fig. 8), and is drawn through the other end, where a plug of wood holds it tight and tense. The figure shows the arrangement of 30 candles in three rows of ten each, prepared for casting. For this purpose it is essential that the temperature of the moulds should be 122° to 130° F., near the melting-point of the acids. This object is attained by placing the moulds in an oven, heated preferably by steam, to the proper temperature, or, as in the figure, by a steam-jacket C C surrounding the chamber B, in which the moulds hang, while the air escapes by *r*, and the water of condensation by *r'*. When the moulds have the proper temperature, the melted stearine is turned in at a temperature when the mass in the vat is milky with the newly-forming crystals. The grapple for removing the mass when cold is put in place, and the whole left to cool, after which the plugs are removed below and the whole mass is withdrawn, the candles are broken from the feeder, and the latter is thrown into the melting-vat to be again used in moulding more candles. This process involves much hand-labor, and is too slow for the demands of a large establishment. It is, in fact, now used chiefly by those who buy the stearine in blocks, while the manufacturers of stearine, who produce candles on a large scale, employ a continuous-acting apparatus of American origin, in which the wicking is automatic, and the moulds are both heated and cooled by a continuous system. Fig. 9 shows in elevation a recent form of this apparatus, as now made by Morane of Paris, having ten sections of twenty moulds, heated in place by steam, and cooled by a current of air from a blower. It is divided into two sections, the lower one *b* holding the bobbins of prepared wicks for continuous threading of the moulds. The upper compartment is a box of plate iron containing the moulds, and heated by steam from the pipe V. The figure shows a section of the moulds with its reservoir, raised by the winch and supported on the carriage C, which traverses the length of the ways to take up each section in turn. The wicks are held firm by a screw at top, which gives them the requisite tension, while the free ends are cut off beneath the tips of the elevated moulds. By this machine all the hand-labor of "cottoning" or wicking is avoided, and by the use of alternate heat and cold, either as steam and air, or otherwise by warm and cold water-baths alternately, the moulds are warmed and

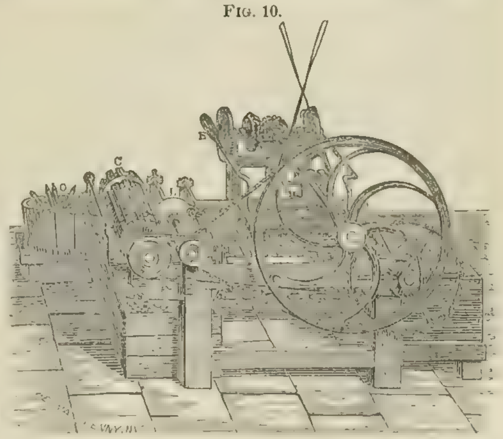
Fig. 9.



chilled with certainty and little loss of time. In very large establishments this system is carried still further by arranging twelve similar machines on a circular tramway, at the centre of which are two elevated tanks, one of hot and one of cold water, which flow successively into each machine as it arrives in due order of rotation opposite the spigots. In this apparatus the necessity of a reservoir or basin of melted stearine over the moulds is avoided by the use of a mechanism which forces up the stearine by a piston from below, with the advantage of filling the moulds completely under pressure, and of making the candle of any desired length or diameter. A fuller description of this apparatus by Morane is beyond our present limits.

The bleaching, washing, drying, trimming, and polishing of the candles complete the mechanical operations of this industry. The slightly yellowish color which the star candle usually has when it leaves the mould is removed by an exposure to sunlight for some days, or perhaps two weeks, in a place provided with a glass roof and suitable shelving for this purpose. No chemical agent other than light has been found practicable. As the candles are more or less soiled by handling and by dust, they are washed off in a dilute solution of sodium carbonate, and dried on an endless apron of cloth, upon which mechanism they roll in contact with each other. As the lower ends are more or less uneven, these are cut off by a circular saw, and the surface of the candles is at the same time polished by the friction of brushes moving lengthwise over them. These last operations of trimming and polishing are combined in

Fig. 10.



the machine shown in Fig. 10. The candles O are placed in grooves of the revolving cylinder C, which brings them under the rapidly-moving circular saw L, which cuts them neatly to even lengths, whence they are carried forward by a grooved apron of wood beneath the brushes B, which are rapidly moved back and forth by the crank E, and thus receive the final finish before packing in boxes.

Paraffine Candles.—Since paraffine has become an article of commerce, it has been much used to "break the grain" of stearine candles in place of beeswax, and with decided advantage, producing a candle of superior beauty. By itself, paraffine produces a candle of much beauty, but liable to droop with warm weather, while its extreme fluidity renders it undesirable for a movable light. The moulding of pure paraffine candles is also attended with peculiar

difficulties. It is therefore seldom used alone, but when from 5 to 20 per cent. of stearine is added, candles are obtained having the appearance of wax. But the same lowering of the fusion point of the mixture already noticed for stearic and palmitic acids occurs with stearine and paraffine. Thus, if equal weights of paraffine, melting at 122° F., and palmitic acid, of 132° melting-point, are mingled, the result is a body fusing at 113° F.

Colored Candles.—Stearine, paraffine, and wax candles are made of almost any desired color now by the use of aniline colors of the desired tint. Formerly, metallic oxides and some vegetable colors were chiefly used, which as a rule caused the candles to burn badly, and sometimes to emit poisonous fumes. Stearine may be colored black by heating for a short time in contact with the bruised nuts of *Anacardium orientale*.

Wax Candles.—See WAX.

For many recent details in this article the writer is indebted to M. J. Bouis's *Stearique (Acide)* in Ad. Wurtz's *Dict. de Chimie*, as also to private communications from R. G. Mitchell, E. S. Wayne, and E. S. Pease. For the literature of the subject the reader may consult: *Reports of the Juries* (London, 1851, 619–624); Chevreul, *Recherches chimiques* (1819); Richardson and Watts (London, vol. i.); Muspratt's *Chemistry*, art. "Candles" (ed. of 1876); Watts's *Dict. of Chemistry*; Morfit's *Chemistry* (Philadelphia, 1847), "Soap and Candles;" Payen, Pelouze and Frémy, Regnault, Berzelius, and Dumas's *Chim.*; Roret's *Encyc.*, "Fat Acids:" testimony of J. Lawrence Smith, *Record Supreme Court of the U. S.* in case of Mitchell *v.* Tilghman (669); also in same record testimony of Edward S. Wayne, J. C. Booth, R. E. Rogers, F. A. Genth, B. C. Tilghman, and others; *Annales de Ch. et Phys.* (Paris, 1854 [3], t. xli., 246–316); Gehler's *Physikalisches Wörterbuch* (Leipsic, vol. ii., p. 544); *Stearic-Acid Industry*, by J. L. Smith; *Reports of the U. S. Commissioners to the Paris Exposition of 1867* (ii., 118, Washington, 1870). B. SILLIMAN.

Ste'arine ($C_{57}H_{110}O_6 = (C_3H_5)_{111}(C_{18}H_{35}O_2)_3$). Stearine is a glyceride or ether of glycerine, as shown by the formula *tristearine*. The constitution of the glycerides has already been explained under FATS and OILS. In commercial parlance, *stearine* is a term applied to the impure stearic acid obtained by the saponification of fats in the preparation of star candles. (See STEARIC ACID INDUSTRY.) Tristearine is the natural form of stearine in the hard fats of both kingdoms. From the seeds of *Brindonia indica* stearine of absolute unity can be obtained, as shown by Bouis and Pimentel (*Compt. rend.*, xliv. 1355). Pure stearine from this source is perfectly white, and crystallizes in mammillary radiations of a nacreous lustre, ending in very delicate needles. This stearine, when fused, is much more transparent than that from animal fats, which obstinately retain traces of oleine and other fat acids. It is very brittle. By saponification it yields directly stearic acid, melting at 158° F., and its analysis affords stearic acid 95.72 per cent., while calculation calls for 95.73 per cent. B. SILLIMAN.

Stearns, county of Central Minnesota, lying W. of the Mississippi, drained by Sauk River, and containing Sauk Lake, with many other streams and ponds. It is traversed by St. Paul and Pacific R. R. The W. part is hilly, the remainder prairie-land. There are breweries, saw-mills, flour-mills, and manufactories of wagons, furniture, and agricultural implements. Staples, wheat, oats, Indian corn, potatoes, hay, wool, and butter. Cap. St. Cloud. Area, 1379 sq. m. P. 14,206.

Stearns (ASAHEL), LL.D., b. at Lunenberg, Mass., June 17, 1774; graduated at Harvard 1797; practised law at Chelmsford many years; was county attorney for Middlesex; member of Congress 1815–17; professor of law at Harvard Law School 1817–29; and subsequently commissioner (with Lemuel Shaw) for revising the statutes of Massachusetts. D. at Cambridge Feb. 5, 1839. Author of a valuable *Summary of the Law and Practice of Real Actions, with an Appendix of Practical Forms* (Hallowell, 1824).

Stearns (GEORGE LUTHER), b. at Medford, Mass., Jan. 8, 1809; became a wealthy merchant at Boston, and a prominent member of anti-slavery organizations; founded the *Commonwealth* and *Right Way* newspapers; aided to equip John Brown for his Free-State campaigns in Kansas; was conspicuous as his friend during the later crisis at Harper's Ferry; was instrumental during the civil war in recruiting in Massachusetts three regiments of colored men, and rendered similar services in Pennsylvania, Maryland, and Tennessee, receiving from Secretary Stanton a commission as major. D. at Medford, Mass., Apr. 9, 1867.

Stearns (SAMUEL), b. at Epping, N. H., in 1770, son of Rev. Josiah Stearns (1732–88); graduated at Harvard 1794; was ordained minister of a congregation at Bedford, Mass., 1795, and filled that post until his death, Dec. 26, 1834. Author of seven published sermons and addresses.

Stearns (Rev. WILLIAM AUGUSTUS), D. D., LL.D., fourth president of Amherst College, b. at Bedford, Mass., Mar. 17, 1805, the son and grandson of Congregational clergymen; graduated at Harvard College 1827; studied theology at Andover, and after teaching a short time at Duxbury was ordained to the gospel ministry, and installed pastor of the church at Cambridgeport Dec. 14, 1831. In 1854 he accepted the presidency of Amherst College, which he held till the time of his death, June 8, 1876. Besides valuable addresses given during his connection with the college, he published several sermons, with papers in the *Bibliotheca Sacra*, *Biblical Repository*, and *New Englander*, a work on *Infant Church Membership*, and *Life and Select Discourses of Samuel H. Stearns*. J. H. SEELYE.

Ste'arone. This body was derived by Bussy (*Ann. Chem. Phys.*, liii. 410) from the decomposition of stearic acid by quicklime, a fourth part of the latter being distilled with one of the former, producing liquid hydrocarbons and a solid body which he named *stearone*. The liquid hydrocarbons were removed by pressure, and the solid residue, treated by ether, yielded a solution which on standing deposited colorless crystalline pellets of a pearly lustre. Stearone is insoluble in water, soluble in boiling alcohol, in fat-acids, and in concentrated acetic acid. It burns with a very brilliant flame and becomes highly electric by friction. Alkalies do not attack it. Hot sulphuric acid burns it with evolution of sulphurous acid. Hot nitric acid does not attack it, but hot nitro-sulphuric acid decomposes it, with the formation of an acid volatile oil (*Rowney*). The *margarone* of Rowney is esteemed identical with stearone. It melts at 86°–88° F. if made from pure stearic acid, but if from impure, its melting-point may be as low as 76°. B. SILLIMAN.

Ste'atite [Gr. στέαρ, στέατος, "fat"], or **Soapstone,** a kind of stone which receives both its names from its unctuous quality. It is a compact form of talc, and is an impure hydrated silicate of magnesia. It has some use in the porcelain manufacture. A soft white sort is the French chalk of the toilette and of the tailors' shops. Powdered steatite is employed as a lubricant, and is an ingredient in several kinds of steam-packing. Steatite is easily cut into figures, which are then hardened by fire and colored to imitate more costly stones. Steatite is employed in making stoves and foot-stoves for use in cold weather, since it retains heat for a long time. It is abundant in many parts of the U. S. and other countries.

Steb'bing (HENRY), D. D., b. in England about 1800; graduated at St. John's College, Cambridge, 1823; became perpetual curate of St. James's, Hampstead road, London, 1836; chaplain to University College Hospital 1837, and rector of St. Mary, Somerset, London, 1857. Author of a *History of Chivalry and the Crusades* (2 vols., 1830), *Lives of the Italian Poets* (3 vols., 1831), *History of the Christian Church from its Foundation to A. D. 1492* (2 vols., 1833–34), *History of the Reformation* (2 vols., 1836), *History of the Church of Christ from 1530 to the Eighteenth Century* (3 vols., 1838–42), of several volumes of poems, and numerous other religious and historical works, including a *Continuation of Hume and Smollett's History of England* (6 vols., 1837); was in 1828, with J. S. Buckingham, one of the original editors of the *Athenæum*, and afterward edited the *Cabinet Library of Divinity* (15 vols., 1836) and select works of Bishops Tomlinson and Beveridge, and of De Foe, Baxter, and Jeremy Taylor.

Ste'dingk, von (CURT BOGISLAUS LOUIS CHRISTOPHER), COUNT, b. at Pinnau, Pomerania (then belonging to Sweden), Oct. 26, 1746; graduated at the University of Upsala 1768; entered the army in youth; took part in a war against Prussia; rose to the rank of lieutenant-colonel in the royal regiment of Swedes in the French army; was an intimate friend of Count Fersen, and, like him, volunteered his services in the cause of the American Revolution; sailed with D'Estaing's fleet for the West Indies 1778; commanded a brigade of infantry in the attack upon Grenada, and led one of the two principal assaults upon Savannah, Oct. 9, 1779, where he lost half his brigade of 900 men and was himself severely wounded; was honored with membership in the order of Cincinnati; held high command in the war against Russia 1787; became ambassador to St. Petersburg 1790, and was Swedish plenipotentiary in the peace conferences at Paris 1814. D. at Stockholm.

Sted'man (CHARLES), b. in England about 1745; was an officer under Lord Percy at the battle of Lexington 1775; served under Lord Howe in Pennsylvania and New Jersey, and under Cornwallis in his Southern campaign, and published *The History of the Origin, Progress, and Termination of the American War* (2 vols. 4to, London,

1792; 8vo, Dublin, 1794), said by the bibliographer Lowndes to have been written by William Thomson, LL.D.—a work valuable for its military maps and surveys. Stedman was during his later years a deputy comptroller of the stamp-office. D. at London June 26, 1812.

Stedman (EDMUND CLARENCE), b. at Hartford, Conn., Oct. 8, 1833, son by a former husband of Mrs. E. C. Kinney, the poetess; studied at Yale College; became in 1852 editor of the Norwich *Tribune*, in 1853 of the Winsted *Herald*; settled in New York in 1855; became in 1859 a poetical contributor to the New York *Tribune*; was war-correspondent of the New York *World* 1861–63; contributed to the *Atlantic* and other magazines; studied law; was in 1863 private secretary to Attorney-General Bates at Washington, and has been since 1865 a stockbroker in New York. Author of *Poems Lyric and Idyllic* (1860), *Alice of Monmouth, and other Poems* (1864), *The Blameless Prince, and other Poems* (1869), and of a volume of critical essays on *The Victorian Poets* (1875). His scattered *Poems* were collected in a single volume in 1873. He delivered his narrative poem, *Gettysburg*, in 1872 at a meeting of the Army of the Potomac, and his verses for commencement at Dartmouth College 1873. He has prepared a series of *Hebrew Pastorals*, of which some specimens have been printed, and has made a careful study of Theocritus and the Sicilian-Greek school of idyllic poets. (See biographical notice in *Scribner's Monthly*, Nov., 1873.)

Steed'man (CHARLES), U. S. N., b. Sept. 24, 1811, in South Carolina; entered the navy as a midshipman Apr. 1, 1828; became a lieutenant in 1841, a commander in 1855, a captain in 1862, a commodore in 1866, a rear-admiral in 1871; retired in 1873. Served in the naval battery at Vera Cruz during our war with Mexico, and commanded the Bienville at the battle of Port Royal, and the Ticonderoga in both the Fort Fisher fights. Highly commended by Rear-Admirals Du Pont and Porter.

FOXHALL A. PARKER.

Steedman (JAMES BARRETT), b. in Northumberland co., Pa., July 30, 1818; went to Ohio in 1837, and in 1843 was elected to the State legislature; was among the earliest in 1849 to try gold-mining in California; in 1851 was made a member of the Ohio board of public works, and subsequently was chosen printer to Congress. At the outbreak of the civil war he was appointed colonel of an Ohio volunteer regiment; served with credit in West Virginia and Kentucky; was made brigadier-general in July, 1863, and for services at Chickamauga was made major-general in Apr., 1864. He was actively engaged in Sherman's Atlanta campaign; afterward was with Thomas in Tennessee, and took part in the battle of Nashville. Resigned his commission in July, 1866, and was appointed by Pres. Johnson collector of the port of New Orleans.

Steel. *Definition.*—It is necessary to define the term "steel" at some length, since the old classification very inadequately describes the modern cast, malleable compounds of iron, carbon and metalloids used for structural purposes, and constituting at least three-fourths of the metal now made by steel processes. The old term "steel" referred to the cast malleable product of iron and so much carbon (from $\frac{3}{4}$ to $1\frac{1}{4}$ per cent.) that the metal would harden when heated to redness and quenched in water; it is used almost exclusively for cutting tools. The homogeneity of this metal is, however, an equally distinguishing quality, and is due to its having been poured into a mould while in a fluid state, so that the slag might separate by gravity, and the metal might become solid and crystalline. Wrought iron, on the contrary, while having similar chemical properties, and often as much carbon, consists of pasty masses from which the slag is rarely quite expelled by the pressure that sticks them together; it is therefore laminated in structure. As the soft compounds and those largely varying in chemical constituents came gradually to be produced by casting processes, it was natural and convenient to enlarge the term *steel* to cover them; and the use of the term was at the same time rendered legitimate and scientific by basing the classification on one of the grand characteristics—structure due to casting—rather than on ingredients, as heretofore, especially since structural qualities were constantly increasing in importance. It is found practically convenient to distinguish between all the cast malleable compounds, whether hard or soft, by affixing the name of the metalloid chiefly incorporated, such as "chrome steel," "manganese steel," and the like, or the percentage of carbon, or both. It is important to know the amount of carbon in structural steels, and this may be readily determined. To call the soft steels "wrought iron" would involve not only the sub-classifications mentioned, but another to distinguish structural variety. The general usage of commerce, as well as of works, is rapidly fixing this enlarged definition; it is, however, criticised on the ground of new use for an old name, while some objectors propose a classification based on arbitrary degrees of resilience, or of strength, or of hardening capacity, or of several combined qualities. They would call all compounds on one side of the arbitrary line "steel," and all on the other side "iron." Now, exact definitions must be based on differences which always exist in every form and phase of the materials defined, and not on differences which, however great they may be in certain forms and phases of the materials, run together at one point, and there cease to be differences. If we divide steel from wrought iron by an arbitrary line of percentage of any ingredient, or of modification, such as hardening, due to any ingredient, there must be some point at which the difference between steel and wrought iron is infinitely small. If, however, we define steel as a compound made homogeneous by fusion, while wrought iron, although the same in composition, is heterogeneous from welding, there is always and at every grade of the materials a large and radical difference. Casting fluid steel and welding pasty iron are always distinct in their characters and results; they do not at any point shade into each other. It is hardly possible in this paper to give an outline of the controversy, but, as this article is intended to refer to those compounds of iron which are generally known and sold as steel, such as Bessemer rails and Martin boiler-plate, as well as tool steel and spring steel, the definition must for these purposes be as follows: *Steel is a compound of iron which has been cast from a fluid state into a malleable mass.* The term "cast" prefixed to steel thus becomes unnecessary. Puddled iron combined more or less highly with carbon, without any change in structure by melting, under the names of "puddled steel," "blister steel," etc., is not true steel, according to current nomenclature, nor according to that adopted after the old high tool-steels were first made. The terms "pot" or "crucible" steel, "Martin steel," and "Bessemer steel" are convenient for distinguishing processes of manufacture, but they do not necessarily distinguish between steels which differ either chemically or mechanically.

Nature and Composition of Steel.—From the preceding definition it will be observed that the grand structural characteristic of steel, to which it largely owes its value for all uses, is homogeneity due to fusion; also, that its chemical constituents and the characters due to them are very various. The important chemical qualities of tool-steel are: (1) the tempering quality, which is due, first, to the presence of say $\frac{3}{4}$ to $1\frac{1}{4}$ per cent. of carbon; second, to the mechanical mixture of this carbon with the metal by means of slow cooling from a red heat, which makes the metal comparatively soft, so that it can be cut with the ordinary tools; third, the extreme hardening of the metal, when, by means of sudden cooling, the carbon is chemically dissolved in the iron. (2) An important condition of tool-steel is its freedom from ingredients, such as phosphorus and silicon, which induce brittleness. Excepting some modern tool-steels, in the manufacture of which chromium, titanium, and some other metalloids are employed, the best tool-steels have but a few hundredths of 1 per cent. of any ingredient except carbon and iron. The precise effects of the metalloids are not well determined, and are little understood.

The more important qualities of structural steels vary with their precise uses. In general, great resistance to statical strains, or to those gradually applied, is accompanied by comparative brittleness and unfitness to resist strains suddenly applied. High resistance, resilience, hardness, and brittleness increase, up to certain limits, with the amount of impurities, chiefly carbon, contained in the metal. Low resistance, softness, ductility, and toughness become more marked, within certain limits, as the impurities become less. But too little as well as too much impurity makes steel weak and unsuitable for structural purposes. It requires what is called "body" to give it resistance to either statical or sudden strains. This "body" is imparted by carbon, manganese, silicon, phosphorus, and by other ingredients; but too much of either of them, or of certain compounds of them, weakens the metal. While we know, generally, that the substances mentioned may to a certain extent replace one another as body-giving elements, and that some of them appear to neutralize others (for instance, that manganese restores the ductility of steel made brittle by phosphorus), we are but yet on the outskirts of definite and formulated knowledge regarding the mechanical effects of chemical mixture in iron and steel. Great progress is making, however, by means of combined chemical and mechanical tests, and there is no doubt that not only steel, but other constructive metals, will by these means be compounded to more perfectly meet the present and a vastly increased range of uses.

The considerable variation in the composition of steels fit for the same purposes is shown by Table I. Sulphur and copper do not materially affect structural qualities; they

TABLE I.—*Good Steels.*

	1. Martin boiler-plate, very soft.	2. Martin boiler-plate	3. Martin boiler-plate.	4. Martin boiler-plate, very tough.	5. Martin "phosphorus-steel" rail	6. Bessemer rail.	7. Bessemer rail.	8. Bessemer rail, hard.	9. Bessemer machinery steel.	10. Bessemer machinery steel.	11. Bessemer machinery steel.	12. Bessemer machinery steel.	13. Bessemer boiler-plate.	14. Crucible (Krupp) machinery.
Carbon	0.150	0.170	0.210	0.250	0.120	0.280	0.300	0.560	0.165	0.390	0.537	0.490	0.210	0.480
Silicon	0.025	0.020	trace	trace	0.030	0.050	0.100	0.350	0.100	0.027	0.042	0.009	0.029	0.220
Phosphorus	0.040	0.070	0.050	0.030	0.286	0.101	0.120	0.118	0.070	0.122	0.058	0.036	0.074	0.039
Manganese	0.160	0.550	0.540	0.750	0.750	0.350	0.480	0.800	1.000	0.778	0.432	0.576	0.350	1.000
Copper	.....	.....	.....	.....	.....	.....	0.280	0.070	.....	0.373	0.040	0.025		
Sulphur	trace	0.001	0.050	.....	0.130	0.028	.....	0.080	0.160	0.123	0.031	0.030	.....	0.049

tend to make the metal "red short" or unmalleable at ordinary working heats. Manganese, up to 1 per cent., promotes toughness, and, as in No. 5, Table I., appears to neutralize the hardening action of phosphorus. Carbon, silicon, and phosphorus must be low in boiler-plates and in parts which are subjected at the same time to tension and vibration. They may all be high in suitably-shaped compression members of structures.

Table II. shows steels (Nos. 1 and 2) red-short from want of manganese, although a similar composition in No. 1, Table I., was not red-short. The former, however, were made by the Bessemer process, and needed more manganese to remove the oxide of iron formed in the conversion. This will be further referred to. No. 5, Table II., is both red-short and brittle from excess of phosphorus. No. 3 is a little brittle from carbon; removing two thirds of its phosphorus would leave it tough. Nos. 6 and 7 are, on the contrary, weak for the want of carbon.

TABLE II.—*Miscellaneous Analyses.*

	1. Bessemer, red-short.	2. Bessemer, red-short.	3. Bessemer, rather brittle.	4. Bessemer, very brittle.	5 Bessemer, rotten hot and cold.	6. Bessemer, low tensile strength.	7. Bessemer, rails yielded to impact.	8. Good, hard wrought iron.
Carbon	0.292	0.180	0.744	0.150	0.480	0.060	0.142	0.036
Silicon	0.011	0.057	0.040	0.029	0.046	0.035	0.062	0.179
Phosphorus	0.061	0.080	0.089	0.240	0.589	0.098	0.085	0.088
Manganese	0.144	0.140	0.450	0.240	trace	0.305	0.472	0.029
Copper	0.016	.....	.....	0.030	.....	0.015	0.065	0.007
Sulphur	0.012	0.115	0.030	0.040	0.053	0.070	.....	0.028

Table III. shows the strength and ductility of three kinds of steel, due to carbon.

TABLE III.—*Mechanical Qualities due to Carbon.*

Fagersta (Sweden).			Neuburg (Austria).			Cockerill (Seraing).		
Quantity of carbon.	Average breaking load.	Percentage of stretching.	Carbon.	Breaking load.	Percentage of stretching.	Carbon.	Breaking load.	Percentage of stretching.
	Lbs. per sq. inch.			Lbs. per sq. inch.				
1.00 p. c.	126,486 to 146,383	2 to 6 p. c.	0.88 to 1.12	126,486 to 149,226	5 p. c.	0.65 and more.	98,063 to 156,332	5 to 10 p. c.
0.70 p. c.	100,905 to 130,750	4 to 6 p. c.	0.62 to 0.88	103,747 to 126,486	5 to 10 p. c.	0.55 to 0.65		
0.45 p. c.	99,404 to 103,747	9 to 10 p. c.	0.38 to 0.62	80,298 to 103,747	10 to 20 p. c.	0.45 to 0.55	79,587 to 98,063	10 to 20 p. c.
0.35 p. c.	68,217 to 69,638	12 p. c.	0.15 to 0.38	68,217 to 80,298	20 to 25 p. c.	0.35 to 0.45		
0.30 p. c.	59,690 to 62,533	11 to 22 p. c.	0.05 to 0.15	56,848 to 68,217	25 to 30 p. c.	0.25 to 0.35	68,217 to 79,587	20 to 25 p. c.

As already mentioned, while there is a general rule for the compounding of steel, by means of which a variety of materials and processes may be utilized, the exact effect of the ingredients upon each other and upon the general result can only be formulated when many thousands of chemical and physical tests are made and compared. Carbon appears to be the most important modifying element, whether as a condition of tempering, or in too small quantity to be materially affected by being quenched in water. Its amount may be easily regulated in all steel processes; and its proper regulation is the chief feature of the steel manufacture at present. There is as yet little attempt to combine, control, and utilize the other ingredients mentioned (excepting perhaps manganese), but only to avoid, as far as possible, the raw materials which would introduce them into steel.

The Manufacture of Steel.—(1) *The Pot-Steel Process.*—This is the oldest and simplest. It at first consisted in melting wrought iron with carbon in clay crucibles. Thus Indian "wootz" is made, containing as much as 1½ per cent. of carbon, so that it requires decarburization before it can be forged. In the present manufacture other ingredients besides carbon, chiefly manganese, are added. Sometimes substances intended to combine with and remove the impurities in the wrought iron are introduced, but generally these impurities remain in the steel. The finest steel must therefore be made from wrought iron which has been purified by reworking with pure fuel, and which was originally made from pure ores. The melting-point of wrought iron is so high that it has been usual to carburize it by cementation (see FURNACE) in order to fuse it at a convenient temperature in crucibles. This cemented or blistered bar was the steel of commerce until Huntsman melted it in a crucible in 1770, producing a true cast steel. Steel for boiler-plates and some other uses would be too highly carburized if made of melted cemented steel, so that wrought iron, a very little charcoal, and some manganese are now fused together to make the softer pot steels. The use of the Siemens furnace (see FURNACE) and the modern improvement of crucibles render the melting of wrought iron practicable and cheap. Pot steel has been experimentally made from spongy iron produced by deoxidizing iron ore without fusing it. (Sponge steel will be further referred to.) The cheaper grades of pot steel are largely made from Bessemer and Martin steel rail-ends and other scrap. This material, being made directly from cast iron, without that purification from silicon and phosphorus to which wrought iron could have been subjected in puddling, produces an inferior steel to that made from the purest wrought iron for purposes, like tool-steel, requiring both hardness and toughness. By melting wrought iron and a little cast iron together, especially cast iron containing manganese, the cheaper grades of steel are produced. The impurities of the cast iron remain in the steel. Although pot steel has been cheapened by using the materials mentioned, and by means of the gas-furnace, the less refined grades of steel are made at so much less cost and with so much greater uniformity by the Martin process, and within certain limits by the Bessemer process, that the pot process is becoming gradually confined to the finer grades of tool-steel: and here it must probably long retain its superiority, chiefly because it can begin with a highly-refined iron, from which especially phosphorus, silicon, and sulphur have been more or less completely eliminated. Pot steel is also the more suitable for castings to be used without further working, as it remains for some time "dead melted" in the pots, and so parts with the gases which give porousness to ingots made by more rapid processes. Manganese, however, promotes sound casting in all processes.

The apparatus for making pot steel is comparatively

simple. The gas pot-furnace is shown in article FURNACE, and the operation of the regenerative gas-furnace is fully described in the same article. The coke pot-furnace is a smaller "melting-hole" or fireplace, in which from two to four pots are set in a bed of coke, the combustion of which is urged by a powerful draught. The top of the series—sometimes hundreds—of melting-holes is level with the shop-floor. A series of ash-pits open to a tunnel underneath the floor. Boilers to furnish steam to hammers and roll-trains are usually driven by the waste heat from the pot-furnaces. The pots hold from 40 to 75 pounds of metal each, and melt three charges in twelve hours. They are usually made of fire-clay in England and of plumbago in this country, depending on the quality of the refractory material at hand. The pots are generally charged when cold with all the materials to be fused, set in the furnace, covered with tight lids, and withdrawn for pouring by means of tongs. They endure from two to six rounds. The consumption of coke in the ordinary furnace is 3 to $3\frac{1}{2}$ tons per ton of steel; in the regenerative gas-furnace it is from $1\frac{1}{4}$ to $1\frac{1}{2}$ tons of a cheap coal per ton of steel.

The soundness of ingots largely depends on the skill with which the pots are emptied into the ingot-moulds. The stream must pour uniformly into the centre of the mould, and must not strike or spatter against the sides. For large castings several hundred pots are sometimes poured, one after another, into a small ladle standing over the ingot-mould, but the stream from the bottom of the ladle into the mould must be unbroken. Steel low in carbon chills very rapidly, so that casting operations must be performed with celerity. Ingot-moulds are made of cast iron, sometimes in two sections held together by hoops, and separated to take out the ingot. Large moulds are usually solid, and tapered, so that the ingot will slip out endwise when it contracts by cooling. Ingots are heated and worked by the various means described in the articles FURNACE and ROLLING-MILL. (See especially FURNACE, *Description of Furnace*, regarding the working of small pot-steel ingots.)

(2) *The Siemens-Martin (or open-hearth) Process.*—The melting of the ingredients of cast steel in large quantities and cheaply on the open hearth of a reverberatory furnace, rather than in small quantities and expensively in pots, having been often unsuccessfully attempted, was patented in a more scientific form by the eminent metallurgist Heath in 1845, and was then experimentally carried out with limited success. The Siemens regenerative gas-furnace, by means of the intensity and uniformity of its heat, first furnished practical conditions to the open-hearth process about 1862. It was also demonstrated by Messrs. Martin that the addition of manganese at a certain stage was necessary to the production of sound and practically malleable steel. (The action of manganese will be further referred to.) By common consent, the process has been called, for the above reasons, the Siemens-Martin process. (The Siemens open-hearth steel furnace and its operation are fully exhibited and described under FURNACE.) The hearth or bed of the furnace consists of a shallow iron tank, ventilated below to prevent the concentrated heat of the hearth and the regenerators from endangering the structure, and lined with a very refractory material, generally silica, nearly pure, and just fusible enough to set into a solid mass. The red-hot air and gas entering and burning at, say, the right-hand end of the furnace, play upon the materials placed on the hearth, and pass down into the regenerators at the left end, where they give off their heat to a checkerwork of fire-bricks. The current being reversed after some thirty minutes, the air and gas enter at the left end through the newly-heated regenerators and pass out at the right end.

The materials employed are various, and consequently the process varies, although the decarburization of pig iron is always a part of it. In order to obtain a sufficiently intense combustion there must be a slight excess of air; the flame is therefore oxidizing, and would seriously waste wrought iron or the ingredients usually melted in pots. A bath of cast iron, which on account of its carbon can be melted without serious loss, is first necessary; in this are immersed and protected the more readily oxidizable materials for the production of steel. The amount of cast iron varies from 10 to 33 per cent. of the total charge. For fine steels it should be as small as possible, so as to introduce the least amount of phosphorus, silicon, etc.

The more common process is known as the scrap process, and this again is divided into (1) the fusion of pig and scrap wrought iron or steel charged together, the former melting while the latter is heated preparatory to melting; (2) the dissolving of either hot or cold scrap in a bath of pig previously melted; (3) the dissolving of wrought-iron sponge in a cast-iron bath. The operation in all these cases is chiefly the melting of the decarburized iron forming the bulk of the charge, and the oxidation of the greater part of the carbon and silicon in the crude cast iron, and also, to a certain extent, of the phosphorus and other impurities. A portion of the iron is also oxidized, and this oxide of iron makes the product unmalleable or red short. To remove the oxygen something must be added which has a greater affinity for it than the iron has. Manganese is such a thing, and it is easily and cheaply introduced in the form of pig iron called spiegeleisen, which contains 10 to 15 per cent. of manganese, or of an artificial ferro manganese containing as high as 60 per cent. By this means an excess of manganese can be introduced, so that any desired proportion of it shall remain in the steel. If the decarburization of the cast iron and the dilution of the carburized and uncarburized portions of the charge are carried only to such an extent that a highly carburized product remains, less manganese is needed to make it malleable, and this may be supplied by melting a manganiferous pig iron with the charge. Dissolving scrap in the bath is the more common process: the scrap is fed in a little at a time, so as not to chill the charge and cause it to set on the bottom of the furnace, and also to maintain uniformity in the temperature and working of the furnace. In order to save part of the stress on the steel furnace, an auxiliary furnace is employed in many works to heat the scrap and spiegeleisen before charging them into the bath. Wrought iron sponge is charged like scrap, either cold or hot, although it is difficult to prevent it from rapidly oxidizing when hot until it is protected by the bath. Wrought iron sponge is simply iron ore heated in the presence of carbon to such a degree that the carbon will remove the oxygen from the iron ore, but not from the silica or other metalliferous ores present. When sponge is melted in the bath, the silica and the phosphorus (if it is combined with lime instead of iron) and some other impurities, being lighter than iron, float off with the slag. The blast furnace, on the contrary, smelts more or less of the metalloids, and incorporates them with the pig iron, from which they are imperfectly removed by subsequent processes. The manufacture of sponge-steel is not fully developed nor largely practised, but it offers many theoretical advantages.

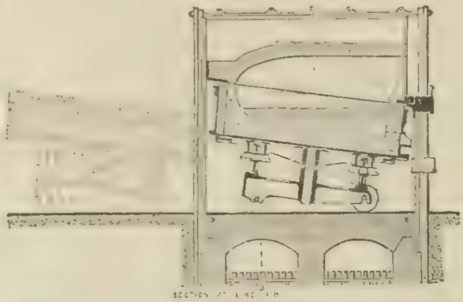
In the production of boiler-plate and of steels to be subjected to blows and vibration while in tension, for which the open-hearth process is largely used and well adapted, about 20 per cent. of the best "Bessemer" pig, containing less than 0.10 per cent. of phosphorus, and preferably not over 1 per cent. of silicon, is employed, the remainder of the charge being charcoal blooms made from "Bessemer" ores, or puddle-bar made by the boiling process, so as to free it as much as possible from phosphorus. For cheap steels, especially those in which hardness without great resistance to impact are required, a less pure pig and any wrought-iron scrap, such as old rails, may be employed. The phosphorus imparted by the latter may be rendered harmless by employing a rich ferro-manganese at the close of the process, thus adding a large amount ($\frac{3}{4}$ to 1 per cent.) of manganese and only 0.10 to 0.15 per cent. of carbon. (See Analysis No. 5, Table I.)

To ascertain when the charge is so far completed as to be ready for the manganese, samples are dipped out of the bath and tested from time to time. The decarburization is accurately denoted by the toughness of the sample and by the appearance of its fracture. As soon as the manganese is thoroughly diffused through the bath, the charge is tapped out and cast in a manner to be further referred to. The open-hearth furnace is made to hold from 3 to 10 tons, the more usual capacity being 5 to 6 tons. The time of the operation is from eight to eleven hours.

The pig-and-ore process, as developed by Mr. Siemens, consists in decarburizing a bath of pig iron by iron ore, and then adding ferro-manganese in the usual manner. The ordinary proportions are $5\frac{1}{2}$ tons of pig and more or less ore in proportion to its richness, usually about 30 cwt. The iron in the ore is added to the bath, and a little limestone is thrown in to facilitate its separation. The theory is to use ore enough to make good the waste of the iron by oxidation. Although pig and ore may be employed alone with success, there is usually 10 or 15 per cent. of scrap made in rolling and forging, and this scrap is returned to the steel furnace. Sometimes 25 per cent. of scrap is added. The process thus partially takes the character of the pig-and-scrap process, although the use of ore as a rapid decarburizer of the large amount of pig employed gives it a distinctive character. The pig and scrap are first melted, the time being four or five hours. During this period an inch or more of slag forms over the bath. Then the ore, in lumps up to 3 or 4 inches in diameter, is charged a little at a time, until the bath is nearly ready for the manganese, when it is allowed to stand, so that the iron may work out of the ore and slag. The usual amount of ferro-manganese finally added is 7 per cent. of a metal containing 12 to 15 per cent. of manganese. After the charging of the ore begins, there are two distinct periods:

first, the rising of the slag; this increases in weight, but much more in volume, and is covered with large and heavily moving blotches or bubbles; second, the boiling of the metal, when the slag settles and becomes thinner, and the whole surface of the bath is covered with a lively spouting of the metal and slag, sometimes of the metal through the slag. These periods represent the following operations: (1) The silicon in the pig, having at this temperature a higher affinity for oxygen than the carbon has, is burned out first, partly by the flame, which is somewhat oxidizing, and partly by the oxygen in the ore. Thus, slag is rapidly

Fig. 1.



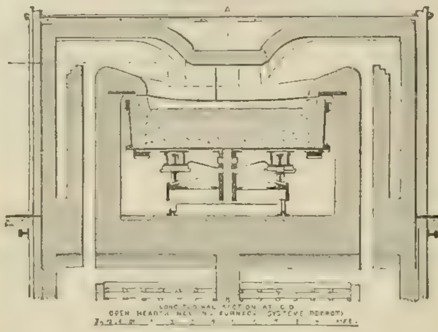


Fig. 2.

formed and also thickened by the release of the silica and other impurities in the ore. (2) When the silicon of the pig is nearly consumed, its carbon begins to burn freely and to throw off carbonic oxide, which makes the now hotter and thinner slag boil violently.

The Pernot revolving-hearth furnace is shown by Figs. 1 and 2. The regenerators may be exactly like those shown under Furnace, and before referred to. The hearth is inclined at an angle of 5° or 6° to the vertical, and is rotated by an engine and gearing (not shown in the engraving) at the rate of about two revolutions per minute. The effects are—first, that the melted bath is constantly agitated; second, that the solid scrap, such as rail-ends, are alternately dipped into the bath and brought up into the flame; third, that a portion of the side-slope of the hearth is constantly exposed to the flame. In the stationary hearth the heat can only penetrate the bath through the blanket of slag, while in this the bath is heated partly by the side-slopes. Both the decarburization of the cast iron and the dissolving of the scrap must of course be facilitated by these mechanical means. As a result, the Pernot furnace makes four heats in the twenty-four hours, instead of two, or at most three, as made in the stationary hearth. Again, the whole hearth is mounted on wheels, and may be removed to the position shown by the dotted lines in Fig. 1, thus giving ready access to both the hearth and the roof and ports for repairs, and facilitating the cooling of the furnace, so that workmen may get at it. The general arrangement of an improved open-hearth steel plant is shown by Fig. 3 in plan and Fig. 4 in cross-section. The Pernot furnace being employed, which must be charged on the tapping side, a wide platform, 13 feet above the ground floor, is arranged on this side. On the other side provision is made for drawing out and repairing the movable furnace-hearths. The furnace-valves are placed under this platform, also the engines for rotating the hearth. The arrangement of plant for stationary furnaces would be similar, except that the 13-foot platform might be omitted, the ladle A might swing closer to the furnace, and the furnace might consequently be lower; its height is regulated by the convenient height of the ladle for casting the metal in moulds which stand in the ingot-pit. The operation of casting will be referred to under *The Bessemer Process.* The materials are raised by the hydraulic hoist J. When the scrap process is employed, that material is heated in the auxiliary furnace, being charged on the back side and pulled out on a car on the front side; from the car it is pushed into the steel furnace. When the ore process is employed, the pig, which forms the bulk of the charge, is raised by the lift J to the cupola E, where it is rapidly melted and run into the ladle F. The ladle is raised by a hydraulic lift, and tapped out into either steel furnace. A slag-car under the tapping-spout is arranged to catch and carry away the voluminous slag which follows the steel out of the furnace. The hydraulic cranes B B swing over the casting-pit to set the moulds and remove the ingots. Two ovens are provided to dry the flasks for casting ingots in groups from the bottom—a process which will be further referred to. Another plant like this may be added to the end of this, and so on indefinitely, the gas-producer system and the material-yard being extended on the one side, and the railway system for transporting ingots on the other.

The Bessemer Process.—The chemical part of the Bessemer process may be generally stated as the oxidation of the carbon and silicon in melted crude cast iron, so as to make it malleable, by means of air-blasts. This definition, to some extent, describes puddling and the earlier processes of making malleable iron. In all these processes the air oxidizes a portion of the iron, and the oxide of iron thus formed undoubtedly oxidizes a part of the carbon and silicon. In puddling, however, the mixing of the oxidizing agent, so that it may come in contact with all parts of the iron successively, is promoted by stirring the melted mass by manual power; but so slow is the process, and so small are the masses that can be treated by a workman, that not even the heat of the combustion thus promoted, nor even the additional heat of the burning coal, can keep the iron *fluid* when deprived of its carbon. The purified iron is withdrawn in a plastic condition, mixed with slag. It requires compression, piling, heating, and recompression to reduce it to a solid bar. The radical and essential differ-

Fig. 3.

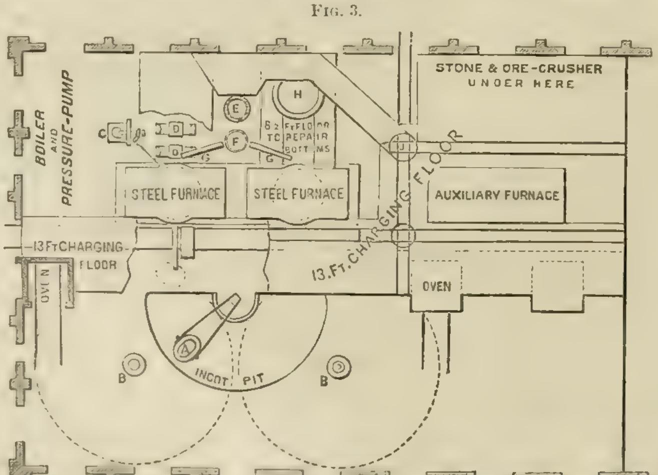
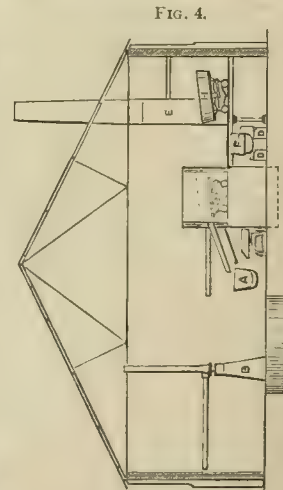


Fig. 4.

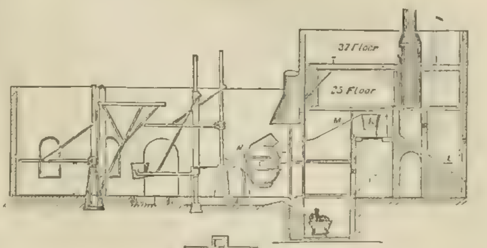


ence between this process and the Bessemer process is a *mechanical* difference, and it consists in the *intense and violent stirring* of the Bessemerized iron. To this alone is due the production and maintenance of a temperature, without any other fuel than the carbon and silicon contained, that *keeps the metal fluid*, so that it can be cast into homogeneous, malleable ingots. In puddling, the iron is agitated by the power of one man; in Bessemerizing, it is torn into spray by a 500-horse engine. In the one case it is stirred by a single iron bar; in the other it is pierced by innumerable bars of iron, squeezed solid, like rods of glass, penetrating every part, and enveloping every atom of iron in an atmosphere of oxidizing material. The combustion thus takes place not in successive sections of the mass, but throughout the whole of it, at the same time, and in the shortest possible time; and the heat arising from *such* combustion has not time to escape from the mass until purification is completed. The quantity of iron that can be treated, in comparison with the mass of heat-conducting surroundings, is also an important feature. The individual reactions are, as far as we can judge, as rapid and complete in one case as in the other; the fluid condition of Bessemer metal is due simply to the vastly greater number of these reactions that are compelled to occur in a given space of time by the mechanical force and distribution of air-blasts.

The Bessemer process as first performed, and as still practised to a very limited extent abroad with irons rich in manganese, consists in applying the blast until all but one-fourth to one-half of 1 per cent. of the carbon is burned out, and then casting the product. Stopping the blast at this point, however, is very uncertain; hardly any irons contain the right amount of manganese for this treatment, and the process has certain mechanical objections. Hence, the nearly universal practice is to blow the iron until *all* the carbon is exhausted—a point readily determined. But the product now, as in the open-hearth process before described, contains so much oxide of iron that it is red-short and crumbles in working. To reduce this oxide of iron, manganese, which has a stronger affinity for the oxygen than the iron has, is added by running into the converter 8 to 10 per cent. of melted spiegeleisen, which is a pig iron containing 10 to 15 per cent. of manganese, or by otherwise adding ferro-manganese to the charge. Any desired amounts of carbon and manganese are also thus added to the product. No phosphorus is removed from the iron in the Bessemer process. Only the carbon and the greater part of the silicon are oxidized. It is therefore important to start with pig irons having a little less phosphorus, sulphur, and copper than the steel may safely contain. But it is not usually practicable to use irons low in silicon, for the oxidation of this element produces the high temperature necessary to keep the mass fluid. Manganese is to a certain extent a substitute for silicon in this respect, and always a valuable ingredient, but the greater part of the irons of the world do not contain it in important quantities. Usually, a pig containing from 2 to 2½ per cent. of silicon is required. This will heat the charge to such a degree that 10 to 15 per cent. of scrap may be worked with the pig-iron charge. If there is more silicon than this, too much of it is likely to be left in the steel. One reason why silicon has greater heating power than carbon (it is stated by Akerman to have nine times as much) is because the product of its combustion, slag, remains in the converter, while the product of the combustion of carbon goes out in gaseous form, and carries much heat with it.

A standard American Bessemer plant consists (1) of a *melting department*. The furnace and working-floor are shown in plan by Fig. 5; sections of these floors and the furnaces are shown by Fig. 6. There are hoists at *a* for coal, etc., and at *b* for iron; four cupola furnaces and their platforms and blowing machinery; two ladles, K, standing on scales, for weighing the melted iron; and spouts M, N, Fig. 6, for conducting it to the vessels or converters; two reverberatory furnaces for spiegeleisen, and their spouts. (2) The *converting department*, shown in ground-plan by Fig. 5 and in cross-section by Fig. 6. It contains two 5-ton to 7-ton vessels N, in which the melted iron is treated by air-blasts. The vessels will presently be illustrated. Also, a ladle and a hydraulic ladle-crane at E, Fig. 5, by means of which the steel is received from the vessels and poured into the ingot-moulds, which stand upon a depressed part of the floor called the "pit." Three other hydraulic cranes swing over the pit to set the ingot-moulds and remove and load the ingots. Two of them swing over the vessels to assist in their daily repairs. The water- and air-pressure reservoirs are surmounted by a platform *d*, Fig. 5, standing upon which boys, by turning valves, admit water to the cranes and air to the vessels by means of underground pipes. All the constant operations of hoisting, lowering, and blowing are conducted from this platform, which overlooks the entire converting department. The details of

Fig. 6.



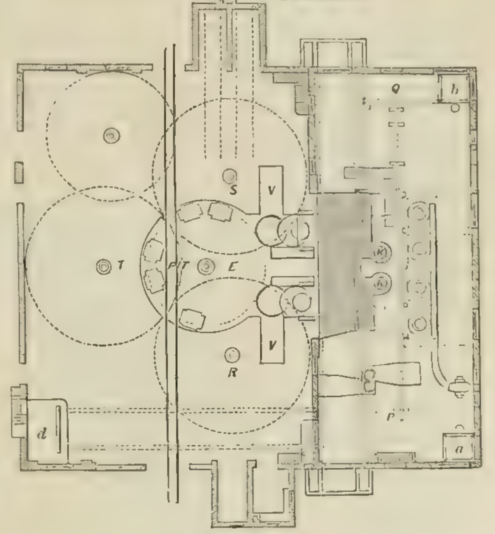


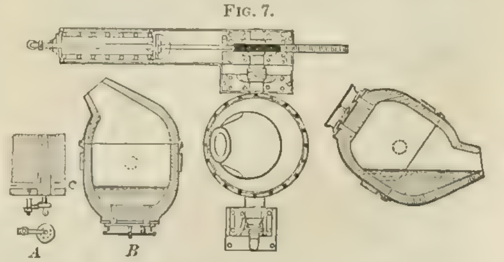
Fig. 5.

these and other parts will be further described. (3) *The Engine Department.*—This is not shown in the engravings. It contains a blowing-engine, usually a double engine, capable at normal speed of receiving 8000 to 11,000 cubic feet of air per minute, and delivering it at 25 pounds pressure per square inch. The water-pressure machinery for actuating the hydraulic machinery consists of a pair of Worthington duplex pumps, each having two 25-inch steam-cylinders, and two 9-inch water-cylinders, 24-inch stroke. The boilers should be capable of 800 horse-power.

The pig-iron, having been hoisted to the charging platform, is put, with, say, 10 per cent. of coal, into one of the cupolas and melted. When some 15,000 to 16,000 pounds (whatever charge is determined on) have run into one of the ladles K, the latter is turned over by means of a worm-wheel, thus pouring the iron into the spout, which leads it to one of the vessels.

Before following the iron through the converting process, let us glance at the construction of the vessel, the simplest

Fig. 7.

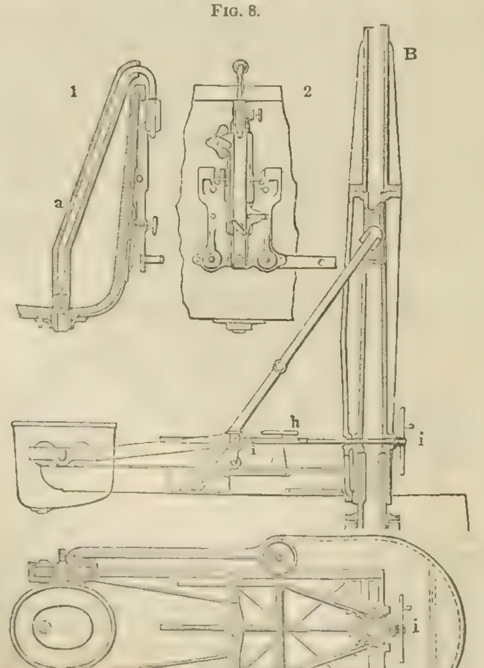


form of which is shown at Fig. 7. A vessel that will convert a 6-ton charge is 8½ feet in external diameter and 15 feet high. It is made chiefly of ½-inch to ¾-inch iron plates, and lined nearly a foot thick with refractory material. At one end it has an 18-inch opening, called the nose; at the other a tuyere-box, communicating with the blowing-engine. From the tuyere-box 12 fire-brick tuyeres, each perforated with twelve ⅜-inch holes, project through and are imbedded in the lining. A tuyere is shown in section by A. These tuyeres last but ten or fifteen heats, and are arranged, as we shall see farther on, to be rapidly renewed. The vessel is mounted on trunnions, and turned by a hydraulic cylinder by means of a rack and pinion. When the charge enters,

the tuyeres are turned up as at C, so that the iron will not run into them. The blast is then admitted, and the tuyeres turned down so that the metal will flow over them, and be pierced by the entering columns of air. The cubical contents of the vessel is eight to twelve times that of the charge of iron, in order to give room for ebullition. The vessel-lining is heated red hot and the fuel discharged before the iron is turned in. The iron is now subjected to 144 streams of air, three eighths of an inch in diameter, at 15 to 25 pounds pressure, for about 20 minutes. Most of the silicon is first burned out, the result being slag, and a comparatively dull flame at the converter-mouth. When the carbon begins to burn freely, the volume and brilliancy of the flame increase: and as the surging mass grows hotter, and boils over in splashes of fluid slag, the discharge is a thick, white, roaring blaze, and the massive vessel and its iron foundations tremble under the violent ebullition. Toward the close of the operation the flame becomes thinner, and when decarbarization is complete, it suddenly contracts and loses illuminating power. The determination of this period is the critical point of the process. Ten seconds too much or too little blowing injures or spoils the product. At the proper instant, as determined best by the spectroscope or by colored glasses, but usually by the naked eye, the foreman turns down the vessel and shuts off the blast. The charge of spiegeleisen is then run in, when another flaming reaction occurs. The vessel being still farther depressed, the steel runs into the ladle, pure, white, and shining, from under its coating of red hot slag. A blanket of slag, most useful in preserving its temperature, follows it into the ladle. The metal is now let into the ingot-moulds by means which will be further illustrated. After the exterior surface of the steel has crystallized, the mould is removed, and the ingot is ready for reheating and rolling.

In working out the Bessemer process the most novel and difficult problem, obviously, was, how to hold and handle fluid iron while it was being treated with violent blasts of air, and how to do this with such celerity that the metal would *remain* fluid. To this end the first *radical* feature of the Bessemer apparatus was imbedding the tuyeres in the lining of the vessel; or, in other words, the perforation of the bottom part of the vessel-lining. The bottoms of the tuyeres (Fig. 7) are luted with plastic clay inserted in openings in the tuyere-box, grooved to hold the luting, so that no air can leak by, and held in place by a dog (A). Semi-plastic refractory material, chiefly ground silicious stone, is then rammed between and around the tuyeres, thus forming the continuous lining of the vessel. The second radical feature is the rotating vessel. The very limited use of a stationary vessel having similar tuyeres

FIG. 8.



has been referred to; but, as recarbonization cannot be performed in such a vessel, and as it is otherwise impracticable for a maximum production, we may properly omit its consideration. We have already observed the value of the rotating vessel in placing the tuyeres under the metal to blow, in removing them to stop blowing, in receiving the iron from the cupolas, and in pouring the steel into the casting ladle. If a tuyere fails while blowing, as is often the case, at the first indication the perforated bottom is turned up out of the metal, where it can be reached and repaired.

The ladle-crane (Fig. 8) is another radical departure from the nearest kindred practice. The ladle, instead of swinging from a crane-chain, as in a foundry, is rigidly held in a fixed orbit. This feature was original with Bessemer, and to it he added the old ladle with a pouring-nozzle in its bottom, regulated by a movable stopper (1 and 2). This consists of a loam-coated rod *a*, armed at its lower end with a round-ended fire-brick or plumbago stopper fitted to the concave top of a fire-brick nozzle. The stopper is raised and lowered by a lever *o* in the hand of the workman. Thus, the heavy steel is discharged pure, while the lighter slag and impurities are left at the top. Pouring steel into moulds over the rim of a ladle, as in foundries, would make excessive scrap from spilling and chilling, and is wholly impracticable. The vertical motion of the crane is necessary in pouring from the vessel, to keep the ladle close under the nose, thus preventing too great a fall of the stream, and consequent slopping. The ladle is also tipped by a worm and worm-wheel *h*, to regulate the position of the nozzle over the moulds and to turn over the ladle for heating and repairs. The hydraulic crane generally used in American works is also illustrated by Fig. 8, and consists of a cylinder open at the top only, and requiring chiefly vertical support from the solid pier on which it rests. The ram passes through an upper stuffing-box and through a top support in the roof of the building. The jib is placed between these supports, so that the lateral strain on the ram is comparatively small. The ram is stepped upon a column of water which is substantially frictionless. The amount of hydraulic pressure employed has been regulated chiefly by the proportions of the crane; that is to say, it was found that for an 8-ton crane, having a 10-foot lift and 22-foot jib, a 13-inch ram was well proportioned for strength. Adding frictions and fluctuations of pressure, it was found that 300 pounds per inch on this 13-inch ram was abundant for all emergencies; and the working pressure has been fixed at about this point, instead of being carried to 1500 pounds or more, as is so usual in other hydraulic machinery. The water is pumped into an accumulator, consisting of a cylinder and weighted ram like those of a crane. When the cylinder is full, the ram, by means of suitable gearing, nearly shuts off the steam from the pump by means of a lever and throttle-valve. This arrangement saves some steam, and prevents the pump from running too fast when several cranes happen to be started at once.

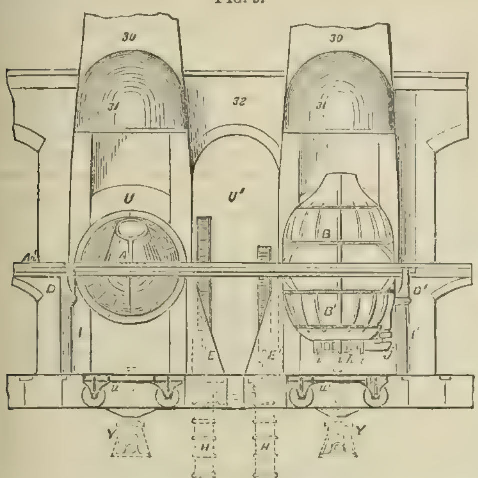
The English vessel-lining is a hard sandstone called "ganister." It contains about 93 per cent. of silica, 4 per cent. of alumina, 1 or 2 per cent. of oxide of iron, and often a little soda, lime, potash, etc. It is a true quartzite. This is ground into sand and dust, and mixed sometimes, but not always, with a little fire-clay while being ground. It is then wetted to a semi-plastic consistency, and rammed into a solid wall between an iron mould temporarily inserted and the shell of the vessel. The hardness and uniformity of the ramming is of special importance. The lining is at first slowly dried, and then glazed by filling the vessel half full of coal and blowing for four to five hours at two or three pounds pressure. The vessel is then ready for use. In this country no stone exactly like ganister has yet been found. We use any hard, dense sandstone, or any quartz, mixed with 10 or 12 per cent. of ground fire-clay. The chemical composition of many of these stones is similar to that of ganister, except that they contain less alumina. The *natural mixture* of the small amount of alumina in ganister appears to give the mass a degree of density and cohesion, both wet and dry, that can hardly be obtained with three or four times the amount artificially mixed. Too much alumina is *chemically* eaten away; this is why tuyeres fail so soon. A fire brick vessel lining, though hard enough to stand the abrasion of the surging mass, would be chemically destroyed in a very few heats. Silica, on the contrary, although refractory enough, is soon washed away, because it will not fuse into a dense mass. The mechanical structure of quartzite has an important bearing on its endurance when rammed into the vessel. The heat of successive charges compacts and hardens it.

Interposing ladles between the cupolas and vessels is important in many respects: (1) The cupola cannot be so economically and regularly worked if its hearth has to fill up with the whole vessel-charge of iron every thirty or forty minutes. (2) The weight of the charges should be some-

what uniform, to promote uniformity and accuracy of blowing, and to recarburize with a fixed percentage of spiegeleisen. This can only be accomplished by weighing the charge between the cupola and the vessel, and the ladles are placed on scales for this purpose. (3) Several charges are often run into the ladles when the converting department is not ready for them; otherwise the cupola would have to be dumped and part of a day's work lost.

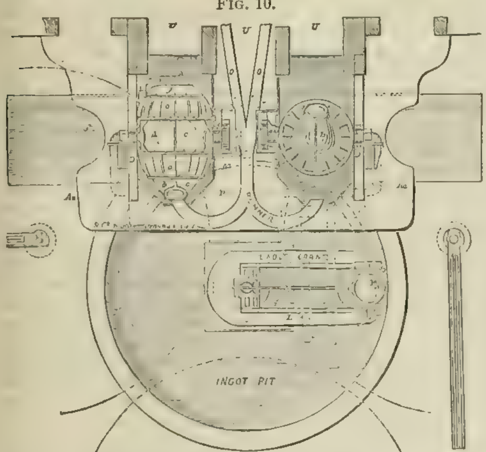
We come, finally, to the general arrangement of plant. The standard English plant, worked out by Bessemer, is still adhered to in England and on the Continent, excepting only in a very few of the later works. The standard American plant is illustrated by Figs. 5 and 6 and by Figs. 9 and 10, which show a plan and elevation of the vessels and their immediate surroundings. The most conspicuous

FIG. 9.



feature is the arrangement of the vessels, especially their height above the general floor, and the consequent shallow-

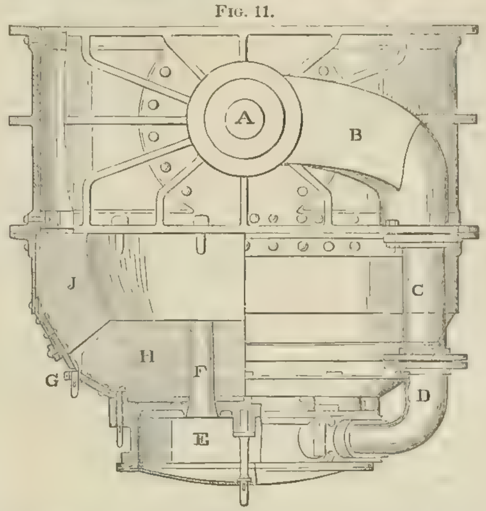
FIG. 10.



ness of the casting-pit. The English vessel-centres stand only three or four feet above the general floor, and the bottom of the casting-pit must hence be eight or nine feet below it. In this confined, unventilated, and comparatively inaccessible gulf the longest-continued and the hottest manual work is performed. Here the steel is poured and the red-hot ingots and moulds are handled. In the American plant the vessel-centres are nine feet above the general floor, and the pit is but three feet deep—just deep enough for convenient casting. All the operations of casting are performed, all the ingots and moulds are handled, by men standing on the general working floor of the building. Convenient access, free ventilation, and a short lift of moulds and ingots are thus secured. The high vessel also allows the removal of the vessel-bottoms on the general floor; and there is a second story of working room by means of the platforms around the vessels at the level of their centres. The runners are accessible for repairs, and the vessel-noses for the insertion of scrap, from this platform. When highly-siliconized or hot irons are used, some steel scrap is put into the vessel cold, and melted as well as reconverted with the iron charge. In the American plant the rear of the vessels is open to a floor in the cupola building, from which they may be conveniently fired, and where the tuyere-boxes may be opened, the tuyeres repaired, and the vessel-bottoms set. The converting-house floor under the cranes is thus clear for ladle repairs—twelve to fifteen casting-ladles are required—for storing ingot-moulds, or for other purposes requiring crane power. The vessel-bottoms are removed and replaced by means of a hydraulic lift and a car under each vessel. The exterior trunnion of the vessel is supported by a beam instead of a pier, so that the vessel-bottom or a whole section of the vessel can be removed laterally for repairs after it has been let down upon the car by the lift.

The lower part of a modern vessel is shown by Fig. 11. Air enters the trunnion A, and passes down the pipes B, C, and D, the latter of which comes off with the remov-

FIG. 11.



able vessel-bottom H. When one bottom and its tuyeres are worn out, it is, together with its tuyere-box E, pulled out of the vessel. A new bottom is then inserted, keyed to the pins G, and the joint between the bottom H and the vessel-lining J is made good by ramming plastic refractory material into it from the outside of the vessel. Thus, the bottom can be changed in an hour, although more time is generally allowed, while by old methods of construction the joint was made from inside the vessel, and it was necessary to wait half a day for it to cool.

When the steel is intended for rails—and 90 per cent. of that made in this country is so used—the charges are so regulated as to cast either five or six ingots, and a little over as a margin for chilling and spilling. Each ingot makes either three or four rails; it is usually 14 inches square at the bottom, tapering to 13 inches at the top, so as to slip out of the cast-iron ingot-mould, and 4 to 5 feet long, weighing a ton or more. The ingots are removed hot, each charge together on a car, to the blooming mill, and if any heating-furnace is ready, they are charged into it directly, thus saving much heat. They must be allowed to crystallize, however, before rolling. If the interior of an ingot is still pasty from the heat of conversion, it will go to pieces in the rolls. Ingots for three or four rails each are used, instead of ingots for single rails—first, to save a repetition of manipulations in working. This must be done by machinery to be done cheaply, and a *machine* can handle a big ingot as quickly as a little one. Second, the extreme top of an ingot is unsound, and must be cut off and reconverted; a double ingot yields but one scrap-end for two rails. Third, a single rail might be rolled from a 7-inch or 8-inch ingot, but the steel would be too little condensed; a 4 inch ingot receives three or four times as much work in the rolls, and the density and uniformity of the bar are improved in proportion. The practice is growing in the direction of large ingots and large reductions for all purposes; and the counterpart to this—to cheapen cost—is handling by steam and reducing rapidly by heavier rolls and hammers.

Casting ingots in groups from the bottom is an improvement now in nearly general use, upon which there has been much experimenting. The most cheap and convenient apparatus is illustrated by Figs. 12 to 17. Fig. 13 shows the "flask," an iron platform having pockets L and channels K, as seen in cross-section at N, Fig. 14. These pockets and channels having been filled with suitable moulding material (chiefly sand or old fire-bricks pulverized, and fire-clay), the iron patterns (Fig. 17) are driven into the

channels, thus moulding "runners," as seen at J, Fig. 13, and in section at M, Fig. 14. These runners are partly covered with fire-bricks E E, Fig. 12. The whole apparatus is then thoroughly dried in an oven. A centre-sprue and funnel (A, Fig. 16) is set over F, Fig. 12, whence all the runners radiate, and the ingot-moulds (B B, Fig. 16) are set over the pockets through which the sprues have openings between the covering bricks. Steel poured into the funnel A, runs into the bottoms of all the ingot-moulds at once and rises quietly and evenly within them. Steel poured into the top of an ingot-mould, splashes and sometimes spatters against the sides of the mould, thus making an unsound ingot. Bottom-casting is also a rapid operation, while top-casting requires a small stream and the opening and closing of the stopper at each mould; and in case of soft and quickly-setting steel these interruptions often lead to the chilling of the nozzle and the production of much scrap. Bottom-cast ingots, especially when the steel tends to be red-short, are much more solid and malleable than those poured from the top.

Fig. 12.

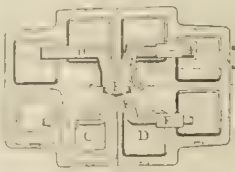
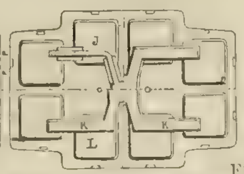
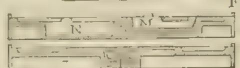


Fig. 13.



Figs. 14. 15.



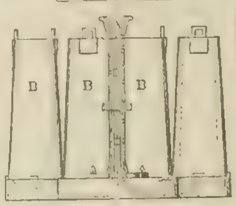


Fig. 16.

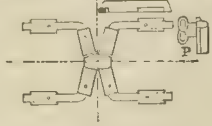


Fig. 17.

The average product of the standard American Bessemer plant is about 1200 tons of ingots per week per pair of vessels of six feet internal diameter, usually rated as 6-ton vessels. As much as 1600 tons per week have been produced. The annual aggregate capacity of American steelworks is as follows: pot steel, 45,000 tons per year; open-hearth steel, 40,000 tons; Bessemer steel, 500,000 tons. A. L. Holley.

Steel, Chemical Nature, etc. See Appendix.

Steele, county of S. E. Minnesota, drained by Lester River and affluents of Cannon River, and containing several lakes. The soil is fertile, and diversified by forest and prairie. It is intersected by Chicago Milwaukee and St. Paul and Chicago and North western R. Rs., which pass through its capital. Staples, wheat, oats, Indian corn, wool, and hay. Cap. Owatonna. Area, 432 sq. m. P. 8271.

Steele, tp., Daviess co., Ind. P. 738.

Steele, tp., Wood co., West Va. P. 1562.

Steele (Anne), b. at Broughton, Hampshire, England, in 1717; wrote many poetical pieces, chiefly devotional, of which two volumes were published in 1760 under the name of "Theodosia." D. in 1778. Her collected *Poems and Hymns* (1780; Boston, 1808) were edited by Caleb Evans, D. D., and a new edition in 1863 by John Sheppard.

Steele (Ashbel), b. at Waterbury, Conn., Jan. 31, 1796; became pastor of a Presbyterian church at Washington, D. C., and was a writer for several religious and political newspapers. Author of *Chief of the Pilgrims, or the Life and Times of William Brewster* (1857).

Steele (Frederick), b. at Delhi, N. Y., 1819; graduated at the U. S. Military Academy July 1, 1843; served in the war with Mexico, gaining the brevets of first lieutenant and captain for Contreras and Chapultepec; was ordered to California 1849–55, and in 1855 to the Western frontier until the outbreak of the civil war, when, as major of the 11th Infantry, he was engaged in Missouri; in Sept., 1861, appointed colonel 8th Iowa Vols., and at the battles of Dug Spring and Wilson's Creek in command of a brigade; for the latter battle was commissioned brigadier-general of volunteers Jan. 29, 1862, and commanded a division in the army of the South-west until November, when promoted to be major general of volunteers and assigned to the 13th army corps, which he led in the Yazoo expedition and capture of Arkansas Post (Dec., 1862–Jan., 1863); transferred to the 15th corps, he was engaged in the Vicksburg campaign, when his division was sent to Helena, Ark., and captured Little Rock Sept. 10; in 1864 commanded the department of Arkansas, and on Nov. 29, 1864, went to the aid of Gen. Canby in the reduction of Mobile; after commanding various districts in the South-west, was assigned (Oct., 1865) to the command of the department of Columbia, and retained in the volunteer service until Mar., 1867, when mustered out. For the capture of Little Rock he was brevetted brigadier-general, and for meritorious services major-general U. S. A. In July, 1866, he was assigned to the coloneley of the 20th Infantry, which he held at the time of his death, at San Mateo, Cal., Jan. 12, 1868.

Steele (J. Dorman), Ph. D., b. at Lima, N. Y., in 1836; graduated at Genesee College 1858; became a successful teacher of natural science in several schools; served as a volunteer under Gen. McClellan in the Peninsular campaign 1862; has been since 1866 principal of Elmira Free Academy, and has prepared some successful manuals for "fourteen-week courses" of *Chemistry* (1868), *Descriptive Astronomy* (1868), *Natural Philosophy* (1869), *Geology* (1870), and *Physiology* (1871).

Steele (Sir Richard), b. in Dublin in 1671, the son of an English barrister, secretary to the duke of Ormond; was educated at the Charter-house and at Oxford, where, failing to take a degree, he enlisted as a private in the horse-guards; rose to be ensign; wrote the *Christian Hero* (1701), which he dedicated to Lord Cutts, colonel of fusileers, who procured for him a captaincy in his regiment, shortly after which he started as a dramatist, his first comedy being *The Funeral, or Grief à la Mode* (1702), followed by *The Tender Husband* (1703) and *The Lying Lover* (1704). Through the influence of Addison, who had been his schoolfellow at the Charter-house, he was appointed court-gazetteer and usher to Prince George of Denmark, the husband of Queen Anne. So loose and extravagant were his habits that he was always in pecuniary difficulties; but such was his amiability of disposition that he always found friends to assist him, and was successively appointed to lucrative offices, among which were commissioner of the stamp-office, surveyor of the royal stables, governor of the royal comedians, justice of the peace for Middlesex, and commissioner of forfeited estates in Scotland. In 1713 he was returned to Parliament for Stockbridge, but was expelled in the following year on account of political articles written by him, but was knighted by the king, and returned to Parliament for Boroughbridge in 1715. In 1720 his patent as governor of the royal comedians was revoked, by which, according to his own statement, he suffered a loss of £10,000, and in the following year he brought out his successful comedy of *The Conscious Lovers*, which was dedicated to the king, who sent him a present of £500. His first wife, who died soon after their marriage, brought him a plantation in the West Indies, and his second wife was a Welsh heiress, but he squandered his large income in dissipation and unprofitable speculations, and being attacked with a paralytic stroke, which disabled him from literary work, he retired to his estate at Llangunnor in Wales, where he d. Sept. 1, 1729, and was, at his own request, privately buried. Several of Steele's political essays and pamphlets had a high reputation in their day, and his comedies were well received upon the stage. But his chief fame rests upon his connection with the *Tatler* and the *Spectator*, almost the earliest of that long series of periodical works which occupy so prominent a place in English literature, although in these his part was much inferior to that of Addison. The *Tatler* (1709–11) contained 271 numbers; 164 were by Steele, and only 42 by Addison, who only began to write for it near its close. This was succeeded by the *Spectator* (1711–14), containing 635 numbers, of which 240 were by Steele and 274 by Addison. After the discontinuance of the *Spectator*, Steele, with the co-operation of Addison, started the *Guardian*, but Addison soon withdrew, and the work was brought to a close with the 176th number, of which 82 were by Steele. His *Poetical Miscellanies*, original and translated (1714), some of them being furnished by others, possess little merit. Thackeray, in his *English Humorists*, speaks very genially of the character and writings of Steele, while Macaulay in his essay upon the *Life and Works of Addison* rather disparages them. The best life of Steele is *Memoirs of the Life and Writings of Sir Richard Steele, Soldier, Dramatist, Essayist, and Patriot*, by H. R. Montgomery (London, 1865). A. H. Guernsey.

Steele Creek, p.-v. and tp., Mecklenburg co., N. C. P. 1951.

Steel Engraving. See Engraving.

Steele's, tp., Richmond co., N. C. P. 1656.

Steell (John), b. at Aberdeen, Scotland, in 1804; studied art at Edinburgh and sculpture at Rome; successfully competed for the execution of the sitting statue of Sir Walter Scott which forms part of the monument to that

novelist in Edinburgh; produced the colossal statue of Queen Victoria placed above the Royal Institution, Edinburgh, and the bronze equestrian statue of the duke of Wellington erected in 1850 in front of the Register House, Edinburgh. Others of his statues are of Admiral Saumarez, of Lords Melville and Jeffrey, of Marquis Dalhousie, and Hon. James Wilson at Calcutta, of Prof. John Wilson erected at Edinburgh 1865, the Scottish National Memorial to Prince Albert, colossal bronze statues of Sir Walter Scott and of Burns for Central Park, New York, colossal statues of Allan Ramsay and Dr. Chalmers for Edinburgh, and much-admired monuments to the 42d and 93d Highlanders in the cathedrals at Dunkeld and Glasgow.

Steel Pens. See Pen.

Steelville, p.-v., Meramec tp., cap. of Crawford co., Mo., near Meramec River, in an iron- and coal-producing region, has 1 weekly newspaper. P. 232.

Steel′yard, or **Roman Balance** [Ger. *Schnellwage*], a form of the balance in which the object to be weighed is counterpoised by a smaller weight which may be moved upon the longer arm of a suspended lever. Another form, rarely seen, has the fulcrum movable and the weight fixed at the end of the long arm. The weight is indicated by readings at the place on the lever where the movable weight or movable fulcrum is when equilibrium is produced.

Steen, tp., Knox co., Ind. P. 1285.

Steen (Jan), b. in 1636 at Leyden; studied the art of painting under Brouwer, and afterward under Von Goyen, whose daughter he married. As he worked slowly, received small prices for his pictures, and liked to spend much money, he established a beer-brewery in Delft, but failed, and lost himself in coarse dissipations, leaving his large family almost destitute. D. in 1689. His pictures are mostly genre pieces, scenes of low life, such as the *Festival of St. Nicholas*, the *Oyster Feast*, the *Bowling-Alley*, etc. Some of his pictures, such as the celebrated *Representation of Human Life*, are in the gallery at the Hague. (See Van Westrheenen, *Jan Steen, Étude sur l'Art en Hollande* (the Hague, 1856).)

Stee′ple-Chase. See Horse-Racing.

Steering and Sailing Rules. See Road, Law of the, by J. N. Pomeroy, LL.D. See also Great-Circle Sailing and Sailing.

Steer′ing Apparatus. Besides the rudder there are other important appliances which have a limited use in the steering of ships. Such are the use of two screws in steamers, one on either side of the rudder. If these be worked in contrary directions, the vessel will be turned around in a very much shorter course than if the rudder be used alone. So on the Mississippi River and its tributaries the side-wheel steamers have paddle-wheels which act independently of each other; and if one wheel be turned forward and the other reversed, the vessel can be turned upon its centre as a pivot. Steering is in part effected by changing the rate of revolution of each wheel.

Steer′pen, tp., Chesterfield co., S. C. P. 545.

Stee′vens (George), b. at Stepney May 10, 1736; was educated at King's College, Cambridge; devoted himself to Shakspearian studies, and in 1766 published in 4 vols. 8vo, *Twenty of the Plays of Shakespeare, being the whole number printed in Quarto during his Lifetime*, etc., which led to his association with Dr. Johnson in an annotated edition published in 1773 under their joint names. Afterward, in conjunction with Isaac Reed, he prepared two new editions (1785 and 1793), in which he left out superfluous syllables and supplied such as had been omitted through the ignorance or carelessness of the early printers. His editions remained the standard for the text for almost fifty years. He also assisted in the preparation of the *Biographia Dramatica*, and furnished contributions to Nichols's *Biographical Anecdotes of Hogarth*. D. at Hampstead Jan. 22, 1800.

Stef′fens (Henrich), b. at Stavanger, Norway, May 2, 1773; was educated in Denmark 1779-94, and studied theology and natural science, especially mineralogy, at the University of Copenhagen; went in 1794 to Germany, and became, through the study of Schelling's writings and through personal intercourse with the author, a zealous adept of the new sensational science, the so-called "philosophy of nature" (*Recension von Schellings naturphilosophischen Schriften* (1800), *Grundzüge der philosophischen Naturwissenschaft* (1806), *Anthropologie* (2 vols., 1822), and *Polemische Blätter zur Beförderung der speculativen Physik* (1829-35)); continued his study of mineralogy and geology at Freiberg under Werner (*Geognostisch-geologische Aufsätze* (1810) and *Handbuch der Oryktognosie* (3 vols., 1811-19)); was appointed professor of natural science in 1804 at Halle, in 1811 at Breslau, and in 1831 at Berlin. D. at Berlin Feb. 13, 1845. In religion he first turned from the stiff orthodoxy in which he was educated to the pietism of Spener, which he found at Halle; then he became an ardent preacher among the Old Lutherans at Breslau; and finally, at Berlin, he settled down in Schleiermacher's elegant religion of the feeling (*Von der falschen Theologie und dem wahren Glauben* (1824), *Wie ich wieder Lutheraner wurde und was mir das Lutherthum ist* (1831)); in politics he made the campaigns of 1814-15, and without being put in Spandau, was very loud in his enthusiasm for Jahn's Turner institutions and for the political commotions among the students at the Prussian universities. His autobiography, *Was ich erlebte* (10 vols., 1840-45), was translated into English by W. L. Gage under the title *The Story of my Career as Student at Freiberg and Jena* (Boston, 1863), and republished under the title *German University Life* (Philadelphia, 1874).

Stegoceph′ala [Gr. στέγος, a "cover," and κεφαλή, "head"], a name applied to a group of extinct amphibians by Prof. E. D. Cope, and employed as an ordinal designation for a compound of the Labyrinthodontia, Ganocephala, Microsaura, and Xenorhachia. The so-called order is characterized by the usual cranial elements being distinct, including frontals and pterygoids, and adding "postorbitals" and "supertemporals;" the orbitosphenoids normal; the teeth having ankylosed bases or lodged in shallow alveoli; and the inferior pelvic elements distinct. The four groups above designated are considered as suborders, although by some naturalists the first two, at least (Labyrinthodontia and Ganocephala), are ranked as orders. The group was best represented during the Carboniferous period. Theodore Gill.

Steilacoom′ City, p.-v., cap. of Pierce co., Washington Ter., on Puget Sound and on Pacific division of Northern Pacific R. R., has 1 weekly newspaper. P. 314.

Stein, von (Charlotte Albertine Ernestine), b. at Weimar Dec. 25, 1742, a daughter of Court-marshal von Schardt; was married in 1764 to Baron Friedrich von Stein, chamberlain of the stables, to whom she bore seven children in the first eight years of their marriage. Immediately after Goethe's arrival at Weimar, in 1775, that most remarkable friendship sprang up between him and her which lasted uninterruptedly to his first Italian journey in 1788 and his connection with Christiane Vulpius, afterward his wife, and which never was broken, though it lost its passionate character. She d. at Weimar Jan. 6, 1827. Her letters to Goethe she burned, but his to her have been edited by A. Schöll (3 vols., Weimar, 1848). Several letters by her to other persons—as, for instance, to Charlotte von Schiller—have been published; also a tragedy in prose, *Dido*, which interests by its allusions to actual circumstances.

Stein, von (Heinrich Friedrich Karl), Baron, b. at Nassau-on-the-Lahn Oct. 26, 1757; studied jurisprudence at Göttingen 1773-77; travelled; entered the civil service of the Prussian government in 1780, and was made chief of the department of commerce, manufactures, and indirect taxation in 1804. Strongly opposed to the policy adopted by the president of the cabinet, Count Haugwitz, and by the king himself, he was dismissed Jan. 4, 1807, but recalled immediately after the Peace of Tilsit (July 20, 1807), and made president of the cabinet. In this position he developed an astonishing energy. His internal reforms were a complete reorganization of the Prussian state. Serfdom was abolished, and universal obligation of military service introduced; the manorial estates of the nobility were taxed, all citizens made equal before the law, a liberal municipal system established, etc. His final aim was to elevate the peasant class and to create a powerful and intelligent middle class, and thus, on this basis, to renew the contest with Napoleon. He had also a clear idea of what a united Germany meant, and was averse to that division of the country into petty states which had given the history of the nation such a chaotic and anarchical aspect. But his career was suddenly stopped. An incautious letter, in which he criticised the policy of Napoleon and spoke of his own hopes and plans, fell into the hands of the French police, and was published in the *Moniteur* Sept. 8, 1808. On Nov. 24, Stein was compelled to resign, and on Dec. 16, Napoleon sent a decree from Madrid which outlawed him and confiscated his property. He went to Austria, thence to Russia, but once again he was at the head of the political affairs of Germany during the period between Napoleon's disaster in Russia and the Peace of Paris, when he actually was the leader of the diplomatic coalition against France. After peace had been concluded, his influence soon became comparatively small. The German princes hated him for his ideas of a German unity; the absolutists hated him for his ideas of a representative form of government; and he himself was unwilling or un-

able to associate with those violent but vague aspirations which fermented in the German people. He retired to his estates, where he died, June 29, 1831. Monuments have been erected to him in Nassau and in Berlin. His biography has been written several times, among others by Pertz. His correspondence and letters have been published, and are of great importance for the history of that time.

Stein (Lorenz), b. at Eckernförde, Sleswick, Nov. 15, 1815, in humble circumstances; studied, through the support of the Danish government, jurisprudence at the University of Kiel; published in 1841 *Geschichte des dänischen Civilprocesses*, and received a stipend from Copenhagen; went to Berlin and Paris, and published in 1844 *Der Socialismus und Communismus des heutigen Frankreich*; was appointed professor of political economy at Kiel in 1846, but was dismissed in 1852 on account of his participation in the rebellion of 1848; published his *System der Staatswissenschaften* (2 vols., 1852–56); removed in 1855 to Vienna, and entered the Austrian civil service. Among his later works are *Lehrbuch der Volkswirthschaft* (1858), *Lehrbuch der Finanzwissenschaft* (1860), *Die Verwaltungslehre* (1865–68), etc.

Stein'bok (*i. e.* "stone buck"), a name applied to different species of the family Bovidæ. (1) The German designation *Steinbock* (and hence the Dutch *steinbok*) was originally conferred on the ibex or bouquetin of the mountains of Southern Europe, a species of goat, and to that animal it properly belongs. (See Bouquetin and Ibex.) (2) The Dutch settlers of Southern Africa applied the name to a species of antelope not uncommon in that region, and it is now incorporated in the English vocabulary of animals in connection with it. The species is the *Nanotragus tragulus* (*Pediotragus campestris* of Gray). It is an animal of graceful and symmetrical form, with the head well proportioned, having a bovine nose and large muffle; the horns, developed only in the males and over the orbit, erect, elongate, and subulate; the legs long and slender; the feet destitute of side hooflets; and the tail very short. The color is a fulvous ash above and on the sides, and white beneath. The length is generally rather less than three feet and a half, and the height at the shoulder somewhat more than a foot and a half. The species is peculiar to Southern Africa, and most abundant on the stony plains and valleys thereof, and especially the open flats, where large stones and clumps of trees are found here and there. It is very swift, and progresses by great bounds. It is also very timid, and readily alarmed. It is much esteemed for its flesh. Theodore Gill.

Stein'er (Henry H.), M. D., b. in Frederick, Md., Jan. 8, 1816; graduated in the medical department of the University of Pennsylvania Mar., 1838; entered the U. S. army as surgeon June, 1839, and as such served in the Florida and Mexican wars. From 1843 to 1845 he was stationed at Augusta, Ga., to which place, on resigning his position in the army, Jan., 1852, he returned, and made it his home. During the late war he was a Confederate brigade surgeon. He still (Mar., 1876) resides in Augusta. Alexander H. Stephens.

Steiner (Lewis Henry), M. D., b. at Frederick City, Md., in 1827; graduated at Marshall College, Mercersburg, Pa., 1846, and in medicine at the University of Pennsylvania 1849; became a physician at Baltimore; was connected with the Sanitary Commission during the civil war; has been for several years professor of chemistry in the Maryland College of Pharmacy at Baltimore, one of the editors of the *American Medical Monthly*, and a contributor to literary reviews. Has published addresses, reports, and essays upon scientific and medical topics.

Stein'ersville, p.-v., York tp., Belmont co., O. P. 73.

Stein'le (Johann Eduard), b. at Vienna in 1810; studied painting at the academy of design in Vienna, under Cornelius at Munich, and under Overbeck at Rome, and was appointed professor at the Städel Institute in Frankfort in 1850. His principal works are the frescoes in the choir of the cathedral of Cologne, angels on gold ground; *Solomon's Judgment*, in the Kaisersaal of Frankfort; the four frescoes in the museum of Cologne, etc.; published a number of illustrations to Shakspeare's dramas, Brentano's tales, etc.

Stein'metz, von (Karl Friedrich), b. at Eisenach, grand duchy of Saxe Weimar, Dec. 27, 1796; entered the Prussian army in 1813 as a lieutenant; fought against the French; became a captain in the regiment of Kaiser Franz in 1835; fought at the head of two battalions of the 2d infantry regiment in Mar., 1848, in the streets of Berlin; was subsequently made governor of the academy of cadets at Berlin, and made his name illustrious as commander-in-chief of the 5th army corps in the campaign against Austria in 1866. On June 27, 28, and 29, 1866, he made a stand at Nachod, Skalitz, and Schweinschädel with his corps and one brigade against three corps of the enemy, defeated them, drove them back, and took 11 guns and 6000 prisoners. By this victory he made it possible for the second army to debouch, on which manœuvre the success of the Prussian battle-plan depended. He received immediately the highest order, that of the Black Eagle, and the Diet voted him a national dotation. In the war against France in 1870 he was appointed commander-in-chief of the 1st army, consisting of the 1st, 7th, and 8th army corps, but he held this position only for a short time, as he came in conflict with the supreme command—in what manner is not exactly known, but it seems as if the advance of the 1st army on Aug. 6, and the measures taken by the general during the advance toward and around Metz on Aug. 14, 15, and 16, did not agree with the plans of Von Moltke. In reality, the general now lost his independent command, his army being united to that of Prince Friedrich Charles, and the supreme command given to the prince. Nominally, however, Steinmetz remained a commander, subject only to the orders of the king, and thereby, as well as from the stubbornness of his character, arose disagreements between him and the prince. The result was, that in Sept., 1870, Steinmetz was appointed governor-general of Posen and Silesia, and removed from the theatre of war. He handed in his resignation, which, however, the king did not receive. He was made a general-field-marshal and placed *à la suite*. D. Aug. 3, 1877. August Niemann.

Stein'thal (Heymann), b. at Anhalt, Germany, May 16, 1823; studied philology and philosophy at Berlin, afterward (1852–55) in Paris, where he especially devoted himself to the Chinese language and literature, and was appointed professor at the University of Berlin in 1863. He was a disciple of Wilhelm von Humboldt, and represented the philosophical treatment of philological science. His principal works are—*Ursprung der Sprache* (1851), *Charakteristik der hauptsächlichsten Typen des Sprachbaues* (1860), *Die Mande-Negersprachen* (1867), *Abriss der Sprachwissenschaft* (1871), *Die Sprachwissenschaft W. von Humboldt's und die Hegel'sche Philosophie* (1848), *Gedächtnissrede auf W. von Humboldt* (1867), besides a number of minor essays in scientific periodicals.

Stein'wehr, von (Adolph Wilhelm Friedrich), Baron, b. at Blankenberg, Brunswick, Germany, Sept. 25, 1822; educated in the military academy at Brunswick; became a lieutenant 1841; resigned his commission 1847; came to the U. S. in that year, and unsuccessfully offered his services to the government in the Mexican war; married at Mobile, and went back to Germany; returned to the U. S. 1854; bought a farm and settled at Wallingford, Conn.; raised the 29th New York Regiment 1861, and commanded it in the first battle of Bull Run; became brigadier-general of volunteers Oct. 12, 1861; was commander of the 2d division of the 11th corps in the campaign on the Rapidan and the Rappahannock, and took part in the battles of Chancellorsville and Gettysburg. Author of an "Eclectic Series" of school geographies, of a *Topographical Map of the U. S.*, and of the *Centennial Gazetteer of the U. S.* (Philadelphia, 1873). D. at Buffalo, N. Y., Feb. 25, 1877.

Stellar System. See Stars, by P. A. Secchi.

Stel'lio, a genus of lizards of the family Agamidæ. The best-known species is *S. Cordylina* of the Levant. Strict Mohammedans kill it, because they conceive that by the frequent bowing of the head it intends to offer insult to their religion, mocking their own gestures at prayer. The Turks use its flesh and excrement in preparing a cosmetic.

Stem. See Botany, by Prof. Asa Gray, M. D., LL.D.

Stem'bel (R. N.), b. Dec. 27, 1810, in Maryland; entered the navy as a midshipman Mar. 27, 1832; became a lieutenant in 1843, a commander in 1861, a captain in 1866, a commodore in 1870; retired in 1872, and made a rear-admiral on the retired list in 1875. Served with gallantry on the Western waters during the civil war, and was wounded May 10, 1862, while commanding the gunboat Cincinnati in an engagement with Confederate rams. Highly commended for "gallantry and skill." Foxhall A. Parker.

Sten'dal, town of Prussia, province of Saxony, on the Uchte, manufactures leather, tobacco, woollen, linen, and cotton stuffs, and trades in corn and cattle. P. 7603.

Stendhal. See Beyle (M. H.).

Sten'house (John), LL.D., F. R. S., b. at Glasgow, Scotland, Oct. 21, 1809; educated at Glasgow grammar school, at the Andersonian University of Glasgow, and at the University of Giessen, having enjoyed the instructions in chemistry of Prof. Graham, Dr. Thomas Thomson, and Baron Liebig; was lecturer on chemistry at the medical school of St. Bartholomew Hospital, London, 1851–57, and assayer to the royal mint 1865–70; has published above 80 papers on chemical subjects and on sanitary science, and

was awarded a royal medal of the Royal Society Nov. 30, 1871, "for long-continued chemical researches, which have proved of great value in the arts and manufactures."

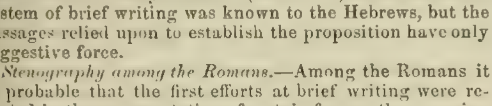
Ste'no (Nicolaus), b. at Copenhagen in 1638; studied medicine, especially anatomy, in his native city, in Paris, and Bologna, and was appointed professor at the University of Copenhagen, but embraced in 1667 the Roman Catholic creed; removed to Florence; became physician to the grand duke of Tuscany; took holy orders in 1676, and d. on a missionary tour at Schwerin in 1687. Discovered the duct of the parotid gland, called "Steno's duct;" among his numerous writings in Latin, Italian, and French are *Elementa Myologiæ* (1667) and *Discours sur l'Anatomie du Cerveau* (1669). Leonardo da Vinci, Palissy, and Steno were the only scientists before the last part of the eighteenth century who understood what fossils meant.

Stenog'raphy [Gr. στενός, "narrow," "close," and γράφειν, to "write"]. This is a generic term, which, like "short-hand," embraces every system which seeks the rapid representation, by means of written characters, whether upon alphabetic, phonetic, or hieroglyphic principles, of the words of speech. To those systems which are based upon the phonetic principle is given the name *phonography*, which therefore indicates a *species* of stenography. Some of the various names under which new stenographic systems have been introduced are—*tachygraphy* ("swift writing"), *brachygraphy* ("short writing"), *semigraphy* ("sign writing"—that is, "writing with signs"), *cryptography* ("secret writing"), *bodiography*, *zeiglography*, *polygraphy* ("writing for all"—that is, "universal writing"), *radiography* ("easy writing"), *thoögraphy* ("swift writing"), *stenography* ("close writing"), and *phonography* ("sound writing").

The Early History of Stenography.—*Stenography among the Greeks.*—The great value and need of some method of representing in legible characters spoken words as fast as uttered was appreciated in the earliest times, and traces of short-hand writing may be found among the Greeks not very many centuries later than the introduction and diffusion of the art of writing. The conclusion has been arrived at that among the Greeks, Xenophon was the inventor of stenography, some method of which he employed in recording the *Memorabilia* of Socrates. Many references show that some style of writing briefer than that in common use was known at this time, though it is not clear that use was made of characters not found in the common alphabet. It has been suggested that certain references in the Bible to "ready writers" (Ps. xlv. 1) show that some system of brief writing was known to the Hebrews, but the passages relied upon to establish the proposition have only suggestive force.

Stenography among the Romans.—Among the Romans it is probable that the first efforts at brief writing were reflected in the representation of certain frequently-recurring words by contractions in the ordinary spelling, as by their initial letters; thus: R. P. for *Res Publicæ*, P. R. for *Populus Romanus*, S. P. Q. R. for *Senatus Populusque Romanus*. The next step was the representation of certain frequently-recurring terminations of words by arbitrary contractions or signs; and the next, the representation by arbitrary characters of words and phrases. Ennius the poet is said to have invented and used (239–169 B. C.) a series of 1100 arbitrary characters for the ready representation of words. The first attempt at any *system* of stenographic writing is variously attributed to Cicero and to his freedman Tiro. Certain it is that Tiro, by the use of a system which he had mastered if not invented (and which is said to have been improved by Mæcenas), took down and thus secured the preservation of Cato's great oration against the proceedings of Cæsar respecting the Catilinarian conspiracy, as well as Cicero's own orations respecting the same. Julius Cæsar, Augustus, and Titus Vespasian are said to have been proficient in the art of short-hand writing; and this is clearly shown by many references in Horace, Ovid, and other writers. We give an illustration of the Tironian system.

Tironian Notes.



Translation.

Cum petitionibus sacerdotum justis & rationabilibus
divini cultus amore favemus, & eas cum Dei adjutorio

Stenography among the French.—There are said to be still extant, in the characters of the Tironian system, an inventory and fifty-four charters of Louis the Pious, successor of Charlemagne, copies of which were republished at Paris in 1747. But, whatever use was made of stenography during the Middle Ages, few traces are found of it previous to the end of the eighteenth century. The first work of importance to herald the revival of the art was an adaptation of Taylor's (English) system (1792) by Theodore Pierre Bertin. The system of Fayet, *Nouvelle Écriture et Sténographie* (1832), is said to be the most meritorious and popular now in use in France.

Stenography among the Germans.—The credit of the first introduction of short-hand into Germany (1666) is given to one Marshof. His system was rapidly followed by others. The systems at present generally in use are those of Gabelsberger and Stolze, which have the merit of preserving to a great degree the lineality of the writing and of avoiding sharp angles and the distinction between light and shaded characters.

Stenography in Great Britain.—Probably in no other nation have so many systems of short-hand been put forth as in England. The earliest of any prominence was that of Timothy Bright (London, 1588)—*Characterie, an Art of Short, Swift, and Secret Writing by Character.* Two years later appeared the system of Peter Bales, under the curious title, *The Writing Schoolmaster, in three parts.* The author says, "Brachygraphy, or the art of writing as fast as a man speaketh *treatably*, may seem difficult, but it is in effect very easy, containing a many commodities under a few principles: the shortness whereof is attained by memory, the swiftness by practice, the sweetness by industry." The more prominent of the succeeding systems have been those of Willis (1602–23), Rich (1654–69), Mason (1672–1707; republished with improvements by Gurney in 1763 and by Byrom in 1767), Taylor (1786), Lewis (1815), Harding (1823–28), and Pitman (1837), with many new editions to date. Pitman's system, by reason of its phonetic principle, its simplicity and legibility, and the copyright protection afforded it, soon outstripped all others in popular estimation, and is now practically the only system used in Great Britain, though Taylor's and Gurney's are still used by a few of the older writers.

Stenography in the U. S.—But few stenographic systems have ever received even temporary encouragement in the U. S.; and this is due to the striking superiority of such as have found favor, as well as to their comparative earliness in the field. The first system introduced here was that of Keyes A. Bayley (New York, 1831). This was followed by several American editions of Isaac Pitman's (English) system, by Andrews and Boyle, Booth, Paterson, and Benn Pitman (1847–54). Lindsey's tachygraphy (which is slow, and has the feature of writing in the vowels, and the merit of lineality) was introduced 1864–69. Graham's system was introduced in 1858, and rapidly found favor all over the country. Munson's system (introduced in 1866) is very similar to Graham's, both being founded on that of Isaac Pitman, and has received a considerable degree of support.

The more prominent systems at present in use in Germany, France, Great Britain, and the U. S. have proved equal, in the hands of experts, to the task of keeping pace with the most fervid oratory; but it must be acknowledged that the requirements of the art are so arduous that only those who have devoted years to the practice, and are, withal, specially adapted for the work, can ever hope to make themselves equal to the highest exactions of the reportorial profession. It is to be hoped, and not without confident expectation, that the vast strides in the perfection of the art will speedily be duplicated, and the possibilities of verbatim reporting be made to approximate at least the common orthography in its universal availability. But whether this is to be done by the invention of new stenographic material, by new uses of old material, or by discarding the pen and pencil and introducing *writing-machines*, or machines for recording vocal sound, remains yet to be seen.

The reliability of the art once established, it rapidly grew into favor, and is now very extensively employed in correspondence and in facilitating the composition of authors and editors. Thousands of short-hand amanuenses are now employed in the U. S. alone. In 1860 the legislature of the State of New York passed a law authorizing the employment of stenographers in the courts of New York county when the consent of counsel could be obtained. The innovation proved so beneficial that the law was soon made applicable to the entire State and the official stenographer constituted an officer of the court. California made a similar provision in 1860, Maine in 1867, and other States, East and West, in rapid succession. The proceedings of Parliament were first reported (surreptitiously) by the aid of stenography nearly two centuries ago. This, like many another useful innovation, has had to fight its way against bitter and unreasonable

opposition. But now the legislative proceedings both in Great Britain and the U. S. are regularly reported with considerable liberty of a full and faithful portrayal. (See also PHONOGRAPHY and WRITING-MACHINES.)

JOHN FRANCIS MEYER.

Stenostom'idæ [from *Stenostoma*—στενός, "narrow," and στόμα, "mouth"—the typical genus], a family of reptiles of the order Ophidia and sub-order Scolecophidia, distinguished by the development of teeth only on the lower jaw, and hence named Catodontiens by Duméril and Bibron. The form is worm-like, being cylindrical and as large behind as before; the scales are smooth, and disposed in longitudinal rows alike all round; the head is short, with a high projecting rounded snout, and with a row of smaller median and larger lateral scales above a narrow rostral and broader lateral shields, and a row of enlarged upper labial plates; the eyes are very small; the nostrils between the postrostral and labial plates; the mouth a little cleft, and transversely arched; teeth only in the lower jaw; anus near the posterior end. The skull exhibits, in contrast with related families, distinctive characters in the want of ectopterygoid bones, the presence of prefrontal, the development of alveolar ridges and malar processes to the maxillary bones, and the existence of a pelvis with a pubis. The family is represented by small species in South America and Africa. (See SCOLECOPHIDIA and TYPLOPIDÆ.)

THEODORE GILL.

Stephan (HEINRICH), b. Jan. 7, 1831, at Stolp, Pomerania, the son of a mechanic; received a good education, and entered in 1848 the postal service, where he made a rapid and brilliant career by his great talents and unwearied industry; in the beginning of 1876 was made postmaster-general of the German empire. He is the reformer of postal affairs in Germany. Possessed of an extraordinary talent for organization, energetic and consistent, he negotiated the transfer of the post from the princely house of Thurn and Taxis to the North German confederacy Jan. 28, 1867, and brought uniformity and order into the postal department of the newly-created empire. In the postal systems of other countries he also introduced reforms through the numerous postal treaties which he concluded with foreign countries, and which exclusively aim at the facilitation of intercommunication and traffic. In spite of this almost overwhelming business, Stephan found time to acquire comprehensive linguistic knowledge, to study classical antiquities, philosophy, and political economy, and to develop his views by travel. He also wrote *Geschichte der preussischen Post* (1859) and a good book on Egypt, *Das heutige Ægypten* (1872).

Ste'phen, the name of three saints of the Roman Catholic Church: (1) STEPHEN THE DEACON, generally called the PROTOMARTYR, because he was the first of all Christian martyrs. His history, as given in chapters vi. and vii. of the Acts of the Apostles, is well known. His festival is held on Dec. 26, both in the Eastern and Western churches.—(2) STEPHEN THE POPE, whose reign (253–257) is most memorable for his controversy with Cyprian, which shows that at that time the bishop of Rome did not dream of exercising any supremacy in Christendom. His festival is celebrated Aug. 2.—(3) STEPHEN THE KING. (See HUNGARY, *History*.) In Hungary and Southern Germany he is a very popular saint, and a great number of churches are dedicated to him.

Stephen, the name of ten popes. There is, however, some confusion in the order of their succession, caused by the circumstance that Stephen II. died three days after his election, Mar. 27, 752, before he had been consecrated, for which reason he is not reckoned at all by some historians. The most remarkable of these popes is STEPHEN III. (752–757). After asking in vain for help against the Lombards from the Byzantine emperor, Constantine Copronymus, he went in person to Pepin le Bref, chief of the Franks, whom he crowned king on the condition that he should expel Astolphus, the Lombard king, from the exarchate of Ravenna and the Pentapolis and bestow these territories on the see of St. Peter. Pepin made two campaigns in Italy, but succeeded at last in forcing the Lombards to retreat from the above territories, which he then gave to the papal see, in spite of the protest of the Byzantine emperor, thereby laying the foundation of the temporal power of the pope.—STEPHEN VII. (896–897) is most noticeable for the curious but weighty argument against the infallibility of the pope which his reign presents. Belonging to another political party than his predecessor, Formosus, he had the corpse of the latter exhumed, stripped of the papal insignia, mutilated, and thrown into the Tiber, at the same time annulling all his ordinances, and even his consecrations.—STEPHEN VIII. (929–931) was simply the infamous tool of Theodora and Marozia.—STEPHEN X. (1057–58) was a son of Duke Gotelon of Lower Lorraine, and was elected pope through the influence of Cardinal Hildebrand, who was the real master of the Church.

Stephen, king of England, b. in Normandy about 1100, son of Stephen, count of Blois, by Adela, daughter of William the Conqueror. William, the only son of Henry I., was drowned in 1120, and the heir-presumptive to the crown was his daughter Matilda, who was married to Henry V., emperor of Germany; but before the death of her father the emperor died, and she married Geoffrey Plantagenet, earl of Anjou, without the royal sanction, which was held to invalidate her right to the succession. Upon the death of Henry I. (in 1135), Stephen claimed the succession, although he was not next in the line, even if Matilda was set aside, for he had an elder brother, Theobald, count of Blois; he was, however, chosen by a party of the prelates and nobles, and his election was sanctioned by the pope. The cause of Matilda was taken up by another party in England, headed by her natural brother, Robert, earl of Gloucester, and after a contest of several years Stephen was defeated and made prisoner at Lincoln Feb. 2, 1141. The rule of the empress was so unpopular that a revolt broke out, and her brother, the earl of Gloucester, was in turn defeated, and captured at the battle of Wilton, Sept., 1143, but was exchanged for Stephen. The civil war now raged with varying fortunes for ten years. In 1153, Prince Henry Plantagenet, son of Matilda, arrived in England at the head of a considerable force; but before a decisive action took place, the barons on both sides entered upon an armistice, and finally concluded an agreement by which Stephen should retain the crown during his life, and that after his death Henry should succeed him. Stephen survived this treaty only a few months, and with him ended the line of Anglo-Norman kings of England. D. Oct. 25, 1154.

Stephen (Sir GEORGE), b. in 1794; studied medicine with a view to an army appointment; afterward entered Magdalen College, Cambridge, but did not remain; entered the office of a London solicitor; was called to the bar, and practised many years as an attorney; was appointed by the government to collect evidence against Queen Caroline, and subsequently was active in the cause of police and parochial reform, for which he was knighted by Queen Victoria at her first levée in 1837. In 1849 he took up his residence in Liverpool, but in 1855 emigrated to Australia. He was an earnest advocate of the abolition of slavery in the British colonies, and published, among other works, *Adventures of a Gentleman in Search of a Horse* (1835), *Adventures of an Attorney in Search of Practice* (1839), *The Niger Trade and the African Blockade* (1849), *The Principles of Commercial Law* (1853), *Anti-Slavery Recollections*, in a series of letters to Mrs. Harriet Beecher Stowe (1854), and a *Life of Christ*, intended for the use of schools. He was a brother of Sir James Stephen. D. ———.

Stephen (HENRY JOHN), cousin of Sir James and Sir George, b. in England in 1787; was called to the bar at the Inner Temple 1815; became commissioner of bankruptcy; was a distinguished practitioner at the London bar, and became sergeant-at-law 1827. D. at Clifton Nov. 28, 1864. Author of a *Treatise on the Principles of Pleading in Civil Actions* (1824; 8th American ed. Philadelphia, 1859), of a *Summary of the Criminal Law in its Present State* (1834), and of *New Commentaries on the Laws of England* (London, 4 vols., 1841–45; New York, 1843–46). In the preparation of three subsequent editions of this great work the author enjoyed the assistance of his son, JAMES STEPHEN, LL.D., b. in England in 1820, who was called to the bar at the Middle Temple 1846; became professor of English law at King's College, London, recorder of Poole, registrar of bankruptcy at Leeds, and circuit judge at Lincoln. He issued two revised editions of his father's *Commentaries* (1863 and 1868), also *Questions* for both editions, and is author of treatises on *Bar Etiquette* (1851), *The Common-Law Procedure Act* (1860), and *A Digest of the Law of Evidence* (1876).

Stephen (JAMES), b. at Poole, Dorsetshire, Eng., in 1759; was educated at Winchester; became a barrister, and subsequently a parliamentary reporter; received an appointment in the prize court at the island of St. Christopher's, where he acquired an intimate knowledge of colonial law; returning to England with an ample fortune, he obtained a large practice as advocate in prize cases before the privy council; published a pamphlet, *War in Disguise, or the Frauds of Neutral Flags* (1806); was returned to Parliament for Tralee; appointed under-secretary for the colonies, and was made a master in chancery for his services in drawing up the system of continental blockade against Napoleon. He was connected by marriage with Wilberforce, sharing in his religious and anti-slavery principles. Besides a number of political essays, he published *History of Toussaint l'Ouverture* (1814) and *Slavery of the British West Indies* (2 vols., 1824–30). He was the father of Sir

James and Sir George Stephen. D. at Bath Oct. 10, 1832.

Stephen (Sir James), son of James Stephen, b. in London Jan. 3, 1789; graduated as bachelor of laws at Cambridge in 1812; practised as a barrister in chancery until 1823, when he became counsel to the colonial department, and afterward also to the board of trade; in 1834 was made under-secretary of state for the colonies, retiring from office in 1847, when he was knighted, and in 1849 became regius professor of modern history in the University of Cambridge. He was for many years a contributor to the *Edinburgh Review*, for which he furnished many brilliant articles, a portion of which have been collected under the title *Essays in Ecclesiastical Biography* (1849; 4th ed., with a biographical notice by his son, 1860). He published *Lectures on the History of France* (1851). D. at Coblentz Sept. 15, 1859.

Stephen (James Fitzjames), son of Sir J. Stephen, b. in Mar., 1829; was educated at Trinity College, Cambridge, where he took his degree in 1852; was called to the bar in 1854; became recorder of Newark-on-Trent, and in 1869 was appointed legal member of the council of the governor-general of India, remaining there until 1872, during which period he endeavored to consolidate and simplify Indian law. He has published *Essays by a Barrister* (1862), *General View of the Criminal Law of England* (1863), and *Liberty, Equality, and Fraternity* (1873).

Stephen (Leslie), nephew of Sir James, b. in England about 1835; graduated at Trinity College, Cambridge, where he became fellow and tutor; took orders in the Church of England; has contributed largely to the literature of Alpine travel; is editor of the *Cornhill Magazine*, and author, among other works, of *Hours in a Library* (2 vols., 1874–76), a collection of acute literary criticisms.

Stephen Bathori, descended from a celebrated Hungarian family; was woiwode of Transylvania when, on account of his marriage with Anna Jagellon, a daughter of Sigismund Augustus, he was elected king of Poland in 1575, after the flight of Henry of Anjou. He reigned until 1587, and was much loved by his subjects. Although a zealous Roman Catholic, he was tolerant and just. He put the Jesuits at the head of the new university which he founded at Wilna, and gave them many other preferments, but their exertions in order to induce him to put down by force the Reformation in Poland were in vain. In military respects he was successful, and humiliated the Russians several times. With his son, Gabor Bathori, who was woiwode of Transylvania 1608–13, but not king of Poland, the male line of the family became extinct.

Ste′phens, county of N. W. Texas, the name having been changed from Buchanan in 1862. The surface is diversified with hills and valleys, and is generally well watered. Stock-raising is the principal industry. Cap. Breckenridge. Area, about 900 sq. m. P. 330.

Stephens, or **Stephanus** [Fr. *Estienne* or *Étienne*], a family of French printers, several of whom were also noted as scholars. Henry Stephens, the founder of the house (b. about 1460; d. in 1520), established himself in 1502 as a printer in Paris, where his works became famous for the accuracy and beauty of their typography. He was aided, and afterward succeeded in business, by his three sons, the most distinguished of whom was Robert (b. 1503; d. Sept. 7, 1559), who was eminent as a scholar, and in 1531 began the publication of his great *Dictionarium, seu Thesaurus Linguæ Latinæ*, of which he put forth three editions, the last in 1545, and which has been several times republished. He also published editions of the Bible, with notes which were censured by the Sorbonne; but Stephens was protected by Francis I., who had made him royal printer. After the death of the king, the Sorbonne prohibited the sale of his Bibles, and he was obliged to take refuge in Geneva, where he died. He published nearly a dozen complete editions of the Bible in Hebrew, Greek, Latin, and French, and numerous separate editions of the New Testament in various languages, besides many other very important works. The present division of the New Testament into verses was made by him.—After he had taken refuge in Geneva, the business in Paris was conducted by his younger brother, Charles (b. 1504; d. 1564), who was appointed printer to Henry II., and put forth numerous classical and scientific works.—Henry, son of Robert (b. 1528; d. Mar., 1598), was especially eminent as a Greek scholar, and carried on his business at first in Paris, and afterward in Geneva. He ruined himself, financially, by the publication of his immense *Thesaurus Linguæ Græcæ* (1572, 5 vols. fol., reprinted with additions London (by Valpy) 1815–28, and again Paris (by Didot), 9 vols. fol., 1831–65), for at that time Greek students were too few in number to afford purchasers for an edition. He subsequently travelled from place to place, visiting all the principal libraries, for the purpose of collecting materials for various works, which he procured to be printed by others. Among these works is his *La Précellence du Langage françois* (1579).—Paul, the son of Henry (b. 1566; d. 1627), carried on for many years the printing-business at Geneva.—Anthony, the son of Paul (b. 1592; d. 1674), removed from Geneva to Paris, where for nearly half a century he conducted a printing-house, but with ultimate ill-success, and died at the Hôtel Dieu in Paris in utter destitution, and with him was extinguished the line of famous scholars and printers which had lasted almost two centuries and through five successive generations.

Stephens (Alexander Hamilton), LL.D., b. near Crawfordville, Ga., Feb. 11, 1812; was graduated at the University of Georgia in 1832; came to the bar in 1834; entered upon political life in 1836 as member for Taliaferro of the State house of representatives; was successively re-elected to the same office until 1840; declined an election in 1841; the next year was chosen State senator by the same constituency. The Western and Atlantic R. R., which links Atlanta with Chattanooga, owes its construction chiefly to him. In 1843 he was elected member of the House of Representatives of the U. S. That office he occupied for sixteen consecutive years, until 1859, when he voluntarily retired to private life. The Compromise measures passed by the Congress of 1850, which for a time gave peace to the sections, had no bolder, abler, or more eloquent champion than Mr. Stephens. He was chosen a delegate to the State convention of that year—the convention which established the celebrated "Georgia platform." In 1855 he united with the Democrats to defeat the Know-Nothing party. In the Presidential campaign of 1860 he was placed at the head of the Douglas-Johnson electoral ticket. He was a delegate to the State convention of 1861 which passed the ordinance of secession. That measure he earnestly opposed by speech and vote, but, whilst he advised against the *policy* of secession for existing grievances, he maintained the *right* of a State to peaceably secede from the Federal Union for sufficient cause. When a majority of the convention passed the ordinance of secession, he readily acquiesced in their decision. He was a member of the Confederate provisional congress; was chosen Vice-President of the provisional government of the Confederate States; was appointed commissioner to the convention between their government and the State of Virginia; was elected by the people, without opposition, to the Vice-Presidency of the Confederacy under the permanent constitution, as it was styled; and, when in Feb., 1865, the fortunes of the Confederacy were desperate beyond the reach of hope, he was placed at the head of the commission on the part of the Confederate States government in the famous Hampton Roads conference. After the collapse of the Confederacy, he was arrested and confined a prisoner of state in Fort Warren for five months; he was released on his own parole in Oct., 1865. In Feb., 1866, the general assembly elected him, by a large majority, against his wishes, freely expressed, to the office of U. S. Senator, but Congress ignored the restoration of Georgia to the Union under the Presidential proclamation of Andrew Johnson; so Mr. Stephens was not allowed to take his seat in the Senate. He was elected a member of the 43d Congress, and also of the 44th, in each case without more than nominal opposition. Mr. Stephens belongs to what is known as the Jeffersonian school of American politics, and of course among the cardinal articles of his political creed are State rights, State sovereignty, local self-government: he has always advocated the largest liberty of the citizen compatible with the attainment of the two prime objects of government—viz. protection to property and preservation of order. He is the author of a *Constitutional View of the War between the States* and of a *Compendium of the History of the United States*.

J. D. Waddell.

Stephens (Ann Sophia **Winterbotham**), b. at Derby, Conn., in 1813; in 1831 became the wife of Mr. Edward Stephens; soon after, they went to Portland, Me., where in 1835–37 she edited the *Portland Magazine*, and in 1836 compiled the *Portland Sketch-Book*, a volume composed of the writings of natives or residents of that city. In 1837 they removed to New York, her husband subsequently receiving an appointment in the custom-house. She has edited and contributed to various periodicals, and has written many tales and novels, and some fugitive poems. A uniform edition of her works, now numbering about 20 vols., has been issued. Among her most successful novels are—*Fashion and Famine* (1854), *The Old Homestead* (1855), *Mary Derwent* (1860), *The Rejected Wife* (1863), *Silent Struggles* (1865), *Mabel's Mistake* (1868), *Wives and Widows* (1869), *Married in Haste* (1870), *The Reigning Belle* (1872), *Bellehood and Bondage* (1873), and *Phemie's Experience* (1874).

Stephens (Edward Bell), b. at Dublin, Ireland, in 1797; was for some years assistant professor of chemistry at Dublin; afterward devoted himself to literature at London, writing for several magazines, and was one of the earliest of the "special correspondents," having spent several years in Spain in the service of the *Times* newspaper during and after the Carlist war. D. at Madrid Oct. 10, 1844. Author of a work on *The Basque Provinces* (2 vols., 1837).

Stephens (Edward Bowring), b. at Exeter, England, about 1810; studied sculpture under E. H. Baily; gained in 1843 the gold medal of the Royal Academy for an alto-rilievo of *The Battle of the Centaurs and Lapithæ*; spent three years at Rome, where he produced *Satan tempting Eve* and *Satan vanquished*, both of which figured in the great London Exhibition of 1851; and executed, among other admired works, *Eve contemplating Death* (1853), *Euphrosyne and Cupid* (1856), *The Angel of the Resurrection* (1861), and a colossal portrait-statue of Sir Thomas D. Acland (1862). D. May 2, 1857.

Stephens (Henry), b. at Keerpoy, Bengal, British India, in 1795; studied agriculture at the University of Edinburgh, and in 1815 commenced practical farming, undertaking researches which were published in his standard works, *The Book of the Farm* (3 vols., 1842–44), *Manual of Practical Draining* (1846), *Catechism of Practical Agriculture* (1855), and *Book of Farm-Buildings* (1861). He was editor of the Scottish *Journal of Agriculture* 1832–54, and was awarded at the great Exposition of Paris 1855 a gold medal for his very useful writings.

Stephens (James Francis), b. at Shoreham, Sussex, England, Sept. 16, 1792; was for many years a clerk in the admiralty office; president of the British Entomological Society, and an enthusiastic writer and collector upon his favorite branch of natural history. His collection of British insects was by far the most complete in existence. D. at Kennington, near London, Dec. 22, 1853. Author of *Illustrations of British Entomology, or a Synopsis of British Insects* (London, 86 parts, 12 vols., 1828–46), *A Systematic Catalogue of British Insects* (1829), *Nomenclature of British Insects* (1829), *Manual of British Coleoptera* (1839), of various *Catalogues of British Lepidoptera in the British Museum*, and contributed largely to periodicals devoted to natural history.

Stephens (John Lloyd), b. at Shrewsbury, N. J., Nov. 28, 1805; graduated at Columbia College 1822; studied law at Judge Gould's law-school at Litchfield, Conn.; practised his profession eight years in New York City; made a tour through Italy, Greece, Turkey, Russia, Poland, and Germany, and a second tour to Egypt and Palestine; contributed to Hoffman's *American Monthly Magazine* a series of letters describing his travels, which were so well received as to induce the publication of fuller narratives in his *Incidents of Travel in Egypt, Arabia Petræa, and the Holy Land* (New York, 2 vols., 1837) and *Incidents of Travel in Greece, Turkey, Russia, and Poland* (2 vols., 1838); was appointed in 1839 by Pres. Van Buren a special commissioner to Central America for the purpose of negotiating a treaty with that republic, which he found distracted by the civil war which soon put an end to the confederation, and was unable to effect his object; proceeded to Costa Rica; journeyed northward by land through Nicaragua, Honduras, and San Salvador to Guatemala, visiting all the principal cities, and giving special attention to the wonderful remains of ancient cities, especially those of Copan, of which accurate daguerreotypes and drawings were made by his companion, Mr. F. Catherwood; proceeded through Northern Guatemala to Chiapas, Tabasco, and Yucatan, examining the vast ruins of Palenque, Uxmal, and other ancient cities, which he was the first to make known with any approach to accuracy by his celebrated work, *Incidents of Travel in Central America, Chiapas, and Yucatan* (New York, 2 vols., 1841); returned to Yucatan, and in 1841, with Mr. Catherwood, equipped for a more careful archæological survey, the important results of which were embodied in his *Incidents of Travel in Yucatan* (2 vols., 1843). In 1846, Mr. Stephens was a delegate to the convention for revising the constitution of New York; became in 1847 an active organizer and officer of the first Ocean Steam Navigation Co.; made the voyage to Bremen in the first steamship (the Washington) of the new line; took part in the enterprise projected after the discovery of gold in California for the construction of a railroad across the Isthmus of Panama, becoming successively vice-president and president of the company; travelled over the isthmus inspecting the route; visited Bogotá, and negotiated with the government of New Granada the contract for that work 1849, and personally superintended its construction during two successive winters, 1850–52, thereby contracting the disease of which he d. in New York Oct. 10, 1852. A monument has been placed at the highest point traversed by the Panama R. R. to his memory.

Stephens (Linton), b. near Crawfordville, Ga., July 1, 1823, a brother of A. H. Stephens; was graduated at the State University 1843; his professional studies in the law were prosecuted at the universities of Virginia and Harvard. He represented for a series of years the counties of Taliaferro and Hancock in the house of representatives or in the senate of Georgia. At the age of thirty-five he was appointed by the governor of the State to fill a vacancy on the supreme court bench. His decisions, running through three volumes of the *Georgia Reports*, are distinguished for precision, perspicuity, and power of logic. He was a delegate to the convention of 1861 which passed the ordinance of secession. He voted against that measure, but when it was carried by a decided majority, he elected to share the fortunes of the people of Georgia. At the time of his death (July, 14, 1872) he stood at the head of the Georgia bar. J. D. Waddell.

Stephens (William), b. on the Isle of Wight, England, Jan. 28, 1671, son of Sir William, lieutenant-governor of that island; graduated at King's College, Cambridge; studied law at the Middle Temple; sat in Parliament 1696–1722; settled at Charleston, S. C., about 1730; was appointed secretary of the colony of Georgia 1737; became "president" of the county of Savannah 1741, and governor of Georgia 1743–50. D. in Georgia in Aug., 1753. Author of *A Journal of the Proceedings in Georgia* (London, 3 vols., 1742). His biography was written by a son under the title of *The Castle-Builder, or the History of William Stephens of the Isle of Wight* (London, 1759).

Ste'phenson, county of N. W. Illinois, bordering on Wisconsin, watered by Pecatonica River, and intersected by several railroads. It has an undulating surface and fertile soil. Cattle, horses, sheep, and swine are raised, and carriages, saddlery, woollen goods, and iron castings manufactured. Staples, Indian corn, wheat, oats, barley, potatoes, and dairy products. Cap. Freeport. Area, 550 sq. m. P. 30,608.

Stephenson (George), b. at Wylam, Northumberland, England, June 19, 1781, the son of a poor colliery laborer. He was in childhood an engine-boy; was gradually promoted to be a fireman, and in time was placed in charge of an engine, which he studied until he had mastered its construction so as to be able to take it apart and put it together again. He married at the age of eighteen, and was taught to read by his wife. He had a great aptitude for mechanics; mended shoes, cut out garments, and repaired clocks at odd hours. Accident gave him an opportunity of putting in motion a steam-engine which had been disabled, and in 1812 he was made engine-wright at Killingworth Colliery, with a salary of £100 a year, upon which he declared that his fortune was made. The problem of constructing a locomotive steam-engine was then engaging many minds, and he was in 1814 the first to construct one which would move upon a common road. While engaged in devising improvements upon this, he observed the increased draught in the furnace produced by letting the waste steam escape up the chimney; hence originated the steam-blast, which was introduced into his second locomotive, built in 1815, in which year he devised a miner's safety-lamp, for which a large prize had been offered by colliery-owners; but Sir Humphry Davy having simultaneously invented his safety-lamp, this prize, valued at £2000, was awarded to him, £100 being awarded to Stephenson by the committee; a separate subscription of £1000 was raised in 1817, which was presented to Stephenson, and his lamp is still in use in some English collieries. Stephenson now turned his attention to improvements in railways as well as engines. The first railway built by him, opened in 1822, 8 miles long, was so successful that in the next year he was appointed engineer of the railway recently authorized to be constructed between Stockton and Darlington, and in 1825 of the Liverpool and Manchester line, which was commenced in 1826. He had in the mean time set up an establishment at Newcastle-upon-Tyne for the manufacture of locomotives. At this time the best engineers held that the use of locomotives was practically impossible, and that safety and speed could be attained only by stationary engines placed at short intervals along the line. Stephenson persuaded the directors of the railway company to offer a reward of £500 for the best locomotive which should be adapted for their use, and set himself at work, with the aid of his son, to devise such a one. The public trial took place Oct. 6, 1829, and the prize was adjudged to have been gained by his engine, the Rocket (see Railroad), which attained an average speed of 14 miles an hour, and for a short distance was driven at the rate of 29 miles. For the next fifteen years he was actively engaged

as a railway engineer and contractor in England and on the Continent, still carrying on his great locomotive-factory at Newcastle, and also engaging largely and profitably in coal-mining and limeworks. He passed the closing years of his life at his magnificent seat of Tapton Park in Derbyshire. D. Aug. 12, 1848, leaving behind him a memory in every respect noble. He retained during all his life, in speech and manners, much of the rustic simplicity belonging to his early life, and declined the honor of knighthood, which was urged upon his acceptance; but by common consent he has received the title of "the father of railways," and in 1862 a colossal bronze statue was erected in honor of him at Newcastle-upon-Tyne. (See Smiles, *Life of George Stephenson* (1857; enlarged in 1864, and again in 1868).)

Stephenson (Robert), son of the preceding, b. at Willington, near Newcastle-upon-Tyne, Oct. 16, 1803. His early years were marked by few advantages, but as his father's circumstances improved he gave his son the best education within his means, and in 1822 sent him to the University of Edinburgh, where he remained a year studying chemistry, mathematics, and geology, after which, for another year, he assisted his father in railway surveying and in the locomotive-works at Newcastle. In 1824 he accepted an engagement to go to South America, where for three years he superintended the working of the Colombian Mining Association. He then returned to England, where he aided his father, partly in laying down the line of the Liverpool and Manchester Railway, but more especially in the locomotive-works; and to him more particularly than even to George Stephenson belongs the honor of the practical development of the locomotive railway-engine. He was appointed engineer of the London and Birmingham Railway, which, built wholly under his direction, was opened in 1838, and from this time he was employed in similar undertakings at home and abroad. His attention was in the end turned especially to the subject of iron bridges for railways, and of these he constructed several of the most stupendous in the world, notable among which are the high-level bridge crossing the Tyne at Newcastle, the viaduct over the valley of the Tweed at Berwick, the Conway tubular bridge, the Britannia tubular bridge crossing the Menai Straits, the Victoria tubular bridge over the St. Lawrence in Canada, and those crossing the Nile at Benah and Kaffre Azzayat in Egypt. In 1847 he was returned to Parliament for Whitby, retaining his seat until his death. He was a prominent member of several scientific associations, received the great gold medal of honor from the French Industrial Exposition of 1855, and was president of the Institute of Civil Engineers from 1855 to 1858. He published a *Description of the Locomotive Steam-Engine* (1838), *Report on the Atmospheric Railway System* (1844), and *The Great Exhibition, its Palace and Contents* (1851). D. Oct. 12, 1859. He was buried in Westminster Abbey, where a memorial window of stained glass has been placed to his memory. (See Smiles's *Life of George Stephenson* (enlarged editions of 1864 and 1868), and *Life of Robert Stephenson*, by J. C. Jeaffreson and W. Pole (1864).)

Ste'phensport, p.-v., Breckenridge co., Ky., on Ohio River. P. 160.

Ste'phensville, p.-v., cap. of Erath co., Tex., on Bosque River. P. 162.

Ste'phentown, p.-v. and tp., Rensselaer co., N. Y., on Harlem Extension R. R. P. 2133.

Step'ney, p.-v., Monroe tp., Fairfield co., Conn., on Housatonic R. R.

Steppe, the name given by the Tartars to the plains of Central Asia. They are usually covered with grass, and correspond in their aspects and relations to the prairies of the U. S. and the llanos and pampas of South America. (See Prairie.) J. S. Newberry.

Steppe Murrain. See Rinderpest.

Step'toe (Edward Jenner), b. in Virginia in 1816; graduated at West Point 1837; was distinguished in the Florida war 1838–42; was assistant instructor of infantry tactics at West Point 1842–43; commanded a battery of light artillery in the Valley of Mexico 1847; was brevetted for gallantry at Cerro Gordo and at Chapultepec; declined the governorship of Utah Territory 1854; became major of the 9th Infantry 1855; was in command of an expedition against the Indians of Washington Territory Apr., 1856; was made lieutenant-colonel of 10th Infantry 1856, and resigned Nov. 1, 1861. D. near Lynchburg, Va., Apr. 1, 1865.

Sterculia'ceæ [from *Sterculia*, one of the genera], a natural order of exogenous trees, shrubs, and herbs, mostly tropical. Many of the trees are of prodigious size, such as the baobabs, and those of the genera *Bombax* and *Ceiba*. Many of them produce abundantly a substance called silk-cotton, which resembles true cotton, but will not spin well. The wood is often very light and soft. The order contains medicinal plants, and produces some excellent fruits, some gums, a few valuable bark-fibres, and a number of useful timber-trees. But its most important product is chocolate, from the oily seeds of *Theobroma cacao*. It is usual to divide the order into three sub-orders—Bombaceæ, Helictereæ, and Sterculieæ—but some make six or more sub-orders, and assign Bombaceæ to Malvaceæ.

Stere. See Weights and Measures, by Pres. F. A. P. Barnard.

Sterelmin'tha [Gr. στερεός, "solid," and ἕλμινς, "worm"], a name applied by Prof. Owen to those intestinal worms which are destitute of an intestinal cavity, the "Vers Intestinaux Parenchymateux" of Cuvier. The group so named was regarded as a "class" of Entozoa, and characterized by "the nutrient canals or cavities excavated in the parenchyma of the body;" and to it were referred the "orders" Tænioidea, Trematoda (containing the turbellarians as well as true trematods), and Acanthocephala. The class is an artificial one, not adopted by modern naturalists. (See Tænioidea, Trematoda, and Turbellaria.) Theodore Gill.

Ste'reoscope [Gr. στερεός, "solid," and σκοπεῖν, to "view"], a modern optical instrument by means of which two plane representations of a natural object, taken from different points of view, may be so united as to form a single impression of the object in relief. Binocular vision, or the dissimilarity of the two pictures as seen by each eye separately, has been known for more than 2000 years. Euclid (300 or more B. C.), Galen (131 A. D.), Leonardo da Vinci (1584), Baptista Porta (1593), Aguilonius (1613), Gassendi (1658), Harris, Smith, Porterfield, and others of later date have either distinctly alluded to or fully described the phenomenon. In 1823 the attention of Mr. Elliot was called to the subject of binocular vision in connection with the estimation, by the eye, of distance. About 1834 he conceived the idea of constructing an instrument which, by combining two dissimilar plane representations of an object, would produce the effect of relief. This idea he did not carry into execution till 1839. In the mean time, Wheatstone made a communication to the British Association in 1838, on the physiology of vision, and exhibited a reflecting stereoscope of his own construction. The difficulty of procuring pictures which should differ from each other only as the two impressions upon the eyes of a single spectator differ, proved almost insuperable before the discovery and application to stereoscopic purposes of photography. In monocular vision, or vision with one eye, the effect of relief is produced, as in the most perfect plane pictures, by shadow and the delicate gradation of tints. In binocular vision the effect is produced by the superposition of the image formed by an object on one retina upon that formed on the other. In viewing solid objects each eye sees an image slightly differing from that seen by the other. A thin book held edgewise eight or ten inches in front of the nose will look differently to the two eyes of a spectator; the right eye will see the back and part of the right cover, while the left eye will see the back and part of the left cover. Both eyes at once will see the back and a portion of both covers; seeing at the same time somewhat round the sides, the object is manifestly solid. The binocular camera takes two such impressions as would simultaneously form themselves upon the two eyes of a spectator. These two images are then united either by a muscular effort of the eye itself or by means of reflectors or refractors, and a single image, standing out in relief, is the result. The earliest form of stereoscope, Wheatstone's reflecting stereoscope, is cumbrous and expensive; many other forms have since been used, but all are constructed upon the same principle. The two impressions are displaced by means of mirrors, lenses, prisms, or the muscular effort of the eyes themselves, so that the one is superimposed upon the other. It is found that a single lens cut into halves or quarters is better than two whole lenses, the curvature being more accurately alike, and only the inner half of the lens being essential to the proper displacement of the pictures. The stereoscopic effect of relief, however, is not produced by the superposition of the two pictures merely; for if the two are united in the most perfect way by means of a camera, the resultant picture is, to monocular vision, blurred and imperfect. This same picture, however, when viewed binocularly, is seen distinct and in perfect relief. Distance is estimated principally by the convergence of the optic axes of both eyes upon an object. The eyes look upon a solid by converging upon some one point their optic axes, and estimating the distance of that point by the angle of convergence; this point is perfectly distinct, though the remainder of the solid is indistinct. Running quickly from point to point over the surface of the solid, each point has its distance from the eyes separately estimated, and the object is seen

in relief. It is the same in the case of stereoscopic vision; the two pictures superimposed differ from each other, but at a certain focal distance all corresponding points in the two are made to unite. The distance of the point of union is estimated by the eye, and so in turn each point has its distance from the spectator estimated, and the stereoscopic image stands out in as clear relief as the solid from which the two impressions were derived. The constant change in the muscles of the eye to effect the union of the two impressions is difficult to some people, or even impossible; in some cases the two eyes of the spectator have different focal distances, or other discrepancies of vision, which make it difficult to see stereoscopic images in relief and single.

The earliest refracting stereoscope was made by Andrew Ross for Sir David Brewster, and was exhibited at Birmingham in 1849, but no attention was given to it by the English opticians. In 1850 the inventor carried it to France, and submitted the instrument to the Abbé Moigno, and to M. Soleil and M. Duboscq, the eminent Parisian opticians. M. Duboscq began at once constructing lenticular stereoscopes, and executed many beautiful slides, which soon attracted thousands of spectators. In the great Exhibition of 1851, M. Duboscq exhibited a fine stereoscope, which for the first time attracted attention in England. The demand soon became immense, and opticians of all kinds devoted themselves to their construction. A long, bitter, and fruitless controversy arose between Sir David Brewster on his own behalf and that of Elliot, and Wheatstone on his own behalf, in regard to the priority of the invention of lenticular stereoscopes.

The lenticular stereoscope, which is the most common form, generally consists of a pyramidal wooden box, blackened on the inside and having a lid to admit the light from above if the pictures are opaque. The bottom of the box is made of fine ground glass for transparent pictures; in the top of the box are fitted two lenses (or half or quarter lenses, as the case may be). The bottom, holding the "slide," and the top, with the lenses, may be made to approach or recede from each other to suit different eyes. Among the various forms of the instrument may be mentioned the reflecting stereoscope of Wheatstone; the single reflecting stereoscope, where the direct impression from the picture on one eye is superimposed upon a reflected impression upon the other eye; the double reflecting stereoscope, where both impressions are reflected; the total reflection stereoscope, where a single prism is used, and one image is refracted, totally reflected, and refracted again, while the other impression is direct. Of refracting stereoscopes there are, among others, the single prism, the opera-glass, the eye-glass, the reading-glass, the camera, the chromatic, and the microscope stereoscopes. Among the best is Smith & Beck's achromatic stereoscope. S. B. Herrick.

Stereotyping. See Printing, by W. S. Paterson.

Sterility. See Appendix.

Ster'let (*Acipenser ruthenus*), a small species of sturgeon found in various Russian rivers and the Caspian and Black seas, into which they empty, and esteemed for its flesh. It is characterized by a narrow, pointed snout, which is more or less produced (being half the length of the head or thereabouts), and the slightly fringed barbels; the dorsal shields, 11 to 17, are moderately developed, the lateral ones, 60 to 70, small, and the abdominal, 13 to 15, moderate; the skin is densely covered with minute denticulated ossifications of subequal size. It rarely or never attains a length of three feet, and a common size is two feet in length and three pounds in weight. It leaves the sea in May and June, and ascends the rivers, sometimes very high up, for the purpose of spawning. It has not only a superior reputation as a table-fish, but from its roes is made the best caviare, which constitutes a noteworthy article of trade in Russia. Its introduction into rivers of the U. S. has been strongly recommended, and it has been claimed that the Mississippi and Ohio rivers would be especially suitable for it. The Russian government has introduced it into waters about St. Petersburg, and "in 1870 a considerable number of the young fry were transported from Russia and introduced into the waters of Sutherlandshire, Scotland, in apparently good condition." Their embryonic life is so short that it is difficult to transport the eggs with success, but such was done in the case just cited. Specimens obtained for the Brighton aquarium were imported in the wells of a fishing boat from the Volga River to St. Petersburg, and thence by steamer to London. Theodore Gill.

Sterling. See Pound Sterling.

Ster'ling, p.-v. and tp., Windham co., Conn. P. 1022.

Sterling, city and tp., Whiteside co., Ill., on Chicago and North-western and Rockford Rock Island and St. Louis R. Rs., 110 miles W. of Chicago, has 12 churches, 2 academies, and 3 high schools, 2 banks, fine water-power, manufactories of school furniture, flour, and wood and iron work. P. of v. 3998; of tp., exclusive of city, 712. W. F. Eastman, Ed. "Gazette."

Sterling, tp., Crawford co., Ind. P. 1327.

Sterling, p.-v. and tp., Worcester co., Mass., on Fitchburg and Worcester division of Boston Clinton and Fitchburg and on Worcester and Nashua R. Rs., has flourishing manufactures, beautiful scenery, a celebrated camp-meeting ground, 12 public schools, a good town-hall and library, and 3 churches. P. 1670.

Sterling, tp., Macomb co., Mich. P. 1549.

Sterling, tp., Blue Earth co., Minn. P. 661.

Sterling, p.-v. and tp., Johnson co., Neb. P. 480.

Sterling, p.-v. and tp., Cayuga co., N. Y., on Lake Ontario and on Lake Ontario division of Rome Watertown and Ogdensburg R. R., includes the v. of Fairhaven, the N. terminus of Southern Central R. R. P. of v. 237; of tp. 2840.

Sterling, tp., Brown co., O. P. 1394.

Sterling, p.-v. and tp., Wayne co., Pa., on Delaware Lackawanna and Western R. R. P. 1454.

Sterling, tp., Polk co., Wis. P. 250.

Sterling, tp., Vernon co., Wis. P. 1060.

Sterling (John), b. at Kames Castle, Isle of Bute, July 20, 1806, son of Edward Sterling, editor of the London *Times;* was educated at Glasgow and Cambridge; went to London in 1827; was a short time on the editorial staff of the *Athenæum*, and during a part of 1830–31 resided for his health in the West Indies. Returning to England, he took deacons' orders in 1834; was for a short time a curate, but soon gave himself wholly to literary studies and pursuits. Among his works are—*Arthur Coningsby*, a novel (1833), *The Onyx Ring* (originally in *Blackwood's Magazine;* republished 1856), *Minor Poems* (1839), *The Election*, a poem (1841), and *Strafford*, a drama (1843). Two volumes of his *Essays and Tales* were edited, with a *Memoir*, by Julius C. Hare (1848), and Thomas Carlyle has written *The Life of John Sterling* (1851). D. at Ventnor, Isle of Wight, Sept. 18, 1844.

Sterling Run, p.-v., Lumber tp., Cameron co., Pa., on Sinnemahoning River, and on Philadelphia and Erie division of Pennsylvania R. R.

Sterling's Mills, p.-v. and tp., Robeson co., N. C. P. 1088.

Sterling Valley, p.-v., Sterling tp., Cayuga co., N. Y. P. 172.

Stern'berg, town of Austria, province of Moravia, has important manufactures of linen and cotton fabrics, which are widely known under the name of "Sternberg wares." P. 13,500.

Sterne (Laurence), b. at Clonmel, Ireland, Nov. 24, 1713, son of a lieutenant in the British army; was educated at Jesus College, Cambridge, where he graduated in 1740; entered into holy orders, and was presented by his uncle with the valuable benefice of Sutton, Yorkshire, to which that of Stillington, 1½ miles distant, was soon after added. Here he lived for nearly twenty years. In 1759 he published the first two volumes of *Tristram Shandy*, which became popular at once, and gained for him from Lord Falconbridge the additional curacy of Cotswold. He had been married nearly twenty years, and now, leaving his wife and daughter at York, he went to London, where or upon the Continent most of the remainder of his life was spent. He published several occasional sermons, and at intervals 7 volumes entitled *The Sermons of Mr. Yorick, or Sermons by Laurence Sterne, A. M., Prebendary of York*, etc. (1760–69). His *Life and Opinions of Tristram Shandy, Gent.*, in all 9 vols., was published at intervals (1759–67). The *Sentimental Journey*, his best work, was written in France, from which, late in 1767, he returned to London to see it through the press. D. in London Mar. 18, 1768. The latest *Life of Sterne* is by Percy Fitzgerald (London, 1864).

Stern'hold (Thomas), b. probably in Hampshire about 1500; was educated at Oxford, and became groom of the chambers to Henry VIII. and Edward VI.; with John Hopkins was joint author of the first version of the Psalms into English metre. His 1st edition appeared in 1548, and contained 19 Psalms; the 2d, *All such Psalmes of David as Thomas Sternehold, late Groome of yͤ Kinges Maiesties Robes, didde in his Lifetime draw into English Metre* (1549), contained 37 Psalms translated by Sternhold and 7 by Hopkins. Other editions followed until 1562, when *The Whole Booke of Psalms collected into English Metre by T. Sternhold, J. Hopkins, and others, conferred with the Ebrue, with apt Notes to Sing them withal*, was annexed to the Book of Common Prayer. Of the entire number of

Psalms, 51 were versified by Sternhold. D. in Aug., 1549.

Stern'inæ [from *Sterna*, the Latin generic name of the typical genus, and the sub-family suffix, *-inæ*], a sub-family of the family Laridæ, distinguished by the straight bill with equal projecting mandibles, which are always compressed, and attenuated to the pointed tips; the base is destitute of a cere. The species are among the most common and familiar birds of the sea-coast. Several resort especially to the low sandy islands of the coast of the U. S., where they are sometimes to be seen in immense numbers, and where they breed. They lay from two to four eggs, generally in slight depressions in the sand, and sit on them chiefly in the night and cold weather, leaving, to a considerable extent, to the sun the office of calorification. The young are, however, tenderly cared for by the mother. They feed chiefly on fish, but also on other marine animals. Species are found in all parts of the world, and 72 are recognized by Mr. G. R. Gray, who admits only four genera: (1) *Sterna*, with 50; (2) *Hydrochelidon*, with 14; (3) *Gygis*, with 1; and (4) *Anous*, with 7 species. THEODORE GILL.

Sternoptych'idæ [from *Sternoptyx*—Gr. στέρνον, the "breast," and πτύξ, "fold"—the chief genus], a family of fishes of the order Teleocephali and sub-order Isospondyli, all containing some quite peculiar forms. The body is compressed; the skin naked, but with rows of phosphorescent spots on the sides below; the lateral line is indistinct; the head compressed; the opercular apparatus incompletely developed; mouth with moderately deep lateral cleft; upper jaw with its margin formed above by the intermaxillary, and laterally in part by the supramaxillary, bones; teeth on the intermaxillary as well as supramaxillary and dentary bones, and sometimes on the palate; branchial apertures continuous below, and very wide; branchiostegal rays 8 to 10; back with a short submedian rayed fin and a posterior small adipose fin; anal fin variable in development; pectoral fins moderately low on the scapular arch; ventral fins moderately far behind; the ovaries communicate by oviducts externally, and consequently the eggs are expelled directly into the water; pseudobranchiæ are present. The family thus defined is identical with that so named by Günther (*Cat. Fishes B. M.*, vol. v., p. 384) after the exclusion of the Chauliodontidæ. It includes fishes which are mostly inhabitants of the open or deep seas, and of small size. It is differentiated into two sub-families—viz. (1) Sternoptychinæ, distinguished by a rudimentary spinous dorsal fin, with the genera *Sternoptyx* and *Argyropelecus*; and (2) Cocciinæ, characterized by the absence of the spinous dorsal fin, with the genera *Coccia* and *Maurolicus*. It is doubtful, however, whether these are really so closely related. A species of *Maurolicus* (*M. borealis*) sometimes wanders to the northern coast of the U. S. THEODORE GILL.

Sternopyg'idæ [from *Sternopygus*—Gr. στέρνον, the "breast," and πυγή, the "rump"—one of the chief genera], a family of fishes of the order Gymnonoti, peculiar to South America, and embracing species nearly related to the electrical eel. The body is much elongated and somewhat eel-shaped, but with the back rounded and the sides compressed downward; the anus is situated in the breast or between the rami of the lower jaw; cycloid scales are developed; the head is conic, more or less produced forward, and naked; the opercular apparatus incomplete; the mouth terminal, and generally very small; the upper jaw not protractile, and with its margin formed above by the intermaxillaries, and laterally by the supramaxillaries; teeth variable in development; branchial apertures restricted to the sides; branchiostegal rays 4 or 5; dorsal fin entirely absent, or at most represented by a rayless band in a longitudinal groove, which readily becomes detached except anteriorly, and then appears as a whip-like appendage; anal fin very much elongated, and extending from behind the anus to the posterior end of the body; caudal absent or small; pectoral fins normally developed; ventrals none; the ovaries have oviducts, and hence the eggs are expelled from them directly into the water; the stomach is a cæcal sac, and pyloric appendages are developed; the air-bladder is quite peculiar in its development, and is connected with the ossicles of the organ of hearing. The family is especially distinguished from all except the electrical eel (Electrophoridæ) of South America, and the Amblyopsidæ and Aphredoderidæ of North America, by the advanced position of the anus; and even in this respect the species *Sternarchorhynchus* and *Rhamphichthys* are exceptional, inasmuch as in them the anus is even considerably in advance of the eyes, and close behind the symphysis of the lower jaw. In most respects the species are related to the electrical eel, but distinguished by the development of the mesocoracoid bones and other anatomical characters, as well as the presence of scales and the want of the electrical apparatus. Many species dwell in the fresh-water streams and lakes of South America, and represent as many as six genera. (See Günther's *Catalogue of Fishes*, vol. viii. pp. 1–9.) THEODORE GILL.

Sternothær'idæ [from *Sternothærus*, the typical genus], a family of turtles (order Testudinata) of the group Pleurodires, peculiar to Africa and the neighboring islands. The head is depressed and covered with symmetrical horny plates, and the temporal muscles with hard dermal shields; the zygomatic arch is moderately developed; the beak is naked; the lower jaw strong; the alveolar surfaces of the jaws thin, and with thin submarginal ridges; the shell is oval and depressed; "the hyosternal bones are divided transversely, giving ten bones to the plastron instead of eight;" the feet have each three series of phalanges (*Cope*) and five claws. The family is distinguished from the Pelomedusidæ by Prof. Cope on account of the number of bones in the plastron and the number of rows of phalanges in the feet. The living species are confined to Africa and the island of Madagascar; five are recognized by J. E. Gray. They are very aquatic in their habits, and rarely leave the water. THEODORE GILL.

Ster'num [Gr. στέρνον], or **Breast-Bone**, a bony or semi-cartilaginous plate which serves as the anterior (or inferior) point of union of many of the ribs. It represents the blended hæmal spines of the dorsal vertebræ. In fishes, batrachians, and serpents it is absent. In tortoises it becomes the lower shell or plastron, and is much widened. In most birds it is strongly keeled in front, the keel serving as a point of attachment for the strong wing-muscles. In man it consists of three pieces, of which the uppermost is the *manubrium*; the next, the *gladiolus*; and the lowest, the ensiform or xiphoid cartilage.

Sternutation. See SNEEZING.

Stesich'orus, b. at Himera in Sicily 632 B. C.; attained a great reputation as a lyrical poet. D. 560 or 552 B. C. His true name was TISIAS, but he was called Stesichorus ("arranger of choruses") from the artistic form of his poems, which consisted of choral odes composed of strophes, antistrophes, and epodes, like the chorus of the tragedy—a form which he is said to have invented. His life, as told by the ancients, is full of fables, but his fame among all connoisseurs of Greek literature—Cicero, Longinus, Quintilian, etc.—is an established fact. The existing fragments of his works have been edited by Kleine (Berlin, 1828); they are also found in the collections by Schneidewin, *Delectus Poesis Græcorum* (1839), and by Bergk, *Poetæ Lyrici Græci* (1867).

Steth'oscope [Gr. στῆθος, the "breast" or "chest," and σκοπεῖν, to "examine"], an instrument employed by physicians for the physical exploration of the chest. The scientific study of the sounds elicited by the heart and lungs, and to a minor degree by other organs, as the stomach and intestines, is termed *auscultation*. Direct application of the ear is termed *immediate or direct auscultation*, as distinguished from *mediate auscultation*, in which conducting media—instruments—are interposed, to isolate, convey, and intensify sound. Laennec, the founder of methodical auscultation, introduced the solid stethoscope, a tube made from a single piece of wood (Fig. 1). This instrument, modified, is chiefly employed in Europe. It is from 10 to 12 inches long, has a flanging chest piece to receive sound, an open canal to convey sound, the solid structure also serving to conduct it, and a broad flat ear-piece for apposition to the ear and the exclusion of extraneous sounds. The medical profession is indebted to the late Dr. Camman of New York for originating the "binaural" or "double stethoscope," an instrument quite generally used by American physicians, and recognized abroad (Fig. 2). It comprises two distinct conducting tubes of silver plated metal, capped by small rubber ear-pieces, which fit the external auditory canal, so as to exclude external sounds; they are jointed, to be self retaining upon the listener's head, and receive through flexible rubber connections the sound collected by a single flanging chest-piece. For purposes of careful diagnosis, by concentrating local sound, conducting it to the exclusion of surrounding noise, and conveying a separate but similar and simultaneous impression to each ear, it is

FIG. 1.

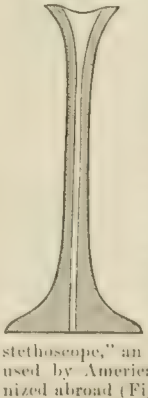


FIG. 2.

invaluable. It is further valuable in hospital and other public service, avoiding contact of the listener's head with unhealthy and untidy patients. It is especially serviceable in localizing the origin of sounds, as of small cavities in the lungs, valvular diseases of the heart, and in aneurism. An adventitious roaring or murmur generated in the lungs or in the conducting passages of the instrument must not be interpreted erroneously: habit quickly enables the listener to ignore this constant sound. The best auscultators prefer the unaided ear for habitual chest examination, reserving the stethoscope to aid in special and obscure cases. The habitual use of the stethoscope blunts the delicacy of the hearing.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Stet'son, p.-v. and tp., Penobscot co., Me. P. 937.

Stettin', town of Prussia, capital of the province of Pomerania, on the left bank of the Oder, at its entrance into the Stettiner Haff, and is strongly fortified. The site it occupies is hilly, and its streets are consequently uneven, but the houses are neat and substantial, and many buildings, such as the royal palace, the citadel and barracks, and the town-hall, are very handsome. Its sugar-refineries, oil mills, glassworks, breweries, distilleries, and manufactures of anchors, sailcloth, rope, tobacco, soap, candles, hats, etc., are very important, and as a place of commerce it is the second port of Prussia. Only small vessels can reach it, however; its port on the Baltic is Swinemünde. P. 76,280.

Stettin, p.-v. and tp., Marathon co., Wis. P. 712.

Stetti'ner-Haff, an expansion of the Oder, covering an area of about 200 sq. m., with a depth of from 12 to 18 feet, and communicating with the Baltic through three narrow mouths, the Pene, the Swine, and the Delvenow, of which the middle one is the most important.

Steuart (Sir JAMES DENHAM), b. in Edinburgh in 1713; was educated at the University of Edinburgh; became an advocate; married the daughter of the earl of Wemys, and was rapidly rising in his profession when, the rebellion of 1745 breaking out, he espoused the cause of the Stuarts, and was obliged to go into exile, where he remained ten years, when he was permitted to return to Scotland, and his estates were restored to him. He published *Apologie du Sentiment de Monsieur le Chevalier Newton sur l'ancienne Chronologie des Grecs* (1757) and *An Inquiry into the Principles of Political Economy* (1770), which preceded by several years Adam Smith's *Inquiry into the Nature and Causes of the Wealth of Nations*. D. in 1780.

Steu'ben, county of N. E. Indiana, bordering on Ohio and Michigan, drained by St. Joseph's and Pigeon rivers, and intersected by Fort Wayne Jackson and Saginaw R. R., which passes through its capital. The surface consists of prairie diversified with woodland, and the soil is fertile. There are many cattle, horses, sheep, and swine. Staples, Indian corn, wheat, oats, hay, wool, and dairy products. Cap. Angola. Area, 340 sq. m. P. 12,854.

Steuben, county of S. W. New York, bordering on Pennsylvania, drained by Canisteo, Conhocton, and Tioga rivers, and traversed by branches of Erie and other railroads. The soil is tolerably fertile, though the surface is hilly. There are numerous manufactories of carriages, agricultural implements, saddlery, leather, and iron castings, and a considerable amount of lumber is exported. Staples, Indian corn, wheat, oats, hay, wool, and dairy products. Caps. Bath and Corning. Area, 1425 sq. m. P. 67,717.

Steuben, tp., Marshall co., Ill. P. 1178.

Steuben, tp., Steuben co., Ind. P. 1253.

Steuben, tp., Warren co., Ind. P. 1068.

Steuben, p.-v. and tp., Washington co., Me. P. 1062.

Steuben, p.-v. and tp., Oneida co., N. Y., on Utica and Black River R. R. The township was granted to Baron Steuben 1786; he began settlement by erecting a log house 1789, and d. here Nov. 28, 1794. A monument to him was erected 1870-71. There are 8 churches in the town, of which the citizens are chiefly Welsh. A magazine in the Welsh language, maintained here since 1840, is now published in the adjoining town of Remsen. P. 1261.

Steuben, tp., Crawford co., Pa. P. 1020.

Steuben, von (FRIEDRICH WILHELM AUGUST HEINRICH FERDINAND), BARON, b. Nov. 15, 1730, in the fortress of Magdeburg, Prussia, where his father was an officer; spent his early childhood in military encampments, including residences at Cronstadt and in the Crimea; served as a volunteer when fourteen years of age in the campaign of 1744 and the siege of Prague; educated in the Jesuit colleges of Neisse and Breslau, acquiring a superior knowledge of mathematics and a fair acquaintance with history and polite literature; entered the Prussian army as a cadet 1747; became ensign 1749, lieutenant 1753; was wounded at the battle of Prague, and distinguished at Rossbach, 1757; became adjutant-general 1758; wounded at Kunersdorf 1759; was aide to Gen. Knoblauch in his brilliant march into Poland 1761; was taken prisoner and carried to St. Petersburg; won the favor of the grand duke Peter; was soon exchanged; made captain (1762), and placed on the staff of Frederick the Great, from whom he received, with a few other selected officers, special instruction in tactics; took part in the siege of Schweidnitz, 1763; withdrew from the army at the Peace of 1763, receiving from Frederick a lay-benefice worth 400 thalers; travelled through Germany, making at Hamburg the important acquaintance of the French general, the count of St. Germain; was appointed in 1764 grand marshal to the court of the prince of Hohenzollern-Hechingen; filled that post ten years, being also made general of the prince's guard and, by the margrave of Baden, knight of the order of Fidelity; travelled extensively with the prince, visiting Paris and the courts of various German princes, where his rank procured him access to the most celebrated literary and social circles; resigned his marshalship about 1775, in consequence of a religious controversy, being a Protestant in a Roman Catholic court; resided for a time at the court of Baden at Carlsruhe; he renewed his friendship with the count of St. Germain in Alsace; became acquainted at Montpellier with the English earls Warwick and Spencer, to whom he proposed, in the spring of 1777, to visit England, but passing through Paris was then induced by St. Germain to offer his services to the American insurgents through the agency of Silas Deane; embarked for America in the autumn of that year with several other officers, taking Peter S. Duponceau as secretary and interpreter; landed at Portsmouth, N. H., Dec. 1; was received with honor by the authorities; proceeded overland to the American encampment at Valley Forge, Pa., where he was welcomed by Washington; received the appointment of inspector-general (with the rank of major-general) Mar. 29, 1778; took part as a volunteer in the battle of Monmouth in the following June; rendered memorable services, which can scarcely be overrated, in drilling the officers and men of the Continental army into efficiency; prepared a manual of instruction for the army, adopted by Congress and printed 1779; was a member of the court-martial on Major André; took command of the forces in Virginia 1780, and rendered good services at the siege of Yorktown 1781. Remaining as a citizen of the U. S. after the war, it was with difficulty that he procured an adjustment of his claims upon Congress, but was ultimately assigned a pension of $2500 and received grants of land from several States. On the tract given him by New York, in Oneida co. (now called Steuben), he settled, accompanied by North, Popham, Walker, and others of his former aides; built a log hut 1789; gave away to poor soldiers a large portion of his lands, and passed the closing years of his life in cheerful toil as a farmer. D. at Steuben Nov. 28, 1794. A *Life* by Francis Bowen appeared in Sparks's series; another containing much new material was published by Friedrich Kapp (1860), and an epitome of the latter may be found in Greene's *German Element in the War of Independence* (1876). PORTER C. BLISS.

Steu'benville, city and tp., cap. of Jefferson co., O., on Pittsburg Cincinnati and St. Louis and Cleveland and Pittsburg R. Rs., 70 miles below the latter place, contains 17 churches, a female seminary, and 5 public schools, 2 daily, 1 semi-weekly, and 1 weekly newspapers, an extensive nail manufactory, blast furnaces, foundries and machine-shops, glassworks, an oil refinery, boiler-works, and the usual business-houses. Rich deposits of bituminous coal exist here. P. of v. 8107; of tp., exclusive of city, 2100. JOSEPH B. DOYLE, ED. "HERALD AND NEWS."

Ste'vens, an unorganized county of N. W. Dakota, not included in the census of 1870. It is bounded S. W. by Missouri River, and consists mainly of the Plateau du Couteau du Missouri, the N. E. corner being crossed by Mouse River. Area, about 3100 sq. m.

Stevens, an unorganized county of S. W. Kansas, bordering on the Indian Territory, and intersected by Cimmaron River. Area, 720 sq. m.

Stevens, county of W. Minnesota, intersected by Pomme de Terre River, and traversed by St. Paul and Pacific R. R. The surface is rolling and there are several lakes. Small quantities of wheat and oats are produced. Cap. Morris. Area, 576 sq. m. P. 174.

Stevens, county in the N. E. of Washington Territory, touching upon Idaho and British Columbia. It is intersected by the Columbia River, and watered by numerous streams. Much of it consists of barren plains and rugged mountains, with large tracts of fertile soil interspersed. Gold is found on the bars of the Columbia and upon some

of the other streams. Cap. Fort Colville. Area, about 28,000 sq. m. P. 734.

Stevens (ABEL), D. D., b. in Philadelphia Jan. 19, 1815; studied at the Wesleyan University, Middletown, Conn.; joined the Methodist ministry, and in 1834 was stationed at Boston; in 1837 made a European tour, and after his return was stationed at Providence, R. I.; in 1840 became editor of *Zion's Herald*, a denominational journal, at Boston, and in 1852 of the *National Magazine*, an illustrated monthly started in New York by the Methodist conference, which was discontinued after two or three years. He made a second visit to Europe in 1855, and in the following year was elected by the conference as editor of the New York *Christian Advocate and Journal*, an official organ of the denomination. He subsequently became joint editor of the *Methodist*, an independent journal established in New York, retaining this position till 1874. Besides contributions to current and cyclopædic literature, he has published—*Memorials of the Introduction of Methodism into New England* (1848), *Memorials of the Progress of Methodism in the Eastern States* (1852), *Church Polity*, *The Preaching required by the Times*, *Sketches and Incidents*, *a Budget from the Saddle-Bags of an Itinerant*, *Tales from the Parsonage*, *The Great Reform*, *Systematic Benevolence*, a prize essay, *History of the Religious Movement called Methodism* (3 vols., 1858–61), *Life and Times of Nathan Bangs, D. D.* (1863), *History of the Methodist Episcopal Church in the United States of America* (4 vols., 1864–67), *The Centenary of American Methodism* (1866), *The Women of Methodism* (1866), and *Compendium of the History of Methodism* (1868).

Stevens (ALEXANDER HODGDON), M. D., LL.D., son of Gen. Ebenezer, b. in New York City in 1789; graduated at Yale College 1807; studied medicine in London and Paris; was professor of surgery in Queen's (now Rutgers) College 1814–16, in the New York College of Physicians and Surgeons 1826–37, and again 1840–44, having meanwhile filled the chair of clinical surgery; was president of that institution 1843–55, of the American Medical Association 1848, and of the State Medical Society for several years. D. in New York City Mar. 30, 1869. He edited Cooper's *First Lines of Surgery* (2 vols., 1822) and was author of treatises *On Inflammation* (1811), *Cases of Fungus Hæmatodes of the Eye* (1818), *A Clinical Lecture on Injuries* (1837), *Lectures on Lithotomy* (1838), and addresses.

Stevens (ALFRED GEORGE), b. at Blandford, Dorsetshire, in 1817; manifested an early artistic genius; went to Italy in 1833, where he spent nine years in studying the old masters, and upon his return to England was employed principally in decorative work for architects, founders, and manufacturers, his name being almost unknown to the public, though he was widely known among artists. In 1850 he went to Sheffield, where under his influence the Sheffield School of Art rose to the highest place of any in the kingdom. His finest decorative work is at Dorchester House, Park lane, London; it includes carvings in wood and marble, painted ceilings and panels, enamelled and metal work, all executed by his own hand. In 1858 he received the commission for the Wellington Monument in St. Paul's, London; completed the principal portions, and executed models and designs for all the rest, but, owing to ill-health and other causes, the work was left unfinished at his death, in London, May 1, 1875.

Stevens (EBENEZER), b. at Boston, Mass., Aug. 25, 1751; was a member of Paddock's Company of Boston Artillery, and one of the famous "Boston Tea Party" Dec., 1773; removed soon afterward to Rhode Island; raised two companies of artillery and one of artificers for the expedition against Quebec, in which he served as lieutenant, having been commissioned May 8, 1775; became captain of Knox's regiment Jan. 11, and brevet-major Nov. 9, 1776; commanded the artillery at Ticonderoga and at Stillwater; was appointed lieutenant-colonel Apr. 30, 1778; was assigned to Lamb's regiment; served under La Fayette in Virginia; was, alternately with Lamb and Carrington, in command of the artillery during the siege of Yorktown; was one of the founders of the Society of the Cincinnati, and became after the war a leading merchant of New York in the West India and Mediterranean trade; agent of the war department, and a major general of militia. D. at Rockaway, L. I., Sept. 2, 1823.

Stevens (EDWARD), b. in Culpeper co., Va., in 1745; became colonel of the 10th Virginia regiment 1776; distinguished himself at Brandywine and Germantown, and as brigadier general at Camden, Guilford Court house, and Yorktown; was a trusted friend of Washington, and for many years a member of the Virginia senate. D. in Culpeper co., Va., Aug. 17, 1820.

Stevens (EDWIN AUGUSTUS), b. at Hoboken, N. J., in 1795, son of John and brother of Robert L. Stevens; took part in their steamboat experiments and enterprises, and in conjunction with his brothers established passenger and tow boats on the Hudson and other rivers. At the breaking out of the civil war he urged the government to put in service the iron-clad floating battery of which his brother had long before undertaken the construction, offering to complete it at his own risk, and to receive payment only in case it should prove successful; this offer being declined, he expended considerable sums on the vessel, and upon his death bequeathed it to the State of New Jersey, together with $1,000,000 for its completion; this, however, proved insufficient, and the battery remains unfinished. He had early purchased the entire site upon which the city of Hoboken has been built; by which and by his other enterprises he amassed an immense fortune; endowed the Hoboken high school, and bequeathed nearly $1,000,000 to establish at Hoboken the Stevens Institute of Technology. D. at Paris Aug. 7, 1868.

Stevens (GEORGE ALEXANDER), b. in London in the first half of the last century; was a strolling player, vocalist, lecturer, and dramatist. Among his productions are—*Religion, or the Libertine Repentant* (1751), *The Birthday of Folly* (1754), *The History of Tom Fool* (1760), *Hearts of Oak* (1762), *A Lecture on Heads*, which gave rise to a curious literary controversy (1765), *The French Flogged* (1767), *Songs, Comic and Satyrical* (1782), *Trip to Portsmouth* (1773). After his death appeared *The Adventures of a Speculist*, compiled from his papers, with a *Life*, preface, and notes (1788). D. Sept. 6, 1784.

Stevens (HENRY), son of Henry and a descendant of Capt. Phineas, b. at Barnet, Vt., Aug. 24, 1819; studied at Middlebury College 1838–39; graduated at Yale College 1843, and at Cambridge Law School 1844; established himself at London 1845, where he has since resided, as agent for American libraries in the purchase of rare and valuable books; has been instrumental in placing in the British Museum a very complete collection of "Americana," and has purchased for the Smithsonian Institution, the Library of Congress, and the chief libraries of the U. S. most of their recent valuable acquisitions. He has published several valuable bibliographical treatises and catalogues, among which are—*A Catalogue Raisonné of English Bibles* (1854), *A Catalogue of American Books in the Library of the British Museum* (1856), a *Catalogue of the Crowninshield Library* (1860), and of the library of Baron Humboldt (1861), which latter collection he had purchased, *Historical Nuggets* (2 vols., 1858), *Bibliotheca Americana* (1861), and *Bibliotheca Historica* (1870), the latter book being the catalogue of the library of his father, of whom it contains a biographical sketch. He also prepared indexes to the State papers in London relating to New Jersey (1858), Maryland (10 vols.), Rhode Island (6 vols.), and Virginia (1858), the three latter being in MS.; published a work on *The Tehuantepec Railway* (1869), and two small volumes of *Historical and Geographical Notes* (1869) relating to early explorations in America.

Stevens (ISAAC INGALLS), b. at Andover, Mass., Mar. 25, 1818; graduated from the U. S. Military Academy July 1, 1839; served in the war with Mexico, and for gallantry at Contreras and Churubusco and at Chapultepec was brevetted captain and major. From 1849 to 1853 he was principal assistant and in charge of the office of the U. S. Coast Survey at Washington; in March of the latter year he resigned from the army to accept the governorship of Washington Territory; conducted the pioneer survey of the route for the Northern Pacific R. R., an account of which he published; delegate to Congress from Washington Territory 1857–61; on the outbreak of hostilities was made colonel of the 79th (Highlanders) N. Y. Vols. Moving his command to Washington, he was made a brigadier general of volunteers Sept. 28, and attached to the Port Royal expedition, which left Hampton Roads a month later. On July 4, 1862, he was made a major-general of volunteers, and a week later transferred to Newport News in command of a division; at the second battle of Bull Run his division (9th corps) was hotly engaged. Near Chantilly, on the morning of Sept. 1, 1862, his division encountered the enemy, when Stevens, ordering a charge, placed himself at the head of his command, where he was shot through the head and instantly killed.

Stevens (JOHN), b. in England about 1660; served as a captain in the army of James II. in Ireland after the revolution of 1688; settled in London soon afterward, and, being conversant with the chief modern languages, supported himself for many years as a translator until his death in 1726. Among the valuable works which he made accessible to the English reader were Faria é Souza's *Portuguese Asia* (3 vols., 1695) and *History of Portugal* (1698), Mariana's *General History of Spain* (folio, 1699), Veitia Linage's Spanish *Rule of Trade to the West Indies* (1700),

Sandoval's *History of Charles V.* (1703), Herrera's *General History of America* (6 vols. 8vo, 1725–26; 2d ed., 1740), and the venerable Bede's *Ecclesiastical History of the English Nation* (London, 8vo, 1723). Capt. Stevens was also author of several original works, chiefly historical, covering a wide range of subjects, among which were *Ancient and Present State of Portugal* (1705), *History of Batavia* (171[illegible]), ***History of Persia*** **(1715),** ***History of the Wars of Charles XII.*** (1715), *Monasticon Hibernicum* (1722), intended as a supplement to Dugdale's *Monasticon Anglicanum*, of which he made an abridgment (1718), and to which he added two volumes entitled *The History of the Ancient Abbeys*, etc. (2 vols. folio, 1722–23), *The Royal Treasury of England, or An Historical Account of Taxes* (1725, 2d ed., 1733), compiled *A New Collection of Voyages and Travels* (published in monthly numbers, 2 vols. 4to, 1708–10; 2d ed., 1719), and prepared a *Spanish and English Dictionary* (folio, 1706; 4to, 1726), in which was included a collection of 7000 Spanish proverbs.

Stevens (John), b. in New York in 1749; became interested in the question of navigation by means of steam, and as early as 1789 presented a memorial to the New York legislature stating that he had perfected his plans, and in 1804 launched a small vessel worked by steam with screws, and in 1807 built a steamboat which he called the Phœnix. Fulton had in the mean time built his steamboat, the Clermont, and obtained the exclusive right of navigating the Hudson by steam, and Stevens sent his vessel to the Delaware River. In 1812 he planned a revolving steam-battery to be plated with iron, and involving essentially the principles afterward embodied in the monitors, and in the same year put forth an essay on railroads, indicating the methods of operating them by steam, and suggested the construction of a railway from Albany to Lake Erie. The Camden and Amboy R. R. was planned by him. D. at Hoboken, N. J., in 1838.

Stevens (John Austin), b. in New York City Jan. 22, 1795, son of Gen. Ebenezer by his second wife, Mrs. Sands, sister of Col. Ledyard of Revolutionary fame; graduated at Yale College 1813; became a partner in his father's mercantile house 1818; was a delegate to the Philadelphia free-trade convention; an early member (from 1820) of the New York chamber of commerce, of which he was long the secretary; was one of the founders and the first president of the Merchants' Exchange, president of the well-known Bank of Commerce from its organization in 1839 to 1866, and president of the associated banks of New York, Philadelphia, and Boston, which, during the late civil war, saved the credit of the U. S. government by repeated loans, amounting in the aggregate to $150,000,000, and chairman of the treasury note committee which managed the details of the transaction; was widely known as a skilful financier, whose advice was often sought by the U. S. treasury department; took an active interest in benevolent institutions; long governor of New York Hospital; combined Whig with free-trade principles, and was noted among his intimate friends for literary and scientific attainments, of which he made no public display. D. in New York City Oct. 19, 1874.

Stevens (John Austin), Jr., son of John Austin, b. in New York Jan. 21, 1827; graduated at Harvard 1846; became a merchant in New York; was secretary of the chamber of commerce of New York 1862–68; was prominent in patriotic organizations during the civil war, and is author of *The Valley of the Rio Grande* (1864), *Memorial on Ocean Steam-Navigation* (1864), *Colonial Records of the N. Y. Chamber of Commerce, with Historical and Biographical Sketches* (1868). He is an accomplished antiquarian investigator, and has contributed to the literature of the country several valuable papers on American history.

Stevens (Phineas), b. at Sudbury, Mass., about the end of the seventeenth century; removed in childhood to Rutland, N. H.; was carried prisoner to Canada at the age of sixteen; was a volunteer in the expedition of 1746 against Canada; gallantly defended Charlestown (or "Fort No. 4") against the French and Indians Mar., 1747, for which he was presented with a valuable sword by Admiral Knowles; was in command of that fort until 1750, and made a visit to Canada in 1749, of which the *Journal* was printed in the *New Hampshire Historical Collection*, vol. v. D. at Charlestown in 1756.

Stevens (Robert Livingston), b. at Hoboken, N. J., in 1788, the son of John Stevens; became early interested in the steam-navigation ideas of his father, and made many improvements in the construction of vessels, among which was that of giving concave water-lines to the hull; and subsequently engaged largely in the building of steamboats. In 1813 he invented and made for the government elongated percussion shells for smooth-bore guns, and in 1822 used anthracite coal in a furnace, and soon after in his steamers; in 1836 introduced the T-rail on the Camden and Amboy R. R., of which he was president, and in 1842 was commissioned to build for the U. S. government an iron-plated floating battery which remained uncompleted at his death. (See Ships.) D. at Hoboken Apr. 20, 1856.

Stevens (Samuel), son of Gen. Ebenezer, b. in New York in 1784; graduated at Yale College 1805; studied law; became a distinguished member of the New York bar; was prominent in the politics of his native State; and rendered important service in the introduction of the Croton water, having been one of the first commissioners of the aqueduct construction. D. at New York Nov. 24, 1844.

Stevens (Thaddeus), b. at Peacham, Vt., Apr. 4, 1793; graduated at Dartmouth College in 1814; went to Gettysburg, Pa., where he taught in an academy, at the same time studying law; was admitted to the bar in 1816, and soon acquired an extensive practice. In the Presidential canvass of 1828 he was a strong opponent of the election of Gen. Jackson; in 1833 and several times subsequently he was a member of the State legislature, in 1836 a member of the convention to revise the State constitution, canal commissioner in 1838, and active in introducing the public-school system in Pennsylvania. In 1842 he removed to Lancaster; in 1848 was elected Representative in Congress; was re-elected in 1850, 1858, 1862, and thereafter to each Congress until his death, serving at various times as chairman of important committees, being one of the acknowledged leaders of the Republican party, and distinguishing himself for his earnest advocacy of measures in opposition to slavery, for the emancipation and enfranchisement of the colored race, and after the war for stringent proceedings against the seceding States. He was one of the most active managers in the impeachment trial of Pres. Johnson. The degree of LL.D. was conferred upon him by Middlebury College in 1867. D. at Washington Aug. 11, 1868.

Stevens (Walter H.), b. in New York City about 1827; graduated at West Point 1848; was appointed lieutenant of engineers, in which capacity he served at Fort Adams, Newport, R. I., 1848, in repairing the fortifications on the Mississippi River below New Orleans 1849–53, and on the defences of the coast of Texas 1853–61; was dismissed from the army May 2, 1861, having attached himself to the Confederate cause; became an officer of engineers on Gen. Beauregard's staff; rose to the rank of brigadier-general; surrendered at Appomattox Court-house, Va., Apr., 1865, after which he went to Mexico and became chief engineer of the Mexico and Vera Cruz R. R. D. at Iberville, La., in Dec., 1867.

Ste'vensburg, p.-v. and tp., Culpeper co., Va. P. of v. 150; of tp. 2000.

Ste'venson, p.-v. and tp., Jackson co., Ala., at intersection of Memphis and Charleston and Nashville and Chattanooga R. Rs. P. 1348.

Stevenson (Andrew), b. in Culpeper co., Va., in 1784; became a prominent lawyer, member and Speaker of the Virginia legislature and of the Federal Congress (1821–34; Speaker 1827–34), and minister to England 1836–41; was afterward distinguished as a scientific agriculturist, and became rector of the University of Virginia. D. at Blenheim, Albemarle co., Va., June 25, 1857.

Stevenson (Edward), D. D., b. in Kentucky in 1797; joined the Kentucky conference in 1820; rose to the highest distinction in the ministry, and took an active part in the organization of the Methodist Episcopal Church, South, and was missionary secretary and book-agent of the connection. D. in Kentucky July 6, 1864. T. O. Summers.

Stevenson (John), D. D., b. in England about the beginning of the nineteenth century; was long a missionary in India, and became a learned Orientalist. He translated from the Sanskrit, for the Oriental Translation Fund, *The Sanhita of the Sama-Veda* (1841), and from the Maghadi *The Kalpa Sutra and Nara Tatva—two works illustrative of the Jain Religion and Philosophy* (1848); edited from MSS. the Sanskrit text of the *Sama-Veda* (1843), and published a work on *Hindoo Caste* (1857).

Stevenson (Sir John Andrew), Mus. Doc.; b. in Dublin, Ireland, in 1760, son of a professor of music; became vicar-choral at St. Patrick's cathedral, Dublin, 1783; composed the music for two of O'Keefe's popular farces, Dr. Holton's opera, *The Contract*, and Mrs. Atkinson's *Love in a Blaze;* produced various original operas and glees, the fine oratorio *The Thanksgiving*, various pieces of sacred music including two volumes of *Cathedral Anthems*, and set to music some of the psalms; but won his chief celebrity by the musical arrangement of Moore's *Irish Melodies*, which occupied him much of the time from 1802 to 1816. He was knighted 1802. D. at the seat of his daughter, the marchioness of Headfort, in the county of Meath, Sept. 14, 1833.

Stevenson (JOHN W.), son of Andrew, b. at Richmond, Va., May 4, 1812; graduated at the University of Virginia 1834; studied law; settled at Covington, Ky., 1841; became county attorney, member of the State legislature (1845–47), and of the constitutional convention 1849; was one of the revisors of the civil and criminal codes of practice; Presidential elector 1852 and 1856; member of Congress 1857–61; chosen lieutenant-governor 1867; was acting governor 1867–68, governor 1869–71, and U. S. Senator for the term 1871–77.

Stevenson (ROBERT), b. at Glasgow, Scotland, June 8, 1772; was engineer to the board of commissioners for Northern lighthouses 1797–1842, during which time he erected no less than twenty-three lighthouses, of which the most celebrated was that on Bell Rock in the German Ocean, 12 miles from Arbroath, on the E. coast of Scotland 1807–11; was employed on numerous engineering works, chiefly bridges, river and harbor improvements, and railway surveys; published *An Account of the Bell-Rock Lighthouse* (1824), contributed to scientific periodicals, and drew up professional *Reports* which if collected would fill four large volumes. D. at Edinburgh July 12, 1850.

Stevenson (THOMAS G.), b. in 1836 at Boston, Mass., where he was educated. His fondness for military life was early manifested, and he became an active member of the State militia, rising from the ranks to be major of the 4th battalion of Massachusetts Infantry, which body under his care and instruction attained a high degree of excellence in discipline and drill. The outbreak of civil war in 1861 found him ready for duty in the field, and in the fall of 1861 he was commissioned colonel of the 24th Massachusetts Vols., which regiment he had organized, and which he led in the Burnside expedition resulting in the capture of Roanoke Island and Newberne, N. C. In the subsequent events in North and South Carolina the regiment bore an honorable part. His appointment as brigadier-general of volunteers was made in Nov., 1862, and he commanded a brigade from that date, though not confirmed until Mar., 1863. In the summer of the latter year he was engaged in the operations against Charleston, S. C., including the descent upon Morris Island and siege of Fort Wagner, where he was in command of the reserves. In the Richmond campaign of 1864 he commanded a division of the 9th corps (army of the Potomac) through the "Wilderness" battles, but fell on the second day of the struggle around Spottsylvania, May 10, 1864.

Stevens' Plains, p.-v., Westbrook tp., Cumberland co., Me., on Maine Central R. R.

Stevens Point, p.-v. and tp., cap. of Portage co., Wis., on Wisconsin Central R. R. and Wisconsin River, at the base of one of the most valuable pine districts in the West, has 6 churches, good schools, 3 banks, 3 foundries, 2 newspapers, machine and repair shops of the railroad, and 6 saw and 6 shingle mills. P. of v. 1810; of tp. 1895. McGLACHLIN & SIMONS, EDS. "JOURNAL."

Stevens's, tp., Darlington co., S. C. P. 1918.

Ste'vensville, p.-v. and tp., King and Queen co., Va. P. 4077.

Stev'inus, or **Stevin** (SIMON), b. at Bruges, in the Belgian province of West Flanders, in 1550; was teacher of mathematics to Maurice of Nassau, stadtholder of Holland, who made him inspector of the dykes. He wrote in Dutch a number of essays on statics, hydrostatics, fortification, navigation, and on various mechanical problems, which have been translated into Latin, French, and German. D. at the Hague in 1620. The French translation of his works by Albert Girard appeared at Leyden in 1634, in 2 vols. (See Quetelet, *Simon Stevin* (Brussels, 1845).)

Steward (or **High Steward**) **of Scotland,** an ancient hereditary office of great dignity and power at the Scottish court from the twelfth to the fifteenth century, called in Latin *dapifer* or *seneschallus*. The incumbent not only exercised a real jurisdiction over the royal household, but collected and controlled the royal revenues, and was assigned in war the post nearest to the sovereign. This office was conferred by David I. early in the twelfth century on Walter, second son of Alan, lord of Oswestry, along with extensive grants of land, including the barony of Renfrew. The title was soon assumed by that family as a surname, and became the origin of the family name of the Stewart or Stuart dynasty by the accession of Robert, the seventh high steward, to the throne of Scotland, when the seneschalship was merged in the Crown. In 1469, by act of the Scottish Parliament, the hereditary estates of the stewards became the appanage of the king's eldest son, along with the titles of high steward of Scotland and baron of Renfrew, and it is now borne by the prince of Wales in the form of great steward of Scotland.

Steward of England, Lord High, anciently the first officer of state at the English court. This dignity was hereditary in the descendants of Hugh Grentmesnil, lord high steward in the time of Henry II.; passed by marriage successively to the De Bellomonts and Montforts, earls of Leicester; reverted to the Crown on the death and attainder of Simon de Montfort (1265); was granted with the earldom of Leicester to Edmund, youngest son of Henry III., and continued annexed to that title or to that of Lancaster until the accession of its incumbent, Henry IV., to the throne. Since that period the office has fallen into abeyance, but a temporary lord high steward is created under the great seal at coronations and at the trials of peers, the incumbent, after performing the required service, terminating his commission by breaking his wand of office.—This office must be distinguished from that of LORD STEWARD OF THE HOUSEHOLD, anciently entrusted with the control of the royal servants, over whom he exercised a civil and criminal jurisdiction, not entirely repealed until about 1850, though long fallen into abeyance. It is now a merely nominal office, conferred during the pleasure of the sovereign, or rather that of the prime minister; has a salary of £2000, and confers a seat in the privy council and precedence over all peers of equal degree.

Stew'ardson, tp., Potter co., Pa. P. 210.

Stew'art, county of S. W. Georgia, separated from Alabama by Chattahoochee River, and watered by several of its tributaries. Staples, cotton, Indian corn, and sweet potatoes. Cap. Lumpkin. Area, about 500 sq. m. P. in 1870, 14,204.

Stewart, county of N. W. Tennessee, bordering on Kentucky, intersected by Cumberland River, and traversed by Louisville Nashville and Great Southern R. R. The surface is undulating and the soil fertile. Iron ore abounds, which is worked up into blooms and pigs. Staples, tobacco in large quantities, Indian corn, and wool. Cap. Dover. Area, 425 sq. m. P. in 1870, 12,019.

Stewart, tp., Fayette co., Pa. P. 1266.

Stewart (ALEXANDER), b. in England or Scotland about 1740; became captain in the British army 1761, lieutenant-colonel of the 3d Foot July, 1775; served in the Southern campaign in the Revolutionary war under Lord Cornwallis; succeeded to the command of the British forces in South Carolina May, 1781, and was defeated by Gen. Greene Sept. 8, 1781, at Eutaw Springs, the last pitched battle of the war of American independence; became major-general 1790. D. in Feb., 1793.

Stewart (Rev. ALEXANDER), LL.D., b. in 1781; was minister of the parish of Douglas, Scotland; one of the foremost Scottish literati, and a leading contributor to the *Edinburgh Encyclopædia*. He published several textbooks which were widely used and passed through many editions, among which are—*Cornelius Nepos, with Notes*, etc. (1819), an edition of *Mair's Introduction*, *Goldsmith's History of England, with a Continuation*, *History of Scotland*, *Stories from the History of Scotland*, *Discourses* (1829), and *Compendium of Modern History* (18th ed. 1861). D. at the Manse of Douglas Nov. 14, 1862.

Stewart (ALEXANDER TURNEY), b. near Belfast, Ireland, Oct. 27, 1802; left an orphan at an early age, he was cared for by his maternal grandfather; distinguished himself at school, and was entered at Trinity College, Dublin, where he did not graduate. Upon the death of his grandfather, a distant relative, a member of the Society of Friends, became his guardian. He emigrated to New York about 1818, bringing with him a few hundred pounds, a part of a small estate which he inherited, and for a time taught mathematics and the classics in a private school. Having invested his ready money in a small mercantile venture, he found himself unexpectedly left alone in the business with the rent of the shop on his hands, and forced to become a trader. Returning to Ireland, he sold his other property, invested the proceeds in Irish laces and similar goods, and in 1823 opened a small store in Broadway, and commenced the business which has since grown to be the most extensive dry-goods establishment in the world, with branches in England, Scotland, Ireland, France, and Germany, besides large manufactories of woollens, carpets, and hosiery in the U. S., England, and Scotland, the whole employing about 8000 persons. In addition to his manufacturing and mercantile business, he came to be a large holder and improver of real estate in New York and vicinity, Saratoga, and other places, and at the time of his death was reputed to be one of the three wealthiest men in the U. S., the other two being John Jacob Astor, who had a few weeks before inherited the bulk of the great Astor estate, and Cornelius Vanderbilt, who acquired the greater part of his property in railway operations. He retained all through his life his early fondness for clas-

sical literature, and was a munificent patron of art in certain departments, his picture-gallery containing some of the finest examples of modern art, while he had little appreciation for the works of the old masters. Among his enterprises was the establishment of a town called Garden City, on Long Island, a few miles from Brooklyn. Here he purchased a tract of 10,000 acres, upon which he built more than 100 dwellings adapted for persons in moderate or comfortable circumstances, none of which were to be sold, but all of which would be rented furnished if desired, he himself defraying all the expenses of grading, lighting, and watering the streets and building a railway to connect Garden City with Brooklyn. Some years before, he had commenced the erection of a large and costly building in New York designed as a home for working girls; and he had also made preparation for the erection of a similar building for young working men, each structure being designed to afford accommodation for 1500 inmates. He took no prominent part in public affairs, except that during the civil war he was an earnest upholder of the national government, and in 1869 accepted from Pres. Grant the nomination as secretary of the treasury. The nomination was withdrawn, it being found that he was rendered legally ineligible for that position on account of his being engaged in the importation of foreign merchandise. He was president of the honorary commission sent by the U. S. government to the Paris Exposition of 1867. During the Irish famine of 1846 he chartered a vessel which he freighted with breadstuffs at his own expense for gratuitous distribution among the sufferers, and brought back, free of charge, as many emigrants as the vessel would carry, stipulating that all should be of good character, and taking care that situations should be ready for them upon their arrival. He made considerable donations to the sufferers of the Chicago fire of 1871 and in the Franco-German war; but apart from these, his benefactions, public or private, were not considerable, either during his life or by his will. D. in New York Apr. 10, 1876, leaving no children. By his will his entire estate, with the exception of certain legacies, was devised to his wife, who, with Henry J. Hilton, his confidential friend and legal adviser, and William Libbey, his sole surviving business-partner, were appointed executors. To Mr. Hilton was left a legacy of $1,000,000, and to several of his principal employés sums amounting in the aggregate to something more than $100,000; his wife being also requested in a codicil to make provision for others who had been long employed by him in such amounts as she should think proper; she appropriated for this purpose a further sum of a little more than $200,000, making the entire amount of his legacies, exclusive of that to Mr. Hilton, about $325,000.

A. H. Guernsey.

Stewart (Balfour), LL.D., F. R. S., b. at Edinburgh, Scotland, Nov. 1, 1828; educated at the Universities of St. Andrew's and Edinburgh; settled in Australia, where he was engaged in business in Melbourne 1852–54; afterward devoted himself exclusively for a year or more to the study of science; returned to Great Britain 1855; was for some months assistant to the superintendent of the Kew Observatory, and for three years assistant to Prof. Forbes in Edinburgh in his lectures and experiments upon mechanics; was appointed director at Kew July 1, 1859, secretary to the meteorological committee Jan. 1, 1867, and professor of natural philosophy at Owens College, Manchester, July 7, 1870, which post he now (1876) fills, retaining the directorship of Kew; is the discoverer of the law of equality between the absorptive and radiative powers of bodies, for which he received the Rumford medal of the Royal Society 1868; is author, jointly with Messrs. De la Rue and Loewy, of *Researches in Solar Physics*, and with Prof. P. G. Tait of papers giving the results of experiments on *Heating produced by Rotation in Vacuo*, and of a remarkable religio-scientific treatise, *The Unseen Universe* (1875), being speculations on the "physical basis of immortality"; has contributed numerous papers, chiefly on meteorology and magnetism, to the *Transactions* of the Royal Society, and has published *Elementary Lessons in Physics* (1870), *Elementary Treatise on Heat* (1871), the *Physics Primer* (1872) in Macmillan's Series, and the *Conservation of Energy* (1873) in the "International Scientific Series."

Stewart (Charles), b. in Scotland about 1770; went to India at an early age in the military service of the East India Company, in which he rose to the rank of major, and was subsequently professor of Oriental languages in the company's training college at Hertford. D. about 1840. He edited the Persian text of the *Anvari Soohyly, or Fables of Pilpay*; published a *Descriptive Catalogue of the Oriental Library of the late Tippoo Sultaun, to which are prefixed Memoirs of Hyder Ally Khan and his Son, Tippoo Sultaun* (Cambridge, 1809), and translations of the *Travels of Mirza Abu Taleb Khan in Asia, Africa, and Europe* (London, 2 vols., 1810), the *Memoirs of the Mogul Emperor Timur* (1830), and those of Humayun (1832), and was author of a *History of Bengal* (1813).

Stewart (Charles), U. S. N., b. in Philadelphia July 28, 1778; went to sea at the age of thirteen as cabin-boy in a merchant-vessel, and before he was twenty had become captain of an Indiaman. In 1798 he entered the U. S. navy as a lieutenant, and in July, 1800, was appointed to the command of the Experiment, a schooner of 12 guns, with which, Sept. 1, he captured the French privateer Deux Amis, 8 guns, and soon after the Diana, 14 guns, also recapturing several American vessels which had been taken by the French. In 1804, in command of the brig Siren, he took part in the naval operations against Tripoli, aiding Decatur in the destruction of the American frigate Philadelphia, which had fallen into the hands of the dey of Tripoli. He was made captain in 1806; in the summer of 1813 took command of the frigate Constitution, 52 guns, and in December sailed from Boston for the West Indies, making several captures of British vessels. In Dec., 1814, he sailed on a second cruise, and on Feb. 20, 1815, captured the British ship Cyane, 34 guns, and the Levant, 21 guns. The action was fought at night, and lasted forty minutes; the American loss was 15 killed and wounded, that of the British 41; the Levant was, however, recaptured by a British squadron. In 1816–20, Stewart commanded the Mediterranean squadron, in 1821–23 that of the Pacific, subsequently serving on the board of navy commissioners, as commander of the home squadron, and of the naval station at Philadelphia. He was placed on the retired list in 1857, but resumed service in 1859, and was placed in command of the Philadelphia navy-yard with the rank of senior naval officer, and in 1862 was made rear-admiral on the retired list. D. at Bordentown, N. J., Nov. 7, 1869.

Stewart (Charles Samuel), D. D., b. at Flemington, N. J., in 1795; graduated at the College of New Jersey in 1815; studied law at Litchfield, Conn., and theology at Princeton, and in 1822 was ordained as missionary to the Sandwich Islands, where he remained until 1826, when he returned to America to advocate the cause of foreign missions. In 1828 he was appointed chaplain in the U. S. navy; made several voyages, after which for many years he was chaplain of the naval station at New York. He published—*Private Journal of a Voyage to the Pacific Ocean and Residence in the Sandwich Islands* (1828), *Visit to the South Seas* (1831), *Sketches of Society in Great Britain and Ireland* (1834), *Brazil and La Plata* (1856), and *Personal Record of a Cruise* (1856). D. at Cooperstown, N. Y., Dec. 14, 1870.

Stewart (David), duke of Rothesay and earl of Carrick, son of Robert III., king of Scotland, b. about 1377; received the above titles from his father Apr. 28, 1398; became regent of Scotland Jan. 27, 1399, and defended Edinburgh against Henry IV. of England 1400, but was soon after seized by the opposite party and imprisoned in Falkland Castle, where he soon died by starvation 1401. The earls of Albany and Douglas were accused of this crime, but were declared innocent after an examination before the great council at Holyrood May 16, 1402.

Stewart (Dugald), b. at Edinburgh Nov. 22, 1753, son of Matthew Stewart, professor of mathematics in the College of Edinburgh; studied there and at Glasgow; was in 1774 appointed assistant professor to his father, whom he succeeded in 1785; in the same year receiving the chair of moral philosophy, which he resigned in 1810 on account of failing health, and passed the remainder of his life in literary labor at his seat on the Frith of Forth, the sinecure office of gazette writer for Scotland, with a salary of £600, having been created for him. He is one of the not unfrequent examples of color-blindness, several quite different colors having been undistinguishable by him. The following is a list of his principal works, with the dates of their original publication, many of which, however, subsequently appeared with considerable augmentations: *Elements of the Philosophy of the Human Mind* (1792), *Outlines of Moral Philosophy* (1793), *General View of the Progress of Metaphysical, Ethical, and Political Philosophy*, prefixed to the supplement to the *Encyclopædia Britannica* (1816), *The Philosophy of the Active and Moral Powers of Man* (1828). He also wrote biographies of Adam Smith, Thomas Reid, and Dr. Robertson. The best edition of his collected works is that prepared by Sir William Hamilton (1856). D. at Edinburgh June 11, 1828.

Stewart (Esme), lord of Aubigny, earl and duke of Lennox, b. in France about 1555, grandson of John, third earl of Lennox, and deriving his French title from Sir John Stewart of Darnley, constable to the Scots army in France in the wars of Charles VII.; arrived in Scotland in Sept., 1579, and immediately became a favorite of his

cousin, King James VI., who created him earl of Lennox Mar. 5, 1580, duke of Lennox and earl of Darnley Aug. 5, 1581; took an active part in the political intrigues of the time, instituting legal proceedings against the ex-regent Morton, and secured his condemnation and execution for the murder of Darnley; quarrelled with the Church, and was accused of treason and expelled from Scotland Dec., 1582. D. at Paris May 26, 1583.

Stewart (Hamilton), b. Sept. 4, 1813, in Jefferson, and reared in Scott co., Ky., and thence removed to Texas in the year 1838. In May of that year he established the *Civilian* newspaper, and continued to own and edit the same as an independent Democratic paper through all the mutations of government for a third of a century. He resided in Galveston from the foundation of the city; was repeatedly its mayor, and represented it in the legislature and in the constitutional convention in 1856. In the days of the republic he enjoyed the confidence of Presidents Houston and Jones, and was opposed to the policy of annexation, and after Texas was a State of the republic was unwilling to annul the compact. During the Presidency of Mr. Pierce and of Mr. Buchanan, he served as collector of customs in the city of Galveston, but was not retained in office during the Confederacy because of his opposition to secession. For ten years preceding the war he was regarded as the editor of the most prominent newspaper opposed to the secession doctrine. At the present time Mr. Stewart is one of the editors of the Galveston *News*, the leading newspaper of Texas. C. G. Forshey.

Stewart (Sir Houston), b. in Renfrewshire, Scotland, in 1791; entered the navy at an early age; served at Flushing and at the siege of St. Jean d'Acre; was chosen to Parliament 1852; was a lord of the admiralty 1850-52; was admiral and second in command in the Black Sea during the Crimean war, rendering services off Sebastopol for which he was knighted 1856; was subsequently commander-in-chief on the North American Station and at Plymouth (1860-63), and governor of Greenwich Hospital 1869-72. D. in Dec., 1875.

Stewart (John), b. in Ireland; emigrated to America; married a sister of Gen. Wayne; entered the Revolutionary army, commanded a corps of light infantry, and had a severe engagement at Indian Field with Emmerick's command of Tories and Indians, Aug. 31, 1778, and received a gold medal from Congress for his gallantry at the storming of Stony Point, July 15, 1779. D. near Charleston, S. C., from being thrown from his horse.

Stewart (Robert M.), b. at Truxton, N. Y., Mar. 12, 1815; went to Kentucky in boyhood, and in 1838 emigrated to Missouri, settling in Buchanan co.; was a member of the State constitutional convention of 1845; sat ten years in the State senate; was governor 1857-61; inaugurated the railroad system of Missouri; and was for a short time an officer of the Union army 1861, but retired on account of ill-health. D. at St. Joseph Sept. 21, 1871.

Stewart (Matthew), earl of Lennox, b. in Scotland about 1510, son of John Stewart, third earl, by his wife, Lady Anne Stewart, daughter of the earl of Athol: became heir-male of the Stewards of Scotland by the death of King James V.; married Lady Margaret Douglas, only child of Archibald, earl of Angus, by the queen-dowager Margaret, sister of Henry VIII., and had by this marriage two sons, of whom the elder became the well-known Earl Darnley, the unhappy cousin, husband, and victim of Mary Queen of Scots. Matthew succeeded to the earldom in 1526; spent his youth in France and in the Italian wars; returned to Scotland 1533; became a formidable rival of Bothwell at the court of the infant queen, for whom he attempted to negotiate a marriage with the English prince, afterward Edward VI.; took at first the Roman Catholic side in the civil war, but soon went over to the party of the English king; was consequently banished, declared guilty of treason, and his estates confiscated Oct., 1545; conducted unsuccessful invasions of Scotland 1545-47; was imprisoned with his countess in the Tower of London for having planned the marriage of the queen of Scots with their son Darnley 1562; was allowed to return to Scotland Sept., 1564; was restored to his estates and honors Dec., 1564; took part in the plot against Riccio 1565; was prominent in the movement which resulted in the seizure and imprisonment of the queen at Lochleven Castle June 15, 1570; was the next day declared lieutenant-governor of Scotland in behalf of his grandson, the infant prince James VI.; was elected regent July 12; conducted the war against the partisans of Mary; took Dumbarton Castle Apr., 1571, but was unable to secure that of Edinburgh; held a Parliament at Leith May 9, 1571, and when on his way to hold a Parliament at Stirling was attacked and mortally wounded by a party of the queen's friends. D. at Stirling Sept. 4, 1571.

Stewart (Robert). See Castlereagh, Viscount.

Stewart (William M.), b. in Wayne co., N. Y., Aug. 9, 1827; removed to Ohio with his family in childhood; prepared himself for college; spent eighteen months at Yale 1848-49, after which he left college for the gold fields of California; spent two years in the mines; commenced the study of law 1852; was appointed in the same year district-attorney for the county of Nevada; was acting attorney-general of California 1854; was a lawyer in San Francisco 1854-56; afterward resided at Nevada City and Downieville; removed to the Territory of Utah (now Nevada) 1860; sat in the legislature 1861; was a member of the constitutional convention of 1863; was elected as a Republican one of the first U. S. Senators from Nevada, and was re-elected 1869 and 1875.

Stewart Island, also called **New Leinster,** the southernmost and smallest of the three chief islands of New Zealand, is of triangular form, about 100 miles in circumference, with an area of 1000 sq. m.; consists largely of hills, of which there are three ranges, the highest summits exceeding 3000 feet; is separated from New Leinster by Foveaux Strait, 20 miles wide, and forms a part of the province of Southland.

Stewart's Creek, tp., Harnett co., N. C. P. 997.

Stewart's Creek, tp., Surry co., N. C. P. 796.

Stew'artstown, p.-v. and tp., Coos co., N. H. P. 909.

Stewartstown, p.-v., Hopewell tp., York co., Pa. P. 212.

Stew'artsville, p.-v., Robb tp., Posey co., Ind. P. 135.

Stewartsville, p.-v., De Kalb co., Mo., on Hannibal and St. Joseph R. R.

Stewartsville, tp., Richmond co., N. C. P. 1887.

Stey'er, town of Austria, province of Upper Austria, at the confluence of the Steyer and the Ens, is famous for its manufactures of machinery, arms, files, knives, and every kind of steel and iron goods. P. 13,392.

Stib'ium, the Latin name of Antimony (which see).

Stichæ'idæ [from *Stichæus*—Gr. στίχος, a "row" or "line"—the typical genus of the group], a family of fishes of the order Teleocephali and sub-order Acanthopteri, peculiar to the northern seas. The body is more or less elongated; the skin covered with cycloid scales; the lateral line sometimes absent, sometimes simple, and sometimes with ramifications and parallel branches (hence the name); the head compressed, and more or less pointed forward; the opercular bones unarmed; the mouth with a lateral oblique cleft; the upper jaw scarcely protractile; teeth present on both jaws, and sometimes on the palate; branchial apertures produced forward; branchiostegal rays six; dorsal fin very long, and sustained throughout by rigid spines; anal elongated; caudal distinct; pectorals well developed; ventrals jugular, each with two or three rays; the stomach is cæcal, and around the pylorus are developed a few cæca. The skull is depressed behind the eyes, and the skeleton offers a number of peculiarities, contrasting with the characters of the Blenniidæ and other related families. A dozen or more species are known, which, according to some authors, represent only two genera, and according to others as many as nine. Nine species inhabit the Arctic and northern waters of the Atlantic coast of America, and two (*Leptoblennius serpentinus* and *Eumesogrammus sub-bifurcatus*) are found in the New England waters N. of Cape Cod, although rather rare. Little is known of their habits, and they are of no economical value. Theodore Gill.

Stick, Composing. See Printing, by W. S. Paterson.

Stick'ing-Plaster, or **Adhesive Plaster,** for surgeons' use, is made of resin, lead plaster, and soap, melted together and spread by machinery upon stout muslin. It is an article of great value in practical surgery, but requires rather frequent renewal, as it loses its adhesive qualities. It has to be warmed before application, but is not loosened by wetting. Light adhesive plasters, court plasters, and the like, are made of silk or goldbeater's skin, covered on the adhesive side with a solution containing isinglass and gum-benzoin, while the back of the plaster receives a varnish of Chian turpentine and benzoin. These plasters are wetted before application.

Stick'leback (*i. e.* "back with spines"), a name applied to the species of the family Gasterosteidæ. This family, on the whole, agrees with the typical constituents of the order Teleocephali, but it and some others (Aulostomidæ, Fistulariidæ, etc.) exhibit important peculiarities which necessitate their isolation as an independent suborder (or, according to Cope, an order) which has been named Hemibranchii (which see). The popular designation is given on account of the stout rigid spines with

which the back is armed. The form is fusiform and more or less elongated; the body naked or covered with lateral plates; the lateral line little defined and continuous; head compressed, conic, or more or less produced forward; cheeks covered by the enlarged second suborbital bones; opercular bones unarmed; mouth terminal, and with an oblique lateral cleft, but rather small; teeth villiform, and confined to the jaws and pharyngeal bones; branchial

The Stickleback (*Gasterosteus aculeatus*).

apertures continuous below; branchiostegal rays three on each side; dorsal fin represented by a variable number of free stout spines (2–15) and an oblong fin with articulated rays; anal fin obliquely opposed to the dorsal; caudal well developed; pectorals well developed, and separated by a broad area from the head; ventral fins represented by enlarged spines with an axillar ray each, and inserted more or less behind the basis of the pectorals. The stomach has pyloric cæca in small number (2), and the air-bladder is simple. The forms agreeing in these characters are differentiated by others, and several quite distinct generic types exist. These are (1) *Gasterosteus*, which has two or three free dorsal spines; (2) *Pygosteus*, which has seven to nine free dorsal spines; (3) *Apeltes*, which is distinguished by the absence of a bony cuirass between the ventral fins; and (4) *Spinachia*, peculiar in the family for its elongated form and the large number (15) of dorsal spines. Co-ordinated characters exist which serve to combine the first three genera in one sub-family (Gasterosteinæ), and the fourth in another (Spinachiinæ). The Gasterosteinæ are inhabitants of fresh and brackish as well as salt water, and the freshness or saltness of the water seems to be a matter of indifference to them; the Spinachiinæ, however, are confined to salt water almost exclusively. *Gasterosteus* and *Pygosteus* are found in North America, as well as Europe and Asia; *Apeltes* is confined to North America, and *Spinachia* to the seas of Northern Europe. The species are all small, rarely exceeding six inches, and generally very much less. Although so small, they are nevertheless extremely pugnacious and voracious, and attack without hesitation animals many times larger than themselves. The females are plain-colored, but in the breeding season the males assume resplendent hues, which render them quite attractive, and which are very changeable and affected by the nature of the ground as well as their passions. The most notable peculiarity about them is the care which they take of their young. The species are all, so far as known, nest-builders, and construct quite elaborate receptacles for their eggs; but the males do all the work. The nests of the different generic types differ in details. They are all, however, formed of particles of grass, roots, sticks, or leaves, which are united together by a viscid mucus or kind of silk-like thread exuded from the body and wound round the material collected. The *Gasterostei* excavate a cavity at the bottom of the water, and, laying therein the foundations, build up the sides and roof. The *Pygostei* select adjoining reeds some distance above the bottom, and construct their nests in mid-water. In all cases an aperture is left, and elaborately prepared at the side for the entrance of the female. After the nest is ready, the male seeks out a gravid female, conducts her to the nest, and she deposits a few eggs, and then escapes by an aperture already made or which she herself makes opposite to the one she entered by. This is repeated day after day until a considerable number of eggs is accumulated. Each time the male rubs himself against the female and passes over the eggs. For about a month, while the eggs are maturing, the male watches over them with jealous care, and only leaves when the young are hatched and ready to care for themselves. The eggs are large in proportion to the size of the fish, and few in number, not much, if at all, exceeding 100 in the common *Gasterostei*. This may be considered a characteristic, co-ordinated with the care taken of them. The habits of these fishes are the subject of quite an extensive literature. The number of species is doubtful, some naturalists admitting many and others few. In the North Pacific are several genera (*Aulorhynchus*, *Aulichthys*, and *Auliscops*) which are nearly related to *Spinachia*, but differ in such respects as to have been combined in a peculiar family named Aulorhynchidæ. THEODORE GILL.

Sticoah, tp., Cherokee co., N. C. P. 398.

Stieg'litz (HEINRICH), b. at Arolsen, principality of Waldeck, Germany, Feb. 22, 1803; made some desultory studies in philosophy and philology at the universities of Göttingen and Leipsic, and was appointed custos in the library and teacher in the gymnasium of Berlin in 1828; in the same year he married Charlotte Sophie Willhöft (b. in Hamburg June 18, 1806). On various occasions he wrote verses for the benefit of the Greeks, in the *Berliner Musenalmanachs*, etc. Other works are—*Bildern des Orients* (4 vols., 1831–33), *Stimmen der Zeit in Liedern* (1834), etc. To arouse the vigor of his mind, his wife stabbed herself, Dec. 29, 1834. He continued to lead a wandering life; wrote poems—*Gruss an Berlin* (1838); travelling sketches—*Montenegro und Montenegriner* (1841), *Istrien und Dalmatien* (1845); confessions—*Selbstbiographie* (1865) and *Erinnerungen an Charlotte* (1865), all lean, unimpressive, insignificant, and died of cholera at Venice Aug. 24, 1849.

Stieh'le, von (GUSTAV), b. at Erfurt, Prussian Saxony, Aug. 14, 1823; entered the Prussian army in 1840, and made his career in the staff. In 1860 he took charge of the historical department of the staff; in 1864 he made the Danish campaign in the staff of Wrangel; was ennobled, created a lieutenant-colonel and royal aide-de-camp, and subsequently military attaché in London and Vienna; in 1866 he was a member of the staff of the king, participated in the preliminaries of Nicolsburg, and carried on the final military negotiations subsequent to the Peace of Prague; in 1870–71 he was chief of staff of the second army under the command of Prince Friedrich Charles, and concluded the capitulation of Metz with Gen. Jarras, Oct. 27, 1870. After the war he was made director of the general department of war in Nov., 1871, and lieutenant-general and commander of the 7th infantry division Oct. 29, 1875.

Sti'gand (WILLIAM), b. in 1827; was educated at Shrewsbury School and St. John's College, Oxford; studied equity law at Lincoln's Inn, and was called to the bar in 1852; has resided in France, Italy, and Germany, and travelled in Spain and the Orient. He has contributed to the *Edinburgh Review* and the *Quarterly Review*, and has published *A Vision of Barbarossa and other Poems* (1860), and *Athenais, or the First Crusade*, which is only the first portion, comprising six cantos, of an epic in the Spenserian metre (1866).

Stigma. See PISTIL.

Stigmatiza'tion [from Gr. στίγμα, "a puncture"], a term employed in the legendary literature of the Roman Catholic Church to denote the miraculous impression upon certain saints of marks similar to the five wounds of Christ (*stigmata*) or of the crown of thorns. The most remarkable instances are those of St. Francis of Assisi (Sept. 15, 1224) and Veronica Giuliani (1694). Many persons, among whom was St. Catharine of Siena, are alleged to have felt at regular intervals the pain of such wounds, but without any external mark.

Stiles, p.-v. and tp., Oconto co., Wis. P. 373.

Stiles (EZRA), D. D., LL.D., b. at North Haven, Conn., Dec. 15, 1727; graduated at Yale College 1746; studied theology; was ordained a Congregational minister June, 1749; was tutor at Yale College 1749–55; engaged in a series of researches with an electrical apparatus sent to the college by Dr. Franklin, and made the first electrical experiments in New England; preached for a short time to the Stockbridge Indians 1750; studied law; was admitted to the bar 1753, and practised two years in New Haven; pronounced a Latin oration in honor of Franklin on the occasion of his visit to New Haven Feb., 1755; was pastor of a church at Newport, R. I., 1755–77; was inaugurated president of Yale College June 23, 1778; acted also as professor of divinity after 1780; delivered lectures on scientific subjects; studied several Oriental languages; carried on scientific and philological inquiries by means of correspondence with travellers in remote portions of the earth; published many addresses and sermons; was author of a *History of Three of the Judges of King Charles I.* (1794) and *An Account of the Settlement of Bristol* (1785), and left to Yale College 45 bound volumes of MSS. and correspondence. D. at New Haven May 12, 1795. His daughter married Dr. Abiel Holmes, who published his *Life* (1798) and edited the *Family Tablet* (1796), containing poems by members of the Stiles family.

Stiles (HENRY REED), M. D., b. in New York City Mar. 10, 1832; studied medicine; practised as a physician at Galena, Ill., and afterward at Brooklyn, N. Y., and filled important medical and sanitary offices in that city and in New York. Author of a *History of Ancient Windsor, Conn.* (1859), with a *Supplement* (1863), *The Stiles Genealogy* (1863), *History of Brooklyn, N. Y.* (3 vols., 1869–70),

Bundling, its Origin, etc. (1869); edited the *Autobiography of Thomas Douglas* (1856), *The Wallabout Prison-Ship*, *The Revolutionary Adventures of Ebenezer Fox*, Andrew Sherburne's *Memoirs*, and the *Prison-Ship Narrative*, and has been an important contributor to the *New York Historical Magazine*, of which he was also for some time the editor.

Stiles (William H.), b. in Savannah, Ga., about 1810; studied law; commenced practice at Savannah 1831; was solicitor-general of the eastern district of Georgia 1833–36; member of Congress 1843–45, chargé d'affaires to Austria 1845–49, and was a colonel in the Confederate army. D. at Savannah Dec. 20, 1865. Author of a *History of Austria in 1848–49*.

Stiles'ville, p.-v., Franklin tp., Hendricks co., Ind. P. 205.

Stil'icho, son of a Vandal chieftain in the Roman service; grew up in the camp, but developed such eminent talents in military, administrative, and diplomatic affairs that the emperor Theodosius gave him his niece and adopted daughter, Serena, in marriage, made him commander-in-chief of the whole military force of the Western empire, and appointed him guardian to the young Honorius. After the death of Theodosius (in 394 A. D.) Stilicho was the actual ruler of the Western Roman empire, and it is probable that he subsequently formed an idea of placing his own family on the imperial throne; he married his son to Placidia, the daughter of Theodosius, and his daughter, Maria, to the emperor Honorius. The earlier part of his career was mostly occupied by rivalries with Rufinus, guardian of Arcadius, who had received the Eastern Roman empire, and the feuds ended with the assassination of Rufinus. But soon more serious affairs demanded his attention. In 403, Alaric invaded Northern Italy, and the empire was in imminent danger. Stilicho brought in haste the legions together which were stationed in Britain, Gaul, and all along the northern frontier of the empire; defeated Alaric first at Pollentia, then at Verona, and drove him out of Italy. A second time he saved the empire. On the withdrawal of the legions from the frontiers immense swarms of Vandals, Alans, Sueves, etc., gathered under Radagaisus, invaded Italy in 406, and besieged Florence. With a small army of veterans and some auxiliary troops composed of Visigoths and Huns, Stilicho attacked them, compelled them to give battle, and routed them completely; Radagaisus was put to death and his troops were sold as slaves. In spite of these brilliant successes, his position became by degrees totally undermined. The Roman authority was much weakened in the provinces by the recall of the legions, and in some places—as, for instance, Britain—it was never really re-established. This gave rise to a general discontent among the vainglorious Roman people, and at the court, Olympius, a eunuch, succeeded in turning the mind of the young emperor from his guardian by exciting his jealousy, and even his fear. While Stilicho was encamped at Bologna, a number of his friends were put to death at Pavia under a riot which was instigated by Olympius and the emperor. In the camp Stilicho's friends demanded, for the sake of their own safety, that he should march immediately against Pavia and punish Olympius; and when he hesitated they rebelled against him. He fled from the camp and took refuge in a church of Ravenna, from which, however, he was allured, and assassinated Aug. 23, 408.

Still (John), D. D., b. at Grantham, Lincolnshire, England, about 1543; educated at Christ's College, Cambridge; took orders in the Church of England; became Lady Margaret professor of divinity at Cambridge 1570; held livings in Suffolk and Yorkshire; became prebendary of Westminster 1573, master of St. John's College 1574, and of Trinity College 1577, archdeacon of Sudbury 1577, prolocutor of the convocation 1588, and bishop of Bath and Wells 1592. D. at Wells Feb. 26, 1608. Author of *A Ryght Pithy, Pleasant, and Merie Comedie, intytuled Gammer Gurton's Nedle, played on the Stage not longe ago in Christe's Colledge in Cambridge. Made by Mr. S., Master of Arts*, etc. (London, 1575). This piece, abounding in low humor, supposed to have been written as early as 1565, was long considered the first extant English comedy, but that rank is now assigned to Udall's *Ralph Royster Doyster*.

Stillé (Alfred), M. D., b. in Philadelphia Oct. 30, 1813; graduated at the University of Pennsylvania in 1832; became resident physician at the Philadelphia Hospital in 1836; afterward studied in Paris and other European cities, and returning to America became resident physician at the Pennsylvania Hospital 1839–41; lecturer on pathology and practice of medicine to the Philadelphia Association for Medical Instruction 1844–50; physician to St. Joseph's Hospital 1849; professor of the theory and practice of medicine in the Pennsylvania Medical College 1854–59, and in 1864 in the University of Pennsylvania. Besides contributions to journals, he has published *Medical Instruction in the U. S.* (1845), *Elements of General Pathology* (1848), *Report on Medical Literature* (1850), *The Unity of Medicine* (1856), *Humboldt's Life and Character* (1859), *Therapeutics* (1860; enlarged and revised eds. 1864 and 1874), *War as an Element of Civilization* (1862), and *Epidemic Meningitis* (1867).

Stillé (Charles Janeway), LL.D., b. in Philadelphia in 1819; graduated at Yale in 1839; became professor of English literature in the University of Pennsylvania in 1866, and provost of the university in 1868. Besides several literary addresses, he has published—*How a Free People Conduct a Long War* (1862), *Northern Interest and Southern Independence* (1863), *The Historical Development of American Civilization* (1863), *Memorial of the Philadelphia Central Fair for the U. S. Sanitary Commission* (1864), *History of the U. S. Sanitary Commission* (1866), and *Memoir of Rev. William Smith, D. D.* (1869).

Stillé (Morton), M. D., b. in Philadelphia Oct. 27, 1822; graduated in medicine at the University of Pennsylvania in 1844; subsequently studied his profession in Dublin, London, Paris, and Vienna; began practice in Philadelphia in 1847; was resident physician at the Pennsylvania Hospital 1848–49; revisited Europe 1850–52, and became lecturer in the Philadelphia Association for Medical Instruction in 1857. He prepared, in conjunction with Francis Wharton, a *Treatise on Medical Jurisprudence* (1855; 2d ed., with the medical portion revised and enlarged by his brother, Alfred Stillé, 1860). D. at Saratoga Aug. 20, 1855.

Stil'lingfleet (Edward), D. D., b. at Cranbourne, Dorsetshire, in 1635; was educated at Cambridge; entered holy orders; became rector of Sutton in 1657; preacher at the Rolls 1664; rector of St. Andrew's, Holborn, and lecturer at the Temple 1665; prebendary of St. Paul's 1667 and of Canterbury 1669; chaplain to Charles II. 1670; archdeacon of London 1677, and bishop of Worcester 1689, holding also several other ecclesiastical preferments. He ranks among the foremost of English polemics, his life having been an almost uninterrupted controversy with Roman Catholics, Nonconformists, and Socinians. His collected works fill 6 large folio volumes, many of them having been frequently republished in different forms. The most important are—*Irenicum, a Weapon-Salve for the Churches Wounds* (1661), *Origines Sacræ, or a Rational Account of the Christian Faith* (1662), *Rational Account of the Grounds of the Protestant Religion* (1665), *Discourse Concerning the Idolatry practiced in the Church of Rome* (1671), *Unreasonableness of Separation from the Church of England* (1681), *Origines Britannicæ* (1685), and *Discourse in Vindication of the Doctrine of the Trinity* (1697). D. at Westminster Mar. 27, 1699.

Stillin'gia [named for Dr. Benjamin Stillingfleet, 1702–71], an interesting genus of euphorbiaceous trees, shrubs, and herbs. The U. S. have several species. *Stillingia sylvatica*, or queen's root, is an herb of the Southern States whose root has a good reputation as an antisyphilitic remedy. Our other native species are shrubs. The tallow tree of China (*S. sebifera*) is naturalized in the Southern States. It is a beautiful tree, and from its seeds the Chinese extract large amounts of a white tallow-like fat, very useful for candles. The wood is hard, and is a good substitute for box. The leaves give a black dye.

Still'man (Samuel), D. D., b. in Philadelphia Feb. 27, 1737; his parents having removed to Charleston, S. C., he was educated there, and ordained as pastor of a Baptist church in 1759; was subsequently settled at Bordentown, N. J., and finally in 1765 as pastor of the First Baptist church in Boston, where he remained until his death. He was an eloquent preacher, and a warm patriot during the Revolutionary war; was a delegate to the Constitutional Convention of 1788, and one of the original incorporators of Brown University in 1764, taking a warm interest in the welfare of that institution. He published several sermons and discourses, among which are—*On the Repeal of the Stamp Act* (1766), *Ancient and Honorable Artillery Sermon* (1770), *Election Sermon* (1779), *Hon. Samuel Ward*, preached before Congress (1776), *Masonic Discourse at Charlestown* (1785), *Fourth of July Oration at Boston* (1789), and *Washington* (1800). A volume of his sermons, with a *Memoir* by Rev. Thomas Gray, was published in 1808. D. at Boston Mar. 12, 1787.

Stills. See Distillation.

Still'water, city and tp., cap. of Washington co., Min., at the head of navigation on St. Croix Lake for large steamers, and on Lake Superior and Mississippi and St. Paul Stillwater and Taylor's Falls R. Rs., in lat. 45° N.,

25 miles from Mississippi River, 18 miles from St. Paul. A regular line of small steamers plies between Stillwater and Taylor's Falls, 20 miles above, on St. Croix River. The business portion of the city is located on a small plain surrounded by bluffs, the latter crowned by fine residences. Stillwater contains 10 churches, 2 national and 2 savings banks, a public library, and a club room, and has 3 weekly newspapers. It is the fourth city in size and importance in Minnesota. There are 9 large saw-mills, with a daily capacity of 500,000 feet, employing capital to the amount of $3,000,000. P. of city, 1124; of tp. 4506. Settled in 1843. A. B. EASTON, ED. GAZETTE.

Stillwater, p.-v. and tp., Sussex co., N. J. P. 1632.

Stillwater, p. v. and tp., Saratoga co., N. Y., on Hudson River and on Saratoga Lake, has 4 churches and numerous factories. The township includes the incorporated village of Mechanicsville and the post-village of Bemis's Heights, notable for the two battles of Sept. 19 and Oct. 7, 1777 (sometimes called the battles of Stillwater), which led to the surrender of Burgoyne. P. of v. 737; of tp. 3401.

Stilt, a name applied to birds of the genus *Himantopus* (family Recurvirostridæ), and related to the avocet. They are distinguished by the excessively long legs, the straight, slender bill, which is slightly compressed, the feet with the middle and outer toes connected by a small web and destitute of a hind toe, and the tail projecting beyond the wings. Six species of the genus are recognized by G. R. Gray as inhabitants of various parts of the world. One species is found in America, and ranges from the Northern U. S. to Paraguay. Its total length is about fourteen inches, of which the bill forms three inches, and the tail also three inches; the tarsi are about four inches in length, and rather longer than the tibiæ; the color is a glossy black on the head above, the neck behind, the back, and the wings; white on the head in front of and behind the eyes, and beneath; the bill is black, and the legs red. It not only dwells by the sea-coast, but is found far inland, at least on the lakes and rivers of the Western U. S. Individuals generally associate together in flocks of twenty or thirty, more or less. They prefer muddy flats with reedy margins. They breed in the U. S., and make nests of grasses, etc. They lay generally four eggs; these are relatively large and of a yellowish or ochraceous color, with dark-brownish blotches and lines. On the ground, whether walking or wading, according to Coues, they move gracefully and with measured steps; the long legs are much bent at each step (but only at the joint), and planted firmly and perfectly straight. When feeding, the legs are bent backward at an acute angle at the heel-joint, to bring the body lower. They feed mostly on aquatic insects, as well as the eggs and young of fishes, and small fishes of different kinds. THEODORE GILL.

Stilts [Dutch, *stelt*], sticks or crutches upon which a person stands so as to increase the length of his stride. They are usually mere toys, employed by boys in play, but in the department of the Landes in south-western France the peasantry make use of stilts as a common method of progression through the deep sands of that region. The stilts there used are sometimes very long, and the people acquire great skill in their use.

Stimp'son (WILLIAM), M. D., b. at Roxbury, Mass.; studied medicine, and has devoted himself especially to conchology, upon which he has published many papers in scientific journals and in the *Smithsonian Contributions*. Among his works are—*Revision of the Synonomy of the Testaceous Mollusks of New England* (1851), *Synopsis of the Marine Invertebrata of the Grand Manan* (1854), *Prodromus Descriptionis Animalium Evertebratorum* discovered in the Pacific expedition of Ringgold and Rodgers (parts i.–viii. 1857–60), *Notes on North American Crustacea* (1859), and *Researches upon the Hydrobiinæ and Allied Forms* (1865).

Stim'ulants [Lat. *stimulus*], a term very commonly and also very loosely used in medical parlance. It is applied to such agents as are able to promptly set on foot and keep going the immediately vital functions of circulation and respiration. Such are, pre-eminently, strongly nourishing hot food if it can be digested; if it cannot, then alcoholic or ethereal potions, ammoniacal solutions, opium, heat, etc. The term "stimulant" is also used to signify the action of a drug or poison in causing an increased display of function on the part of any particular organ or apparatus. EDWARD CURTIS.

Stines'ville, p.-v., Bean Blossom tp., Monroe co., Ind., on Louisville New Albany and Chicago R. R. P. 140.

Sting-Fish. See TRACHINIDÆ and WEEVER.

Sting'ray, a name applied to the species of the genus Trygon (family Trygonidæ). They all have the body rhombic and moderately broad, the skin smooth or provided with tubercles, the nasal valves coalescent into quadrangular flaps, the teeth flattened, and the tail long and tapering, and destitute of a true fin, and at most with cutaneous folds, which, however, do not extend to the extremity; the tail is armed with an elongated spine (sometimes with two) compressed from before backward, and with teeth or serratures at each side directed downward. These spines are the "stings" which have ensured the popular name to the forms in question. The species are quite numerous, 24 determinable and 5 doubtful ones having been recognized by Günther. They are found in almost all tropical and temperate seas, and are much dreaded on account of the wounds which they inflict with their spine-bearing tail. They can whip the tail around with great ease, and transfix the incautious intruder with the spines. Tetanus is sometimes the result, but the wound is a physical injury solely, and not the result of poison. A species (*Trygon centrura*) is quite common along the eastern coast of the U. S. (See also TRYGONIDÆ.) THEODORE GILL.

Stink'stone, a name applied to certain bituminous limestones which on being struck emit the smell of sulphuretted hydrogen. The British Islands abound in stones of this character and of various geological ages, some of them useful building-stones.

Stink'-Wood, the hard, durable wood of *Oreodaphne fœtida* (order Lauraceæ). It grows in South Africa, and is handsome and valuable, but possesses a disagreeable smell, even when seasoned. *O. fœtens*, a tree of the Canaries, has wood of a vile odor, but others of this widespread genus are of pleasing fragrance.

Stir'ling, county of Scotland, bordering N. on the Forth, comprises an area of 489 sq. m., with 98,179 inhabitants. The western part of the county is mountainous, and rich in iron, coal, and freestone. In the northern part are found large plains of a rich clayey soil, producing good wheat, barley, beans, and clover. Agriculture, cattle-breeding, mining, and manufacturing are pursued with success.

Stirling, town of Scotland, capital of the county of Stirling, on the Forth, contains a fine old castle, has extensive manufactures of tartans, shawls, rope, soap, leather, and malt, and carries on an important trade both on the river and by its extensive railways. P. 14,276.

Stirling, p.-v. of Hastings co., Ont., Canada, 15 miles N. W. of Belleville, is the seat of considerable trade and manufacturing interests. P. 779.

Stirling (JAMES), F. R. S., b. in Stirlingshire, Scotland, in 1690; educated at Baliol College, Oxford; taught mathematics for several years at Venice; conducted a nautical school on Tower Hill, London, and afterward superintended the mines at Leadhills, Scotland, where he d. in 1772. He made some remarkable mathematical discoveries in regard to Newton's "lines of the third order" and methods of differentiation, which were embodied in his Latin tracts *Lineæ Tertii Ordinis Neutonianæ, etc.* (Oxford, 1717), and *Methodus Differentialis, sive Tractatus de Summatione et Interpolatione Serierum Infinitarum* (London, 1730), and contributed to the *Philosophical Transactions* papers *On the Figure of the Earth* (1735) and *On a Machine to Blow Fire by the Fall of Water* (1745).

Stirling (JAMES HUTCHISON), LL.D., b. in Scotland about 1835; received a thorough training in literature, philosophy, and science, and is author of *The Secret of Hegel, being the Hegelian System in Origin, Principle, Form, and Matter* (2 vols., 1865), *Sir William Hamilton, being the Philosophy of Perception* (1865), *Jerrold, Tennyson, Macaulay, and other Essays* (1868), *As Regards Protoplasm* (1869), and other works, and the translator of Dr. Albert Schwegler's *Handbook of the History of Philosophy* (1867). Dr. Stirling is an opponent of Häckel and Huxley on biological theories.

Stirling (LORD). See ALEXANDER (WILLIAM), EARL OF.

Stirling (PATRICK JAMES), b. at Dunblane, Perthshire, Scotland, in 1809; studied law but never practised; became pupil of Dr. Thomas Chalmers in political economy, and published *The Philosophy of Trade, or Outline of a Theory of Profits and Prices* (1846), *Australian and Californian Gold Discoveries* (1852), and translated Frederick Bastiat's *Harmonies of Political Economy* (1860), to which he prefixed a notice of the life and writings of the author.

Stirling (Sir THOMAS), BART., of Ardoch, b. in Scotland about 1735; became a captain in the Royal Highlanders July, 1757; served under Abercrombie at Lake George 1758, and Amherst at Lake Champlain 1759, at the siege of Niagara, and the invasion of Lower Canada 1760; was stationed in 1765 at Fort Chartres, Ill., whence he marched to Philadelphia 1766, became lieutenant-colonel 1771, col-

onel 1779, and major-general Nov., 1782; served throughout the war of the Revolution; took part in the battles of Long Island, Fort Washington, Red Bank, Brandywine, and Springfield; was made a baronet and lieutenant-general 1796, and full general Jan. 1, 1801. D. May 9, 1808.

Stirling (Sir William). See Maxwell.

Stith (William), b. in Virginia in 1689; was educated in England, where he studied theology and took orders in the Church of England 1731; became in that year master of the grammar-school of William and Mary College; chaplain of the Virginia house of burgesses 1738, and president of William and Mary College and rector of Henrico parish from 1752 to his death, at Williamsburg, Sept. 27, 1755. He was a brother-in-law of Peyton Randolph, and author of a *History of the First Discovery and Settlement of Virginia* (Williamsburg, 1747; 2d. ed. 1753), of which a reprint was recently issued by Joseph Sabin (New York, 1866). It traces the history only to 1624, has been by some critics censured as inelegant in style, but is admitted to be accurate and faithful, and the work is of the greater value since the materials on which it was based were destroyed by fire.

Stitt'ville, p.-v., Trenton and Marcy tps., Oneida co., N. Y., on Utica and Black River R. R. P. 243.

Stoat. See Ermine.

Stobæ'us (Joannes) received his surname from the circumstance of his being a native of Stobi in Macedonia. Nothing else is known of his personal life, not even the age in which he lived, though it cannot have been much earlier or later than the sixth century of our era. For the instruction of his son, Septimius, he made a collection of pithy sayings on various subjects from about 500 Greek authors, and these quotations have become of great interest to us, as in most cases the works from which they were taken have perished. They are arranged in two separate works—*Anthologion* and *Eclogæ*—both edited by Meineke, the former in 4 vols. (1855–57), the latter in 2 vols. (1860–62).

Stock. See Gilliflower.

Stock, tp., Harrison co., O. P. 771.

Stock, tp., Noble co., O. P. 1650.

Stock'bridge, p.-v. and tp., Berkshire co., Mass., on Housatonic River and R. R., has 2 banks, a public library, an academy, 1 woollen, 1 paper, 4 pulp, 3 grist, and 3 saw mills; is noted for picturesque mountain-scenery; includes the beautiful Lake Mahkeenac, and has numerous villa residences, chiefly occupied during the summer by wealthy citizens of Boston. Originally called Housatonic, this township was the chief residence of the tribe of Indians of the same name, also called Stockbridge Indians, who were christianized in the eighteenth century by the labors of John Sargeant, Timothy Woodbridge, and the celebrated Jonathan Edwards (1751–57), to whose memory a monument has been erected here. The tribe, numbering 400, removed after the Revolution to Madison co., N. Y., afterward to the vicinity of Green Bay, Wis., and now reside near Fort Leavenworth, Kan. Stockbridge was the native place of several eminent persons, including Miss C. M. Sedgwick, Mark Hopkins, and Cyrus W. Field. P. 2003.

Stockbridge, p.-v. and tp., Ingham co., Mich. P. 892.

Stockbridge, p.-v. and tp., Madison co., N. Y., on Oneida Creek and on New York and Oswego Midland R. R., has 6 churches, valuable limestone and gypsum quarries, and several factories; was formerly the residence of the Stockbridge or Housatonic Indians, who came here from Stockbridge, Mass., after the Revolution, and removed to Wisconsin early in the present century. The remains of an ancient Indian burial-place and the ruins of a prehistoric fortification are pointed out. P. 1847.

Stockbridge, p.-v. and tp., Windsor co., Vt., on White River. P. 1289.

Stockbridge, p.-v. and tp., Calumet co., Wis., on Lake Winnebago, formerly the residence of the tribe of Stockbridge Indians from New York. P. 1978.

Stockbridge (Henry), b. in Hampshire co., Mass., Aug. 31, 1822; graduated at Amherst College in 1845; studied law in Baltimore, and was admitted to the Maryland bar in 1848. During the civil war he took an earnest part in favor of the Union; in 1864 was a member of the legislature, and drafted the act by which a constitutional convention was convened for the abolition of slavery in Maryland; was a member of that convention, took an active part in its proceedings, exerted himself to secure the adoption of the constitution framed by it, and defended it before the court of last resort. He instituted and conducted to a successful issue in the Federal courts proceedings by which were annulled the indentures of apprenticeship by means of which the effect of the emancipation clause was sought to be evaded, and thus secured the enfranchisement of more than 10,000 colored children in the State.

Stock Corporations. See Stocks, Law of, by Prof. J. N. Pomeroy, LL.D.

Stock'-Dove, the *Columba œnas*, a wild European pigeon, named from its habit of nesting in hollow *stocks* or tree-stumps, although it often builds in rabbit burrows, etc. It is a handsome gray bird, with a purplish breast, scarlet eyes, orange bill, and red toes and legs. It is some fourteen inches long. The young birds are prized as food.

Stock'-Exchange, an association of brokers and dealers or jobbers in stocks, bonds, and other securities created either under national, State, or municipal authority, or by corporations concerned with the business of common carriers, with mining, manufacturing, banking, or other commercial or industrial pursuits. In the U. S. such securities, when evidences of debt, importing an engagement to pay a sum of money on a future day, are denominated bonds; while under the name of stocks are included shares in the stock of corporations, representing money contributed to the particular enterprise at the outset, at the risk of the business. But State bonds are also called stocks, and sometimes stock, in the singular. In England railroad bonds are known as debentures, and seldom have the security of a mortgage, while the word "stock" is there applied: (1) to the public funds or government securities, representing money lent to the nation; and (2) to the capital stock of railway or other companies when it is not divided into shares, but is indicated as so much money, at the original par value.

Joint-stock companies, having the privilege of a limited liability of the shareholders, are among the most efficient of all the devices of modern ingenuity for the furtherance of undertakings far beyond the resources of any single individual or firm. It is a truism to say that without the aid of associated capital the grand engineering works which are a principal boast of our times would never have been possible; and it is obvious that the stock exchange acts as a powerful auxiliary to the principle of association, by attracting capital from hoards or passive investments, familiarizing the public with the comparative merits of different undertakings, holding up its attractive prizes as the rewards of judicious adventure, though, by its occasional disasters and panics, pointing out the ruinous nature of the unsound or unwarranted enterprise, and the peril which constantly attends upon over-construction and over-trading. Affording a market always at the service of any who desire to discontinue or change their investments, it has enormously enlarged the circle of investors, which would else almost have been limited to the small number of people who can hold on for a lifetime. Furnishing a demand for money on call loans, repayable at the lender's option, and secured by a deposit of pledges immediately convertible into cash, it has rendered serviceable the vast mass of floating capital always present at the chief commercial centre awaiting permanent employment.

History.—The earliest annals of the New York Stock Exchange are somewhat meagre, the great fire of 1835 having destroyed the record of the constitution adopted in 1817, the date of its first regular organization. A tablet in the wall of the present board-room declares indeed that the exchange was founded in 1792, but the evidence of so early an origin consists only in a document bearing that ancient date still preserved among the archives, and containing a mutual agreement on the part of its twenty-four subscribers that they "will not buy or sell for any person whatsoever any kind of public stock at a less rate than one-quarter per cent. on the specie value," and that they will give a preference to each other in their negotiations. Only a few of the names are recognizable as among the members of the institution established twenty-five years later, and the organization was probably quite imperfect. The business of a stockbroker early in the present century comprised dealings in sterling exchange, commercial paper, specie, and bullion, everything relating to exchanges of money, the procuring of loans on mortgage, and other miscellaneous negotiations, besides sales of the few stocks and bonds then current. Transactions were mostly at the Tontine Coffee-house, on the N. W. corner of Wall and Water streets—a place of great resort for merchants—and on the street near by, or under the shade of an ancient and famous button wood tree which grew in front of No. 60 Wall street. The revival of commerce after the war of 1812–15 gave occasion for a vigorous growth of mushroom companies and for several new local banks in or near the city, and there was soon an obvious need of a formal association of brokers. Such a need will always be felt when men congregate for the transaction of business in commodities which are liable

to sudden and wide fluctuations in price, and where bargains of magnitude require to be made in haste and without formal writings. This want led to the formation in 1817 of the New York Stock and Exchange Board. Of the founders of the association there are still (1876) two venerable survivors, Mr. John Warren (b. 1796), who only relinquished active business in 1875, and Mr. William Lawton (b. 1795). The constitution of 1817 was based upon that of the board at Philadelphia, obtained from that city by a special committee of which Mr. Lawton was one. There were at first about 25 members, and no initiation fee was required. Anthony Stockholm is believed to have been the first presiding officer. The oldest quotations appearing on the records are of date Aug. 18, 1817, as follows: U. S. 6s, 102¾@⅞; Louisiana 7s, 108¾@⅞; ditto 3s, 65; Yazoo, 79¾ bid; N. Y. State 6s, 100¼; City 6s, 101; U. S. Bank, 141 bid. Exchange: on London, par (the old par of $4.44 to the £); francs, 5 fr. 40c. (to the dollar); Amsterdam, 39. Spanish dollars, 100¾. The meetings were held in the office of Mr. Samuel I. Beebee, No. 47 Wall street, then in a room in the rear of Mr. Leonard Bleecker's, and afterward in the old *Courier and Enquirer* building, near the buttonwood tree. The revised constitution of 1820, the oldest extant, was signed by 39 members before 1821. Many of these, such as Nathaniel Prime, Leonard Bleecker, John G. Warren (father of Mr. John Warren), and Philip Kearny, were gentlemen of long experience in the banking business, and of the highest character. The tone of the old records bears witness to their nice sense of commercial honor and scrupulous regard for the right, as well as their dignified and urbane manners. The membership increased slowly until 1824, when 12 were added, including J. L. Joseph, afterward eminent as a leader; his firm were agents for the Rothschilds. In 1825 we first find the name of Jacob Little, who perhaps has had the widest reputation as an operator until recent times. Other notabilities were the Wards, Samuel, John, and Henry; and, later, Morris Franklin, the Gallatins, the Nevinses, and John Alstyne. The initiation fee was fixed at $25 in 1823; raised in 1827 to $100 and to $150 in 1833. A retiring president (as, for instance, Mr. James W. Bleecker, 1827–30) was usually presented with a service of plate, and the custom has come down almost to the present. In May, 1827, the board removed to an upper room in the Merchants' Exchange, on Wall and William streets, the windows looking out on Garden street, now called Exchange Place. The sessions were invariably secret, and it was a point of honor, then as long afterward, not to reveal the names of buyers or sellers, the dealings not being recognized by law. Small lots of stock were most common, 10 or 25 shares, and 1000 would have been a handsome aggregate for a day. Transactions were chiefly on a credit of 10, 30, or 60 days, sometimes 6 or 12 months, the property meanwhile remaining with the seller, and the buyer paying interest. A list was kept of the various securities—U. S. or State stocks, shares of the U. S. Bank, the city banks, insurance companies, etc.—and these, in their order, were called up one by one. Dealings were allowed in each security only as it was reached in turn, and when the list was exhausted, business closed for the day. The secretary kept a record of all bargains, and the minutes, read over at the conclusion, were final evidence of the terms of contracts. This *call* of stocks long continued the model after which the business was conducted, and as to all but the active speculative shares it is still observed. When a contract matured, the seller delivered the property to the buyer by going to the transfer-office of the company issuing the stock and making an assignment to him of the required number of shares. When the stockholder of record could not personally attend, he gave a warrant of attorney to a third party to effect the transfer. This warrant, sometimes signed in blank, might be filled up by the holder with the name of the attorney. The buyer might or might not take out a certificate of stock, the company's books being sufficient evidence of ownership. He was bound to make payment in full, and in strictness might be required to furnish bank-notes or a certified check, though in early days such a demand was rare. The custom of delivery by transfer continued until a recent period, except in the case of companies having no transfer office in New York, when the seller might tender a certificate, accompanied by a power of attorney to effect a transfer on the books of the corporation wherever kept; this latter is now the usual method. The call ended, the brokers returned to their offices to make private record of their doings and report to clients. In process of time a second though informal call was held in the afternoon. The generally steady growth of the board was checked by a severe panic in 1826. By 1830 several railroad stocks had come into the market, such as Mohawk, Catskill, and Harlem. Morris Canal and Delaware and Hudson Canal also became active. In 1834 the trade in U. S. stocks was of such magnitude and the fluctuations so violent that the "Union committee" of that day addressed a remonstrance to the board against "excessive speculations" (meaning chiefly the time-bargains at long-sellers' options), "tending to breed distrust and unsettle confidence," though the board in a dignified tone declined to recognize the propriety of "this interference." The prosperity of the association from time to time may be fairly estimated by the amount of its annual charitable donations—$550 in 1825, and so nearly every year, with occasional extra gifts, until 1836, which marks a high tide with a regular appropriation of $2100. In 1838, $1000 were contributed to the relief of sufferers by the great Charleston fire. These charities, more liberal than they now seem, are entitled to rank with the gift of $5000 to the Sanitary Commission twenty-five years later, since even in 1840 the board had only 87 active members. After the fire of 1835 the sessions were for some years held at a hall in Jauncey Court. The five years following the financial crash of 1837 were characterized by depression in the stock business as in the general trade of the country. In 1840 the surplus fund, about $20,000, was distributed among the members, many of them finding the dividend of about $200 very welcome. The initiation fee from $350 was reduced to $200, and in 1843 the officers' salaries were cut down nearly one-half. After the return of the board to a hall in the (rebuilt) Merchants' Exchange in 1842, serious detriment was experienced from a rival organization called the "Bourse," composed partly of former members of the board who had obtained discharges in bankruptcy under the U. S. law of 1841, but were not, by the rules of the Stock Exchange, entitled to readmission. This Bourse, or "open board," met at a lower room in the Exchange building. By 1846 most of its members were absorbed by the regular board, and its sessions discontinued. The year 1844 was distinguished by a long-remembered panic (June 12), with a sudden fall of 30 to 40 per cent. in some stocks.

The downfall of the "Bourse" was the signal for renewed prosperity in the Stock Exchange. The initiation-fee was advanced to $400, and many new members were received. During the ten years following, railway construction proceeded with rapidity, the volume of business, both speculative and for investment, increased many fold, and the basis for improvement was substantial, depending, not as in 1835–37 on an inflated currency, but on actual progress of the railway system, especially toward the West, and in part on the earnings of completed roads. A further stimulus was given by the influx of gold from the California mines. A rude shock was indeed experienced in 1854 from the frauds of Robert Schuyler, president of the New York and New Haven R. R. Co., who issued spurious certificates of its stock to the amount of $1,900,000, but the business of the street, with that of the country, soon recovered. Its activity was greatly heightened by the excessive issues of bank-notes, until in 1857 the sudden failure of the Ohio Life and Trust Co. brought on a panic of extreme severity, with an enormous decline in shares, wide-spread insolvency, and the serious crippling of many solid railroad enterprises. The fall brought large profits to a few who had looked for it, and who stood "short" of stocks, some contracts for future delivery having been settled at a profit of 50 to 80 per cent. to the bears. Quotations ruled very low for the next four or five years, stocks which now hold a high rank having been depressed in 1859–61 to 5 per cent. of their par value, since it was then doubtful whether the properties could be saved from foreclosure under mortgages. The tide first decidedly turned after the passage of the legal tender act, or after Congress most injudiciously took away from the U. S. notes their right of conversion into bonds. The outbreak of the civil war was met by a burst of loyal enthusiasm in the Stock Exchange, evidenced by liberal gifts of money, resolutions of sympathy with those of its members who volunteered, and a vote of all the surplus in the treasury in aid of the national cause. Securities of the rebellious States issued after secession were forbidden to be dealt in. The rising tide of irredeemable paper soon told upon prices, and the years 1862–63 witnessed a general advance. The U. S. loans were on a scale quite too large for the means of New York capitalists alone, though their subscriptions were most liberal, but all the new national securities were heartily welcomed to the list, and the first offer at the board to sell U. S. stocks "short" was indignantly rebuked. The suddenly-acquired riches of contractors, and the presence in New York of large amounts of Southern capital, served to fan the flame of speculation in stocks and gold, which soon attained a great height. A sudden turn of the screw by Secretary Chase in 1864 produced a fall (in Fort Wayne from 152¾ to 101) known as the Morse panic, from the failure of Anthony W. Morse, a wild leader of the "bull" movement; but the reign of high prices was in a few months restored, and the brokers were all too few for the

business crowding upon them. The sessions of the board were too few and too short; even the day was too short; the market opened before 9 A. M., filled the street and the sidewalks near the Exchange, continued through the daylight, and was then adjourned to the Fifth Avenue Hotel, where an excited crowd found midnight come too early. A new open board, organized 1863 in a William street basement, historically known as the "Coal-hole," had several hundred members and transacted an enormous business. An evening exchange up-town was the scene of great traffic until its excesses compelled the down town board to suppress it in 1865. The "open board of brokers" soon had a fine hall of its own on Broad street, and acquired an importance for numbers and wealth which in 1865 69 brought to it a full half of the speculative business. The existence of two rival associations was found inconvenient, and after long warfare and negotiation a consolidation was effected in 1869. A branch of the old board, called the government stock department, was also absorbed. The initiation fee for new members was raised from $3000 to $10,000, but memberships were made transferable, subject to an election as usual, and to the payment of $500 besides the purchase-money. Members have since been received only by purchase, the market-price of seats having varied between $8500 at the highest and $2500; an average of about $5500 is near the present value. From Dec., 1868, to Apr., 1876, 482 seats were sold, changing nearly half of the entire membership, which numbers 1060. In cases of failure, and inability to settle with creditors within a reasonable time, sales are compulsory, proceeds being divided among board-creditors, and any residue paid to the outgoing member. The government of the board, originally a democracy, was vested in a committee of forty, who are classified, and only one-fifth elected in each year. A sub-committee of fifteen decides upon the admission of new members, ten affirmative votes being requisite to an election.

The Black Friday gold-panic of 1869 was followed by many disasters at the Stock Exchange. The great fire at Chicago in 1871 occasioned a decrease of more than 200 millions in the market-value of securities dealt in at the board, numerous failures resulted, and the recovery was not rapid. The Boston fire of 1872 was less severely felt, though its consequences were serious. But the panic of 1873, precipitated by a discovery of unsoundness in one or two leading banking-houses, though caused by excessive outlays of capital in unnecessary and unprofitable railroad construction brought suddenly to a standstill, probably surpassed all others known to this country in duration, intensity, and destructiveness. The board was closed for ten days, during which period all dealings were irregularly effected in the streets; there existed no means of enforcing contracts; and, as confidence in the solvency of the banks was impaired, and those institutions generally declined payment in money, there was hardly any circulating medium. The life-blood of trade was so nearly wanting that 1 per cent. per diem was gladly paid for the use of large sums of money. Adjustments were mostly effected by compromises, as after the unprecedented decline both bulls and bears were involved in a common disaster. The Granger movement at the West during the two following years aggravated the depression and checked recovery, nor was the restoration of confidence in any way helped by the fresh issues of U. S. notes, as these gravitated to New York, and there long continued idle. Periods of spasmodic activity in the stock-market occasionally recur: on single days of great excitement the sales have aggregated 450,000 shares, but 200,000 would represent a good day's business. Of this only a very small fraction is done at the various *calls*. The trade in active stocks is continuous throughout the day from the opening at 10 o'clock until the close at 3. A separate group in the board-room is devoted to each security. A call of the whole list of stocks twice a day is kept up as a matter of form, and is of service in the case of a few inactive stocks. The government, State, and railroad bonds, bank stocks, etc., also have their separate calls daily in an upper room devoted to the purpose, but the transactions in these are comparatively small.

The sales are all reported to the various brokers' offices immediately on their occurrence by means of an ingenious printing telegraph, a recording instrument being placed in each office. A complete history of each day's operations is thus spread out under the eyes of clients, who can watch its gradual development. The recording instruments number more than 700, and are found in the principal hotels and other places of general resort throughout the city. A few exist in other cities, such as Boston and Philadelphia, placing the subscribers in instantaneous communication with the New York stock-market. A printed list, comprising all the transactions of each day, is made up by a printer in the employ of the board, and copies are furnished to the newspapers, giving the greatest publicity to a business which was formerly shrouded in mystery. In these reports of sales abbreviations occur which are not plain to the uninitiated—viz. *b. c.* means between calls; *c.* is cash or for ready money; *s3* or *b3* means for delivery at the buyer's option or seller's option within three days; *s60, s30, b30, b60*, are intelligible in like manner; *opg* is for delivery at the opening of the books of transfer; *xd* is less the dividend. Applied to bonds, *c* means coupon and *r* registered.

From 1854 to 1857 the sessions were held in a room over the Corn Exchange Bank, and afterward in a hall in Lord's Court on Beaver street. The removal to the present spacious building, erected specially for the use of the board, took place in Dec., 1865. The structure is of the most solid and durable character, thoroughly fireproof, and, if not of great outward architectural pretensions, well adapted to its purpose. It is 44 feet in front on Broad street, 86 on New street, the depth between the two being 165 feet. A wing on Wall street gives a third entrance. The extreme height is 75 feet. The board-room, 82 by 54 feet, and 48 from floor to ceiling, is at the New street end. A gallery at its south side is open to visitors. The room devoted to dealings in bonds is in the second story, fronting Broad street, and the floor above contains the committee-rooms. The extensive vaults under the Stock Exchange are most admirably suited to the safe-keeping of securities and other valuables. They contain more than 700 safes, the rental of which, largely derived from non members, is the source of a handsome income. From the visitors' gallery the board-room presents a scene of apparent confusion and turmoil, but the seemingly inarticulate noises and the frantic gestures are no real indication of a distracted mind. The brokers perfectly well hear and understand so much of the loud talk as specially concerns themselves. A chairman presides during the whole day. When called upon to settle disputes, if unable himself to decide, he submits the question to a vote. He preserves a kind of order by occasional vigorous raps of the gavel and by inflicting fines. The number of brokers usually present is 200 to 400, reaching 600 or 700 on a busy day. The accidental intrusion of strangers on the floor, despite the vigilance of the six doorkeepers, is punished by severe though playful hustling —a practice well known also on the London Stock Exchange. The intruder is summarily ejected after being roughly handled. New members have usually a rude greeting on their first entrance. A part of the room is occupied early in the day with loans of stocks for use, and later with call loans of money on stock collateral. These loans were formerly effected on the sidewalk at great inconvenience. The rates for money have at times been distressingly dear, partly because of the usury law, which would forbid a loan at 8 per cent., while for a loan at 7 the borrower has paid a commission of $\frac{1}{8}$ or $\frac{1}{4}$, or in extreme cases 1 per cent., and this for a single day—say 360 per cent. per annum. The money-market has been known to be in a state of such stringency for weeks, or even months, together. But the panic of 1873 was succeeded by a long period of ease and low rates of interest on call-loans, averaging hardly 3 per cent.

The mass of stocks daily bought and sold, or borrowed and lent, sometimes amounting in value to 100 millions, is paid for by checks on city banks, and the varying volume of these transactions is responsible for the greater share of the bank clearings. The latter, therefore, are not, as has been supposed, any fair index of the general movement of commerce. They rather show the activity of the stock-market and the daily shifting of stock loans. Ineffectual efforts have been made to accomplish the settlements by some system of paying differences without handling the property. The London method of settling on the account-day, twice a month, has had advocates, but our system is preferable in point of safety. Failures are less frequent where the solvency of operators is brought to a daily test.

The model of transactions in stocks is the method of an investor buying for permanent holding. He pays down the full price, and the stock is delivered to him or to a broker on his behalf. If the client desire to buy more stock than his ready money will pay for, the broker may provide the means from a loan on hypothecation of the stock. As loans are easily procured to an amount within 20 per cent. of the market-value, the client advances no more than the difference between that value and the sum borrowed. This difference is called a *margin*, and so long as the loan can be continued or renewed the broker can carry the stock until it may suit the client to realize. A decline tends to exhaust the margin, increasing the difficulty and hazard of carrying. The broker calls on his principal for further margin, and if this be not furnished sells out the stock. If many are carrying stocks with a scanty provision of clients' money, they may be compelled to realize all at once, depressing the market still further. The compensation for losses by a decline is found in the position of the *bears*—namely, those who, anticipating a fall, have contracted to

deliver stocks on a future day at a fixed price, and obviously can buy at any lower price with profit. These contracts, called *short sales*, are made deliverable, at the seller's option, on any day within a certain time, say 3, 10, 30, or 60 days (but not longer), and are described as seller, 3, 10, 30, or 60. If the contract be for more than 3 days, the seller must give one day's notice before delivery. Short sales may also be made for *cash*—namely, deliverable on the same day, or for the following day (known as *regular way*). The seller then, having no stock of his own, borrows from a third party, to whom he advances, as security, a sum equal to the current price, makes his delivery, awaits a decline; buys as he can, returns his borrowed stocks, and reclaims the money advanced. Purchases by the bears check a decline, and often prevent panics. In distinction from the bears, those who carry stocks for a rise are called *bulls*, and are said to be *long*. Novices in speculation are generally bulls.

The hazard attending an excessive bull speculation has its counterpart in an oversold market—when, namely, too many operators have made contracts for future delivery, or are borrowing stocks which they have sold and delivered. Any cause tending to advance prices with suddenness may then compel a large number to come in as buyers to cover their engagements. If the stocks required are, by chance or design, nearly all concentrated in the hands of one party, called a *pool*, that party may be able to exact a very high price from the bears. This is called a *corner*. The bear's method of dealing is equally legitimate with that of the bull. He often furnishes a supply of stock which could not elsewhere be obtained, no actual holders desiring to sell. But the bear assumes the risk of a corner. The chief corners have been—Morris Canal, 1835; Harlem, 1835 and 1864; Erie, 1846; Prairie du Chien, 1865; Michigan Southern, 1866; Reading, 1871; and North-western, 1872. Bears were forced to buy North-western at 230 which they had sold at 85 and 90; Harlem and Prairie du Chien were similarly advanced. The obligation of contracts being absolute, their performance, under no matter what difficulties, is enforced by the board, under penalty of suspension for default, and the party entitled to receive stocks may name his own terms to the seller, just as the latter may do when the conditions are reversed. But justice, if not tempered with mercy, is sometimed stayed by considerations of prudence.

The rate of commissions was ½ per cent. on the market value until 1840, when it became ¼ on the par value. It was reduced to ⅛ in 1861, and so remained for many years. After a reduction to $\frac{1}{16}$, the rate of ⅛ per cent. was restored in 1875. To board members the charge is $\frac{1}{16}$, or, in case the principal is substituted on the day of the bargain, $\frac{1}{32}$ of 1 per cent. On all contracts longer than 3 days, 6 per cent. interest is paid by the buyer. On 3-day contracts no notice need be given of the intention of the buyer to receive or that of the seller to deliver. At maturity, if not sooner, actual delivery of the property must be made. Either party may exact security for fulfilment by a mutual deposit of money in a trust company.

The Stock Exchange has been the object of much unreasoning and unmerited censure, and its contracts stigmatized as wagers and gambling transactions which could not be enforced at law. Indeed, before the act of 1856 the aid of legal process to collect a balance due to a broker was denied. Naturally enough, the broker insisted on a moneyed guaranty in his own hands, and was tempted to regard the public as his settled enemies. Having, as toward his fellow-brokers, no reliance save in their honor, he all the more dearly prized that honor. Long experience has taught him that a broker's word is as good as another's bond. Bargains involving large amounts he makes in haste, in the confusion of a crowded room, without witnesses or written memorandum, but he finds that the engagements, sanctioned by honor and conscience alone, are faithfully kept, even at enormous pecuniary sacrifices. Disputes, of rare occurrence, are almost invariably the fruit of honest mistake. The few recorded instances of fraud, not more than six in a history of sixty years, have generally been found among new comers, not regularly bred to the profession, and have invariably been punished by summary expulsion. People who are loudest in denunciation of stockbrokers are not seldom those who have not treated brokers with common fairness and equity, or have made losses in the stock-market by an extent of over trading which borders upon fraud, and so have acquired obliquity of vision and a soured temper. Excessive speculation in stocks—namely, that which goes beyond ability to pay losses—is equally reprehensible with over-trading in any other sort of merchandise, but not more so. Stockbrokers certainly will not suffer in a comparison with other men of business in point of integrity and trustworthiness.

The Stock Exchange has always refused to accept an act of incorporation, and remains a mere club or voluntary association. But the government of the majority has at times seemed at once despotic and capricious.

The presidents of the Stock Exchange, with dates of election, have been—

A. Stockholm	1817	W. R. Vermilye	1861
G. S. Mumford	1818	A. B. Baylis	1862
Edward Lyde	1824	H. G. Stebbins	1863
James W. Bleecker	1827	W. Seymour, Jr	1864
R. H. Nevins	1830	R. L. Cutting	1865
John Ward	1832	Wm. Alex. Smith	1866
Robert D. Weeks	1834	John Warren	1867
R. H. Winslow	1834	Wm. Searls	1868
Edward Prime	1835	W. H. Neilson	1869
Robert D. Weeks	1835	W. Seymour, Jr	1870
David Clarkson	1837	W. B. Clerke	1871
Henry G. Stebbins	1851	Edward King	1872
C. R. Marvin	1852	H. G. Chapman.	1873
John H. Gourlie	1856	G. H. Brodhead	1874
H. G. Stebbins	1858	G. W. McLean	1875
W. H. Neilson	1859	S. T. Russell	1876

And the secretaries—J. Benson, 1818; I. Isaacs, 1824; Bernard Hart (one of the signers of 1792), 1832; G. H. Brodhead (assistant 1849), 1855; B. Ogden White, 1870. Treasurers—James W. Bleecker, 1833; Le Grand Lockwood, 1862; W. A. Smith, 1863; and D. C. Hays, 1866. The duty of calling stocks, performed by the president until 1853, has ever since been discharged by Vice-President M. A. Wheelock (who is, however, now called the chairman), assisted by Vice-Chairman James Mitchell, who has held office since the consolidation.

Stock Privileges.—These are either *puts* or *calls*, or some combination of both. A *put* is a privilege to sell a given stock within a given period at a certain price. The maker of the put stands ready to buy under those conditions if the holder should determine to sell. A *call* is a similar refusal or privilege to buy a stock at a given price within a given time, and the maker stands ready to deliver the stock if called for according to the terms specified. A put and a call may be combined in one instrument, the holder of which may either buy or sell as he chooses at the fixed price. The cost of privileges varies with the length of time they may have to run, the distance of the price named in them from the market-price on the day when made, the activity of the market, and so on. Privileges are partly like policies of insurance, and partly like tickets in a lottery, and it is only in exceptional cases that they are sources of profit to any but the person issuing them. Suppose a put on Rock Island at 100 in 60 days, the market-price now being 105. The holder of the put may buy at 105, and will then be guarantied against any more than 5 per cent. loss. If he should be able to sell Rock Island at 110, he would gain 5 per cent. If, instead, he omits buying until the price is 90, he will gain 10 per cent. by delivering according to the put, if he cannot, before the expiration of 60 days, sell at anything above 100. If none of these favorable turns of the market occur, he loses the price originally paid for the put. The operation of a call is precisely similar in principle. Privileges are little dealt in except by a class of brokers not connected with the board.

Relief Society.—This society was established 1858 on account of distress among the brokers resulting from the panic of 1857. The dues of its members were $12 a year until 1866, when they were abolished, as the accumulated fund had risen to $40,000. It now amounts to $100,000. Its members number about 200, and no more are admitted. The very few beneficiaries receive $20 per week.

Life-Insurance Department.—The Stock Exchange is pledged to pay the sum of $10,000 to the legal representatives of any member within one year after proof of his decease. This payment is a gratuity, free from all claims of creditors, and its benefits extend as well to families of suspended members—namely, those who are in temporary difficulty. For the purpose of keeping up the gratuity fund an assessment of $10 is at every death levied upon each surviving member, and in addition the fund receives one-half of the entire surplus income of the board. Payment is made, one-half to the widow and half to the children; if there be no widow, then the whole to the children; if neither widow nor children, then to the legal representatives. The system has (1876) been in operation three years, during which period the deaths have numbered 34, the low average being due to the constant renewal of the membership, keeping down the average age. The accumulations of the fund will in about twelve years enable the board to discontinue the assessments.

NEW YORK GOLD EXCHANGE.—On the suspension of specie payments in 1861 gold was not at once demonetized. The premium was only 3 per cent. in May, 1862. But with inflation the superior medium was gradually driven out of circulation, hoarded or exported, and became an article of merchandise, dealt in at exchange-offices, at the Stock Exchange, and, later, at Gilpin's reading-room on William

street, the birthplace of the Gold Exchange. This latter, established Oct. 10, 1864, after gold had reached its highest price of 285 (July 11), removed to its present commodious quarters in 1866. It has 486 members, of whom 240 are also members of the Stock Exchange, but the two organizations are entirely distinct, and were at one time almost hostile. The gold premium, another name for the discount on U. S. notes, was the barometer of our national credit during the civil war, and since 1865 has been a measure of the greater or less expectation of a speedy return to specie payments. While the war lasted the gold market was extremely sensitive to reports of military success or failure, and was in some measure controlled by the fears, hopes, or designs of politicians. Most of the decisive events of the war had less apparent influence upon the price than was properly their due, since they were generally anticipated by speculators.

Bargains in gold are chiefly made for delivery on the day following. Settlements were at first effected by actual handling of coin, and it was often necessary to send a heavy truck from office to office with bags of gold. This cumbersome and hazardous practice gave way to a system of depositing coin in the Bank of New York, and handing over its certified checks. These checks were forged in 1865 to a large amount. The next device was the use of engraved U. S. treasury certificates of deposit, issued for that purpose. But a serious loss of these by theft gave occasion for the establishment in 1866 of the Gold Exchange Bank, which has ever since acted as a clearing-house for the exchange. Transactions aggregating 100 to 200 millions a day have been settled with actual handling of no more than 2 or 3 millions, and these in treasury certificates. The clearings for single years have averaged over 50 millions per diem.

Fortunes were made by the bull speculators in gold before 1865, and again by bear operators in the long decline from 285 to 110. The latter movement was, however, much impeded by the excessive short sales and the difficulty of borrowing gold from day to day. A bonus of ½ to 1 per cent. per diem for its use was frequently paid for months together, the available stock of coin having run very low after the free exports. The quantity of gold within reach in New York City was at one time no more than 6½ millions, with a short interest twice or thrice as large. An oversold market furnished the occasion, on Sept. 24, 1869, to put up the price in a day from 141 to 162½, with the swindling device of employing a broker to buy at the extreme rate, and then deliberately to repudiate his purchases. The result was the Black-Friday panic, and the differences arising out of those operations were not adjusted for six years afterward. Both sides of the market were almost equally dangerous, since the default was common to both. The clearings of the previous day were 325 millions, and gold balances 6½ millions. The contracts of Friday aggregated 500 millions, but they were not cleared, as the machinery of the gold clearing-house was broken down, and its operations were restrained by legal process for two months. On the day after its reopening the total clearings were less than 7 millions.

The Gold Exchange has since played a less prominent part, and the price of its memberships, at one time $4000, is now about $500, the board being doomed to extinction on the restoration of specie payments, if not sooner. But meanwhile the wants of importing merchants furnish a real occasion for its continuance, and speculation in gold, whether for a rise or a fall, has a certain importance and exhibits much vitality.

Other Exchanges.—The Philadelphia Stock Exchange was founded about 1800, and had at first only 10 members; the present number is 205. As its first constitution was a pattern for the New York board, so it has of late years borrowed from the latter some of its best features. Memberships are transferable, and purchasers pay a fee of $250 on election. The annual dues are $10, besides fines. The routine of business resembles that at New York, but a portion of the settlements are effected through a clearing-house. A life insurance department has been added, giving $2000 to each deceased member's family. Boston, which is the natural home of numerous mining enterprises, particularly those concerned with the rich copper and silver mines of Lake Superior, has a board of stockbrokers with 88 members. Its organization dates from 1834. The Baltimore exchange, organized 1841, consists of 46 members, and has a fair trade in local securities, besides a good deal of business with New York brokers. Indeed, the boards of all these three cities furnish many orders to the Stock Exchange at New York, which is the centre of speculation in the U. S. San Francisco has three boards, the chief of which, founded 1862, has only 100 members, but its seats are worth $30,000 each. They yield large dividends, and the accumulated fund amounts to $250,000. The others, called the Pacific and the California, though of very recent origin, have a prosperous business. The dealings are wholly in mining shares. The works relating to Wall street and the stock-market which have appeared of late years are, so far as known to the present writer, largely sensational and made up of hearsay. He is indebted for valuable information to Mr. W. Lawton of New Rochelle, as well as to many fellow-members, among them Ex-President Brodhead, Mr. Charles Graham, and Mr. Secretary White; the last-named gentleman having kindly given him access to all the original records. (See also STOCKS, LAW OF.) STRONG WADSWORTH.

Stock'fish, a term used in commerce for salted and dried codfish and related species. The fishes are taken care of as soon as convenient after being caught, split from head to tail, and the vertebral column in part taken out; they are then thoroughly washed and rid of the blood; after the water has been drained off, they are put in large vats, salted, and heavy weights are imposed; they are next washed and brushed, and laid out on the sandy shore and rocks. Finally, they are combined in small heaps, and become ready for the market, this stage being indicated by the assumption of a floury whitish appearance, technically designated as the "bloom." THEODORE GILL.

Stöck'hardt (JULIUS ADOLF), b. at Röhrsdorf, Saxony, Jan. 4, 1809; was educated in a drug-store at Liebenwerda; studied chemistry at Berlin; was a teacher at Dresden, Chemnitz, and finally professor at the College of Thorand; edited *Das polytechnische Centralblatt* 1846–49, *Die Zeitschrift für deutsche Landwirthe* 1850–55, and *Der chemische Ackermann* 1855. He has also given numerous lectures on agricultural chemistry at fairs, farmers' clubs, etc., which have contributed much to elevate agricultural industry in Saxony. His principal writings are *Schule der Chemie* (1846), translated into English by G. H. Peme (Cambridge, Mass., 1850) under the title *The Principles of Chemistry illustrated by simple Experiments; Guanobüchlein* (1851), *Chemische Feldpredigten* (1851), translated into English by J. E. Teschemaker under the title *Chemical Field-Lectures for Agriculturists* (Cambridge, Mass., 1853).

Stock'holm, the capital of the kingdom of Sweden, with 150,446 inhabitants in 1874, beautifully situated at the outlet of Lake Mälar in the Baltic, is divided into (1) *Staden*, the inner city, consisting of the islands of Stadsholmen, Riddarholmen, and Helgeåndsholmen; (2) *Norrmalm*, the northern part, connected with the inner city by a magnificent bridge of granite; (3) *Ladugardslandet*, communicating E. with Normalm; (4) *Kungsholmen*, communicating W. with Norrmalm; (5) *Södermalm*, the southern suburb, connected with the inner city by two drawbridges; and (6) *Saltsjö-öarne*, comprising the islands of Skeppsholmen, Djurgården, Kastellholmen, and Beckholmen, which complete the picture of an island city cut up and traversed in all directions by water. In Staden, which mostly consists of narrow and irregular streets, and is surrounded with a quay, the most prominent building is the royal palace, one of the most beautiful in Europe (built 1697–1754), in the Italian style, and containing a rich library; here are also the palace of the stadtholder, the mint, the town-house, the church of St. Gertrude, Storkyrkan, and the Finnish church. None, however, of the churches of Stockholm have any architectural merit. Of monuments Staden contains the obelisk and the statues of Gustavus IV. and Charles XIV. John. In the island of Riddarholmen stand the Riddarholm church, containing the royal tombs, among which are those of Gustavus Adolphus and Charles XII.; the new house of deputies; and the statue of the founder of Stockholm, Birger Jarl. The bridge which leads from the inner city across the Helgeåndsholmen to Norrmalm is 380 feet long and 64 feet broad; on its eastern side extend the most beautiful promenades of the city, Strömparterren. Normalm has the finest streets, especially the Drottninggata, and the most remarkable public squares. In front of the bridge is Gustavus Adolphus Place, containing the equestrian statue of this king, and enclosed with palaces; the royal theatre is situated here. This part of the city also contains the Brunkeberg Place, the Hay Market, and the place of Charles XIII., surrounded on three sides by rows of linden trees, on the fourth by the sea, and ornamented by the statue of Charles XIII.; the palace of the princes, the Hammer museum, the academy of fine arts, the academy of science with rich collections, the observatory, the national museum, the Clara church, Bethlehem church, the Baptist church, the new synagogue, and the Fersen Terrace, which offers a magnificent prospect. Ladugårdslandet contains the arsenal, the barracks, the veterinary school, the academy of arboriculture, and the Hedwig Eleonora church; the Kungsholmen, the Seraphim hospital, the Carolinian

institute, the garrison hospital; and close by are Mariaberg, the military high school, and Carlberg, the cadet school. In Södermalm are Morebakken, which presents the finest view of the city, the house of the celebrated scholar and spiritualist Swedenborg, and the Catharine and Maria Magdalene churches. Södermalm and Norrmalm are connected by a railway which for boldness in construction hardly has any equal in the world. The central dépôt in Norrmalm is a fine, and, next to the royal palace, the largest, building in the city. Of the Saltsjö öarne, Skeppsholmen is connected with Norrmalm, Kastellholmen with Skeppsholmen, and Beckholmen with Djurgården by bridges. Djurgården, a park of considerable size, is the general resort for amusement and recreation of the city. Communication between the various parts of the city is generally carried on by *angslupar* (small steamboats), which traverse the waters in all directions, with fixed routes and a cheap fare. The surroundings are rich in beautiful points, palaces, and villas, of which the royal summer palace, Drottningholm, is the most noticeable. The city possesses excellent waterworks. Of its institutions for art and science Fria Konsternas Academien, Landtbruks Academien, Musikalska Academien, Vetenskaps Academien, and Karolinska Institutet deserve to be mentioned. Benevolent institutions and schools of all kinds are numerous. The industry is considerable, especially in manufactures of tobacco, leather, linen and cotton fabrics, iron, sugar-refining, etc. The commerce is also considerable, though navigation is closed each year for about five months, during which the harbor is covered with ice.

The city was founded toward the end of the twelfth century by Birger Jarl. In 1389 it was taken by Margrethe, queen of Denmark. On Oct. 11, 1471, the Swedes under Sten Sture defeated the Danes at Brunkeberg, close by Stockholm, and drove them out of the country; but in 1520 they again took the city under Christian II., and the Stockholm massacre took place. During the peaceful times of the nineteenth century the prosperity of the city, like that of the whole country, has much increased.

AUGUST NIEMANN.

Stockholm, tp., Wright co., Minn. P. 534.

Stockholm, p.-v. and tp., Pepin co., Mo., on Mississippi River. P. 499.

Stockholm, p.-v. and tp., St. Lawrence co., N. Y., on St. Regis River and on Ogdensburg and Lake Champlain division of Vermont Central R. R. P. 3819.

Stockholm Dépôt, p.-v., Stockholm tp., St. Lawrence co., N. Y., on Vermont Central R. R.

Stock'ing, a well-known article of apparel, usually knit or woven of wool, cotton, or other fibres. Though known to the Romans, as proved by paintings at Pompeii, its indispensable employment originated much later in the colder climate of Northern Europe, where in the twelfth century they were made of cloth. In the time of Edward II. they had assumed their present form, and at the courts of Spain and Italy in the fifteenth century enormous silk stockings sometimes furnished a substitute both for breeches and shoes. Their domestic manufacture by knitting had become so well established in England in the reign of Elizabeth that a patent was refused to William Lee (1589), inventor of the stocking-frame. He consequently went to France and established a factory at Rouen, but his brother subsequently introduced the invention into Nottinghamshire, where it has ever since been an important industry. The Lee machine was introduced into the U. S. shortly after the Revolution, was modified and adapted to power by Timothy Bailey of Albany 1831, and a stocking-factory established at Cohoes 1832. Several improved stocking machines and knitting-machines have since been patented, and the hosiery business is now an important industry in the New England and Middle States, amounting in 1870 to nearly $20,000,000 and employing above 14,000 operatives. Several other articles are, however, produced by the same machines, and are classed with hosiery in the statistics. Knitting stockings by hand, however, is still practised in almost all families in the agricultural regions.

Stock'land, tp., Iroquois co., Ill. P. 687.

Stock'mar (CHRISTIAN FRIEDRICH), b. at Coburg Aug. 22, 1787; studied medicine, and practised as a physician, first in his native city, then in 1814–15 in the army; became physician to Prince Leopold of Coburg in 1816, and subsequently private secretary; was very active in various diplomatic negotiations—at the marriage of Prince Ferdinand of Coburg with Queen Maria II. of Portugal, at the accession of Prince Leopold to the Belgian throne, at the marriage of the Prussian crown prince with a daughter of Queen Victoria, etc.; he was the intimate friend of Prince Albert and Queen Victoria; received the title of baron. D. at Coburg July 9, 1863. His *Denkwürdigkeiten aus den Papieren des Freiherrn Christian Friedrich von Stockmar*, edited by his son (Brunswick, 1872), were translated into English under the title *Notabilia from the Papers of Stockmar*.

Stock'port, town of England, county of Chester, at the confluence of the Mersey and the Tame, is very irregularly built on rugged and uneven ground, but is one of the centres of the cotton-manufacturing industry of England. P. 53,014.

Stockport, p.-v. and tp., Columbia co., N. Y., on Hudson River and New York Central and Hudson River R. R. P. 1438.

Stockport, p.-v., Windsor tp., Morgan co., O., on Muskingum River. P. 289.

Stocks. See STOCK EXCHANGE and STOCKS, LAW OF.

Stocks [Ang.-Sax. *stocc*], a machine for the punishment of petty offenders, in which the culprit was made to sit for a time with his ankles confined in holes made in timber. It is mentioned in an English statute of 1350, and in Great Britain is not yet quite extinct. Until lately its use for the punishment of slaves was permitted in some of the United States.

Stocks (LAMB), b. at Lightcliffe, Yorkshire, Nov. 30, 1812; was educated at Horton, and studied engraving with Charles Rolls; for some time he was principally engaged upon prints for annuals and for Finden's *Gallery of British Art*, but subsequently executed many larger and more important engravings in line for the *Art Journal*, for the art-unions of London and Glasgow, and for the Association for Promoting the Fine Arts in Scotland. Among his best productions are—Webster's *Dame School*; Faed's *O Nannie, wilt thou gang wi' me?* Wilkie's *Gentle Shepherd*; Frith's *Bed Time*; and the *Meeting of Wellington and Blücher*, from the picture in the Royal Gallery at Westminster. He was made associate engraver to the Royal Academy in 1853, an associate member in 1855, and an academician in 1872.

Stocks, Law of. The capital stock of business corporations is usually divided into equal parts called shares. The amount of the capital itself, the number of these shares, and the par value of each—$100, $50, or $25, as the case may be—are fixed by the charter. When such an association is about to be organized, the capital is contributed by those desiring to become members, each person indicating in writing the number of shares he is willing to take. These subscribers constitute the stockholders or shareholders, and are bound to pay the amount of their subscriptions to the corporation, either in one sum or in instalments, according to the terms of their agreement. As evidence of his interest an instrument called a certificate is issued to each stockholder, certifying in substance that he is the holder of a designated number of shares. In the U. S. shares of capital stock, whatever be the object and business of the corporation, are personal estate; they are things in action; they simply entitle their holder to participate in the profits resulting from the business, to aid in the election of officers, and to receive his portion of the assets remaining for distribution at the final dissolution. Shares are transferable, so that the assignee may become a stockholder. The directors of corporations may pass reasonable by-laws regulating the manner of transferring their shares. The following is the mode in general use, and it is often prescribed by statute: A book is kept by some designated officer in which is registered each certificate of shares, and the name of the person to whom it was issued. In order to complete a legal transfer the holder of the certificate must surrender it up to this officer, who thereupon issues a new one for a like amount to the assignee, registers it in the transfer-book, and cancels the old record. In this manner the directors of the corporation can preserve a correct list of the actual stockholders, keep trace of all the shares, and prevent the issue of duplicates. As it might be very inconvenient for the assignor always to appear in person and surrender his certificate, it is the universal practice to print on the back thereof a power of attorney, to be signed by such assignor, constituting the assignee his agent in order to make the surrender, to procure the cancellation, and to receive the new certificate, as above described. By means of this contrivance shares of stock are constantly transferred in the market to an enormous amount. A blank is often left in the power of attorney for the name of the agent, and the instrument in this form may pass from hand to hand through many successive owners, until at length a purchaser, desiring perhaps to hold the stock as an investment, fills in his own name as the attorney, surrenders the certificate, and takes a new one to himself. Certificates of stock thus endorsed are not strictly negotiable instruments, and yet they are practically treated by business-men in the great financial centres of the U. S. as though they possess-

ed the quality of negotiability. They may be pledged as well as sold, and are thus used to a very great extent as collateral security for loans of money or of other property. Although the bylaws of a corporation may require a surrender, cancellation, and reissue in order to complete a transfer and to create a perfect legal title, it is a settled rule of the American law that from an assignment and delivery alone the purchaser obtains an equitable title which makes him the true owner. If the corporation should refuse to accept a surrender and to issue a new certificate, he may recover from it the full value of the stock. If a transfer should be made through a forged power of attorney—that is, if the signature of the owner should be forged to a power of attorney—and by means thereof a new certificate should be issued, the corporation is responsible to him, and must furnish him with an equal number of shares and the accrued dividends thereon, or, if this for any reason be impossible, must pay him their value in money. If the holder of a certificate should sign the power of attorney in blank, and should then deliver the instrument into the possession of some person for a certain specified purpose—as, for safekeeping—and this person in violation of his duty should fill up the blank, and fraudulently surrender the certificate and procure another one to be issued to a *bonâ fide* purchaser, what effect would be thereby produced upon the rights of the original and defrauded owner? This question has given rise to a great conflict of opinion. If stock certificates were truly negotiable, the title of the *bonâ fide* purchaser would be perfect, and the only remedy of the former holder would be against his guilty agent. It has been urged, however, that as these certificates are ordinary things in action, the assignee would acquire no title, but would take the instrument subject to all the rights of the real owner, who had never intended to part with his property. This doctrine, if established, would virtually put an end to the present mode of dealing with these securities, and would inflict a heavy blow upon the freedom of financial transactions. The New York court of appeals has recently held that the principle of estoppel furnishes a solution of the difficulty, and that the owner is estopped by his acts from setting up a claim against the purchaser in good faith. In this manner the substantial benefits of negotiability are secured. JOHN NORTON POMEROY.

Stock'ton, city and county-seat of San Joaquin co., Cal., at the head of a navigable channel of the same name connecting it with San Joaquin River, 3 miles therefrom, and 100 miles from San Francisco. It was laid out in 1849 by Capt. Charles M. Weber, the owner of the Rancho Campo de Los Francises, a Mexican grant, covering a large portion of the surrounding country. Being at the head of navigation and a convenient point of departure for the gold-mining regions of Calaveras, Tuolumne, and Mariposa cos., it soon became a place of considerable business importance, and commanded the trade of those prosperous counties. After the decline of the mining interest came the development of the agricultural resources of the great San Joaquin Valley, for which Stockton, on account of its location, became the natural business-centre, a distributing-point for farmers' supplies, and is now the most important interior wheat-market in California. Stockton has several large warehouses for the storage of grain, with an aggregate capacity for 3,000,000 bushels. Sailing vessels of 150 tons and steamers of 500 tons burden reach her wharves at all seasons of the year, while the main line of Central Pacific R. R. passes through the city, affording means of speedy communication with San Francisco, and ample facilities for the shipment of the immense crops of grain and other agricultural products of the surrounding country. Stockton has 4 banks, with an aggregate paid-up capital of $1,332,000, most of which is owned by her own citizens. There are 2 flouring mills, with a capacity for manufacturing 800 barrels of flour per day; 2 extensive tanneries, 2 manufactories of agricultural implements, and 2 of carriages and wagons, 1 paper mill, 1 woollen mill, and 2 foundries. There are 2 newspapers—the *Independent*, a morning paper with daily and weekly editions, and the *Herald*, an evening journal, with a weekly edition. The California insane asylum is located within the city limits, occupying a handsome site of 100 acres. The site of the city is a level plain, whose monotony is relieved by scattering oaks; its streets are regularly laid out, and many of them ornamented with choice shade trees. The business portion of the city is principally constructed of brick, and has many fine buildings. There are 14 churches, some of them beautiful and costly edifices, and 5 large public school-houses. Mortuary statistics kept for twenty years show that Stockton is exceptionably healthy—a fact to be attributed to her equable climate and the prevalence during the summer of the trade-winds, which daily sweep over the city from the ocean. The average temperature in summer is 75°, in winter 40°. The average rainfall for the year is about 15 inches. A never-failing supply of pure fresh water is obtained from artesian wells bored to a depth of from 80 to 120 feet, in which the water rises within 6 feet of the surface. P. in 1870, 10,066.

N. M. ORR, ED. "INDEPENDENT."

Stockton, p.-v. and tp., Jo Daviess co., Ill. P. 1214.

Stockton, tp., Greene co., Ind. P. 1240.

Stockton, p.-v., cap. of Rooks co., Kan., on S. fork of Solomon River.

Stockton, p.-v. and tp., Waldo co., Me., on Belfast Bay, at the mouth of Penobscot River. P. 2089.

Stockton, p.-v., Hillsdale tp., Winona co., Minn., on Minnesota division of Chicago and North-western R. R.

Stockton, p.-v., cap. of Cedar co., Mo., 50 miles N. W. of Springfield, has 1 church, a graded school, 1 newspaper, 2 hotels, a tannery, carding-machine, steam grist-mill, and a wagon manufactory. Principal business, produce-trade. P. about 400. H. C. TIMMONDS, ED. "JOURNAL."

Stockton, tp., Camden co., N. J. P. 2381.

Stockton, p.-v., Delaware tp., Hunterdon co., N. J., on Delaware River and on Belvidere division of Pennsylvania R. R.

Stockton, tp., Chautauqua co., N. Y., on Cassadaga Lake. P. 1639.

Stockton, p.-v., Foster tp., Luzerne co., Pa., on Hazelton division of Lehigh Valley R. R.

Stockton, p.-v. and tp., Portage co., Wis. P. 1023.

Stockton (RICHARD), b. at Princeton, N. J., Oct. 1, 1730; graduated at Princeton College in 1748; was admitted to the bar in 1754; became member of the executive council in 1768, and judge of the supreme court of the province of New Jersey in 1774. In 1776 he was chosen a delegate to the Continental Congress, and was one of the signers of the Declaration of Independence. In Sept., 1776, he was captured by a party of royalists, who threw him into prison in New York, where he was treated with great severity; his library was destroyed, and his lands laid waste; he was finally exchanged, but never fully recovered from the effects of the ill-usage which he had received. D. at Princeton Feb. 28, 1781.

Stockton (RICHARD), LL.D., son of the preceding, b. at Princeton Apr. 17, 1764; graduated at Nassau Hall in 1779; studied law, and was admitted to the bar in 1784, and soon rose to the head of his profession in the State. He was a Presidential elector in 1792 and 1801, U. S. Senator 1796–99, and Representative in Congress 1813–15. D. at Princeton Mar. 7, 1828.

Stockton (ROBERT FIELD), son of Richard (1764–1828), b. at Princeton, N. J., in 1796; studied at New Jersey College, but left in his fifteenth year to enter the navy as a midshipman Sept. 1, 1811; was distinguished for gallantry in several naval battles during the war with England; became a lieutenant 1814; captured an Algerine corsair with a boat's crew 1815; negotiated in 1821 the purchase from African native chiefs of the territory now constituting the republic of Liberia; captured many slavers and a Portuguese privateer on the coast of Africa; took part in the extermination of piracy in the West Indies; surveyed the Atlantic coast of the Southern States 1823–24; became commander 1830 and post-captain Dec. 8, 1838; was flag officer of the Ohio in the Mediterranean 1838–39; declined the secretaryship of the navy 1841; was an early advocate of a steam navy; superintended the construction of the sloop Princeton, the first successful war steamship, 1842; was seriously injured by the explosion of one of her guns Feb. 28, 1844, which caused the death of two members of the cabinet; was the bearer to Texas of the resolution of annexation 1845; proceeded to the Pacific as commodore of the U. S. squadron on the coast of California Oct., 1845; took possession of California for the U. S. government, and formed a provisional government 1846, and disputed with Gen. Kearny the chief command—a question subsequently investigated by a court-martial on his nominee, Col. John C. Fremont; returned home across the Plains; resigned from the navy May 28, 1850. Having earlier taken an active part in politics as a Democrat and supporter of Gen. Jackson, though also prominent in the advocacy of internal improvements, especially of the Delaware and Raritan Canal, he now returned to politics with the prestige of his recent services and controversies; was elected U. S. Senator 1851; procured the passage of the law for the suppression of flogging in the navy; opposed the project of intervention in Hungary; was mentioned as a Presidential candidate 1852; resigned his seat in the Senate 1853; was nominated in 1856 for the Presidency by the newly formed "American party," but the ticket was withdrawn before the day of election. D. at Princeton Oct. 7, 1866. (See his *Life, Speeches, and Letters*, 1856.)

Stockton (Thomas Hewlings), D. D., b. at Mount Holly, N. J., June 4, 1808; studied medicine, but became a Methodist preacher, and in 1830 was stationed at Baltimore; was chaplain of the U. S. House of Representatives 1833–35, again 1859–61, and of the Senate in 1862. While in Baltimore he compiled a hymn-book and edited the *Methodist Protestant*, taking strong ground against slavery; was afterward for several years a preacher and public lecturer in Philadelphia, and subsequently resided for a time at Cincinnati. In 1850–56 he was associate pastor of St. John's church, Baltimore, and temporary pastor of a Presbyterian church, and in 1860–68 of the church of the New Testament. He also performed much literary labor of various kinds, including an edition of the New Testament arranged in paragraphs. Among his numerous productions are—*Floating Flowers* (1844), *The Bible Alliance* (1850), *Stand up for Jesus* (1858), *Poems, with Autobiographic and other Notes* (1862), *The Peerless Magnificence of the Word of God* (1862), and *Influence of the United States on Christendom* (1865). His *Life* has been written by Rev. John G. Wilson (1869). D. at Philadelphia Oct. 9, 1868.

Stockton-on-Tees, town of England, county of Durham, on the Tees, is well built, and has corn-mills and breweries, rope-walks and manufactures of sailcloth, blast-furnaces, foundries, engine-works, and building-yards for iron ships, and carries on a considerable trade in corn, coal, and iron. P. 27,738.

Stock'ville, p.-v. and tp., cap. Frontier co., Neb.

Stock'well, p.-v., Lauramie tp., Tippecanoe co., Ind., on Indianapolis Cincinnati and Lafayette R. R. P. 403.

Stockwell (Stephen N.), b. in Hardwick, Worcester co., Mass., Aug. 31, 1823; was apprenticed to learn the printing trade at the age of seventeen, and two years later he entered the composing-room of the Boston *Journal*, where he rose steadily till he became managing editor—a position he now holds. He served two years in the Massachusetts house of representatives, and one year in the senate, and has also been a member of the Boston city council. J. B. Bishop.

Stod'art (James), F. R. S., b. in England in 1760; became a maker of cutlery and surgical apparatus in London; aided Dr. George Pearson in his investigation of the nature and properties of the famous *wootz* or "Indian steel," proving it to be a real cast-steel of a peculiar kind, well adapted for the manufacture of surgical implements of a fine edge; assisted Davy and Faraday in their magnetic and electrical researches at the Royal Institution, with the latter of whom he contributed papers to the *Quarterly Journal of Science* (1820), and to the *Philosophical Transactions* (1822) papers *On the Alloys of Steel*. D. at Edinburgh Sept. 11, 1823.

Stod'dard, county of S. E. Missouri, bounded W. by St. Francis River, drained by the Castor, and intersected by the Cairo and Arkansas division of St. Louis and Iron Mountain R. R. It is a part of the "sunk country" produced by the earthquake of 1811, there being numerous swamps and lagoons. Staples, Indian corn, tobacco, sawed lumber, and flouring-mill products. Cap. Bloomfield. Area, about 800 sq. m. P. in 1870, 8535.

Stoddard, p.-v. and tp., Cheshire co., N. H. P. 667.

Stoddard (Amos), b. at Woodbury, Conn., Oct. 26, 1762; was a soldier in the war of independence 1779–82; became clerk of the supreme court of Massachusetts; was a lawyer at Hallowell, Me., 1792–98; was appointed captain of artillery June 1, 1798; was governor and civil commander of Missouri Territory 1804–05; became major June 30, 1807, and deputy quartermaster July 12, 1812; was dangerously wounded by a shell at the siege of Fort Meigs, O., and d. of tetanus May 11, 1813. Author of *The Political Crisis*, and of *Sketches, Historical and Descriptive, of Louisiana* (Philadelphia, 1812). His papers are in the archives of the Western Reserve Historical Society, Cleveland, O.

Stoddard (David Tappan), b. at Northampton, Mass., in 1819; graduated at Yale College 1838; went as a missionary to the Nestorians of Persia 1843, and d. at Oroomiah, Persia, Jan. 22, 1857. Author of *A Grammar of the Modern Syriac Language* (New Haven, 1855) and of various educational and religious works in Syriac printed at the mission press. A *Memoir* by Rev. Joseph P. Thompson, D. D., was published in 1858.

Stoddard (Elizabeth Barstow), wife of R. H. Stoddard, b. at Mattapoiset, Mass., in 1823; was married in 1852. Besides assisting her husband in several of his literary works, and contributing in prose and verse to periodicals, she has published three novels delineating life and scenery in New England—*The Morgesons* (1862), *Two Men* (1865), and *Temple House* (1867).

Stoddard (Richard Henry), b. at Hingham, Mass., in July, 1825; having lost his father at an early age, he became a mechanic in an iron-foundry in New York; contributed poems to various periodicals, and in 1849 privately printed *Footprints*, a small volume of poems, which was followed in 1852 by a larger volume of poems. In 1852 he received an appointment in the New York custom-house, which he retained till 1870, still pursuing his literary labors. After leaving the custom-house he devoted himself wholly to literature. Besides numerous contributions in prose and verse to periodicals, he has published—*Adventures in Fairy Land* (1853), *Songs of Summer* (1857), *Town and Country* (1857), *Life, Travels, and Books of Alexander von Humboldt* (1860), *The King's Bell* (1862), the story of *Little Red Riding Hood*, in verse (1865), *The Children in the Wood*, in verse (1865), *Abraham Lincoln, a Horatian Ode* (1865), *Putnam the Brave* (1869), and *The Book of the East*, a collection of his later poems (1871). He has also edited *The Aldine*, a literary and artistic journal (1870 *seq.*), *Gen. Nathaniel Lyon's Political Essays*, with a memoir (1861), *The Loves and Heroines of the Poets* (1861), J. G. Vassar's *Twenty-one Years around the World* (1862), *Madrigals, mostly from the Old English Poets* (1865), *The Late English Poets* (1865), enlarged and revised editions of Griswold's *Poets and Poetry of America* (1870), and of Griswold's *Female Poets of America* (1874), *The Bric-à-Brac Series*, being condensations of various recent works upon literature and society (1874 *seq.*), and the *Life and Correspondence of B. R. Haydon* (1876).

Stoddard (Solomon), b. at Boston, Mass., Oct. 4, 1643; graduated at Harvard 1662; became fellow and librarian of Harvard 1667–72; spent two years in Barbadoes for his health, acting as chaplain to Gov. Serle and preaching to the dissenters, and was ordained Sept. 11, 1672, pastor of the church at Northampton, where he remained until his death, Feb. 11, 1729, his grandson, Jonathan Edwards, having been his colleague 1727–29. He published *The Trial of Assurance* (1696); *The Doctrine of Instituted Churches* (London, 1700), in which he contended, in opposition to Increase Mather's *Order of the Gospel*, that the Lord's Supper is a converting ordinance, and thereby gave rise to a theological controversy which lasted some years; *An Appeal to the Learned* (1709), *Guide to Christ* (1714), *Answer to Cases of Conscience* (1722), *Question on the Conversion of the Indians* (1723), *The Safety of appearing in the Day of Judgment in the Righteousness of Christ* (1724); and printed some miscellaneous sermons.—His son, Col. John, b. at Northampton in 1681, graduated at Harvard 1701; took part as captain in an expedition against Canada during which he kept a *Journal* printed in the *Genealogical Register* (Jan., 1851); was for many years member of the council of Massachusetts, chief-justice of common pleas, and colonel of militia. D. at Boston June 19, 1748.

Stoddard (Solomon), b. in 1800; graduated at Yale College 1820; became professor of languages at Middlebury College, Vt., and co-author with E. A. Andrews, LL.D., of a *Grammar of the Latin Language* (Boston, 1836), which has been more widely used than any similar work in America, having passed through more than 60 editions. D. in 1847.

Stoddart (Sir John), LL.D., b. at Westminster, England, in 1773; graduated at Christ Church, Oxford, 1794; studied theology and law, was admitted to the bar 1801; was king's advocate and admiralty advocate at Malta 1803–07; began writing for the London *Times* 1810; was political editor of that paper 1812–16; started the *New Times* (1817–28) in opposition to it; took an active part in the formation of the Law Amendment Society; was caricatured by Cruikshank and others as "Dr. Slop;" was a voluminous political, historical, and philological writer; was knighted 1826, and held the office of chief-justice and judge of the vice-admiralty court at Malta 1826–39. D. in London Feb. 16, 1856. His most valuable works were contributions to the cabinet edition of the *Encyclopædia Metropolitana* entitled *Universal Grammar, or The Pure Science of Language* (vol. ii.), *Glossology, or The Historical Relations of Languages*, and *An Introduction to Universal History* (vol. xi.). The two former works were edited by William Hazlitt in a single volume, *The Philosophy of Language* (1849; 3d ed., 1860).

Stoddert (Benjamin), b. in Maryland in 1751; served in the Revolutionary army, attaining the rank of major; was many years a merchant at Georgetown, D. C., and was secretary of the U. S. navy 1798–1802. D. at Bladensburg, Md., Dec. 17, 1813.

Stoe'ver (Martin Luther), Ph.D., LL.D., b. at Germantown, Pa., Feb. 17, 1820; graduated at Pennsylvania College, Gettysburg, 1838; was tutor in Pennsylvania College 1839–40, afterward principal of its preparatory department and professor of Latin, history, and political economy until

his death, July 22, 1870. He was for many years secretary of the General Synod of the Lutheran Church and editor of the *Evangelical Quarterly Review*, in which he published an interesting series of *Reminiscences of Lutheran Ministers;* edited the *Literary Record* (1847–48); wrote biographies of Dr. H. M. Muhlenberg (1856) and of Dr. P. F. Mayer (1859), and a *Brief Sketch of the Lutheran Church in the U. S.* (1860); had made extensive preparations for a fuller history of the same subject, and was well known for his philanthropy, public spirit, and patriotism, especially as manifested during the civil war by repeated visits to the Union armies under the auspices of the Christian Commission. He rendered valuable aid to Rev. Dr. Sprague in the Lutheran department of his *Annals of the American Pulpit*, and was a frequent contributor to the *Eclectic Magazine*, the *Lutheran Home Journal*, and other periodicals.

Sto'ics [Gr. Στωϊκοί], an ancient philosophic sect, deriving its name from the ποικίλη στοά ("Painted Porch"), in which its founder, Zeno of Citium in Cyprus (flourished about 350–258), kept his school. This school he founded about B. C. 310, and he numbered among his immediate disciples Persæus of Citium, Ariston of Chios, Herillus of Carthage, and Cleanthes of Assos, who succeeded his master. Cleanthes was succeeded by Chrysippus of Soloi, who reduced the Stoic doctrines to something like a system, and he by Zeno of Tarsus. Other celebrated Greek Stoics were Diogenes of Babylon, Antipatrus of Tarsus, Panætius of Rhodes, and Poseidonius of Apamea. Owing mainly to Panætius, Stoicism found numerous disciples among the Roman nobility, and for centuries exercised a great and good influence upon the stronger minds of the empire. Among the Roman Stoics may be mentioned Q. Mucius Scævola, L. Annæus Cornutus, A. Persius Flaccus, L. Annæus Seneca, C. Musonius Rufus, Epictetus, and the emperor Marcus Aurelius.

Stoicism was an offshoot from Cynicism, Zeno having been at first a disciple of Crates the Cynic. It, however, dropped some of the most objectionable elements of Cynicism, and became a civilized philosophy—as civilized, indeed, as ever a philosophy of reflection can be. It was divided by its adherents into three parts—logic, ethics, physics—of which the last was held to be most important, although the second received by far the most attention. Indeed, Stoicism, like all the post-Aristotelian philosophies of antiquity, was essentially ethical.

(A) Under *logic* the Stoics included dialectic and rhetoric, the former of which was in reality a theory of cognition. They attached great importance to what they called a criterion of truth, although they were never able to fix upon any that would satisfy them as absolute. Their theory of sense-perception was essentially the same as that of Locke, the sentient soul being considered as a *tabula rasa*, impressed or otherwise affected by external objects. Perception was followed by memory and conception. Their highest concepts (τὰ γενικώτατα), by which they replaced Aristotle's ten categories, were (Trendelenburg, *Kategorienlehre*, p. 220 *seq.*)—

1. Ὑποκείμενα........................substrata.
2. " ποιά........................ " qualified (essentially).
3. " " πως ἔχοντα. .. .. " " accidentally.
4. " " " " πρός τι. " " " thro' relation.

The Stoics, in the matter of general terms, were nominalists, or, more strictly, conceptualists. Under *dialectic* they included grammar, in the development of which they did some very good work. (See Lersch, *Die Sprachphilosophie der Alten*, pt. ii. pp. 25 *seq.;* Steinthal, *Gesch. der Sprachw. bei den Griechen u. Römern*, pp. 277–363.)

(B) Under *physics* the Stoics included theology. They replaced Aristotle's quaternity of cause by a duality, viz. force and matter, inseparable, and conceived very much as they are by modern physicists. Everything, even God, contains both. Their physical theory was in the main that of HERACLITUS (which see), even down to the notion of a periodical ἐκπυρωσις or return of the universe to primeval fire. At the base of all lies necessity or providence—a tenet perhaps borrowed from Empedocles (περὶ φύσεως, line 1). With periodical conflagration, individual immortality was of course incompatible. The individual, a mere temporary emanation, returns at last to his source.

(C) In their *ethics* the Stoics, if not what is now called altruistic, were essentially unselfish—that is, they rigidly maintained that the end of life was virtue for virtue's sake. What virtue was they found it difficult to define, their "living agreeably to nature" being very vague, not to say that they sometimes made nature mean human nature, sometimes universal nature. Man exists for society, for only in that is virtue possible. Virtue is sufficient for happiness; and pleasure, which naturally accompanies activity, is not to be sought for its own sake. The cardinal virtues are practical wisdom, courage, self-restraint, and justice (φρόνησις, ἀνδρία, σωφροσύνη, δικαιοσύνη), and it requires the possession of them all to constitute the truly wise man, who is free and the equal of Jupiter himself. The Stoics drew a broad distinction between acts and motives, and made the moral quality of acts depend entirely upon motives. Of the works of the Stoics only fragments remain, the most important of which is Cleanthes's splendid *Hymn to Zeus*, of which there is an English rendering in Francis Newman's *The Soul, its Sorrows and Aspirations*, and another in *The Radical* (Boston, 1867). The best and most complete presentation of the Stoic philosophy is in Zeller's *Philosophie der Griechen* (vol. iv., pp. 26–340).

THOMAS DAVIDSON.

Stokes, county of North Carolina, bordering on Virginia and drained by a branch of Dan River. It has a hilly surface and fertile soil. Staples, tobacco, Indian corn, wheat, oats, wool, and honey. Cap. Danbury. Area, 550 sq. m. P. in 1870, 11,208.

Stokes, tp., Union co., Ill. P. 1573.

Stokes, tp., Logan co., O. P. 673.

Stokes, tp., Madison co., O. P. 986.

Stokes (GEORGE GABRIEL), D. C. L., F. R. S.: b. in Ireland in 1819; educated at Bristol College; graduated 1841 as senior wrangler at Pembroke College, Cambridge, where he was elected to a fellowship; has been since 1849 Lucasian professor of mathematics in that university; was elected to the Royal Society, and made in 1851 the brilliant discovery of the change in the refrangibility of light (since known as "fluorescence"), for which he was awarded the Rumford medal of that society 1852; became one of its secretaries 1854; published the experiments and inductions on which his discovery was based in an extended memoir of 100 pages in the *Philosophical Transactions* (1852); made a series of careful experiments at the Kew observatory, for determining the index of friction in different gases; contributed papers on mathematical physics to the *Transactions* of the Cambridge Philosophical Society, and to the *Philosophical Magazine;* made by experiment the rediscovery of the fact (already pointed out by Dr. Thomas Young) that the luminiferous ether is, in relation to the transmission of light, an elastic solid, although, of course, a fluid in relation to the motions of the heavenly bodies. Prof. Stokes has contributed to the *Transactions* of several learned societies, and annually delivers professional lectures on hydrostatics, mechanics, and optics, more especially upon the physical theory of light, at the University of Cambridge and at the Museum of Practical Geology in London. In 1869 he was president of the British Association for the Advancement of Science at its meeting at Exeter.

PORTER C. BLISS.

Stokes (JOHN), C. B., b. at Cobham, Kent co., England, June 17, 1825; educated at private schools and at the Royal Military Academy, Woolwich, and commissioned second lieutenant royal engineers Dec. 20, 1843, first lieutenant 1846, captain 1854, lieutenant-colonel 1867; served in the Kaffir wars of 1846–47 and 1850–51 (medal); deputy assistant quartermaster-general 2d division of the army in Kaffraria Jan.–July, 1851; instructor in surveying and field-works at Royal Military Academy, Woolwich, 1852–55; appointed in 1855 chief engineer to the Turkish contingent engineers, which he raised, organized, and equipped for field-service, and with which he constructed the lines round Kertch in the Crimea during the winter of 1855–56, and Lord Panmure's commissioner for breaking up the Turkish contingent May–July, 1856; British commissioner for improving the navigation of the mouths of the Danube and carrying out the terms of the Treaty of Paris of Mar. 30, 1856, Aug., 1856–Dec., 1871; British delegate to the international conference held at Constantinople (1873) for the purpose of agreeing to an international system of measuring the tonnage of ships, and for the settlement of the Suez Canal dues; commanding royal engineer at Chatham since Jan., 1875, where (Nov. 1, 1875) he was appointed, also, commandant of the school of military engineering. In Dec., 1875, he accompanied the Right Hon. Stephen Cave, M. P., on a special mission to Egypt. Author of a paper on *Engineer Field Equipment of the Turkish Contingent*, and *On Improvement of the Mouths of the Danube and other Rivers*, and of two papers in the *Professional Papers of the Royal Engineers.*

Stokes (WHITLEY), b. in Dublin, Ireland, about 1830; educated at Dublin University; became a distinguished barrister in London; was for some years secretary to the Philological Society, assistant secretary to the government of India, home department, and legal adviser to the viceregal government of India at Calcutta, and is a high authority upon Celtic and Oriental philology, Irish history, and the history of the growth of legal and social institutions. Author of *Irish Glosses* (1860), *The Play of the*

Sacrament, a Middle English Drama (1862), *Old Irish Glossaries* (1864), *Gwreans an Bys, the Creation of the World, a Cornish Mystery, with a Translation and Notes* (1864), *The Indian Succession Act* (1865), *Hindu Law-Books, edited with Notes and an Index* (Madras, 1865), *Goidilica, or Notes on the Gaelic Manuscripts preserved at Turin*, etc. (Calcutta, 186[illegible]), and other philological and legal treatises.

Stoke-upon-Trent, town of England, county of Stafford, in a district called the "Potteries," comprising 10,190 acres, and celebrated for its manufactures of earthenware, which are carried on in about 200 factories. P. of town 11,[illegible]; of parliamentary borough, 130,985.

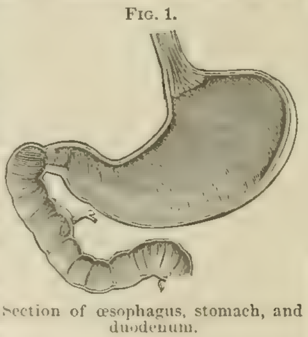
Stol'berg, von (CHRISTIAN), COUNT, b. at Hamburg Oct. 15, 1748; studied (1769–74) at Göttingen, where he was one of the principal members of the so-called *Dichterbund*, to which also Bürger, Voss, Hölty, and Leisewitz belonged; held an office in Holstein under the Danish government 1777–80, and lived afterward on his estate, Windebye, near Eckernförde, in Sleswick, where he d. Jan. 18, 1821. He wrote love poems, patriotic songs, dramas with choirs in Greek style, and translated Sophocles.—His younger brother, FRIEDRICH LEOPOLD, count von Stolberg, b. at Bramstedt in Holstein Nov. 7, 1750: studied also at Göttingen; held different court offices—as ambassador from the prince bishop of Lübeck to the court of Copenhagen, as Danish ambassador to the court of Berlin, as president of the episcopal government at Eutin, etc.; retired in 1800 from public life, and lived on his estate, Sondermühlen, in Hanover, where he d. Dec. 5, 1819. From his mother he had received a very strong religious bias, which was nourished afterward by his friendships and acquaintances, especially with the princess Gallitzin, and in 1800 he was converted to Roman Catholicism after a visit to Rome, and wrote *Geschichte der Religion Jesu Christi* (15 vols., 1811–18). Like his brother, he had belonged to the *Dichterbund*, and he developed great literary activity, writing odes, dramas, novels, etc., and translating Homer, Plato, and Ossian. The poetical works of the two brothers were published in a collected edition of 22 vols. (Hamburg, 1821–26). (See Nicolovius, *Friedrich Leopold, Graf zu Stolberg* (1846); Wilhelm von Bippen, *Eutiner Skizzen* (1862); Menge, *Der Graf Friedrich Leopold von Stolberg und seine Zeitgenossen* (1864).)

Stole [Gr. στολή, a "robe"], in the Greek, Latin, and Anglican churches a silk band or scarf worn upon the shoulders of priests.

Stol'pe, town of Prussia, province of Pomerania, on the Stolpe, which here becomes navigable, has valuable salmon fisheries and manufactures of spirits, tobacco, linens, and articles of amber. It carries on an active trade in corn and cattle. P. 12,483.

Stom'ach, The, and its Diseases [Gr. στόμαχος, from στομα, "a mouth," or "outlet"], the chief organ of digestion; the expansion of the superior end of the alimentary canal for the reception of food, its disintegration and solution, and the digestion of albuminoid matter. The stomach is situated on the left side of the body, below the diaphragm, behind and beneath the free ribs. Its lower extremity extends across the median line. It is a membranous bag or sac, capable of great distension by food and gas, but often flaccid and collapsed when empty.

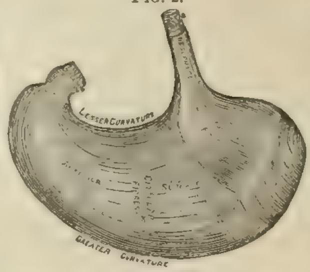
FIG. 1.



Section of œsophagus, stomach, and duodenum.

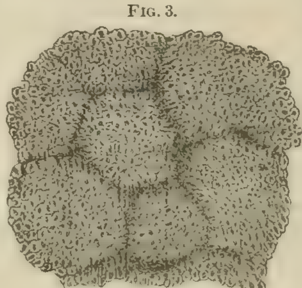
When full it is twelve inches long and four high. The stomach receives food from the œsophagus through its upper or cardiac (Gr. καρδία, "the heart") orifice, so termed because adjacent to the heart. The body of the stomach is beneath the heart at the left side, and is termed the *fundus, cul-de-sac*, or *great pouch*. The *greater curvature* of the stomach is the lower, convex surface; the *lesser curvature* is concave and above. Food leaves the stomach through its lower orifice, the *pylorus* (Gr. πυλωρός, from πύλη, "a gate"), and enters the duodenum, the first section of the small intestine. The stomach has four coats: (1) The external serous layer, a reflection of the peritoneum, covering it at all points except the entrance of the nutrient vessels and nerves in the great and small curves. (2) The muscular layer, which has three separate sets of fibres—the longitudinal, the circular, and the oblique. These muscular bands, acting in different directions, propel the contained food from side to side of the cavity, aiding in its chemical disintegration by thorough admixture with gastric juice. This spiral movement is termed *vermicular* ("worm-like"), and also *peristaltic* (Gr. περιστέλλειν, to "surround" or "wrap up"). (3) The cellular coat, consisting of loose areolar tissue, connects the muscular to the internal mucous coat. It is called also the sub-mucous coat and the vascular coat, as it contains the blood-vessels which supply the elaborate capillaries beneath the secreting glands of the mucous membrane. (4) The mucous coat is thick, especially at the lower or pyloric end, presents large longitudinal folds when the stomach is but partially filled or empty, which disappear when it is distended. Closely inspected, the mucous surface is found to be perforated by innumerable closely-aggregated orifices of the gastric tubules. These are of two kinds: (1) The mucous glands, situated at the pyloric end; (2) the peptic glands, found in all parts other than the pylorus, and secreting the gastric juice. The stomach is constantly lubricated by secreted mucus, which may become excessive in digestive disorders. Gastric juice is chiefly secreted after the ingestion of food. (See DIGESTION and GASTRIC JUICE.) The peptic glands are imperfectly developed in children before the eruption of the teeth. They are partially atrophied in advanced age, when the digestive powers are weak. The stomach is intimately related to important adjacent viscera by both vascular and nerve connections. Its main artery, the gastric, springs from a common root with the hepatic and splenic arteries, and it also receives two branches of each of them. By branches of the sympathetic nervous system its functional activity is influenced by the health of each organ and part of the body; it receives the terminal branches of the pneumogastric nerve, which gives off branches controlling the action of the heart, lungs, and in a measure the larynx and pharynx. It is by these connections that gastric indigestion may cause palpitation of the heart, difficult and sighing breathing, irritability of the larynx, and hoarseness, and by reflex influence many morbid sensations in various parts of the body.

FIG. 2.



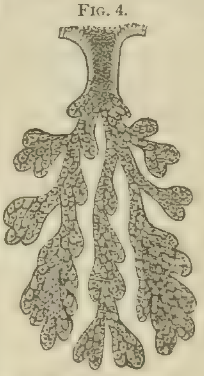
The muscular coat of the stomach.

FIG. 3.



The mucous membrane of the stomach, orifices of the glands; magnified 20 diameters (*Sappey*).

FIG. 4.



A peptic gland, magnified 100 diameters (*Sappey*).

The most frequent diseases of the stomach are its functional disorders. (See INDIGESTION.) In addition to these milder and chronic conditions, the stomach is liable to acute and organic disease. Acute gastritis is of rare occurrence, the result of violent mechanical or chemical irritation, incised and punctured wounds, swallowing corrosive poisons or putrid and acrid food. It is characterized by violent ejection of all food, gastric mucus, traces of blood and bile, by sense of local burning pain, by pallor of the face, feeble flickering pulse, cold extremities, and collapse. Perforating ulcer of the stomach may occur in both sexes from tubercle or specific gummy tumor of the gastric walls, but most frequently exists in young women, often of full habit, due to rupture or embolism of some small blood-vessel, and resulting softening of a conical segment of the stomach-wall thus deprived of nutriment. The symptoms are pain in the stomach upon reception of food, its rejection, and occasional hæmorrhage when the ulcerative process has eroded a blood-vessel. Hæmorrhage from the stomach is termed *hæmatemesis*, and must be carefully discriminated from *hæmoptysis*, the spitting of blood from the lungs.

Cancer of the stomach occurs more often in men than in women—most often occupies the pyloric end, rarely the upper cardiac orifice. It is usually the hard or scirrhus form of cancer. It often occurs in persons of cancerous family history, in others with no hereditary taint and previous personal health, following irritative dyspepsia. When at the pylorus, food is detained in the stomach, and after a time is ejected in great quantity, mixed with mucus, blood, and many fungous products of fermentation, especially Torulæ and Sarcinæ ventriculi. There is a local darting pain, and often a local indurated tumor felt at the epigastrium through the emaciated abdominal wall; the face is dark and cachectic, the body wasted, strength fails, death comes by exhaustion. Extreme neuralgia of the stomach—gastralgia or gastro-dynia—may occur, dependent on deranged nerve-centres or rheumatic or gouty vice of the blood. E. DARWIN HUDSON, JR. REVISED BY W. PARKER.

Stom'ach-Pump, a form of the syringe which has a flexible tube, designed to be passed down the œsophagus into the stomach, after which water is injected through it into the stomach and then withdrawn by reversing the action of the syringe. The operation may be repeated until the stomach is thoroughly washed clear of its contents. The instrument is especially useful in removing poisons from the stomach, and in feeding insane patients who refuse to eat, intending to starve themselves.

Sto'mapod, or **Stomatopoda** [Gr. στόμα, "mouth," and πούς, "foot"], a group of podophthalmous or thoracastracous crustaceans, by some regarded as a peculiar order, but by most as a sub-order. The name has been applied to groups of various extent. By H. Milne-Edwards it was employed for all those Podophthalmia which are destitute of thoracic branchiæ lodged in internal cavities, and consequently embraced the Mysidæ and certain larval forms, as well as the Squillidæ. By later writers it is mostly limited to the Podophthalmia which have an elongated form, a small carapace, leaving exposed the last three or four thoracic segments, five pairs of maxillary appendages, the three posterior pairs of limbs with split extremities (*i. e.* with each a jointed palpiform appendage by the side of the last joints of each of the feet), and with external ramose branchiæ. The Squillidæ form the only recognized family. THEODORE GILL.

Stomata. See RESPIRATION OF PLANTS.

Stomatitis. See MOUTH, DISEASES OF, by E. DARWIN HUDSON, JR., M. D.

Stomiatidæ. See APPENDIX.

Stone. See CALCULUS, by PROF. WILLARD PARKER, M. D., LL.D., and LITHOTOMY, by GURDON BUCK, M. D.

Stone, in Great Britain, is a weight of 14 pounds avoirdupois, but 24 pounds of wool and 8 of butcher's meat make a stone. In other European countries there are weights called stone differing in pounds avoirdupois.

Stone, county of N. Arkansas, formed in 1873 from portions of other counties, bounded N. E. by the White and watered by Little Red River. The surface is irregular and well timbered; the soil fertile, and well suited for cotton, tobacco, grains, and fruit. Cap. Mountain View.

Stone, county of E. Dakota, not included in the census of 1870. The surface is a rolling table-land, forming a part of the Côteau des Prairies. Area, about 700 sq. m.

Stone, county of W. Missouri, bordering on Arkansas, intersected by White River, and crossed in its N. W. corner by Atlantic and Pacific R. R. It has a broken surface, but a fertile soil, with extensive forests and large iron-mines. Staples, Indian corn, wheat, oats, and a little tobacco. Cap. Galena. Area, about 500 sq. m. P. in 1870, 3253.

Stone (AMASA, JR.), b. at Charlton, Mass., Apr. 27, 1818, of a Puritan family which came from England in 1632; learned the trade of a builder, and on becoming of age engaged in railroad and bridge building in Massachusetts; in 1845 became superintendent of New Haven Hartford and Springfield R. R.; in 1846 designed and built a railroad bridge over Connecticut River at Enfield Falls in forty days; in 1848 became one of the contractors to build Cleveland and Columbus R. R., and also Cleveland Painesville and Astabula R. R., of both of which he subsequently became superintendent, and in 1852 president; also aided in building and equipping Chicago and Milwaukee R. R., of which he was president at one time. He has founded car-factories, rolling-mills, and woollen-mills in various Western States, and is the inventor of several valuable improvements in railway construction and machinery. He was president of Lake Shore R. R., from Buffalo to Chicago, from 1869 to 1875. J. B. BISHOP.

Stone (ANDREW LEETE), D. D., b. at Oxford, Conn., Nov. 25, 1815; graduated at Yale College 1837; was three years professor in the New York institution for the deaf and dumb, at the same time studying theology; for some years in the service of the American Sunday School Union at Philadelphia; ordained pastor of a Congregational church at Middletown, Conn., Sept., 1844; pastor of the Park street church at Boston, Mass., 1849–65, and has since 1865 been settled in San Francisco, Cal. Author of numerous published sermons and addresses.—His brother, DAVID MARVINE, b. at Oxford, Conn., Dec. 23, 1817, was long a contributor to literary periodicals, and has been since 1849 editor and one of the proprietors of the *New York Journal of Commerce.*

Stone (CHARLES P.), b. at Greenfield, Mass., in 1826; graduated at the U. S. Military Academy in 1845; when appointed in the army a brevet second lieutenant of ordnance; first lieutenant 1853. In the war with Mexico he served from Vera Cruz to the capture of the City of Mexico, gaining the brevets of first lieutenant and captain for gallantry at Molino del Rey and Chapultepec; ordered to California in 1851, he constructed the Benicia arsenal, at the same time performing the duties of chief of ordnance of the division of the Pacific. In Nov., 1856, he resigned and engaged in the banking business for a year in San Francisco, when (1857) appointed by the Mexican government chief of a commission to survey and explore its lands in Sonora and Lower California. Returning East in 1860, he was appointed Jan. 1, 1861, to organize and drill the District of Columbia militia for defence of the capital. Appointed colonel of the 14th U. S. Infantry May 14, and a brigadier-general of volunteers May 17, he served under Gen. Patterson during the latter's operations in the Shenandoah in July, receiving in Aug., 1861, an independent command of a "corps of observation" guarding the upper Potomac. In Feb., 1862, he was placed in confinement in Fort Lafayette, New York harbor, and held until Aug. 9, when released, not only without charges being preferred against him, but without explanation of the cause of his arrest. In May, 1863, he was ordered to duty in the department of the Gulf, participating in the siege and capture of Port Hudson. Gen. Banks soon after selected him as his chief of staff, which position he held until Apr., 1864, being engaged in the battles of Sabine Cross roads and Pleasant Hill, Apr. 8 and 9. An order mustering him out of the volunteer service (dated Apr. 4) soon after reached him, and he was unemployed until Aug., 1864, when assigned to command of a brigade in the Army of the Potomac, but on Sept. 13, 1864, he resigned his commission in the regular army. In 1870 he entered the military service of the Khedive of Egypt.

Stone (COLLINS), b. at Canton, Conn., in 1812; graduated at Yale College 1832; was for nineteen years (1833–52) teacher in the American asylum for the deaf and dumb at Hartford, Conn.; was principal of the Ohio State asylum at Columbus 1852–63, after which he returned to the Hartford asylum as principal—a post he retained until his death at that place by a railroad accident, Dec. 23, 1870. He had studied theology with Rev. Dr. Hawes at Hartford, and been ordained in Ohio in 1853.

Stone (EDMUND), F. R. S., b. in Scotland about 1690, was the son of a gardener to the Duke of Argyll at Inverary; was at the age of eighteen accidentally discovered by that nobleman while reading Newton's *Principia*; was found to be conversant with geometry, Latin, and French; thereupon taken under the duke's protection and enabled to complete his studies; published treatises on *Conic Sections* (1723), *Fluxions* (1730), and *Mathematical Instruments* (1758), a *New Mathematical Dictionary* (1726), *The Elements of Euclid* (2 vols., 1731), *The whole Doctrine of Parallaxes* (1763), and *Reflections on the Figure of the Earth* (1768); contributed to the *Philosophical Transactions* a paper on *Lines of the Third Order* (1740), in which he pointed out two such lines not noticed by Newton or Stirling (see STIRLING, JAMES); translated from the Latin Dr. Isaac Barrow's *Geometrical Lectures* (1745), and edited an English translation of David Gregory's *Elements of Astronomy, Physics, and Geometry* (2 vols., 1713; 2d ed., 1726), with additions. In his later years he subsisted by giving private mathematical lessons in London, where he died poor in 1768.

Stone (EDWIN MARTIN), b. at Framingham, Mass., Apr. 29, 1805; edited the *Boston Times* (1827), and subsequently the *Independent Messenger* and *Salem Observer*; entered the ministry, and was for thirteen years pastor of a Congregational church in Beverley, Mass., and in 1847 became minister at large, residing at Providence, R. I., contributing to periodicals; has published *Biography of Elhanan Winchester* (1836), *Hymns for Sabbath Schools* (1837), *Hymns and Tunes for Vestry and Conference Meetings* (1842), *History of Beverley* (1843), *Life and Recollections of John Howland* (1857), *History of the Providence Association of Manufacturers and Mechanics* (1860), *Historical Sketches of the*

Rhode Island Re[illegible] (1861-65), *The Invasion of Canada in 1775* (1867), and *The [illegible] and Monetarian*, a memoir of Thomas [illegible] (18[illegible]).

Stone (Frank), b. in Manchester, Eng., Aug. 23, 1800, the son of a [illegible] manufacturer; was engaged in his father's business, at the same time practising painting in water colors; in 1824 adopted art as a profession; went to London in 1831, and in the following year became a member of the Society of Painters in Water-Colors, beginning soon after to paint also in oil, sending to the Academy his *Legend of M[illegible]* in 1840. Among his numerous works are—*P[illegible] Artevelde*, engraved under the title *The Heart's M[illegible]* (1840), *Charles I. and the Infanta of Spain* (1841), *The Bashful Lover and the Maiden Coy* (1842), *The Last Appeal* (1843), *Cross Purposes* (1844), *The Queen and Ophelia* (1845), *Evening* (1846), *The Impending Mate and Mated* (1847), *Christ and the Woman of Bethany* (1848), *The Duet* (1849), *The Gardener's Daughter* (1850), *Bassanio receiving Antonio's Letter*, which gained his election as an associate of the Royal Academy (1851); *Dr. Hooker in the Himalaya* (1852), *The Master is Come* (1853), *The Old, Old Story* (1854), *Doubt* (1856), *Bon Jour, Messieurs!* (1857), and *The Merry and Sad Heart*, not quite finished at the time of his death. D. Nov. 18, 1859.—Marcus Stone, his son, has painted *Elizabeth obliged to attend Mass by her Sister Mary* (1869), *Henry VIII. and Anne Boleyn observed by Queen Katharine* (1870), and *The Royal Nursery 1538* (1871).

Stone (Horatio), M. D., b. in New England about 1810; received a classical and medical education; practised some years as a physician in New York; was led by his artistic inclinations to exchange that profession for that of a sculptor, in which he was chiefly self-taught; settled at Washington, D. C., 1846, opening there a studio and becoming known as a gentleman of rare literary culture and ability; as a poet and essayist contributed frequently to the press, though usually without his signature; studied in Italy 1856–57, and during a second visit there d. at Carrara in Sept., 1875. Among his best known works are the fine statues of Hancock, Hamilton, Taney, and Benton, executed for the U. S. government.

Stone (James Kent), D. D., b. in Boston, Mass., in 1840; graduated at Harvard 1861; studied in Italy and at the University of Göttingen, 1861–63; served in the Union army, from which he soon retired after being disabled; became professor of Latin in Kenyon College, Gambier, O., 1863, of mathematics and soon afterward president 1867; exchanged that post for the presidency of Hobart College, Geneva, N. Y., 1868; became a Roman Catholic 1869, and resigned and joined the congregation of Missionary Priests of St. Paul the Apostle, in New York City. In 1870 he published *The Invitation Heeded*, an account of the steps leading to his becoming a Roman Catholic.

Stone (John Augustus), b. in Concord, Mass., in 1801; made his début upon the stage in the character of Old Norval, but acted only at intervals. For Edwin Forrest he wrote the three plays, *Metamora*, *The Ancient Briton*, and *The Banker of Rouen*. Among his other dramas are *La Roque, the Regicide*; *The Demoniac*; and *Tancred*. Drowned himself, while in a fit of derangement, in the Schuylkill June 1, 1834.

Stone (John Haskins), b. in Maryland; early in the war of the Revolution entered the army as captain in Smallwood's regiment; rose to be colonel in 1776; distinguished himself at the battles of Long Island, White Plains, Princeton, and Germantown, in the last of which he was severely wounded, and obliged to leave the service in 1779. In 1781 became clerk in the office of Robert R. Livingston, secretary of foreign affairs; was subsequently a member of the executive council of Maryland, and governor of the State 1794–97. D. at Annapolis Oct. 5, 1804.

Stone (John Osgood), M. D., b. at Salem, Mass., about 1812; graduated at the medical school of Harvard College 1836; pursued further medical studies in Europe; settled on his return as a physician at New York, where he achieved eminence; was long a surgeon at Bellevue Hospital, and was an active member of the metropolitan board of health 1866–70. D. in New York City June 4, 1876. His services in connection with the ventilation and sanitary drainage of tenement houses were of great value.

Stone (John Seely), D. D., b. at West Stockbridge, Mass., in 1795; graduated at Union College in 1823; studied at the General Theological Seminary, N. Y., and took orders in the Episcopal Church 1826; was rector of churches at Litchfield, Conn., Frederick, Md., New Haven, Conn., Brooklyn, N. Y., Brookline, Mass., and of St. Paul's, Boston; became lecturer in the Philadelphia Divinity School, and in 1867 was chosen dean of the faculty of the Massachusetts Theological Seminary, to reside at Cambridge. Besides several sermons and articles in periodicals, he has published—*Life of Bishop Griswold* (1844), *The Mysteries Opened* (1844), *The Church Universal* (1846; revised and enlarged as the *Living Temple*, 1868), *Life of James Milnor* (1848), *The Contrast, or the Evangelical and Tractarian Systems Compared* (1853), *The Christian Sacraments*, and *Lectures on the Christian Sabbath* (1867).

Stone (Lucy), b. at West Brookfield, Mass., in 1818; graduated at Oberlin College, and became an agent and lecturer for the American Anti-Slavery Society, and was also an early advocate of the cause of woman's rights. In 1855 she was married to Mr. Henry B. Blackwell, still, however, retaining her own name, and for some years lived in seclusion in New Jersey. In 1867 she canvassed the State of Kansas, and established the *Woman's Journal* in Boston 1870.

Stone (Robert King), M. D., b. in Washington, D. C., in 1822; took the degree of M. D. at the University of Pennsylvania 1845, and then visited London, Edinburgh, Vienna, and Paris, studying particularly diseases of the eye and ear; soon after his return was made assistant professor of anatomy in the National Medical College at Washington; was thrown from his carriage and received an oblique fracture of the thigh, which confined him to the practice chiefly of aural and ophthalmic surgery. D. at Philadelphia of apoplexy Apr. 23, 1872. Paul F. Eve.

Stone (Samuel), b. at Hertford, England, about 1600; studied at Emanuel College, Cambridge, 1623–27; took orders in the Church of England; attached himself to the Puritan section of that Church, for which reason he underwent many annoyances from the authorities; embarked for New England on the Griffin with 200 emigrants, headed by Hooker, Cotton, and Haynes 1633; became colleague pastor with Hooker at Newtown (now Cambridge) 1633, and removed with the church to the banks of the Connecticut River 1636, at which time the present city of Hartford was founded and named in honor of Stone's native place. After the death of Hooker, in 1647, he succeeded to the pastorate; was noted for wit and humor, and distinguished as a controversialist, and was engaged in important theological discussions. D. at Hartford July 20, 1663, leaving many MSS. on theology.

Stone (Thomas), b. at Pointon Manor, Charles co., Md., in 1743; was educated by a private tutor; studied law at Annapolis, and in 1764 commenced practice at Frederickton, whence in 1771 he removed to Charles co. He was a member of the Continental Congress 1775–79, and advocated the establishment of an independent government, although at first instructed by the legislature of Maryland to oppose it; the State receding from its opposition, he was one of the signers of the Declaration of Independence; was again elected to Congress in 1783, and was a member of the committee to draft a plan of confederation, and was appointed a delegate to the convention of 1787, but was unable to attend. D. at Port Tobacco, Md., Oct. 5, 1787.

Stone (Thomas Treadwell), D. D., b. at Waterford, Me., Feb. 9, 1801; graduated at Bowdoin College 1820; studied theology; was pastor of the Congregational church at Andover, Me., 1824–30; principal of Bridgeton (Me.) Academy 1830–32; pastor of the Congregational church at East Machias 1832–46, of the First church (Unitarian) at Salem, Mass., 1846–52, of the First Congregational church at Bolton, Mass., 1852–60, and of the First ecclesiastical society at Brooklyn, Conn., 1863–71, after which he retired from active service, and now (1876), resides at Bolton, Mass. He received the degree of D. D. from Bowdoin College 1868. Author of a volume of *Sermons on War* (1829), *Sketches of Oxford County* (1830), another volume of *Sermons* (1854), *The Rod and the Staff* (1856), and of separate sermons and addresses; was a contributor to the *Dial*, the *American Quarterly Observer*, the *Biblical Repository*, and other religious periodicals, and was one of the early members of the so-called "Transcendental school." (See *History of Transcendentalism in New England* (New York, 1876), by O. B. Frothingham.)

Stone (Warren), M. D., b. at St. Alban's, Vt., Feb., 1808; took his diploma from a small medical college in Massachusetts; sailed in a little brig for a new home in the South-west; was wrecked off Charleston, S. C., in the vessel which first brought the Asiatic cholera South, and finally reached New Orleans poor in health and almost destitute; yet in a few years he was the admitted head of the profession in the South-west; in 1836 began to teach anatomy; the next year was made professor of that department in the University of Louisiana, and on the death of Prof. Luzenburg was transferred to surgery, which he held at his death, Dec. 6, 1872. He visited Europe, and contributed papers to professional journals. Paul F. Eve.

Stone (William Leete), b. at New Paltz, N. Y., Apr. 20, 1792; removed to Cooperstown 1809; entered a print-

ing-office; became editor of the Herkimer *American* 1813, subsequently of other political newspapers at Hudson, Albany, and Hartford; conducted at Hudson a literary periodical, *The Lounger*, and was one of the proprietors and editors of the New York *Commercial Advertiser* from 1821 to his death, at Saratoga Springs Aug. 15, 1844. He was for many years one of the political and literary celebrities of New York; had his full share of controversies in both capacities; was a prominent advocate of compulsory education, and for some years superintendent of common schools in New York City. Author of *Letters on Masonry and Anti-Masonry* (1832), *Tales and Sketches* (2 vols., 1834), *Border Wars of the American Revolution* (2 vols., 1834), *Matthias and his Impostures* (1835), *Ups and Downs in the Life of a Gentleman* (1836), *Maria Monk* (1836), *Letters on Animal Magnetism* (1837), *Life of Brant* (2 vols., 1838), *Life of Red Jacket* (1841), *The Poetry and History of Wyoming* (1841), and *Uncas and Miantonomoh* (1842). His *Life of Sir William Johnson*, left incomplete at his death, was finished and published (2 vols., 1865) by his son, W. L. Stone, Jr.

Stone (William Leete, Jr.), son of the above, b. in New York City Apr. 4, 1835; graduated at Brown University 1858 and at Albany Law School 1859; prefixed a *Memoir* of his father to the 2d ed. of the former's *Life and Times of Red Jacket* (1866), and completed his *Life of Sir William Johnson* (Albany, 2 vols., 1865); edited new editions of the other historical works of his father (1864–65); translated from the German the *Letters and Journals* (1867) of Baroness Riedesel and the *Memoirs, Letters, and Journals of Gen. Riedesel* (2 vols., 1868); contributed to magazines and literary periodicals; is editor (1876) of the *New York School Journal*, and author of *Saratoga Springs* (1866), *Life and Writings of Col. William L. Stone* (1866), *History of New York City* (1868; new ed. 1872), *The True History of the Jane McCrea Tragedy* (1874), *Reminiscences of Saratoga* (1874), and *Centennial Sketches* (1876); is engaged upon a *History of the Six Nations* and a work upon *The Campaign and Surrender of Burgoyne*, and has accepted the appointment of "Centennial historian" of the State of New York.

Stone (William Murray), D. D., b. in Somerset co., Md., in 1789; was educated at Washington College, Md.; took deacons' orders in the Episcopal Church in 1802; was for many years pastor of his native parish, and in 1830 was consecrated bishop of Maryland. He published a charge, a pastoral letter, and a sermon. D. near Salisbury, Md., Feb. 26, 1838.

Stone (William Oliver), b. at Derby, Conn., Sept. 26, 1830; became a painter in New Haven, where most of his early works were destroyed in the burning of his studio; removed to New York in 1851, where his first work, *The Mantilla*, was exhibited in 1854, and he was chosen a member of the National Academy in 1859. He painted the portraits of many noted persons, and excelled especially in those of women and children. D. at Newport Sept. 15, 1875.

Stone, Artificial. Several kinds of artificial stone have come into use within the last twenty-five years for architectural and artistic purposes, and for the pavements of cellars, footpaths, areas, and other localities not subjected to the tread of heavy animals. Some of them possess very considerable positive merit, and are of great value in districts where durable and cheap building-stone is not supplied by nature.

Hydraulic concrete, or *béton* (see articles Masonry and Cements), is a species of artificial stone admirably adapted to a variety of most important uses. For foundations in damp and yielding soils and for subterranean and submarine masonry, under almost every combination of circumstances likely to be met with in practice, it is superior to brick masonry in strength, hardness, durability, and economy, and in some cases is a safe substitute for the best natural stone, while it is almost always preferable to the poorer varieties. For submarine masonry, concrete possesses the advantage that it can be laid, under certain precautions, without exhausting the water and without the use of a diving-bell or submarine armor. On account of its continuity and its impermeability to water it is an excellent material to form a substratum in soils infested with springs; for sewers and conduits; for basement and sustaining walls; for columns, piers, and abutments; for the hearting and backing of walls faced with bricks, rubble, or ashlar-work; for pavements in areas, basements, sidewalks, and cellars; for the walls and floors of cisterns, vaults, powder-magazines, etc. Groined and vaulted arches, and even entire bridges, dwelling-houses, and factories, in single monolithic masses with suitable ornamentation, have been constructed of this material alone.

Béton-Coignet is an artificial stone of superior quality which has been introduced by M. François Coignet of Paris after extended experiment and research. Its usual ingredients, and those used and recommended by M. Coignet, are—Portland cement, silicious hydraulic lime, like that obtained at Teil, France, and clean silicious sand, mixed together with a little fresh water. For the sake of economy, common lime is sometimes used instead of the Teil lime, in whole or in part. When this is done, the proportion of Portland cement must be increased. It is deemed essential that only materials of the first excellence of their kind, whether common or hydraulic lime, and Portland cement, should be used for the matrix; that the quantity of water should not exceed what is just sufficient to convert the cement and lime into a stiff viscous paste; and that the sand be incorporated with the matrix by a thorough and prolonged mixing or trituration, producing an incoherent mixture in which every grain of sand is completely coated over with a thin film of the paste, leaving only a very little, if any, of the paste in excess to compensate for imperfect manipulation. A handful of this mixture, when pressed together between the fingers and the palm of the hand, will retain its form without being at all plastic, and if dropped upon the floor will fly apart, resuming its state of incoherency. M. Coignet recommends that the hydraulic lime-paste should first be prepared by trituration in a suitable mill of such design that it will act by both compression and friction; a pug-mill with helicoidal arms will produce this effect. After this, the sand is added and the materials passed through the mill again, or even more than once if necessary to produce a thorough and complete incorporation of the ingredients. If Teil hydraulic lime is used without any common lime, it is not deemed necessary to add any Portland cement for ordinary massive work. When, for any special purpose, it is desired to introduce Portland cement into the mixture in order to increase its hardness and the rapidity of its induration, it had better be done during the process of trituration with the sand, adding at the same time the requisite increment of water if any more be necessary, so that after thorough mixing the material will present the appearance of incoherent pasty powder, which is the characteristic property required. In ordinary practice, when sand and hydraulic lime only are employed, it will be found to answer very well to mix the two together dry with shovels, and then to spread them out on the platform and add the requisite quantity of water by sprinkling. The dampened materials are then shovelled into the mill and triturated thoroughly by passing it through more than once if necessary. When a portion of Portland cement is used, it may be incorporated with the other ingredients before the water is added, or it may be introduced into the mixture in the mill, as may be preferred. When Portland cement alone, or with only a little common lime, is used for the matrix—as will commonly be the case in the U. S., where no good hydraulic lime has yet been discovered—the process is the same as when hydraulic lime alone is used, except that the trituration should be more prolonged, especially if the cement be rather quick-setting. With Portland cement and silicious hydraulic lime similar to that of Teil the following proportions will answer for divers purposes. The mixtures in the two right-hand columns need seldom be used except for ornamental work, requiring removal and handling within two or three days after being made:

Sand, by measure	5	4	5	5	4	4	5	5	5
Hydraulic lime, by measure	1	1	1	1	1	1	1	1	1
Portland cement, dry, by measure	0	0	¼	½	¼	½	1	1¼	1½

When the hydraulic lime is omitted, some one of the following proportions will answer, it being understood that the strength and hardness of Portland cement are diminished by the addition of either sand or lime:

Sand, by volume	6	5	4	4	3	3	2	2
Common lime, by volume	1	1	1	½	½	¼	⅛	0
Portland cement, by volume	1	1	1	1	1	1	1	1

In cases where a stone is to be subjected to wear, like a paving-block, the upper surface for the thickness of one-half to three-quarters of an inch is made richer in cement than the body of the block. The proportion of 1 of cement to 1 of sand for the surface, and 1 of cement to 3 or 4 of sand for the rest of the block, is sometimes used.

The mixing of the ingredients having been accomplished in such manner that each and every grain of sand is coated all over with a thin film of the matrix—almost entirely exhausting the matrix thereby—the material is compacted by ramming in successive layers in a mould of the form and dimension required for the stone. The mould should be capable of sustaining a heavy pressure from within, and of being taken apart and removed from the stone. If the mould be for a detached building-block, and

not for monolithic masonry, a quantity of the mixed material is thrown in and roughly spread out with a shovel to the thickness of 1 to 2 inches. It is then thoroughly compacted by repeated and systematic blows of an iron-shod rammer until the layer is reduced to about one-third its original thickness. Its surface is then scratched or roughened with an iron rake, in order to secure a perfect bond with the succeeding layer, and then more of the material is added and compacted in the same manner. This process is continued until the mould is full. The upper surface is then struck with a straight-edge and smoothed off with a trowel, after which the full mould may be at once turned over on a bed of sand and the bottom, side, and end pieces removed. The block is then finished, and if small may be removed in a day or two. Large blocks, like sills, lintels, and platforms, require a longer time to harden, especially if the proportion of cement used is rather small. The construction of monolithic masonry is conducted in essentially the same manner as when common concrete is used. When a pug mill cannot be procured for mixing the materials, tolerably good results can be obtained by the use of a cubical box of planks rigidly attached to a horizontal axle passing through diagonally opposite corners. The box may measure about 3 feet on each edge, containing 27 cubic feet, and may be arranged to work by horse- or hand-power. A proper charge for it would be about 14 to 16 cubic feet of the materials. It is provided with a trap-door about 20 inches square for charging and emptying. The door is located near one of the six angles farthest from the axle. The ingredients—the cement, sand, and water—are first roughly mixed together on a platform, and then passed into the box with shovels or wheelbarrows, or a large bucket swung from a crane. The grinding and rubbing process of mixture, deemed so important in the preparation of the material, may be secured by putting in the box, with the cement, sand, and water, a number of rounded pebbles or cobble-stones weighing 6 to 8 pounds each. After the batch is emptied upon the platform, these stones are taken out for future use.

From the foregoing description it may be inferred that béton Coignet is nothing more than a hydraulic concrete or béton, from which the coarse fragments or ballast have been omitted, and upon which all the advantages to be derived from a judicious choice in the quality and proportions of the ingredients, and from their thorough manipulation, have been conferred. The most important and costly work that has yet been undertaken in this material is a section, 37 miles in length, of the Vanne aqueduct for supplying water to the city of Paris. This aqueduct, which traverses the Forest of Fontainebleau through its entire length, comprises $2\frac{1}{2}$ to 3 miles of arches, some of them as much as 50 feet in height, and 11 miles of tunnel, in nearly all of which the only sand used was the material excavated at the locality, known as Fontainebleau sand. It includes also eight or ten bridges of large span (57 to 125 feet) for the bridging of rivers, canals, and highways. The pipe is $6\frac{1}{2}$ feet in interior diameter, with a thickness of 9 inches at the top and 12 inches at the sides at the water-surface. The construction of the arches was carried on about two weeks in advance of work on the pipe, and the centres were struck from seven to ten days later. The writer made a personal examination of this work in the winter of 1869–70, when it was only about two-thirds done. Water had been let into a portion of the pipe several months before, and its impermeability found to be perfect. An entire church, with its foundations, walls, and spire constructed of béton-Coignet, at Vesinet, near Paris, was also examined. The steeple is 130 feet high, and shows no cracks or other evidences of weakness. Over 31 miles of the sewers of Paris were laid in the same material prior to June, 1869. The proportions for the sewers were, by measure, sand 5, hydraulic lime 1, Paris cement (said to be as good as Portland) $\frac{1}{4}$. Several large city houses, some for residences and others for business purposes, were built with it in Paris. In one of them, having a cellar below the street-level, and six full stories surmounted with a Mansard roof above, the thickness of the exterior walls was established as follows: cellar, $19\frac{7}{10}$ inches; first story, $15\frac{7}{10}$; second story, $13\frac{8}{10}$; third story, $12\frac{5}{10}$; fourth story, $11\frac{8}{10}$; fifth story, $10\frac{8}{10}$; sixth story, $9\frac{8}{10}$.

Béton Coignet was used for the fluted columns and other interior finish of the Roman Catholic cathedral in Fifth avenue, New York, and for a handsome carriage-way bridge spanning a footpath in Prospect Park, Brooklyn. It has been extensively used in the cities of New York and Brooklyn, and to some extent elsewhere in the U. S., for sills, lintels, steps, and platforms, and for facing the exterior walls of houses. In France the cellars of houses constructed with this material are usually divided into two large compartments by a wall parallel to the street, and these are each covered by a flat arch of the béton, the usual proportions of which are a rise of about one-tenth the span, a thickness at the crown of 5 to 6 inches, and a thickness at the springing lines of $8\frac{1}{2}$ to 9 inches. Although this material does not attain its maximum strength and hardness until after the lapse of some years, it is amply strong when made into building-blocks to be used in a few days after moulding. Experiments made upon specimens varying from fifteen to thirty months in age, composed of 1 measure of dry hydraulic lime, 4 measures of sand, and $\frac{1}{4}$ to $\frac{3}{4}$ of a measure of Portland cement, gave resistances to crushing varying from 2634 to 7495 pounds per square inch. A crushing strength exceeding 6000 pounds per square inch on $3\frac{1}{2}$ to 4 inch cubes represents an exceptionally strong specimen when the proportions are kept within the limits above mentioned. In Paris a considerable trade in statuary, vases, pedestals, etc., made from this material has grown up within the last twelve years. It resists frost and the solvent action of sea-water. Its cost in the U. S., with good Portland cement at $3.75 to $4.75 per cask of 400 pounds, will be from $9 to $12 per cubic yard for labor and materials, with these advantages over brick masonry—that a considerable degree of ornamentation and any desired color, from a light-drab or fawn to a dark-gray or brown, with shades of dark-red and dark-blue, may be conferred upon it at a trifling addition to the cost. By the use of Vicat cement, instead of Portland, a harder and stronger béton can be made, on account of the relative superiority of the former cement. Its cost will also be augmented.

Ransome's Patent Silicious Concrete Stone.—The process of making this stone, as followed for many years after the first patent was issued to Mr. Frederick Ransome of London, England, in 1856, consists in forming in the interstices of sand, gravel, or any pulverized stone a hard and insoluble cementing substance or matrix by the mutual decomposition of two chemical compounds in solution. The compounds employed are silicate of soda ("soluble glass," "liquor of flints") and chloride of calcium. These, when mixed together, form almost instantaneously, by double decomposition, silicate of lime and chloride of sodium (common salt), and the value of the artificial stone thus produced depends on the strength, hardness, and durability of the silicate of lime which binds the particles of sand together. The raw materials employed are principally sand, gravel, flints, chalk, limestone, caustic soda, chloride of calcium, and water. The silicate of soda or soluble glass is made by boiling and dissolving flints in a strong solution of caustic soda, under pressure. It should be of the consistency of molasses, and possess a specific gravity of about $1\frac{7}{10}$. To every bushel of sand about 1 gallon of the prepared silicate of soda is added, and the mass is then thoroughly mixed together in a mill until it attains a putty-like, semi-plastic condition, suitable for compacting into moulds by ramming or by compression. The prepared material is then compressed into moulds of wood or metal, or it may be rolled into slabs when that form is required, as for roofs, footpaths, etc. The slab as soon as formed, and before the process proceeds further, may be cut into pieces of any shape that will adapt it to the uses to which it is to be applied. When the material is once compacted in moulds, it may be taken out immediately, and is not liable to warp, crack, or undergo any subsequent change of form. The moulded blocks or the slabs are then at once drenched with a solution of cold chloride of calcium, which acts rapidly upon the silicate of soda, producing insoluble silicate of lime, whereby the mass is hardened and solidified to such degree that it can be removed and handled without danger of breaking during the remaining steps of the process. The blocks are then conveyed into a tank or cistern containing a solution of chloride of calcium of a specific gravity of about $1\frac{4}{10}$, heated to a temperature of 212° F. In this bath the chemical action is completed, resulting in the formation of silicate of lime through the mass, and the production of a homogeneous artificial stone. After this, the blocks are removed from the cistern, and thoroughly drenched with cold water for a longer or shorter period, depending on their size. By this the chloride of sodium formed during the operation is washed out. The work is then finished and the block ready for immediate use. An essential condition of success is, that the bath of hot chloride of calcium must be applied while the silicate is still moist—that is, as soon as the material is moulded into form. From the reported tests of this stone it appears that the tensile strength obtained by different experimenters is extremely variable, ranging from about 97 to 533 pounds to the square inch, while the strength to resist crushing, obtained on one occasion with 4-inch cubes, is stated as high as 6720 pounds per square inch. Other reports give it a crushing strength of 4200 pounds per square inch on 4-inch cubes. The crushing strength of the samples that gave a tensile strength of only 97 pounds per square inch

is not reported, but would probably not exceed 1200 to 1500 pounds to the square inch. The Ransome stone is adapted to many kinds of architectural embellishment, such as cornices, capitals, door and window dressings, copings, balusters, railings, finials; for garden decorations; for steps, platforms, footpaths, sidewalks, grindstones; for monuments, tombs, and other cemetery requirements. The writer visited the Patent Concrete-Stone Co.'s works, operating the Ransome patent, at East Greenwich, near London, some years ago, and found that the manufacture of grindstones had become a very important and lucrative branch of their business. They are perfectly uniform in hardness and homogeneous in structure, and have been found to be superior to those made from the best natural sandstones of England. Quite recently, a great improvement has been made in the method of producing this stone by which the cost is considerably diminished. It consists in the use of a silicious earth more or less readily soluble in caustic soda or potassa at moderately low temperatures. This material is mixed with lime (or substances containing lime), silicate of soda, and sand, and the mixture is then moulded into the required form in the manner already described. Nothing further is required except sufficient time for induration, which begins as soon as the materials are brought into intimate contact, and goes on gradually, as in the case of a good hydraulic cement. The reactions which produce hardness are simply that the silicate of soda is decomposed, the silicic acid entering into combination with a portion of the lime present, forming a silicate of lime, while a portion of the alkali set free seizes upon the natural soluble silica which constitutes one of the ingredients, and thus forms a fresh supply of silicate of soda (or potash). This, in its turn, is decomposed by a fresh quantity of lime. It appears that the whole of the alkali is not set free at these successive decompositions, but that a portion of it becomes permanently fixed in the formation of a compound silicate of lime and soda. The whole of the alkali thus becomes gradually fixed, obviating the necessity of subsequent drenching with water to secure its removal. The stone made by the new process, after the lapse of three or four months, is fully equal in strength to that produced in the chloride-of-calcium bath.

The Sorel Artificial Stone.—Some years ago, M. Sorel, a French chemist, discovered that the oxychloride of magnesium possessed the hydraulic energy in a remarkable degree, and this cement is the basis of the Sorel stone. It is formed by adding a solution of chloride of magnesium, of the proper strength and in the proper proportions, to the oxide of magnesium obtained by calcining carbonate of magnesia, or *magnesite*. There are several steps in the process, which may be briefly stated as follows: *First*. The magnesite is burnt in ordinary limekilns at a dark cherry-red heat for about twenty-four hours, producing protoxide of magnesium. This is then reduced to a fine powder between horizontal millstones. The best varieties are perfectly white. *Second*. For making stone the burnt and ground magnesite is mixed dry in the proper proportion with the material to be united and bound together—that is, with powdered marble, quartz, emery, silicious sand, soapstone—of which the stone to be imitated or reproduced is composed. The usual proportions are, for emery-wheels, 10 to 15 per cent. of oxide of magnesium by weight; for building-blocks, such as sills, lintels, steps, etc., 6 to 10 per cent.; and for common thick walls, not more than 5 per cent. The dry ingredients may be mixed together by hand or in any suitable mill, care being taken to secure their thorough and intimate incorporation with each other. *Third*. After this mixing they are moistened with chloride of magnesium, for which bittern-water (the refuse of seaside saltworks) has been found to be a cheap and suitable substitute. The bittern-water should be of the density of 15° to 30° Baumé. The moistened material is then passed through a mill, which subjects it to a kind of trituration by which each grain of sand or other solid material becomes entirely coated over with a thin film of the cement formed by a combination of the chloride with the oxide of magnesium. *Fourth*. The mixture is formed into blocks of the required shape and size by ramming or tamping it in strong moulds made of iron, wood, or plaster, in the manner already described for béton-Coignet. The block may be taken out of the mould at once, and nothing further need be done to it. The setting or hardening is progressive and simultaneous throughout the mass, as with other hydraulic cements; the maximum hardness is not attained for several months. This stone so closely resembles the natural stone, from which the solid ingredients are obtained by crushing and grinding, that it is not easy in the absence of chemical tests to detect any difference in either texture, color, or general lithological appearance. The Union Stone Co. of Boston has been operating for some years under the Sorel patent, and has built up a large business in the manufacture of emery-wheels, of which many sizes are made, from the small wheel attached to sewing-machines for sharpening needles to the large grindstone, 48 inches in diameter and 12 inches thick, for manufacturing establishments. The strength of this stone, as well as its hardness, exceeds that of any other artificial stone yet produced, and may, when desirable, be made equal to that of the natural stone which furnished the powder or sand used in its fabrication. From a number of specimens furnished the writer by the Union Stone Co., comprising coarse and fine sandstone of various shades of color, hones, white and variegated marble, emery-wheels, building-blocks, etc., some small blocks were prepared and subjected to crushing, with the results given below. The age and composition were also given by the company:

Inert material.	Oxide of magnesium by weight.	Age.	Size of blocks.	Crushing strength per square inch.
			Inches.	Lbs.
Coral sand	12 per cent.	1 year.	2 · 2⅛ · 1⅞	6235
Pulverized quartz	12 to 15 p. c.	1 year.	1⅞ · 2 · 1⅜	7272
Washed flour of emery.	Not known.	2 years.	1⅞ · 2 · 1⅞	19636
Fine marble	15 per cent.	3 years.	1½ · 1½ · 1½	11555
Mill-sweepings	12 to 13 p. c.	9 months.	1⅞ · 2 · 1⅞	6133
Marble and sand	12 per cent.	2 years.	1⅞ × 2 × 1½	4923
Marble	Not known.	....	1¼ × 1¼ × 1	7680

The speed recommended for the emery grindstones is 3500 feet per minute at the perimeter or grinding surface; the large stones will sustain a speed of 3 to 4 miles per minute at the circumference without breaking. For making sills, steps, lintels, etc., a mixture containing 100 pounds of clean sharp sand, 10 pounds of powdered marble, 10 pounds of the powdered oxide of magnesium, and 10 pounds of the chloride of magnesium in solution will answer very well. The materials for 1 cubic foot of stone will cost about 60 cents, to which should be added 20 to 25 cents per cubic foot for labor. This price may be reduced 10 to 12 cents per foot by incorporating large pebbles and cobblestones in the mixture at the time of moulding the blocks when their form and dimensions are such as to render it admissible. For foundations and plain massive walls the proportion of cement may be reduced and the quantity of cobblestones increased.

The Frear Artificial Stone consists of a mixture of silicious sand and hydraulic cement, to which gum-shellac is added in order to increase its strength and hardness. The cement is first thoroughly incorporated with the sand in the proportion of about 1 measure of cement to 2½ measures of sand, and the mixture is then moistened with a solution obtained by dissolving 1 pound of gum-shellac in from 2 to 4 ounces of concentrated alkali in aqueous solution. This is diluted with water to such degree that about 1 ounce of the shellac is distributed through the cement and sand used in making one cubic foot of the stone. The dampened mixture, after thorough incorporation, may be compacted in moulds by the method already described for béton-Coignet. Some samples of the stone, reduced to 2-inch cubes and then crushed, gave the following results. The mixtures contained 1 part of cement and 2½ parts of sand by measure, and 1 ounce of gum-shellac to the cubic foot. Portland cement was used in Nos. 1, 2, and 3, and Louisville (Ky.) cement in No. 4:

No. 1, 4 weeks old, crushed at 18,000, or 4500 lbs. per sq. inch.
No. 2, 4 weeks old, " " 18,500, or 4620 " " "
No. 3, 3 weeks old, " " 9,000, or 2250 " " "
No. 4, 6 months old, " " 8,000, or 2000 " " "

A 4-inch cube of the same composition and age as Nos. 1 and 2 sustained 57,000 pounds, equal to 3562½ pounds to the superficial inch, under compression, and was not crushed. The introduction of gum-shellac into any mixture of hydraulic cement and sand doubtless adds to its strength while the mixture is yet new or only a few months old; but whether it will add to the strength and hardness acquired by age, particularly where Portland cement supplies the matrix, is certainly questionable. The durability of gum-shellac when exposed to the weather is by no means certain. It readily yields to the solvent power of the alkalies, and should be employed with great caution in localities exposed to such influences.

Portland Stone is the name given to a mixture of Portland cement and sand, or sand and gravel, compacted into form by tamping or otherwise. When properly made, it possesses the essential requisites of strength and hardness in a degree proportionate to the value of the cement employed. The proportions of 1 measure of dry cement to 2 or 2½ measures of sand will answer for most purposes. The manipulation should be prolonged and thorough to ensure the production of a homogeneous stone. When used for flagging, the surface layer to the thickness of about half an inch may advantageously be composed of 1 measure of ce-

ment to $1\frac{1}{4}$ or $1\frac{1}{2}$ of sand, and coarse gravel should be omitted from it.

The strength and hardness of all varieties of artificial stone which owe their induration to the hydraulic properties of the cement or lime used in their manufacture vary directly with the ultimate strength and hardness attainable by the hydraulic ingredients of the stone. An obvious means of improving their quality, therefore, is the employment of the highest grades of cement and hydraulic lime. I am not aware that any good silicious or argillaceous hydraulic lime has ever been manufactured in the U. S., and I know of no calcareous deposit capable of producing such a lime. There are plenty of argillo-magnesian limestones, occupying in their composition, properties, and intrinsic value an intermediate position between the common limes and the argillo-magnesian cements, but their employment offers no advantage that cannot be readily secured by a mixture of common lime and cement, while many of them contain more or less unslaked lime, which, by subsequent extinction, might endanger the stability of the work into which they are introduced. The silicious hydraulic lime obtained from Teil on the river Rhone in the canton of Viviers, department of Ardèche, France, possesses properties which render it specially valuable for artificial stone. The best hydraulic cement for this purpose is the Vicat cement, which is made by mixing together, in suitable proportion, quicklime and clay, tempering the mixture with water, and then forming it into cakes or balls of the proper size for burning in a kiln. These, after drying, are burnt to nearly a white heat, and then ground to a fine powder, which completes the process. It is a stronger cement than Portland, and proportionally more expensive.

Investigations into the laws which govern the breakage of stone should begin with those of homogeneous structure, if such can be found, as properly preliminary to any intelligent discussion of the complications introduced by grain, form of crystallization, and stratification. The artificial stones approach more closely to homogeneity than most natural stones, although there are many limestones and sandstones that will split with almost equal freedom in all directions. Homogeneous stones in small cubes appear to break in all cases in the manner shown in Fig. 1. The forms of the fragments *a* and *b* are approximately either conical or pyramidal. More or less disk-shaped pieces, *c* and *d*, are detached from the sides of the cube with a kind of explosion. In the angles *e* and *f* the stone is generally found crushed and ground into powder by the attrition of the larger fragments. These general results are of course modified by the nature and quality of the grain in the stone, and by those other inherent causes of dissimilarity between any two cubes, although they may have been cut directly apart from each other. This general form of breakage occurs also in non-homogeneous stones when crushed on their beds, but in this case the modification which the grain of the stone produces must be taken into account, as it renders the cube liable to split into more or less rectangular fragments. This frequently lengthens the cone or pyramid in cubes crushed on the bed of the stone, and causes those crushed on edge, or parallel with the quarry-bed, to split into rectangular disks. If cubes of different sizes, cut from a homogeneous stone like any of the artificial stones above described, be crushed between steel plates, it will be found that their resistances per square inch increase with the increase in the dimensions of the cube; so that a 2-inch cube with a pressing surface of four square inches will sustain, before crushing, more than four times the weight which crushes a 1-inch cube. Similar results will be obtained with cubes of natural stone; and the more nearly homogeneous the stone is, the more readily can the results be expressed by mathematical formulæ. Experiments were made under the direction of the writer at Fort Tompkins, N. Y., with two varieties of sandstone from Berea, O., upon cubes of various sizes, from $\frac{1}{4}$ inch to 4 inches, from the results of which the two curves in Fig. 2 were constructed. The stone which gave the lower was the yellowish-gray variety. The cubes were crushed between plates of pine wood varying from $\frac{1}{16}$ of an inch in thickness for the $\frac{1}{4}$-inch cubes to a little over $\frac{3}{8}$ of an inch in thickness for the 4-inch cubes. The bluish stone gave the upper curve, the cubes being crushed between steel plates. This stone being comparatively strong, a $2\frac{3}{4}$-inch cube was the largest that the press would crush with safety. In the curves the abscissas (X) represent the sides of the cubes in inches, and the ordinates (Y) the crushing-pressure in pounds per square inch of bed-surface—that is, the total resistance of the cubes in each case divided by the number of square inches in one of its faces. The form of the theoretical curve is that of a cubic parabola with the equation $Y = \sqrt[3]{X \times a}$, in which *a* is the cube of the unit strain, or, in other words, the cube of the pressure in pounds that will crush a 1-inch cube of the material. In the lower curve *a* is the cube of 7000 pounds, which is the force, in round numbers, required to crush a 1-inch cube of the yellowish-gray stone between plates of pine wood. In the upper curve *a* is the cube of 9500 pounds, the force required to crush a 1-inch cube of the bluish stone between steel plates. The equation for the lower curve will therefore be $Y = 7000 \times \sqrt[3]{X}$, and for the upper one $Y = 9500 \times \sqrt[3]{X}$. *Hence*, for 4-inch and smaller cubes, *The total crushing-pressure in pounds per square inch of bed-surface is equal to the crushing-pressure of a 1-inch cube of the same material, multiplied by the cube root of the side of the cube under trial.* No satisfactory experiments upon larger cubes have been made. Q. A. GILLMORE.

FIG. 1.

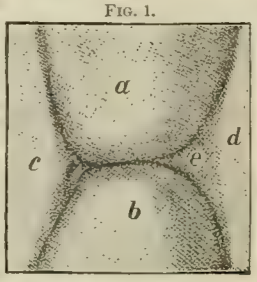
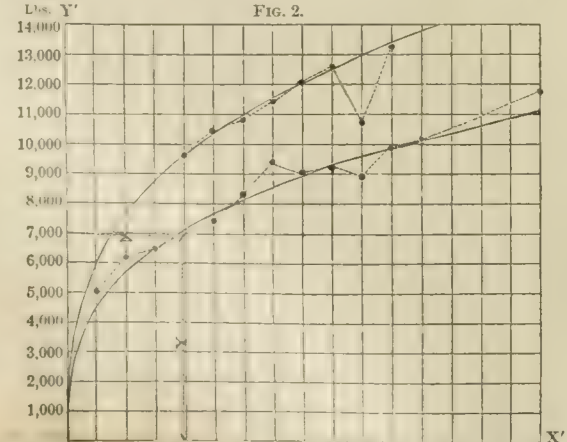


FIG. 2.



Stone-Borer. See APPENDIX.

Stone'borough, p.-b., Sandy Lake tp., Mercer co., Pa., on Jamestown and Franklin branch of Lake Shore and Michigan Southern R. R. P. 471.

Stone [Ang.-Sax. *stân*], **Building.** In the articles MARBLE, GRANITE, SLATE, LIMESTONE, etc., most building-stones have been already described, but a general review of the subject, with comparisons between the different kinds, seems required to give it completeness.

The varieties of building-stone most generally employed are granite, marble, sandstone, and limestone. Trap, serpentine, porphyry, alabaster, and other rarer stones are also used in certain localities. The qualities which are most important in stone used for construction are (1) cheapness, (2) strength, (3) durability, (4) beauty.

The elements that contribute to the *cheapness* of a stone are abundance, proximity of quarries to the place of use, facility of transportation, and the ease with which it is quarried and worked.

The *durability* of a stone is a quality of primary importance in all expensive and permanent structures. The most durable of all building-stones are granite and the stronger and more silicious sandstones. Where an untried stone is offered in market, it has been customary to test its durability by chemical analysis, by exposure to great alternations of temperature by freezing mixtures and otherwise, and by boiling in saline solutions. All these tests are, however, of little value as compared with an examination of the natural outcrops of the rock. By such examination it will be found that some stones soften and disintegrate by weathering, while others have held their angles and faces hard and sharp through countless ages of exposure.

The *strength* of a stone is in some instances a cardinal quality, as when it is to form piers or columns that are to support great weights, or capstones that span considerable intervals. This is also an indispensable attribute of stone that is to be exposed to mechanical violence or unusual wear, as in steps, lintels, door-jambs, etc. The strength of a building-stone is generally tested by applying measured force to cubes of it until they are crushed. This is accomplished by several machines, of which perhaps the most complete is that manufactured by Fairbanks & Co., where the application of power is measured by clockwork,

and the force at which the stone is crushed is recorded on a graduated bar by a stoppage of the machinery. A large number of tests have been applied to the building-stones of the U. S. at the navy-yard in Washington by Gen. Franklin of Hartford, by Maj.-Gen. Q. A. Gillmore, U. S. A., by Prof. Gustave Heinrich of Iowa, by Robt. G. Hatfield, architect, New York, and at the School of Mines of Columbia College. In the reports of these experiments, contained in the documents of which the titles are given below, the methods pursued and the results obtained are fully set forth. By a comparison of these results it will be seen that the strongest of all building-stones now in use in this country are the traprocks of New Jersey, which sustain a pressure of from 20,000 to 24,000 pounds to the cubic inch. With these should be placed the so-called granite of Staten Island, which is in fact a dolerite. The granites vary in strength from 12,000 to 21,000 pounds to the cubic inch; limestones, from 7000 to 14,000; marbles, from 6000 to 14,000, the average being about 10,000; sandstones, from 1600 to 17,000. The following table gives the resistance to a crushing-force of some of our best-known building-stones:

Strength of Building-Stones.

	Strength in pounds per cubic inch.	Weight per cubic foot in pounds.	Authority.
Traps.			
Staten Island, N. Y.	22,250	178.8	Gillmore.
Jersey City Heights	20,750	189.5	"
Pompton, N. J.	24,040	......	"
Granite.			
Westerly, R. I.	17,750	165.6	"
Richmond, Va.	21,250	......	"
Fox Island, Me.	15,062	166.3	"
Port Deposit, Md.	19,750	170.	"
Bay of Fundy (red)	11,812	162.5	"
Quincy, Mass.	17,750	166.2	"
Marble.			
Tuckahoe, N. Y.	12,950	179.7	"
Dorset, Vt.	7,612	164.7	"
Italian, Italy	11,250	168.2	"
Canaan, Conn.	5,812	......	Franklin.
Canaan, Conn.	8,294	......	"
Lee, Mass.	13,444	......	"
Lee, Mass.	9,616	......	"
Pittsford, Vt.	12,239	......	U. S. navy-yard.
Pittsford, Vt.	9,028	......	" "
Statuary marble, Carrara, It.	9,723	......	Franklin.
Limestones.			
Caen, France	3,650	118.8	Gillmore.
Joliet, Ill.	11,250	159.3	"
Canton, Mo.	8,450	146.	"
Marblehead, O.	11,250	150.	"
Kingston, N. Y.	13,900	168.2	"
Glens Falls, N. Y.	11,475	168.8	"
Sandstones.			
Little Falls, N. Y.	9,850	140.6	"
Belleville, N. J.	10,250	141.	"
Middletown, Conn.	6,950	148.5	"
Medina, N. Y.	17,250	150.6	"
Berea, O.	8,300	153.1	"
Amherst, O.	6,650	133.7	"
Amherst, O.	7,832	......	Franklin.
Vermillion, O.	8,450	135.	Gilmore.
Bass Island, Wis.	5,450	127.5	"
Dorcester, N. B.	9,150	.....	"
Massillon, O.	8,750	131.8	"

It very rarely happens that a pressure of more than 50,000 pounds per square foot is sustained by any part of a structure of stone. The pillars of the church of All Saints at Angers are said to sustain a pressure per square foot of 86,000 lbs., the columns of the Pantheon at Paris, 60,000 lbs., but in most of the great architectural monuments the weight sustained is not more than half these. From these facts it might be inferred that any of the varieties of stone above mentioned would meet the requirement of strength, but it should be remembered that no stone is perfectly homogeneous; and, what is of still more importance, the pressure is very likely to be unequally distributed, and so localized as to require for safety a very large excess of strength. No stone should be placed in a position where the pressure upon it will be greater than one-fourth of its normal power of resistance, and all sedimentary rocks should be placed in their natural position. Formerly, it was the habit of architects to interpose a sheet of lead between the stones exposed to great pressure, for the purpose of equalizing the bearing. Recent experiments have, however, demonstrated that their resistance is greatly reduced by the interposition of lead or any other soft substance. The explanation offered of this is that the softer material spreads under the pressure, and tends to tear apart the stone.

Some of the comparative excellences and defects of the best-known American building-stones are briefly stated in the following notes:

Trap, although the strongest of building materials, and exceedingly durable, is little used for architectural purposes from the great difficulty with which it is quarried and wrought. It is an exceedingly tough rock, and, being generally without cleavage or bedding, is especially intractable under the hammer or chisel. It is, however, sometimes used with excellent effect in cyclopean architecture, the blocks of various shapes and sizes being fitted together with no effort to form regular courses.

Granite is the strongest and most durable of all the stones in common use. It generally breaks with regularity, and may be quarried in simple shapes with facility; but it is extremely hard and tough, and therefore can only be wrought into elaborate forms with a great expenditure of labor. For this reason the use of granite is somewhat limited. Its strength and durability commend it, however, for foundations, docks, piers, etc., and for massive buildings; for these purposes it is in use the world over. Granites are usually either gray or red in color, the gray being the more abundant. Serviceable varieties of both are common in all mountainous districts, where the rocks are mostly metamorphic. Excellent granites are found in New England, throughout the Alleghany belt, in the Rocky Mountains, and in the Sierra Nevada. Both gray and red granite have recently come into vogue as a material for sepulchral monuments. Since it is capable of receiving a very high polish, monuments made of it, when carefully dressed, are very handsome and almost imperishable. Most of the granite used in the Atlantic States comes from Rhode Island, Massachusetts, or the coast of Maine. The beautiful varieties of red granite used here are brought from Peterhead, near Aberdeen, Scotland, and from the Bay of Fundy.

Marble is confessedly the most beautiful of all building materials. It was highly esteemed by the beauty-loving Greeks, and all their great masterpieces of architecture, as well as sculpture, were wrought from it. In modern times it has retained something of its ancient repute, and is still the favorite material for the construction of the finest buildings; but the old order of things has passed away, and the reign of democracy has succeeded to that of despotism. As a consequence, temples, cathedrals, and kings' palaces are no longer built, while the palace of industry, the council-hall, and the comfortable abode of the family in the middle class of society are the objects for which architectural designs and building materials are required. These structures are generally utilitarian and modest in plan and material as compared with the castle or palace of olden time, and marbles, the "purple and fine linen" of architecture, are chiefly employed, if at all, in the decoration of interiors. With the increase of wealth and the diffusion of culture, however, the æsthetic qualities of marble are destined to reassert themselves, and the churches, capitols, and other public buildings will in another generation be much more generally built of marble than heretofore. The pure white marbles are too cold in color to be popular among the inhabitants of the temperate zone, and in the cities where soft coal is used are liable to be stained and disfigured by smoke; but the variety of color found in marble is almost infinite, and the clouded, gray, and dove-colored marbles admit of the nicest adaptation of color to climate, surroundings, and architectural design. Much may be done also to relieve the brilliant and pronounced effect of the lighter marbles by avoiding monotony of surface, and correcting lightness of color by shadow-lines. Inexhaustible supplies of the coarser marbles, well adapted to purposes of construction, are known to exist in Westchester co., N. Y., and at various points farther S. in the Alleghany belt. Of the finer marbles every desirable variety may be found in Rutland co., Vt., those of Pittsford especially being capable of fully supplying the wants of the architect as regards both color and texture.

Limestone presents the greatest diversity of qualities as a building material. Sometimes it is jet black, like that of Glen's Falls, is compact, and capable of receiving a high polish; sometimes gray, like that of Lockport; of a delicate dove or cream-color, like the Athens marble, or very light-colored and soft, like the Caen stone, the Bermuda coral rock, and the Florida *coquina*. All these have their excellences and defects as building materials. The darker limestones are too sombre in their normal state, and weather irregularly gray on exposure by the oxidation of the organic coloring-matter. The lighter-colored and fine-grained limestones to which reference has been made are, when sawed and used as ashlars, deservedly esteemed as among our best building materials. They are, however, less easily and accurately worked under the chisel than sandstones, and for this reason and their greater rarity are

far less generally used. The gray limestones, like that of Lockport, when hammer-dressed, have the appearance of light granite, and, since they are easily wrought, they are advantageously used for trimming in buildings of brick. Some of the softer limestones possess qualities which specially commend them for building materials: for example, the cream-colored limestone of the Paris basin (*calcaire grossier*) is so soft that it may be dressed with great facility, and yet hardens on exposure, and is a durable stone. Walls laid up of this material are frequently planed down to a common surface and elaborately ornamented at small expense. The Topeka stone, found and now largely used in Kansas, has the same qualities. It may be sawed out in blocks almost as easily as wood, and yet is handsome and durable when placed in position. The Bermuda stone and *coquina* are treated in the same way. The limestones most esteemed for building purposes in the U. S. are the Dayton stone, quarried at Dayton, O., and largely used in Cincinnati and other Western cities, and the Athens marble, found in Northern Illinois, a favorite stone in Chicago. Both these are derived from the Niagara group, are light-brown or dove-colored, and are very strong and handsome. Excellent building-stones are also obtained from the Corniferous limestone about Sandusky and Charloe, O., and Louisville, Ky., and from the Carboniferous formation at Bowling Green, Ky., and Elletsville, Ind.

Sandstones vary much in color and fitness for architectural purposes, but they include some of the most beautiful, durable, and highly-valued materials used in construction. Whatever their differences, they have this in common, that they are chiefly composed of sand—that is, grains of quartz—to a greater or less degree cemented and consolidated. They also frequently contain other ingredients, as lime, iron, alumina, manganese, etc., by which the color and texture are modified. The value of sandstones as building materials depends on several qualities, such as their color, texture, strength, durability, and facility of working. Where a sandstone is composed exclusively of grains of quartz, without foreign matter, it may be snow-white in color. Examples of this variety are known in many localities. They are rarely used for building, though capable of being employed for that purpose with excellent effect. They have been more generally valued as furnishing material for the manufacture of glass. The color of sandstones is frequently bright and handsome, and constitutes one of the many qualities which have rendered them so popular. It is usually caused by iron—when gray, blue, or green, by the protoxide as carbonate or silicate; when brown, the hydrated; and when red, the anhydrous oxide. The purple sandstones usually derive this shade of color from a small quantity of manganese. The texture of sandstones varies with the coarseness of the sand of which they are composed and the degree to which it is consolidated. Usually, the material which unites the grains of sand is silica, and this is the best of all cements. This silica has been deposited from solution, and sometimes fills all the interstices between the grains. If the process of consolidation has been carried far enough, or the quartz-grains have been cemented by fusion, the sandstone is converted into quartzite, the strongest and most durable of rocks, but, in the ratio of its compactness, difficult to work. Lime and iron often act as cements in sandstones, but both are more soluble, and less strong than silica. Hence, the finest and most indestructible sandstones are such as consist exclusively of grains of quartz united by silicious cement. In some sandstones part of the grains are fragments of feldspar, and these, being liable to decomposition, are elements of weakness in the stone. The very fine-grained sandstones often contain a large amount of clay, and thus, though very handsome, are generally less strong than those which are more purely silicious. The durability of sandstones varies with both their physical and chemical composition. When nearly pure silica and well cemented, sandstones are as resistent to weather as granite, and very much less affected by the action of fire. Taken as a whole, they may be regarded as among the most durable of building materials. When first taken from the quarry and saturated with "quarry water," a weak solution of silica, they are frequently very soft, but on exposure became much harder by the precipitation of the soluble silica contained in them. Since they form an important part of all the groups of sedimentary rocks, sandstones are abundant in nearly all countries; and as they are quarried with great ease, and are wrought with the hammer and chisel with much greater facility than limestones, granites, and most other kinds of rocks, these qualities, joined to their various and pleasant colors and their durability, have made them the most popular and useful of building-stones. In the U. S. we have a large number of sandstones which are extensively used for architectural purposes. Among these may be mentioned—(1) The *Dorchester stone*, which comes from the coal-measures of New Brunswick. This is a pale, olive-green sandstone, of which the color is apparently produced by the silicate and oxide of iron. It is a strong and usually homogeneous stone, although its value is sometimes impaired by balls or particles of pyrites, which, decomposing, produce cavities or black stains. (2) The *brownstone*, of which the Atlantic cities are so largely built. This is derived from the Triassic series, and the most important quarries which furnish it are located at Portland, Conn., Belleville and Newark, N. J. The popularity of this stone may be supposed to attest its excellence, but it varies much in quality. Some varieties are laminated, and are liable to exfoliate, especially when set on edge. It also often contains much lime and feldspar, both of which are elements of weakness and lead to disintegration. Although most of the buildings in which this stone has been used are comparatively new, many instances might be cited where it is already much decomposed; and, on the whole, we are compelled to regard it as lacking in durability. (3) The *Ohio stone*, derived from the Berea grit, a member of the Lower Carboniferous series in Northern Ohio. The principal quarries are located at Amherst and Berea. The stone from Amherst is generally light-drab in color, very homogeneous in texture, and composed of nearly pure silica. It is very resistant to fire and weathering, and is on the whole one of the best and handsomest building-stones known. The Berea stone is lighter in color than the Amherst, but sometimes contains sulphide of iron, and is then liable to stain and decompose. (4) The *Waverley sandstone*, also derived from the Lower Carboniferous series, comes from Southern Ohio. This is a fine-grained, homogeneous stone of a light-drab or dove-color, works with facility, and is very handsome and durable. It forms the material of which many of the finest buildings in Cincinnati are constructed, and is justly highly esteemed there and elsewhere. (5) The *Lake Superior sandstone*, a dark, purplish-brown stone of Potsdam age, quarried at Bass Island, Marquette, etc. This is rather a coarse stone of medium strength, but homogeneous and durable, and one much used in the Lake cities. (6) The *St. Genevieve stone*, a fine-grained sandstone of a delicate drab or straw-color, very homogeneous in tone and texture. It is quarried at St. Genevieve, Mo., and is one of the handsomest of all our sandstones. (7) The coal-measures of Pennsylvania, Ohio, and other Western States supply excellent sandstones for building purposes at a large number of localities. These vary in color from white to dark-red or purple, though generally gray or drab. While strong and durable, they are mostly coarser and less handsome than the sandstones which have been enumerated above. (8) The *Medina sandstone*, which forms the base of the Upper Silurian series in Western N. Y., furnishes a remarkably strong and durable stone, much used for pavement and curbing in the Lake cities.

Serpentine occurs in numerous localities in the Alleghany belt and in the Coast Mountains of California. It is generally a soft rock, unfit for architectural purposes, but a somewhat compact variety found in Chester co., Pa., is not only largely used for construction in that vicinity, but has recently been sent to Philadelphia, and there employed either as the sole material for the walls of buildings or as an adjunct to other stones in their ornamentation. It is of a grayish-green color, and structures built of it assume immediately the soft and pleasing tint that is only acquired by other materials with age. The new building of the University of Pennsylvania and several churches are built of it, in all cases with fine effect.

The following books and papers may be consulted for further information: *A Treatise on the Building and Ornamental Stones of Great Britain and Foreign Countries*, by Edward Hull; *Report of Commissioners on Building-Stones for the new Houses of Parliament* (1839–45); *Economic Geology*, by David Page; *Rocks Classified and Described*, by B. Von Cotta, translated by Lawrence; Ansted's *Practical Geology*; *Report on the Building-Stones of the U. S.*, by Q. A. Gillmore, Bvt. Maj.-Gen. U. S. A.; *Report on the Building-Stone of Iowa*, by Prof. Gustave Heinrich and Lieut. W. P. Butler (1871); *Report on the Marbles, etc. for the U. S. Capitol Extension*, President's Message 1852 (architect's report); *Smithsonian Report for 1856* (p. 303); *Experiments on the Resistance of Stones to Crushing*, made under the direction of Gen. Franklin at Hartford, Conn.; *Trans. Amer. Soc. Civ. Eng.* (No. xlviii.); *Experimental Tests of Building-Stones*, by R. G. Hatfield, N. Y.; *Trans. Amer. Soc. Civ. Eng.* (lvi.). J. S. NEWBERRY.

Stone-Chat, a European bird of the family of warblers (Sylviadæ) and genus *Pratincola*, the *Pratincola rubicola* or *Saxicola rubicola* of authors, about five and a quarter inches in length. The male, in the breeding season, has the head, neck above, and back nearly black; the chin and throat black, and the neck on the sides white; breast chestnut in front and lighter backward; the wing-coverts

of the tertials white, but partly hid by the other coverts, which are blackish-brown, edged with lighter brown: upper tail-coverts white, and tail-feathers blackish; bill and legs black. (*Yarrell.*) The female, as usual, is distinguished by duller colors. The species is common in most parts of Middle Europe and Northern Africa. It is claimed to be a resident throughout the year in England, though mostly migratory in corresponding latitudes on the Continent. It feeds on insects. THEODORE GILL.

Stone-Crop. See CRASSULACEÆ.

Stone'-Fly, a name sometimes given to neuropterous insects of the family Perlidæ. These have long flattened bodies, whose sides are parallel, and which have a large prothorax; the antennæ are filiform and elongated; the mandibles are generally aborted, but labial palpi present; the wings are unequal in size, the anterior comparatively small, the posterior broad, triangular, and generally extending beyond the abdomen; the tarsi are three-jointed. The pupæ are active, and resemble the adult save in the want of wings, and dwell in streams, under stones, etc. The adults mostly inhabit damp lowlands. They are used to a considerable extent, especially in England, as a bait for fishes. THEODORE GILL.

Stone Fort, p.-v. and tp., Saline co., Ill., on Cairo and Vincennes R. R. P. 798.

Stone Fruits, a popular name for those fruits which are known in botany as drupes. Most of them belong either to Amygdaleæ or Chrysobalaneæ, sub-orders of the Rosaceæ. The first-mentioned group includes plums, prunes, apricots, peaches, nectarines, and cherries; those of the other group are chiefly tropical. (See DRUPE.)

Stone'ham, tp., Oxford co., Me. P. 425.

Stoneham, p.-v. and tp., Middlesex co., Mass., on Boston Lowell and Nashua and Boston and Maine R. Rs., 9 miles N. of Boston, contains 5 churches, a public library, 1 savings-bank, excellent public schools, 2 newspapers, a box-factory and steam planing-mill, a machine-shop, and the manufacture of shoes and leather, which forms the principal industry. P. 4513. E. B. FAIRCHILD.

Stone'henge [from the Ang.-Sax. for "hanging stones"], an interesting mass of the remains of rude stone structures, usually referred to Druidical times, though the tendency among recent archæologists is to assign it to some pre-historic race. It stands on Salisbury Plain, 2 miles from Amesbury, Wiltshire, England. It is at present much defaced, but within the memory of man was composed somewhat as follows: At the centre was a large slab of blue limestone, a supposed altar. Around this were nineteen granite posts, some 20 feet in average height, set in an ellipse. Around this was another ellipse of sandstone posts, bearing a transom or lintel of sandstone across the top. There seem to have been six of these triliths. Outside this ellipse was a circle of thirty rough pillars of granite, some 6 feet high. Outside of this there was a circle of thirty sandstone posts, 3½ feet apart and 16 feet high. A horizontal course of stone, dovetailed and mortised to the tops of the uprights and to each other, ran around this circle. Without this circle there was a ditch and double mound of earth. Many sepulchral barrows are found in the vicinity. (See also STONES, STANDING.)

Stone'house, tp., James City co., Va. P. 828.

Stone Lick, p.-v. and tp., Clermont co., O. P. 1880.

Stone Lily. See ENCRINITE.

Stone Mountain, p.-v., De Kalb co., Ga., on Georgia R. R., at the foot of a bare and isolated peak of granite 2200 feet high, much resorted to by tourists. P. 690.

Stone River, Battle of. See MURFREESBORO'.

Stones, Standing. Large, unhewn monoliths raised to an erect position have been found in almost all parts of the world. They are notably numerous in the British Isles, where they sometimes stand singly and sometimes are arranged in groups. It was long supposed that they were in some manner connected with the Druidical worship of the Celtic races, but the results of modern investigation throw much doubt on this theory, while failing to give any other plausible explanation of their origin or purpose. Sometimes they were clearly erected as monuments to preserve the memory of some remarkable event. Thus, one in Scotland is traditionally known as the "Cat Stane" (from Celtic *cath*, "battle"), and another in Norway is known as the *bauta stein* (battle-stone); not unfrequently in Scotland they are now known merely as *hair stanes* (boundary-stones), having from time immemorial served as well-known landmarks, while the original purpose of their erection has been wholly forgotten. A religious idea is certainly connected with many of these stones. One of the most noted is the Lia Fail of Ireland, which was brought to Icolmkill for the coronation of Fergus Erc, was afterward removed to Scone, where it became the coronation-stone of the Scottish kings, and, being carried to England by Edward I., now forms part of the coronation-chair of the sovereigns of Great Britain. Myths are connected with many of the British monoliths, whether standing singly or in groups. Thus, one at Stennis in Orkneys, having in it a hole large enough to admit a man's head, was known as the "Stone of Odin," and within a century past was used for the solemnization of matrimonial and other vows, the person who violated a vow here made being held to be especially infamous. Another series of monoliths in the island of Mull is traditionally affirmed to be a line of guide-posts to point the way for pilgrims visiting the sacred shrine of Iona. There are several remarkable groups of standing stones, the arrangement of which evinces a definite purpose, but what that purpose was is as yet wholly a matter of conjecture. The most noted of these groups is that of Stonehenge. (See STONEHENGE.) The "standing stones" of Stennis, in one of the Orkney Islands, are about 80 in number, and are grouped in two separate circles of 360 and 100 feet in diameter. The standing stones at Avebury, in Wiltshire, stand in two concentric circles, surrounded by an outer circle of 100 stones, the whole being approached by two long avenues of similar stones standing in double lines. Another remarkable group is found at Calbernish, in the island of Lewis. These form four circles, near together, but having no apparent relation to each other. In the principal circle a double line of upright stones runs northward from a large stone in the centre, while to each of the other cardinal points of the compass runs a single line of stones, so that the whole figure is in the form of a cross. That some astronomical idea was in the minds of the builders is apparent from the fact that when upon a clear night one looks over the single line of stones running southward to the top of the large central stone, the apex of this points out exactly the position of the pole-star. At Carnac, in the department of Morbihan, France, is a still more remarkable group of standing stones, of which more than 1000 are still erect, and this is hardly a fourth of their original number. (See CARNAC.) A. H. GUERNSEY.

Stone'wall, tp., Appomattox co., Va. P. 2559.

Stonewall, tp., Frederick co., Va. P. 3388.

Stonewall, tp., Highland co., Va. P. 1632.

Stonewall, tp., Rappahannock co., Va. P. 1763.

Stonewall, tp., Richmond co., Va. P. 1397.

Stonewall, tp., Rockingham co., Va. P. 2212.

Stonewall, tp., Shenandoah co., Va. P. 2410.

Stoneware. See POTTERY AND PORCELAIN MANUFACTURE, by C. F. CHANDLER, M. D., PH. D., LL.D.

Stoney Creek, v., Pasakenta tp., Tehama co., Cal. P. 76.

Sto'nington, p.-v. and tp. and seaport of New London co., Conn., on Stonington and Providence and Stonington and New London R. Rs., and the terminus of Stonington and Providence steamship line, has 6 churches, 3 public-school buildings, 2 banks, and 2 newspapers. Sealing-vessels are fitted out every year for the South Shetland Islands, this industry and whaling being the principal business engaged in. P. 6313. J. S. ANDERSON, ED. "MIRROR."

Stonington, tp., Christian co., Ill. P. 738.

Sto'ny Battery, tp., Newberry co., S. C. P. 1901.

Stony Brook, p.-v., Brookhaven tp., Suffolk co., N. Y., on Hicksville and Port Jefferson branch of Long Island R. R., has a good harbor and some coasting trade.

Stony Creek, tp., Colusa co., Cal. P. 686.

Stony Creek, p.-v., Branford tp., New Haven co., Conn., on Stony Creek Bay of Long Island Sound and on New York New Haven and Hartford R. R.

Stony Creek, tp., Henry co., Ind. P. 934.

Stony Creek, tp., Madison co., Ind. P. 1082.

Stony Creek, tp., Randolph co., Ind. P. 1212.

Stony Creek, tp., Warren co., N. Y. P. 1127.

Stony Creek, tp., Caswell co., N. C. P. 1368.

Stony Creek, p.-v. and tp., Somerset co., Pa. P. 1526.

Stony Creek, tp., Sussex co., Va. P. 1510.

Stony Fork, p.-v. and tp., Watauga co., N. C. P. 366.

Stony Point, p.-v. and tp., Rockland co., N. Y., on the W. bank of Hudson River, at the entrance of the Highlands, opposite Verplanck's Point, takes its name from a small rocky peninsula now crowned with a lighthouse and fog-bell tower, and connected with the shore by a marsh. The house of Joshua Hett Smith, where Arnold held his treasonable interviews, is in this town. The promontory of Stony Point was fortified by the Americans early in the war of the Revolution, but having been cap-

tured, strengthened, and garrisoned by the British, it was retaken by Gen. Wayne in a night-attack July 16, 1779, and the garrison of 543 officers and men taken prisoners. A simultaneous attack was made upon Verplanck's Point, but was unsuccessful, and the fortifications of Stony Point were consequently destroyed and abandoned July 18.

Stop, in the organ, a series or set of pipes of similar tone and quality, tuned in regular gradation according to the order of the scale, and corresponding with the keyboard either in the whole or a part only of its range. These stops are either simple or compound. A "simple" stop (as a diapason, flute, or trumpet) has only one pipe allotted to each key on the keyboard, but in a "compound" stop (as the sesquialtera or mixture) there are from two to five pipes for each key. The stops in a large organ are not only of various *qualities* of tone—soft, loud, delicate, bold, shrill, and the like—or imitations of the trumpet, violin, flute, etc., but are also distinguished by peculiarities of *pitch*, some stops giving the sound represented by the finger-keys to which they belong, others the octave or double octave below or above, while others are tuned in triple octaves above, and even in double and triple thirds and fifths, the whole combining and blending together with united effect, as if each key sounded only one richly-toned pipe. The theoretical basis or *rationale* of this latter class of stops we have already endeavored to explain in the article HARMONIC STOPS, to which we here refer the reader in order to avoid repetition. In structure, organ-pipes are of two classes—viz. *flue*-pipes and *reed*-pipes. The former are either metallic cylinders of various forms and proportions, with a mouth and lip resembling those of the ordinary pitch-pipe; or are square wooden tubes producing sound on the same principle. The latter are chiefly metallic tubes of tapering form, provided with flexible reeds of brass or other metal, the vibrations of which produce a sound richer and more penetrating than that of the flue-pipe. Among the flue-stops are the diapasons, principal, twelfth, fifteenth, tierce, and the compound stops; also the gamba, keraulophon, and the various flute-stops. In the class of reed-stops the most prominent are the trumpet, trombone, horn, bassoon, clarion, cremona, hautboy, and vox humana. The names of the stops are sometimes arbitrary or fanciful, but ordinarily are descriptive—(1) of their quality of tone, as the dulciana, tuba mirabilis, etc.; or (2) of their imitative effect, as the trumpet, hautboy, flute, etc.; or (3) of their pitch, as the quint (or fifth), the twelfth (or octave fifth), the fifteenth (or double octave). Some of the compound stops, however, have names which cannot readily be accounted for, as the sesquialtera, cornet, mixture, and furniture. As many of the simple stops sound octaves, etc. to the finger-keys, it has been found expedient to classify them by a simple rule which shows at once the relation of their *pitch* to that of the diapasons. In the open diapason a pipe eight feet long gives the sound of C C, and on this account it is called an "eight-foot stop." And as the diapasons give the true and proper sound represented by the keyboard, every other stop which is in *unison* with the diapasons is said to be an "eight-foot stop." Taking this, then, as a standard, all stops sounding an octave above the regular pitch are called "four-foot stops," and those sounding the double octave above are "two-foot stops." A pipe, however, with a plug or stopper sounds an octave lower than an open one of the same length, and an eight-foot "*tone*" may therefore be obtained from a pipe only four feet long; hence, as the stopped and the open diapason give the same *tone*, or are of the same pitch, they are both said to be stops of eight-foot tone, or, briefly, eight-foot stops.

WILLIAM STAUNTON.

Stop'page in Trans'itu, a peculiar mercantile remedy, given under certain circumstances to the seller of merchandise. When goods have been sold on credit, and have been delivered to a carrier or other middleman for purpose of transport and delivery to the vendee, and while this transit continues the vendor discovers that the buyer has become or is insolvent, such vendor may stop the goods, retake them into his own possession, and thus, by putting an end to the transit, prevent them from coming into the purchaser's custody. This remedial right of the seller to protect himself, and the act by which the right is enforced, are termed "stoppage in transitu." There have been some doubt and confusion as to the true legal principle which lies at the basis of this special rule. According to the English and American law, as soon as the contract of sale is entered into, the property in the goods at once passes to the buyer without a delivery; but if the sale is for cash, the seller has a lien on the articles, so long as they remain under his control, as a security for their price. The doctrine is now settled that the vendor's remedy of stoppage in transitu is not a recision of the sale, but is rather an extension by analogy of his lien; it is an equitable enlargement of a common-law principle which was originally narrow and special. The vendor does not, by the exercise of his right, become the absolute owner of the goods; he holds them as security, in the nature of a pledge; if the vendee or his assigns should demand them and offer to pay the stipulated price, the seller would be bound to accept the offered payment and to surrender the property. Stoppage in transitu was originally exercised only in cases of water transport, but has since become and now is extended to every species of transit, whether on the high seas, on inland waters, or by land-carriage.

By whom and on what occasion may the Right be exercised?—The right belongs only to a vendor who has sold goods on credit; but this description includes the case of a consignor who sends merchandise to a factor for sale, when the latter would be clothed with at least their apparent ownership, and would become a debtor for their proceeds to his principal, since the relation of vendor and vendee virtually exists under such circumstances. The occasion of the right is the fact that the buyer is discovered after the sale to be insolvent. It is not essential that the insolvency should have actually occurred subsequent to the contract of purchase; if at that time the vendee was really insolvent, but the vendor was ignorant thereof, and only makes the discovery afterward, the right of stoppage arises if the transit has not ended. If, however, the vendor sells goods on credit knowing that the purchaser is then insolvent, he assumes the risk and abandons all right to interfere with them while on their way. It is not necessary that the vendee should have been judicially declared a bankrupt or an insolvent; mere inability to pay his debts as they become due constitutes the insolvency contemplated by the law. Of course, the burden of proof rests upon the seller, who exercises his right of stoppage, to establish this fact in case it is denied and the validity of his proceeding is controverted. When the vendor might stop the goods *in transitu*, he may retain them if they have not yet passed from his actual possession.

How long does the Right continue?—in other words, What facts, acts, and circumstances end or defeat the right? It is wholly impracticable to mention even the numerous particular cases which may arise or have arisen in the transactions of business, and the special questions suggested by them: the broad general principle which determines all these cases and answers these questions can alone be stated. The right of stoppage continues as long as the transit lasts, and ends when the transit ends. The transit itself continues as long as the goods are not yet under the control of the vendee, but are in the hands of a middleman for the purpose of being expedited toward the *final destination* contemplated by the original contract. The transit ends when the goods have arrived at that final destination, and have there come into the custody or under the control of the vendee. This is the settled doctrine in its most general form, and must be applied under the infinite variety of circumstances to the merchandise in the hands of carriers by land or by water, of warehousemen, wharfingers, forwarders, and of every other species of agent or middlemen concerned with their transport or their storage. When the goods have arrived at the place of their destination, and are there placed in the vendee's own warehouse or on his wharf, or in a warehouse or on a wharf which he is in the habit of using as his own and of making the repository for his merchandise, the transit and the right of stoppage have ended. When, also, the goods have arrived at the place to which the vendee intended they should be carried, and where they will stop awaiting his orders and subject to his direction as to what shall be done with them, although not perhaps his regular place of business, the transit has ceased. But when, on the other hand, they are sent to an intermediate party *for the purpose of being forwarded by him* to the purchaser, the transit is not ended by their coming into his possession, although they may there await the vendee's orders as to the time when they are to be forwarded to him. The doctrine concerning the duration of the transit was so clearly and comprehensively announced by one of the most eminent of American judges that I quote his statement in a somewhat condensed form: While the goods remain in the possession of persons concerned in their transportation to the place of destination named by the purchaser, they may, in the event of his failure, be reclaimed by the seller. It is not material whether the person in whose possession they are when the seller interposes his claim be a carrier, a warehouseman, a wharfinger, a packer, or other depositary, or an agent for the purpose of forwarding, nor by which of the parties to the sale he was employed. He may be the agent of the purchaser, designated, paid, and employed by him; yet if the purpose of his employment is to expedite the property toward its destination, or to aid those en-

gaged in forwarding it, the seller's right to stay the final delivery continues. When the seller attempts to claim the goods, the question is, whether they have arrived at the end of their transit; and this depends upon the further question, whether the party in whose hands they are found is acting in the character of an *agent for transportation* or as agent for the purchaser, holding them simply for his use, unconnected with the business of forwarding them. The circumstances of the transaction may be such that the delivery to the vendee is immediate, and that any subsequent transport of the goods is made *by* him in the course of his own business, and is not a conveyance *to* him as contemplated by the original contract of sale; in such a case no right of stoppage arises. If the merchandise arrive from abroad in the port of the consignee, and is there taken by the customs officers and warehoused by reason of his failure or delay in paying the duties, it may still be reclaimed by the consignor. If, however, goods so arriving are placed in a public warehouse, and the consignee by giving the requisite bonds is entitled to withdraw them at any time upon payment of their duties, the constructive delivery to him is complete and the seller's right is defeated. If while the goods are on their transit they should be seized on execution or attached by a creditor of the vendee, the seller's remedy of stoppage is not prejudiced, but can be exercised as against the interfering creditor and the persons acting on his behalf. One of the most interesting questions connected with this subject, and one which gave rise to the gravest judicial controversy, relates to the effect produced upon the consignor's right of stoppage by the consignee's assignment of the bill of lading of the goods when they are transported by ship. The doctrine is thoroughly established that a bill of lading is not completely a negotiable instrument, like a bill of exchange or a promissory note; and the assignee thereof, although taking it in good faith and for value, is not always protected against the real owner or rightful claimant of the goods. A bill of lading is, however, a *quasi* negotiable instrument; it represents the merchandise described in it; it is constantly treated by merchants as a muniment of title; transfers of cargo or parts of cargo on board "to arrive" are made by its endorsement and delivery to the purchaser. If goods are shipped and their bill of lading, originally drawn to the consignee or his assigns, is sent to him, or, being originally drawn to the consignor, is regularly endorsed by him and sent to the consignee, the possession of this written evidence of title by the latter under these circumstances makes him the apparent owner of the property, and clothes him with the apparent power of disposition. If with such a state of facts the consignee, having in his possession a bill of lading regular on its face and vesting him with the apparent ownership, assigns the same to a *bonâ fide* purchaser for a valuable consideration and without notice of the consignor's claims, it being intended by the transaction to transfer the property in the goods themselves, this act will defeat the consignor's or vendor's right of stoppage, although the actual transit has not ended, and although the consignee or vendee, being indebted for the price, is or becomes insolvent.

How the Right should be exercised.—The vendor himself or his agent may interpose and arrest the transport and the delivery to the vendee. The purchaser's insolvency, however absolute and notorious, is not alone sufficient; there must be some positive act of interference by which the seller's right is asserted. This act may be a manual taking possession of the property, but such an exercise of ownership is never required, and would often be wholly impracticable. A notice to the carrier or other middleman of the vendor's right, accompanied by a prohibition from making a delivery to the vendee, and by a demand to surrender up possession to the seller or his agent, is always sufficient, and is the usual mode of exercising the right of stoppage. If the middleman should refuse to comply with the notice, and even if he should violate it by a delivery to the vendee, the vendor's lien would still be preserved; he could recover possession of the goods or their value either from the buyer or from his assignees, while the middleman would also be responsible to him for the damages caused by his own wrongful act. The carrier, however, has a lien upon the goods for his freight earned in their transport, and the warehouseman or wharfinger for his charges, and their claims must be satisfied by the vendor before he can lawfully obtain possession of the merchandise. JOHN NORTON POMEROY.

Storax. See STYRACACEÆ.

Sto'rer (BELLAMY), LL.D., b. at Portland, Me., about 1798; graduated at Bowdoin College 1818; studied law at Cincinnati; was a Representative in Congress 1835–37; subsequently judge of the superior court, and professor in the Cincinnati Law College; at the time of his death was a vice-president of the Evangelical Alliance. D. at Cincinnati June 1, 1875.

Storer (DAVID HUMPHREYS), M. D., b. at Portland, Me., in 1804; graduated at Bowdoin College in 1825; devoted himself especially to natural history, and besides contributions to scientific periodicals has published *Genera, Species, etc. of Recent Shells* (1837), *Ichthyology, etc. of Massachusetts* (1839), *Fishes of North America* (1846), and *History of the Fishes of Massachusetts* (1853, and, with plates, 1866).

Storer (FRANCIS HUMPHREYS), b. in Boston in 1832; graduated at the Lawrence Scientific School in 1855, and is professor in the Massachusetts Institute of Technology; has contributed to scientific periodicals; was the American editor of Barreswill's *Répertoire de Chimie appliquée*, and has published *Alloys of Copper and Zinc* (1859), *Manufacture of Paraffine Oils* (1860), *First Outlines of a Dictionary of the Solubilities of Chemical Substances* (1863–64), and with Charles W. Elliot, *Manual of Inorganic Chemistry* (1869), and *Manual of Qualitative Chemical Analysis* (1870).

Storer (HORATIO ROBINSON), M. D., b. in Boston in 1830; was professor of obstetrics and medical jurisprudence in the Berkshire Medical College; has contributed largely to medical literature, and has published *Why not? a Book for every Woman*, which received the gold medal of the American Medical Association (1866), *Is it I? a Book for every Man* (1867), *Decrease of the Rate of Increase of the Population in Europe and America* (1867), *Nurses and Nursing* (1868), and with F. F. Heard, *Criminal Abortion, its Nature, its Evidence, and its Law* (1868).

Sto'rey, county of W. Nevada, lying between Truckee and Carson Rivers. In the valleys are small tracts of arable land, but silver mining is the principal industry. On Mount Davison, 7000 feet high, is the famous Comstock Lode, one of the richest in the world. Cap. Virginia. Area, 420 sq. m. P. 11,359.

Storey (WILBUR F.), b. in Salisbury, Vt., Dec. 19, 1819; served an apprenticeship to the printing business, went to New York City, and was employed on the *Journal of Commerce*. In the spring of 1838 he removed to Laporte, Ind., where he began the publication of a weekly Democratic newspaper. This and a similar venture at Mishawaka, Ind., in 1841, proving unsuccessful, he established the *Patriot* at Jackson, Mich., in 1842, and in 1854 purchased the Detroit *Free Press*, which he published till 1861, when he purchased the Chicago *Times*, which he has since conducted. J. B. BISHOP.

Stork [Ang.-Sax. *store*], a name given to the birds of the genus *Ciconia* and of the family Ciconiidæ, but especially to *Ciconia alba*. This is a large bird, about three and a half feet long; the head, neck, and body above, as well as below, are white, the wings partly black, and the bill and legs red. It is a migratory species, which in the warm season extends into Northern Europe, and in winter (as well as other seasons) is found in Northern Africa and Asia. It has no cry, but claps its bill together with a loud noise. Storks are great favorites with the people, who conceive that their presence brings good luck. They often build upon the roofs of houses. They display remarkable affection for their young; and according to popular belief are so attached to their old parents that they carry them upon their backs during their long and lofty flights from zone to zone. It is, however, asserted that when one of their number is sick or wounded the others fall upon it and kill it by blows of the beak. They rest by standing on one leg and dropping the beak against the breast. They devour offal, reptiles, and other vermin. The stork is of old a popular emblem of filial piety and conjugal faithfulness. A number of related species are known.

Storks (Sir HENRY KNIGHT), K. C. B., b. in England Apr. 5, 1811; entered the army in 1828, and served on regimental duty until 1846, when employed on the staff in the Kaffir war, 1846–47. In the Crimean war he commanded the British military establishments on the Bosphorus, the Dardanelles, and at Smyrna 1854–55; in the war office as secretary for military correspondence 1857–59, when promoted to be major-general, and was lord high commissioner of the Ionian Islands until 1863; appointed governor of Malta in 1864; was summoned to Jamaica the next year to inquire into the Eyre outbreak on that island, the satisfactory execution of which duty brought him the honor of being sworn of the queen's privy council and becoming Right Hon. In 1868 he became under-secretary of state for war, in 1870 surveyor-general of the ordnance, and in 1871 lieutenant-general and member of Parliament from Ripon. D. at London Sept. 6, 1874.

Storm Lake, p.-v. and tp., Buena Vista co., Ia., on Iowa division of Illinois Central R. R., has 3 churches, a fine school, 2 banks, 1 newspaper, 2 parks, and 1 steam flouring-mill. P. 256. W. L. VESTAL, ED. "PILOT."

Stor'mont, county in the E. of Ontario, Canada, bounded S. by St. Lawrence River. It is traversed by Grand Trunk Railway. Cap., Cornwall. P. including Cornwall, 18,987.

Storms, Hur'ricanes, and **Cy'clones.** When currents of air moving in different directions encounter each other, they impart to the atmosphere a whirling motion, as may often be seen when wind carries up the dust off the ground. Such a movement, on a grand scale, is a storm, which is usually accompanied by rain or snow when the contending winds are of different temperatures. Storms vary in their nature according to their immediate causes, some being due to struggling horizontal, some to ascending, currents of air, modified in their course by chains of mountains and inequalities of the surface; some, again, to mere local causes. The most remarkable for violence and the regularity of their course are the *hurricanes* of the West Indies and of Mauritius in the Indian Ocean, the *cyclones* of the Gulf of Bengal, and the *typhoons* of the South Chinese Sea.

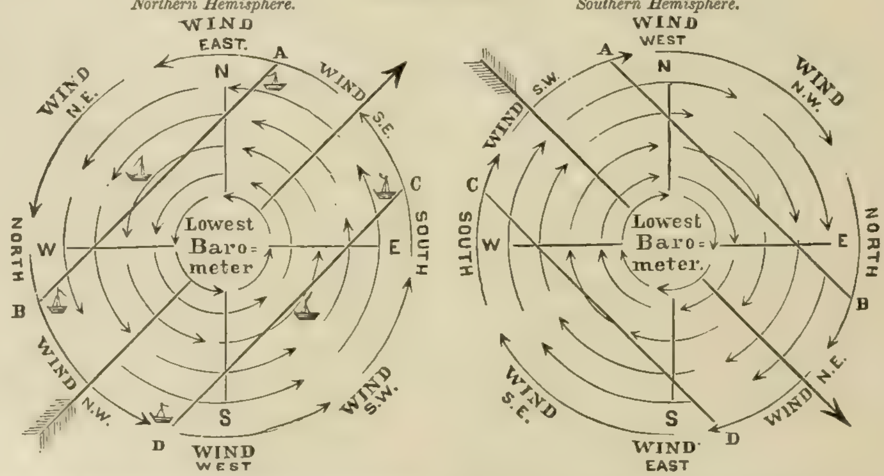
Law of Storms.—All the facts collected with great care and industry by Mr. Redfield of New York, Gov. Reid of Bermuda, Piddington of Calcutta, and Prof. Dove of Germany prove that in these great storms the air has a strong rotary motion round a centre where calm prevails and the barometric pressure is least. All around the wind blows in various and opposite directions, while at the same time the body of the storm has a progressive motion, its course being marked by the track of the centre. In the northern hemisphere this rotary motion is from right to left, or contrary to the direction of the hands of a watch. In the southern hemisphere it is reversed. These storms usually begin within the tropics, but extend far into the temperate regions, where they gradually spend their force. In both regions they follow the course of the general winds peculiar to each zone, by which they are, as it were, borne along. The West India hurricanes usually originate in the Eastern Antilles (see Map in WINDS), and first move westerly toward the tropics. Beyond the limits of the trades (see diagram at the bottom of Map in WINDS) they suddenly turn around, and, carried by the general motion of the atmosphere, sweep over the eastern coast of North America, and after raging in the Atlantic cross to Western Europe, where they finally expire. The Mauritius hurricanes start from the southern tropical ocean, move toward the S. W. to Mauritius and Reunion islands, and thence turn at right angles beyond the tropics in the temperate latitudes. The typhoons, also born in the tropical seas of India and China, move with the monsoons, and their course bends more strongly toward the N. E. when reaching the temperate regions. All these storms cover only a small area at their point of origin, but their violence is extreme. As they advance, their circle gradually enlarges while their fury diminishes. The West India hurricanes of 1839 had a diameter of 300 miles in the Antilles, 500 at the Bermudas, and 800 in the 50th degree of latitude. They occur most frequently at the time of the breaking up of the seasons and the change of the general winds—that is, about the equinoxes. Out of 365 hurricanes which have desolated the West Indies from 1493 to 1855, 245, or over two-thirds, took place from August to October.

The position of the main regions of hurricanes above mentioned, on the S. E. side of the three great continents and near the tropics, is very remarkable, and proves that they are the result of the struggle between the general winds, intensified by the influence of the great bodies of land, varying with the season. Next to the grand volcanic eruptions and earthquakes, no natural phenomenon is more awe-inspiring than these tremendous tempests. The portentous calm and lurid sky which precede the bursting of the storm, the profound obscurity which follows the descending clouds, the extreme violence of the wind uprooting whole forests, tearing down the most solid edifices, sinking the largest ships in a few moments or lifting them up in the air to break them on the shore, and covering their path with ruin and desolation, place these hurricanes among the long-remembered events whose recurrence is ever dreaded by all. (See WHIRLWIND.)

A knowledge of the law of storms enables the navigator to steer his vessel so as to avoid a direct encounter with these tempests. He can ascertain what part of a circular storm he is coming into by observing how the wind begins to veer. In the northern hemisphere, within the tropics, if the wind is N. E., the centre of the storm is on the S. E. of the ship while its body is moving to the N. W. (See figure.) The commander must therefore sail to the S. W., and leave the storm behind him. Within the temperate

Revolving Storms in the

Northern Hemisphere. *Southern Hemisphere.*



regions, the body of the storm moving toward the N. E., he will steer W. or N. W., and thus get out of the path of the storm. In the southern hemisphere the opposite course must be taken.

North-easters. — Our great winter and north-easterly storms are but the left, or western half, of such a revolving mass of air. Suppose the storm strikes a place first at the point A (fig.), the wind will be N. E. The storm passing over it along the line A B, the wind will successively blow from the N. N. E., N. N. W., and finally N. W., clear and cold; after which the storm is over. If the storm begins with a S. E. wind, as at point C, we are in the right-hand half, and while it is passing along the line C D the wind gradually veers to the S., S. W., W., and N. W.; which is always the end. It is thus easy to understand why it is that the wind, though coming from the N. E., blows at Washington and Philadelphia, as Franklin first remarked, before it is felt in New York and Boston.

The *northers* are violent, cold, dry polar winds descending from the top of the atmosphere, and sweeping, mostly during the winter, over Texas and Louisiana, and sometimes reaching Mexico and the Antilles. The *sirocco* of Italy, the *khamsin* of Egypt, the *harmattan* of Guinea, the *simoom* of Arabia, are hot winds from the zone of deserts of Africa and Western Asia, blowing with great fury, more or less periodically at certain seasons.

Tornadoes and *water-spouts* repeat on a small scale, but with scarcely less violence, the phenomenon of cyclones. When opposite winds of different temperatures meet in the upper atmosphere, a vast amount of vapor is condensed into a thick black cloud, and a whirling motion is given to the air, which soon takes the shape of a vast funnel descending lower and lower into the quiet atmosphere beneath as the rapidity of its motion increases. This long revolving column of black cloud draws up in its vortex all the objects in the path of the tornado. On a narrow track, from a few yards to a quarter of a mile wide, trees are uprooted, houses unroofed or carried up into the air by this fearful power of suction. A tornado passing into the sea becomes a *water-spout.* The dark column, descending near the surface, raises the water, which joins in its whirling motion and binds together, as it were, the clouds and

the sea. Like the cyclones, the tornadoes usually move with the general south-westerly winds. A. Guyot.

Storrs (Charles Backus), brother of Dr. Richard Salter, Sen., b. at Longmeadow, Mass., May 15, 1794; educated at Princeton and at Andover Seminary 1820; preached at Ravenna, O., from 1822 to Mar., 1828, when he became professor of Christian theology in Western Reserve College, and was chosen president of that institution 1831. D. at Braintree, Mass., Sept. 15, 1833.

Storrs (Richard Salter), D. D., b. at Longmeadow, Mass., in Feb., 1789, descended from a long line of ministers, his father, who bore the same name, having been thirty-three years pastor at Longmeadow (b. at Mansfield, Conn., 1763; graduated at Yale College 1783; d. 1819); passed a year at Yale College 1802–03; taught in the Clinton Academy, East Hampton, L. I., 1804–06, after which he entered the senior class at Williams College, graduating 1807; studied theology with Rev. Aaron Woolworth at Bridgehampton, L. I.; was licensed by the Suffolk presbytery 1808; preached at Islip and Smithtown, L. I., 1808–09; spent a year at Andover Seminary, graduating 1810; was ordained pastor of the First Congregational church at Braintree, Mass., July 11, 1811, and, with the exception of one period of five years spent as agent of the Home Missionary Society, remained there until his death, Aug. 11, 1873, after a pastorate of sixty-two years. Editor of the *Boston Recorder* (1817–25), and senior associate editor of the *Congregationalist* (1850–56); contributed to the *Panoplist*, the *Home Monthly*, and other periodicals; furnished introductions to Willison's *Sacramental Meditations* (New York, 1850) and to the *Life of Rev. Daniel Temple* (Boston, 1855), and published a *Memoir of Rev. Samuel Green*, about twenty single sermons, one of which was on *Continuance in the Ministry, a Discourse on the Fiftieth Anniversary of his Ordination* (Boston, 1861).

Storrs (Richard Salter), D. D., son of the preceding, b. at Braintree, Mass., Aug. 21, 1821; graduated at Amherst College in 1839; studied law, and afterward theology at the Andover Seminary, where he graduated in 1845, and after serving for a year as pastor of a Congregational church in Brookline, Mass., became in 1846 pastor of the Church of the Pilgrims, Brooklyn, N. Y., a position which he still occupies. He has contributed much to current literature, and was from 1848 to 1861 one of the editors of *The Independent*, a religious weekly. He has published a *Report on the Revision of the English Version of the Bible* undertaken by the American Bible Society; *The Graham Lectures on the Wisdom, Power, and Goodness of God, as manifested in the Constitution of the Human Soul* (1856); and a series of lectures on *The Conditions of Success in Preaching without Notes* (1875).

Storrs (William Lucius), LL.D., b. at Middletown, Conn., Mar. 25, 1795; graduated at Yale College 1814; studied law at Whitestown, N. Y., where he was admitted to the bar 1817; returned soon afterward to Middletown; was a member of the State assembly 1827–29, and its Speaker 1834; member of Congress 1829–33, and again 1839–40; was appointed associate judge of the State supreme court of errors June, 1840, and chief-justice 1856, and was professor of law in Yale College 1846–47. D. at Hartford June 25, 1861. His decisions, which were regarded by jurists as extremely able, are found in the *Connecticut Reports*.—His elder brother, Henry Randolph, b. at Middletown in 1787; graduated at Yale College 1804; practised law at Champion, Whitestown, and Utica, N. Y.; was for five years first judge of Oneida co.; sat in Congress 1819–21 and 1823–31; published a number of Congressional *Speeches*; removed about 1832 to New York City, where he took high rank in his profession. D. at New Haven, Conn., July 29, 1837.

Sto'ry, county of Central Iowa, intersected by Skunk River, and crossed by the Chicago and North-western R. R., which passes through the capital. It has an undulating surface and fertile soil. Staples, Indian corn, wheat, oats, hay, wool, and dairy products. Cap. Nevada. Area, 550 sq. m. P. in 1870, 11,651.

Story (Isaac), cousin of Judge Joseph, b. at Marblehead, Mass., Aug. 25, 1774; graduated at Harvard 1793; practised law at Castine, Me., where he edited the *Journal*, and at Rutland, Mass.; contributed to Russell's *Columbian Centinel* and to Denny's *Farmer's Museum*; published a poetical *Epistle from Yarico to Inkle* (Marblehead, 1799), *Consolatory Odes* (1799), and *The Parnassian Shop, by Peter Quince* (Boston, 1801). D. at Marblehead July 19, 1803.

Story (Joseph), LL.D., b. at Marblehead, Mass., Sept. 8, 1779; graduated at Harvard College in 1798; studied law, and in 1801 commenced practice at Salem; was a member of the State legislature 1805–08, and the acknowledged leader on the Republican side, defending Jefferson's proclamation of embargo as the only measure, short of war, by which American commerce could be protected from the ignominious restrictions of the belligerent European powers. In 1808 he was elected a representative in Congress, where he urged a repeal of the embargo act, on the ground that it was a temporary measure, the purpose of which had now been attained. Having declined a re-election to Congress, he was in 1810 again chosen a member of the State legislature, of which he was elected Speaker. In 1811 he was appointed associate justice of the Supreme Court of the U. S., and in 1820 was a member of the convention for the revision of the State constitution. In 1829 he was chosen Dane professor of law in Harvard University, a position which he held for the remainder of his life, during which the law-school of which he was the head became the foremost one in the U. S. In 1804 he published an unsuccessful volume of poems entitled *The Power of Solitude*, and in 1806 *Memorial of the Inhabitants of Salem*, a pamphlet addressed to Pres. Jefferson relating to the infringements by foreign powers upon the neutral trade of the U. S. He also published many addresses, literary discourses, and reviews, but his fame rests mainly upon his decisions, and especially upon his legal *Commentaries*, of which the following are the principal, all of which have passed through several editions, and most of which have been translated into German: *On the Law of Bailments* (1832), *On the Constitution of the U. S.* (1833), *On the Conflict of Laws, Foreign and Domestic* (1834), *On Equity Jurisprudence, as administered in England and America* (1835), *On Equity Pleadings* (1838), *On the Law of Agency* (1839), *On the Law of Partnership* (1841), *On the Law of Bills of Exchange* (1843), *On the Law of Promissory Notes* (1848). He also edited Chitty *On Bills of Exchange*, and Abbott *On Shipping*, and contributed important legal articles to the *Encyclopædia Americana*, and left in MS. a *Digest of Laws*, supplementary to that of Comyns. His commentaries and written decisions in his circuit comprise 27 volumes, and his judgments in the Supreme Court an important part of 34 volumes more. A collection of his *Miscellaneous Writings* was published in 1852, and his *Life* has been written by his son, William W. Story (1851). D. at Cambridge, Mass., Sept. 10, 1845. A. H. Guernsey.

Story (William Wetmore), son of Hon. Joseph Story, LL.D., b. in Salem, Mass., Feb. 19, 1819; studied law; was admitted to the bar, and published several legal books—*Report of Cases* (1842–47), *Treatise on the Law of Contracts* (1844), *The Law of Sale of Personal Property* (1847), edited the *Life and Letters of Joseph Story* (1851); wrote *The American Question* (1862), *Roba di Roma* (1862), *Proportions of the Human Figure* (1866), *Graffiti d'Italia* (1869), *A Roman Lawyer in Jerusalem* (1870), *Judas Iscariot*; and has published five volumes of poems. As a sculptor he is known chiefly by his large allegorical statues, *Medea*, *Cleopatra*, *The African Sibyl*; by the statue of George Peabody executed for the corporation of London; the statue of Edward Everett in the Boston Public Garden; and busts of his father, J. R. Lowell, Josiah Quincy, and Theodore Parker. Mr. Story has resided in Rome for nearly thirty years, and is better known as an artist on the other side of the Atlantic than at home. He is a man of ardent temperament and various accomplishments. His work is characterized by beauty, grace, and elegance, rather than by originality of conception or depth of sentiment. He was made Chevalier of the Legion of Honor at Paris Exposition 1878. O. B. Frothingham.

Stosch, von (Albrecht), b. Apr. 20, 1818; received his education in the Prussian corps of cadets; entered the 29th Infantry in 1835 as a lieutenant; held various special commands; was one of the tutors of the crown prince of Prussia, and accompanied him on his journey to the opening of the Suez Canal. From 1866 to 1870 he was director of the economy department of the ministry of war, and together with Gen. Podbielski he formed the main support of the minister Von Roon. During the war of 1870–71 he was superintendent-general of the commissary department of the German army in France. In Dec., 1870, he was appointed chief of staff of the army of the Loire, under the grand duke of Mecklenburg, and subsequently chief of staff of the army of occupation left in France after the peace. On Jan. 1, 1872, when the department of the navy was separated from the war department, he was placed in charge of the former, and has since worked with great success for the development of the German fleet. July 26, 1870, he was made a lieutenant-general, 1872 general of infantry, and 1875 admiral. August Niemann.

Stoth'ard (Charles Alfred), son of the succeeding, b. in London in 1786; early distinguished himself by his skill as an artist, being especially successful in the delineation of ancient costumes. His best known painting, *The Death of Richard II.*, was exhibited in 1810, and

in the following year he began the publication of the *Monumental Effigies of Great Britain*, a magnificent series of etchings with descriptions, completed (1811–23) after his death by others. He was selected by the Antiquarian Society to make drawings of the famous Bayeux Tapestry, and in 1819 made sketches from the newly-discovered old pictures on the walls of the Painted Chamber of the House of Lords. D. at Bere Friars, in Devonshire, May 27, 1821, by the giving way of a scaffolding on which he was standing.—His widow, ANNE ELIZA, assisted her brother, Mr. Kempe, in the completion of the *Monumental Effigies*, and was afterward the widow of the Rev. Edward Bray: she was the author of several creditable novels written during her second marriage; of the *Traditions, Legends, and Sketches of Devonshire* (1838), *Handel, his Life, etc.* (1859), and memoirs of her father-in-law and both her husbands.

Stothard (THOMAS), R. A., b. in London Aug. 17, 1755; was apprenticed to a designer of patterns for the silk-trade, but soon became an illustrator of books, and finally a painter. He was elected fellow of the Royal Academy in 1794, and its librarian in 1812. His illustrations for books number more than 4000, among them being those for Milton, Shakspeare, Chaucer, Spencer, the *Pilgrim's Progress*, *Don Quixote*, *Robinson Crusoe*, and Rogers's *Italy*. Among his best paintings are—the *Canterbury Pilgrims*, the *Flitch of Bacon*, and *Four Periods in a Sailor's Life*. D. in London Apr. 27, 1834.

Stouchs'burg, p.-v., Marion tp., Berks co., Pa. P. 397.

Stough'ton, p.-v. and tp., Norfolk co., Mass., on Old Colony and Providence R. Rs., 17 miles S. of Boston, has 6 churches, a public library, schools, 1 newspaper, 3 hotels, and woollen manufactories. Business, boot and shoe making. P. 4914. D. S. HASTY, ED. "SENTINEL."

Stoughton, p.-v., Dane co., Wis., on Chicago Milwaukee and St. Paul R. R., contains 7 churches, good schools, 1 newspaper, manufactories of brooms, cigars, harness, etc., 3 hotels, an extensive carriage-factory, and 1 mill. P. 985. GEO. W. CURRIER, Ed. "COURIER."

Stoughton (ISRAEL), b. in England; emigrated to America, and was one of the early settlers at Dorchester, Mass.; was member of the general court 1634–37; denied some of the powers claimed by the governor and his assistants, for which he was pronounced disabled, but this judgment was soon revoked; in 1637 commanded the Massachusetts troops sent against the Pequot Indians; was commissioner to administer the government of New Hampshire in 1641; assistant to the governor of Massachusetts 1637–42, and again in 1644, when he returned to England. He held large landed estates in Massachusetts, and gave 300 acres to Harvard College. D. at Lincoln, England, in 1645.

Stoughton (JOHN), D. D., b. in England about 1815, is an Independent minister, and author of *Lectures on Tractarian Theology* (1843), *Notices of Windsor in the Olden Time* (1844), *Spiritual Heroes, or Sketches of the Puritans* (1848), *Philip Doddridge, his Life and Labors* (1851), *The Lights of the World* (1852), *Scenes in other Lands* (1853), *Stars of the East* (1853), *Ages of Christendom before the Reformation* (1857), *The Pen, the Palm, and the Pulpit* (1858), *The Song of Christ's Flock in the Twenty-third Psalm* (1860), *Windsor, a History and Description of the Castle and the Town* (1862), *Church and State Two Hundred Years Ago, a History of Ecclesiastical Affairs in England from 1660 to 1663* (1862), *Shades and Echoes of Old London* (1867), and other works; edited Cheever's *Wanderings of a Pilgrim*, etc. (1859) and Rev. William Walford's *Autobiography* (1851), and has written largely for theological and literary periodicals.

Stoughton (WILLIAM), son of Israel, b. in England Sept. 30, 1631; was brought to Massachusetts when an infant; graduated at Harvard College in 1650; studied theology; went to England and became a fellow of New College, Oxford, but was ejected at the restoration of Charles II., and in 1662 returned to New England, where he acquired high reputation as a preacher, but declined any settlement as a pastor. He was an assistant to the governor from 1671 to the dissolution of the government in 1686, and was agent in England for the colony 1676–79; was elected assistant and governor in 1686, but declined to serve; was a justice of the court and a member of Andros's council 1686–89, when he became one of the council of safety who deposed and imprisoned Andros. In May, 1692, he became lieutenant-governor of Massachusetts, and in December chief-justice of the superior court, over which he presided in the Salem witchcraft trials. He was a liberal benefactor of Harvard College, left a tract of land for the support of students there, and another tract for the benefit of schools. D. at Dorchester July 7, 1701.

Stoughton (WILLIAM L.), b. in New York Mar. 20, 1827; studied law, and commenced practice at Sturges, Mich., in 1851; was prosecuting attorney 1856–60 and U. S. district attorney 1861; early in the civil war joined the army; became colonel of the 11th Michigan Vols. in 1862, distinguishing himself at the battle of Stone River; commanded a brigade at Chickamauga, Missionary Ridge, and Atlanta, where he lost a leg, and was brevetted a major-general of U. S. volunteers. He was elected attorney-general of Michigan 1866; Representative in Congress in 1868, and re-elected in 1870.

Stour'bridge, town of England, county of Worcester, on the Stour, manufactures iron, glass, earthenware, and fire-bricks, the latter from a peculiar kind of clay called "Stourbridge clay," on which fire has only a small effect. P. 8773.

Stout'land (formerly STOUTSVILLE), p.-v., Camden co., Mo., near Gasconade River, on Atlantic and Pacific R. R., is a new and thriving railroad town, and near the famous Lead Mountain; has 2 weekly newspapers.

Stouts'ville, p.-v., Monroe co., Mo., on Salt River and on Missouri Kansas and Texas R. R.

Stoutsville, p.-v., Clear Creek tp., Fairfield co., O., on Cincinnati and Muskingum Valley R. R. P. 160.

Stove, an apparatus for retaining and diffusing heat, either for warming and ventilating or for culinary purposes. Stoves are not a very recent invention. A fixed stove (*stuba*) was used by the Romans in the times of the Empire for heating their baths, and in Germany and Scandinavia for baths and for hot-houses (whence our partially obsolete use of *stove* for a conservatory or hot-house). In the Middle Ages they were used for warming dwellings. These stoves were generally constructed of brick or tiles, sometimes of slate or steatite. They were large structures, occupying sometimes the whole side of a room, and in Scandinavia in winter their broad flat surface was, like the Oriental divans, the sleeping-place of the household. The fire was kindled at the bottom, and the heat and smoke passed through various flues before making their exit into the chimney. These stoves saved fuel, a matter of much importance in some of the countries of Europe. Some of them were faced with porcelain or highly ornamented tiles, and formed a stately tower, in the niches of which were statues of porcelain or bisque. These were in the homes of the rich. A specimen of these porcelain stoves was exhibited in the Swedish department at the Centennial Exposition in Philadelphia in 1876. They have ovens and flues for cooking, and when once thoroughly heated require feeding but once in twenty-four hours. One of the first attempts at making a stove or closed fireplace of iron was that of Cardinal Polignac in France about the beginning of the eighteenth century. The cardinal published a description of this in 1709 under the assumed name of Gauger. His treatise was entitled *La Mécanique du Feu, ou l'Art d'en augmenter les Effets, et d'en diminuer la Depense.* The Polignac fireplaces, as they were called, were constructed with hollow backs, hearths, and jambs of iron, to economize the heat. In 1716, Dr. Desaguliers translated and published Cardinal Polignac's treatise in London, and modified his fireplaces to use them for coal instead of wood. But neither these nor the Holland stoves, which were introduced soon after (plain box stoves with a small smoke-pipe or flue at the top, and a single door into which the wood or coal was thrown), ever became popular in England, owing to the strong prejudice of the people in favor of open and visible fires. Dr. Franklin, writing of stoves after the invention of his own in 1745, speaks of a German stove then recently introduced into England, an iron box made of five plates fastened together with screws, one side of which was left open, but when the stove was set, this open side, with the smoke-pipe, was in an ante-room, while the body of the stove projected through the partition to warm a larger room, the fire being fed and the smoke conducted off in the ante-room. There is possibly a reference to this in Bunyan's *Pilgrim's Progress* among the things which Christian saw at the House of the Interpreter, but, if so, it must have been in use before 1650. Franklin's stove was a great advance on all that had preceded it. While it was, in its ordinary use, a fireplace, it was capable of being closed completely, and had a downward draught, distributing the heat through the air-boxes in its sides, till at last the small remainder of the heat made its escape with the smoke through a flue leading into the base of the chimney. A register or "damper" of sheet iron was introduced into the descending flue, which checked and controlled the fire to any desired extent. The principle of action was the same as that of the air-tight stoves which were introduced many years later, and the stove would have been air-tight had it been possible at that time to make the castings sufficiently accurate and close-fitting. In 1771 and the years following Franklin invented several other stoves—one for burning bituminous coal which would con-

sume its own smoke and had a downward draught; and another intended for the same purpose, having a basket grate or cage, with movable bars at the top and bottom, supported by pivots at its centre, and which, after being filled and kindled at the top, could be inverted, and so made to burn from the base. The next inventor of stoves, ovens, and heating and cooking apparatus was Benjamin Thompson, Count Rumford. Between 1785 and 1795 this eminent philosopher devised several improvements in stoves, ovens, and cooking and heating contrivances, all intended to economize fuel and heat. The box stove now in the State-house in Richmond, Va., bearing date 1770, is one of the so-called Holland stoves, and was probably imported from England, as the castings, though rude, are better than American castings of that day.

Previous to 1825 the use of stoves, generally of the box pattern, and very rude, was confined to shops and offices, bar-rooms of hotels, school-houses, court-houses, and churches in the cities and larger villages. In the country the churches were not usually warmed, but the matrons and older women carried their foot-stoves, and the men protected their feet from the cold by stout leather overshoes, technically known as "boxes." In a few of the most wealthy families in the cities cannel and other English coal—"sea coal" was the general term for it—was burned in imported grates, or, in some instances, in the Rumford stove lined with fire-brick. A somewhat larger number, but only in the cities and larger villages, used the Franklin stove, burning wood and making an open fireplace of it. The Franklin coal stove, as he invented it, was not much used in this country. As for the rest of the world, they used the old open capacious fire-place, in which were deposited in the course of the year many cords of fire-wood. Wood was cheap in those days. For the parlor there was a smaller fireplace, but this was only used on great occasions. A huge brick oven adjoined the kitchen fireplace, and required a large quantity of dry wood to heat it. The cheapness of fuel, the cheerfulness of an open fire, and the great weight and roughness of the castings of the stoves of those days, prevented any general use of them either for cooking or heating; and though the old box stove had an oven over the fire and a boiler-hole on the top, it could scarcely be called a cooking stove. Up to the year 1835 stoves in the U. S. were made almost exclusively in blast furnaces, and directly from the ore, instead of being made in foundries or cupola furnaces from pig iron, as they now are; and they were consequently much heavier and ruder than now, and had loose and imperfect joints. Most of them were made in the furnaces of New Jersey and Pennsylvania, though a few were cast quite early in the furnaces at Coldspring, N. Y., and at Salisbury and Canaan, Conn., and from 1820 to 1835 a considerable business was done in stove-making in Rutland co., Vt. During the period from 1795 to 1820 or 1825, though there were some slight modifications of form, there was no material progress made in the construction of stoves. Those for heating purposes were either made on the old German plan—box stoves—to which an oven was sometimes added, placed directly over the fire, or on Franklin's plans of a portable and partly open fireplace. For cooking purposes Count Rumford's cooking stoves or ranges lined with fire-brick or soapstone, and with a ventilating oven, which had been introduced into New York City as early as 1798, and into Boston about 1800, were gradually coming into use, though as yet only English or Welsh coal and wood were used for fuel. The stoves cast in Pennsylvania and New Jersey were mostly either Franklin or box, although a few Rumfords had been cast at heavy expense for particular customers in New York City; but the Vermont stoves were but slight variations from Rumford's patterns. Among the patterns made by these Vermont stove-makers, whose works were at Pittsford and perhaps some other points in Rutland co., Vt., were the Rumford heating stove, the James's cook stove, the Conant cook stove, and the Farmer's stove. These were made as early as 1820, and perhaps earlier. Two brothers by the name of Granger, of Pittsford, were the pioneers in this business. After the opening of the Erie and Champlain canals, the introduction of steamboats on navigable rivers, and the first small beginnings in railroad travel, the facilities for transportation for heavy goods were so much increased that the manufacture of stoves, and especially of cooking stoves, soon became a leading industry. As yet, these were universally wood stoves, but the anthracite coal, which was coming into use in blast furnaces and wherever a high degree of heat was required and a very strong draught was possible, was destined to create a revolution in stoves. The first attempts to use it in New York and Philadelphia were failures. Jordan L. Mott and James Wilson, both of New York, made self feeding stoves between 1827 and 1831 which would burn the English or Welsh coals, and were an improvement on all previous inventions; but it was not until 1833, when Mr. Mott had demonstrated that an anthracite fire could be made successfully from nut and pea-sized coals, and that the depth of the column of coal in his self-feeders must be in direct proportion to its size, the largest coal requiring the highest column, that anthracite coal stoves became salable. An immense mass of refuse coal and screenings had accumulated at the great coalyards on the Schuylkill. In 1835, Mr. Mott purchased this mass of refuse, had it screened into nut and pea sizes, and shipped to New York, and sold it to the purchasers of his stoves. Early in the same year he erected a small cupola furnace and cast his stove-plates from pig iron of the best quality, fluting them to prevent their cracking. This was the first attempt to make stove-plates from pig iron and to make the plates light, even, and smooth; its speedy failure was predicted, but it proved so successful that before the close of 1835 other cupola furnaces were erected in New York, and in Albany that of W. V. Many & Co., built for another purpose, was utilized for making stove-castings of good quality by Joel Rathbone, who had then recently entered upon the business of stove manufacture. This was the beginning of the immense stove business of that city. Providence, R. I., commenced about the same time the manufacture, which is still extensively carried on there. The first cooking stoves manufactured in Albany were of the old ten-plate oval pattern, with oven above the fire and a single hole on the top. These were followed by the saddle-bag pattern, having the oven in the middle over the fire, and the stove-collar and pipe over it, while on either side was an oval projection with a boiler-hole on a level with the stove-top; these projections resembling very closely an inverted pair of saddle bags. The next pattern was the horse-block (so called from the rear portion of the stove, which contained the oven, being a step higher than the front). The rotary stove, having a movable top revolved by means of a crank, so as to bring any desired vessel directly over the fire, was another invention of about this period. Then came the Buck stove, both for wood and coal, having the fire above the oven and reversible flues, which carried the heat and flame around, behind, and below the oven before reaching the smoke-pipe, which was nearly on a plane with the oven-floor. There have been hundreds of modifications of this pattern—with two ovens, one on each side of the fire; with the fire on one side and the oven behind it; with ovens above, on either side, etc.—but in all of them the reversible flue has been the predominating feature. In heating stoves there has been a great variety of forms, and some new principles have been introduced, though many of these seem to have been anticipated by the inventions of Dr. Neil Arnott, an eminent British philosopher and philanthropist. The problem of adapting the heating stove to the use of anthracite coal, and utilizing its great heat-producing power economically, was one which, simple as it now seems, was solved with great difficulty. Dr. Nott, president of Union College, and one of the most eminent philosophers and mechanical geniuses of his time, spent years of time and thousands of dollars in perfecting stoves for the combustion of anthracite. The self feeder had been invented in New York, but one of its applications was a device of Dr. Nott; and the base-burning principle was undoubtedly discovered by him and applied to several stoves, though others seem to have hit upon the same principle with no knowledge of his discovery. Thus, Dr. Arnott's "perfected" stove or "thermometer" stove, which he had in use in 1836, and of which he gave the invention to the British people, was self feeding and base-burning, and he described in 1837 a contrivance for removing the clinkers from its grate without extinguishing the fire. His stove was also wonderfully economical, the fire being kept up in his library, without once going out, for the entire cold season, and maintaining a uniform temperature of 60° to 63° F. (he states that with the same fuel he could have maintained a higher temperature), with a combustion of only six pounds of Welsh stone coal in the twenty four hours. The names best known in this country in connection with these heating stoves and fireplace heaters using coal as a fuel, after Dr. Nott, are Alexander Bradley of Pittsburg, Pa.; Dr. Horace Bushnell of Hartford, Conn.; Treadwell, J. S. Perry, Joel Rathbone, S. H. Ransom, and D. G. Littlefield of Albany; Latrobe of Baltimore; Jordan L. Mott, J. Wilson, Youle & Sabbaton, Gould Thorp, and W. Sanford of New York; Anson Atwood, now of Brooklyn, who is believed to have introduced the hot air current to facilitate combustion and radiation of heat; Frost, Moore, Spear of Philadelphia, and others.

In the cooking stoves and fixed and portable ranges the number of inventors and manufacturers is still larger. One of the most original and ingenious inventors of cooking stoves was Rev. P. P. Stewart of Troy, whose stoves were, and with some modifications still are, very popular. Dr.

Nott also invented several excellent cooking stoves. Albany, Troy, New York City, and Buffalo: Philadelphia and Pittsburg in Pennsylvania: Cleveland, Dayton, and Cincinnati in Ohio; Chicago, St. Louis, Milwaukee, Boston, Providence, Portland, Manchester, Wheeling in West Virginia, and Norwich, Conn., have each a number of manufactories largely engaged in the production of stoves, ranges, and heaters. The efforts of the stove-makers during the last thirty years have been directed rather toward completing the adaptation of the principles of self-feeding, base-burning, hot air feeding, and the anti-clinker arrangement to stoves, and greater accuracy and perfection of the castings, than to the discovery of any new principles. In some instances claims have been honestly made to the discovery of some of the principles named, when investigation proves that they had been discovered and used many years before. The portable range, a large-sized cooking stove, but with a hot-water arrangement, is one of the more recent improvements in stove manufacture. They are well constructed, have all the improved facilities for labor- and fuel-saving, and are particularly noteworthy for the perfection of their castings and finish. One or two manufacturers make stoves entirely of steatite or soapstone. These retain the heat for a long time, and require but a small amount of fuel, as they utilize the whole which they consume.

Another class of stoves are those using either gas or petroleum oil as fuel. The gas stoves are convenient for summer use, and are in demand among housekeepers with small families for the preparation of the lighter meals; but the smell of the burning gas and soot is offensive, and all attempts to use them for heating purposes have proved objectionable. In many towns and cities, also, the price of gas is so high that they are not economical. Six or eight patterns of petroleum stoves have been patented, and are now on the market. Most of them have been objectionable from the odor of the kerosene or petroleum oil, the supposed necessity of having an open reservoir of water over the oil to prevent its becoming vaporized by the heat, and the danger of leakage and vaporization of the oil which attended their use. Two of the recently-patented stoves of this kind dispense with the water-reservoir—Sharp's, by a plate lined with asbestos between the lighted wicks and the oil, and the Florence (Edwards's patents), by a zinc plate elevated on pillars and having a current of cool air constantly passing between this plate and the closely-covered and soldered oil-reservoir. In other respects, the Florence is an improvement on all preceding petroleum stoves, the reservoir of oil being of cast iron cast in one piece and galvanized, while the others are of tinned sheet iron either stamped or soldered, the soot and products of combustion being consumed by the stove, all odor or deterioration of the air being prevented by the peculiar construction, and the stove being provided with a three-hole boiler-plate, as well as a flat-iron heater and two excellent ovens. (The last two items are also in Sharp's and some of the others.) The cooking cylinder can be removed, and a heating cylinder, with downward draught and great heating power, illuminating the room as well as heating it, can be substituted for it. For the purposes for which it is designed this seems to be a decided advance on former inventions.

Estimate of Stove Manufacture in the U. S. 1876.

States.	Foundries.	Men employed.	Tons produced.	Stoves produced.	Value.
Maine	3	75	900	7,200	$126,000
New Hampshire	5	100	1,200	9,600	168,000
Vermont	2	30	360	2,880	50,400
Massachusetts	12	1,450	17,400	139,200	2,436,000
Rhode Island	6	850	10,200	81,600	1,428,000
Connecticut	3	230	2,760	20,080	386,400
New York	45	7,975	95,700	765,600	13,898,000
New Jersey	2	150	1,800	14,400	252,000
Pennsylvania	29	5,215	62,580	500,640	8,761,200
Maryland	2	250	3,000	24,000	420,000
Virginia	1	150	1,800	14,400	252,000
West Virginia	7	700	8,400	67,200	1,176,000
Georgia	1	50	600	4,800	84,000
Michigan	2	500	6,000	48,000	840,000
Ohio	42	4,725	56,700	453,600	7,938,000
Kentucky	6	915	11,100	88,800	1,554,000
Missouri	7	1,900	22,800	182,400	3,192,000
Illinois	10	1,250	15,000	120,000	2,100,000
Indiana	7	675	8,100	64,800	1,134,000
Wisconsin	5	500	6,000	48,000	840,000
Iowa	1	150	1,800	14,400	252,000
Kansas	1	75	900	7,200	126,000
California	1	75	900	7,200	126,000
Total	200	28,000	336,000	2,686,000	$47,040,000
The past year having been one of uncommon depression, and many foundries having been run on one-half or three fourths time, Mr. Perry proposes to deduct, for an average of one-quarter the time not in operation	.....	....	84,000	671,500	11,760,000
Making the actual amount of the year's business	200	28,000	252,000	2,014,500	$35,280,000

The preceding table, furnished for this article by John S. Perry, Esq., of Albany, a former president of the National Stove Manufacturers' Association, gives the statistics of the stove manufacture in the U. S. for the year ending Apr., 1876. It does not, we believe, include furnaces nor soapstone, gas, or petroleum stoves. L. P. Brockett.

Stove Creek, tp., Cass co., Neb. P. 480.

Stow, p.-v. and tp., Oxford co., Me., on Saco River. P. 427.

Stow, p.-v. and tp., Middlesex co., Mass., on Marlborough branch of Fitchburg R. R. P. 1813.

Stow, tp., Summit co., O. P. 925.

Stow (Baron), D. D., b. at Croydon, N. H., June 16, 1801; graduated at Columbian College, D. C., in 1825; edited the *Columbian Star* 1825–27; became pastor of the Baptist church at Portsmouth, N. H., in 1827, of the Baldwin Place church, Boston, in 1832, and of the Rome street church in 1848. He was prominent in the missionary enterprises of the denomination, and president of the trustees of Newton Theological Seminary. Besides numerous contributions to religious periodicals, he published—*Memoir of Harriet Dow* (1832), *Helen's Pilgrimage* (1835), *History of the English Baptist Mission to India* (1835), *The Danish Mission on the Coast of Coromandel* (1837), *Daily Manna* (1842), *Question-Book of Christian Doctrine* (1848), *Christian Brotherhood* (1859), *First Things* (1859), and, in conjunction with Rev. S. F. Smith, *The Psalmist*, a collection of hymns largely used by the Baptist denomination (1849). His *Life* has been written by R. H. Neale (1870). D. in Boston Dec. 27, 1869.

Stow (John), b. in London about 1525; a tailor by trade, he acquired a taste for antiquarian studies, to which, from the age of about forty, he devoted himself with great assiduity and amidst many difficulties, which reduced him to such indigence that at the age of eighty he was constituted, by royal letters patent, a licensed public beggar, being recommended to charity on the ground that he had "compiled and published diverse necessary books and chronicles." His principal works are—*A Summarie of Englysh Chronicles* (1561), *Summarie of Englysh Chronicles Abridged* (1566), *Annales, or a Generall Chronicle of England from Brute vnto this Present Yeare of Christ* (1580), *A Survay of London* (1598), and *The Successions of the History of England*, probably a fragment of a larger work (1638). All of these works have passed through many editions, with additions and continuations by various editors. D. Apr. 5, 1605.

Stow Creek, tp., Cumberland co., N. J. P. 1122.

Stowe, tp., Allegheny co., Pa. P. 739.

Stowe, p.-v. and tp., Lamoille co., Vt., on Waterbury River, has a picturesque mountain-peak called "The Nose," and is the nearest point to Mount Mansfield. P. 2049.

Stowe (Calvin Ellis), D. D., b. at Natick, Mass., Apr. 6, 1802; graduated at Bowdoin College in 1824, and in 1828 at Andover Theological Seminary; was assistant professor of sacred literature at Andover, and assistant editor of the Boston *Recorder* 1828–30; professor of languages in Dartmouth College 1830–33, biblical literature in Lane Seminary 1833–50, and of natural and revealed religion in Bowdoin College 1850–52. In 1852 he became professor of sacred literature in Andover Seminary, resigning the office in 1864. In 1832 he married Harriet Elizabeth Beecher. In 1836 he was sent by the State of Ohio to examine the public-school systems of Germany; upon his return he published a report on *Elementary Education in Europe*, which was distributed at the public expense to every school district in Ohio, and was also adopted by the legislatures of several other States. He translated from the German Jahn's *History of the Hebrew Commonwealth* (1828); prepared from the *Prælectiones* of Lowth a volume of *Lectures on the Sacred Poetry of the Hebrews* (1829); commenced an *Introduction to the Criticism and Interpretation of the Bible*, of which only vol. i. was published (1835), and the *Origin and History of the Books of the Bible* (Part I., containing the New Testament, 1867). He has also published several addresses and educational reports, and contributed largely to religious periodicals.

Stowe (Harriet Elizabeth Beecher), daughter of Lyman Beecher and wife of the preceding, b. at Litchfield, Conn., June 14, 1812; taught for several years at Hartford, and in 1832 was married to Prof. Stowe, then of Lane Seminary, Cincinnati, O. In 1849 she published *The Mayflower, or Sketches of the Descendants of the Pilgrims,* and

in 1851 commenced in the *National Era* of Washington a serial story which was published separately in 1852 under the title *Uncle Tom's Cabin*, and attained a rapid and almost unparalleled success at home and abroad; within ten years there had been made from it two or three French versions and more than a dozen German ones. It has also been translated into Danish, Swedish, Portuguese, Spanish, Italian, Welsh, Russian, Polish, Hungarian, Wendish, Wallachian, Armenian, Arabic, Romaic, Chinese, and Japanese. In 1853 she put forth a *Key to Uncle Tom's Cabin*, in which were set forth the main facts upon which the story was based, together with many incidents in corroboration of its truthfulness. In 1853 she accompanied her husband and her brother to Europe, and upon her return published *Sunny Memories of Foreign Lands* (1854). Her subsequent writings have usually first appeared in periodicals, especially in the *Atlantic Monthly* and in the *Hearth and Home*, of which she was for a time one of the editors. Among these, as published separately, are—*Dred, a Tale of the Great Dismal Swamp*, subsequently published under the title *Nina Gordon* (1859); *The Minister's Wooing* (1859), *The Pearl of Orr's Island* (1862), *Agnes of Sorrento* (1863), *Old Town Folks* (1869), *My Wife and I* (1872).

Stow'ell (William Scott), Baron, b. at Haworth, Durham, Oct. 17, 1745, the son of a merchant of Newcastle; was educated at Oxford, where he took his degree in 1764; became a fellow, then a tutor, and in 1774 professor of ancient history in the university; studied law, and was called to the bar in 1780; rose rapidly in his profession, becoming advocate-general in 1787, and shortly afterward judge of the consistory court and vicar-general of the ecclesiastical province of Canterbury, and in 1798 judge of the high court of admiralty and a privy councillor. He was knighted in 1788, and in 1791 was unanimously returned to Parliament for the University of Oxford, retaining his seat until the coronation of George IV., when he was raised to the peerage. He was the elder brother of John Scott, Lord Eldon. D. Jan. 28, 1836.

Stoyes'town, p.-b. and tp., Somerset co., Pa. P. 288.

Strabane', tp., Adams co., Pa. P. 1547.

Strabismus. See Squinting, by E. Darwin Hudson, M. D.

Stra'bo, b. at Amasia, Pontus, in the latter part of the first century B. C., received an excellent education; studied philosophy under Xenarchus, and undertook extensive travels in Asia Minor, Egypt, Greece, and Italy. At a mature age he wrote a history, which is lost, and a geography in 17 books, which has come down to us nearly entire, and the value of which to us is so much the greater as it contains a great number of historical notes. D. in the reign of Tiberius, after A. D. 21. Editions by Kramer (3 vols., 1844–52) and Meineke (3 vols., 1852–53). English translation by Falconer and Hamilton (3 vols., 1854–57). The French translation, made by La Porte du Theil, Coray, and Gossellin, at the command of Napoleon I. (5 vols., 1805–19), is very rich in notes.

Strach'an (John), D. D., b. at Aberdeen, Scotland, Apr. 12, 1778; graduated at the University of Aberdeen in 1796; studied theology at St. Andrew's; taught a village school until 1799, when he emigrated to Canada, where he taught school at Kingston; took orders in the Episcopal Church; was ordained priest in 1804, and appointed to a mission at Cornwall, where he conducted a grammar school; became rector of York in 1812, executive councillor in 1818, archdeacon of York in 1825, and bishop of Toronto in 1839. From 1818 onward he was a political leader, and the Canadian insurrection of 1837–38 grew out of the strife between his party and that headed by W. L. Mackenzie. The establishment of Trinity College, Toronto, was in a great measure owing to his exertions. D. at Toronto Nov. 1, 1867.

Strachey (William), b. in England about 1585; was the first secretary to the colony of Virginia 1610–12, having been shipwrecked on the Bermudas 1609 with Gates, Somers, and Newport; wrote *A True Reportory of the Wracke and Redemption of Sir Thomas Gates, upon and from the Islands of the Bermudas*, in Purchas's *Pilgrims* (vol. iv. lib. ix. cap. vi.), upon which Shakspeare appears to have drawn in his description of a storm in the *Tempest*—an inference strengthened by the reference in the same drama to the "still-vexed Bermoothes:" compiled *For the Colony in Virginia Britannia, Lawes Divine, Morall, and Martiall* (London, 4to, 1612); and was author of *Historie of Travaile into Virginia Britannia*, written as early as 1618, and first published by the Hakluyt Society from an original MS. (No. 6, 1849) under the editorship of Richard H. Major—a quaint and valuable work, which has but recently supplied the means of correcting the false details of the early history of Jamestown (especially in relation to Pocahontas) which have been so often repeated upon the authority of Capt. John Smith. Strachey projected a larger work, of which this volume forms but "the first and second books of the first decade." The time and place of his death are unknown.

Stradel'la, town of Italy, province of Pavia, about 17 miles N. E. of Voghera. Stradella was a fortified town of some importance, but was dismantled toward the close of the fifteenth century. It is now a place of considerable industry. P. of commune, 8075.

Stradella (Alessandro), b. in Naples 1645; bore the flattering title of "Apollo della Musica." His oratorio, *San Giovanni Battista*, and his opera, *La Forza dell' Amor Paterno*, were much admired. As a writer of songs, too, in the sacred style, he excelled. His fame rests chiefly on the oratorio, his singing in which at the church of St. John Lateran in Rome is said to have disarmed the assassins who had gone there to take his life. D. in Genoa, assassinated by a jealous rival, in 1678. O. B. Frothingham.

Stradiva'rius (Antonio), b. at Cremona, Italy, in 1644; learnt the art of making violins and other string instruments from Nicolo Amati, under whom he worked for several years; in 1668 began to make violins marked with his own signature, and by degrees not only rivalled, but even outshone, his master. His best instruments were made in the period between 1700 and 1725, and command from $1000 to $3000. D. Dec. 17, 1737.

Straf'ford, county of S. E. New Hampshire, bordering upon Maine, watered by numerous streams and crossed by several railroads. The surface is generally rocky and uneven, but the valleys contain some good land. There are numerous manufactories of boots and shoes, cotton and woollen goods, leather, and lumber. Staples, potatoes, Indian corn, oats, barley, hay, wool, and dairy products. Cap. Dover. Area, 675 sq. m. P. 30,243.

Strafford, p.-v. and tp., Strafford co., N. H. P. 1669.

Strafford, p.-v. and tp., Orange co., Vt. P. 1290.

Strafford (Thomas Wentworth), Earl of, b. in London Apr. 13, 1593; studied at Cambridge; travelled on the Continent; married at the age of eighteen; at twenty-one came into possession, by inheritance, of large estates; was knighted and returned to Parliament for the county of York, sitting in several successive sessions, in which he became prominent as an opponent of the court, an associate of Hampden and Pym, and was once imprisoned for his bold opposition to the royal will. But in 1628 he went suddenly over to the king's side; was created Baron Wentworth, then viscount, lord president of the council of the North, a privy councillor in 1629, and lord deputy of Ireland in 1633. His rule in Ireland was harsh and despotic, treating the country as one conquered in war and wholly at the mercy of the victor; and he acquired the designation of "the bad earl." It was his boast that in Ireland he had made the king "as absolute as any prince in the whole world." In Jan., 1640, he was created earl of Strafford, and the title of lord lieutenant of Ireland was conferred upon him, and soon afterward he was appointed to command against the Scots. The royal troops were routed, and Charles I. accepted the terms which the Scots demanded. Strafford had come to be obnoxious as, with Laud, the upholder of all the wrongful and oppressive measures of the king, and was moreover hated by the liberals as a renegade from their side. He foresaw the coming peril, and when Charles was compelled to summon a new Parliament, begged to be sent back to Ireland; but the king sacredly promised that not a hair of his head should be hurt, and he braved the issue. The famous "Long Parliament" convened Nov. 3, 1640, and within eight days Pym appeared before the bar of the House of Lords and in the name of the House of Commons impeached Strafford of an attempt to overthrow the public liberties and subvert the public rights. He defended himself personally, and with such ability that the Commons abandoned their original impeachment and passed a bill of attainder. The Peers were fairly overawed by the fierce attitude of the Commons, and dared not refuse their assent to the bill, which was sent to Charles for his sanction. The king wished to save his minister, for whose safety he had pledged himself, but was cowed by apprehension of a violent revolution, and reluctantly gave his assent, and Strafford was brought to the block on Tower Hill May 12, 1641. That he had been proved guilty of no crime which by the strict letter of the law was a capital one is certain, and the bill of attainder was in fact a retrospective law, justifiable only on grounds sufficient to warrant any other revolutionary proceeding. But, whatever may be said of the course of the Commons in passing the bill, the conduct of Charles I. in sending Strafford to the block for acts which he had himself approv-

ed and sanctioned, and after solemn pledges that he should suffer no harm, is one of the deepest stains upon his memory. The act of attainder was reversed in 1662, after the restoration of Charles II., and the estates of Strafford were restored to his son. His *Letters and Despatches*, edited by Dr. Knowles, were printed in 1739; his *Life* has been written by Elizabeth Cooper (1874). A. H. GUERNSEY.

Straghn, v., Washington tp., Van Wert co., O. P. 68.

Straight University, at New Orleans, La., incorporated in 1869, and open to all without regard to race or sex. It is intended to embrace departments of theology, law, medicine, collegiate, normal, and academic. In the term of 1872–73 the faculty consisted of 10 instructors, and there were 429 students, of whom 233 were males and 196 females: of these, 294 were in the elementary department, 85 in the preparatory and academical department, 30 in the normal department, and 20 in the collegiate, medical, and theological departments.

Strain (ISAAC G.), b. at Roxbury, Pa., in 1821; entered the navy as midshipman; in 1845, at the head of a small party, made explorations in the interior of Brazil, and in 1848 in Lower California. In 1849 he crossed South America from Valparaiso to Buenos Ayres, publishing a narrative of this journey under the title *The Cordillera and the Pampa* (1853). In 1850 he was for a short time attached to the Mexican boundary commission. He afterward commanded an expedition to explore a route for a ship-canal across the Isthmus of Panama, the party suffering extreme hardships and losing several of its members; an account of this expedition, compiled from his papers by J. T. Headley, appeared in *Harper's Magazine* in 1856. In 1856, in the steamer Arctic, he made soundings which demonstrated the practicability of a telegraphic cable between the U. S. and Great Britain. D. at Aspinwall May 15, 1857.

Strait, tp., Dorchester co., Md. P. 987.

Strait's, tp., Carteret co., N. C. P. 991.

Straits Settlements, including Malacca, Penang or Prince of Wales Island, with the province of Wellesley on the continent, and Singapore, were made a separate dependency of the British crown in 1853, and placed under the governor-general of India. On Feb. 1, 1867, the connection with India ceased, the province became a crown colony, and is administered by a governor residing at Singapore. The British possessions of 1215 sq. m. are inhabited by 308,097 persons; the native Malay states of the peninsula (Queda, Perak, Salangor, Rambow, and Johor) are bound to the English crown by treaties, and number 21,460 sq. m., with 209,000 inhabitants. One thousand English troops and a few vessels are sufficient in time of peace to maintain order in the interior and punish piracy. But the revolt in Perak in 1875–76 demanded greater exertions. The English supported the legitimate heir, but he was hated by the higher classes. The resident official, Mr. Birch, was murdered, and the English had to order native troops from India, European soldiers from England, and to raise local troops in Malacca. In Mar., 1876, they succeeded in capturing the chief, and quiet was restored. But a regular administration is still wanted in these countries. Every one takes what he can, and bloody feuds and devastations of the country are the results. Meanwhile, the Chinese, who were expected to immigrate in large numbers, but who, as well known, are not very warlike, have turned away to other countries better governed. E. SCHLAGINTWEIT.

Stral'sund, town of Prussia, province of Pomerania, on the narrow strait which separates the island of Rügen from the mainland, has a good harbor and is strongly fortified. It is an old town (founded in 1209), and played quite a conspicuous part—first, as a member of the Hanseatic League, then, during the Thirty Years' war, as a fortress, after which time it fell to Sweden, which kept it till 1815. It has a very old-fashioned and quaint but neat and interesting appearance, and carries on, besides its manufactures of tinware, paper, tobacco, oil, spirits, and mirrors, an extensive export-trade in grain, wool, cattle, and horses. P. 26,731.

Stramo'nium [Lat.], a drug consisting of the seeds and leaves of *Datura Stramonium*, an annual plant of the natural order Solanaceæ, growing rankly as a weed throughout almost all the temperate and warmer countries of the world. The herb, called "thornapple," and in this country also "Jamestown weed," is a hardy plant, found mostly in rank soil near the habitations of men. Its average height is about three feet. It has an erect stem, with many branches beset with large triangular leaves irregularly sinuate and dentate. The flower is large, white, solitary; the fruit, a large, fleshy, four-celled capsule, thickly covered with sharp spines. The seeds are flat and of a dark-brown color. Both leaves and seeds contain an alkaloid, *daturia*, closely analogous, both in chemical properties and poisonous character, to *atropia*, the alkaloid of belladonna. Medicinally, stramonium is a duplicate of belladonna, and is used for similar purposes. One of its most frequent employments is for the relief of asthmatic attacks, for which purpose the dried leaves or powdered root are smoked. Stramonium is a powerful poison, the effects being, again, identical with those of belladonna.

EDWARD CURTIS.

Strange (Sir ROBERT), b. on Pomona, one of the Orkney Islands, about 1721; studied painting, but in 1745, having joined the army of the Pretender, was obliged to conceal himself; afterward went to Paris, where he became a pupil of Le Bas, the famous engraver, and in 1751 established himself in London as an historical engraver, in which department of art he acquired great eminence, and has been styled "the father of the line manner of engraving in Britain," and was knighted in 1787. He published *A Descriptive Catalogue of Pictures, etc. collected and drawn by Sir Robert Strange* (1769), and *An Inquiry into the Rise and Establishment of the Royal Academy of Arts* (1755; new ed. 1850). A collection of fifty of his principal engravings has been issued in a magnificent atlas, and his *Memoirs*, by James Dennistoun, appeared in 1855. D. in 1792.

Stran'ger, p.-v. and tp., Leavenworth co., Kan. P. 1323.

Strang'ford (PERCY CLINTON SYDNEY SMYTHE), VISCOUNT, b. in 1780; was educated at Trinity College, Dublin, and in 1801 succeeded his father as sixth viscount in the Irish peerage, previous to which he had been for a short time secretary of legation at Lisbon, where he made a translation of the poems of Camoens. He was subsequently employed in the diplomatic service, being sent as ambassador to Portugal in 1806, to Sweden in 1817, to Turkey in 1820, and to Russia in 1825; and in 1825 was raised to the English peerage as Baron Penshurst. He was an ardent lover of the fine arts and of literature, a frequent contributor to the *Gentleman's Magazine* and to *Notes and Queries*, and vice-president of the Society of Antiquaries. His *Poems from the Portuguese of Luis de Camoens, with Remarks on his Life and Writings*, was first published in 1803. D. in 1845.—His son, PERCY ALLEN FREDERICK, who succeeded his elder brother as eighth viscount (b. 1825, d. 1869), was a contributor to various periodicals, and 2 vols. of his *Selected Writings, Political, Geographical, and Social*, appeared soon after his death.

Stran'gles, in the horse, is an abscess which occurs between the branches of the lower jaw. If possible, induce the animal to eat. Foment the throat thoroughly, and as soon as the sore comes to a head, open it, and recovery generally follows. Sometimes, however, the lymphatic glands appear to be inflamed, and occasionally metastatic abscess appears in distant parts of the body. This disease is considered contagious, and there is a similar infectious disease of swine called also "strangles."

Strangula'tion [remotely from the Gr. στραγγάλη, a "halter"] denotes, primarily, the mechanical closure of the air-passages of the neck, so as to prevent respiration. Death by strangulation is speedy, but there may be a chance of recovery for a considerable period. Artificial respiration, stimulant applications to the extremities and chest, and of ammonia to the nostrils, should be tried. Only when all other means have failed should the galvanic battery, a dangerous instrument, be employed. After apparent recovery, death may speedily ensue from secondary causes.

Stran'gury [Gr. στράγξ, a "drop," and οὐρεῖν, to "urinate"], a suppression of the urine. The name is especially applied to such suppression when it depends on the presence of spasm or tenesmus of the urethra. It may be caused by the too free use of Spanish-fly blisters or of oil of turpentine, or it may attend the presence of calculi in the bladder. The warm bath, hot fomentations, mucilaginous drinks, bland enemata, and the like will usually relieve the untoward symptom.

Strasbourg', or **Strass'burg,** fortified town of Alsace, owes its prosperity chiefly to the political and military importance of its location in the great pass which connects France and Germany, and has been, from old times, at once a much-contested strategical point and a flourishing centre of industry and commerce. It is in a beautiful plain on the Ill, the Breusch, and the Rhine-Marne Canal, 3 kilomètres W. of the Rhine, and forms the connection between the railways of Southern Germany and France. It is not well built, the streets being narrow and the houses high, as is generally the case in fortified places; since the Franco-German war, however, it has become more open and regular, as those parts which were destroyed by the bombardment have been rebuilt, and the fortifications which the Germans are erecting leave more space for the

development of the city. The most remarkable of its public buildings is the cathedral, with a tower 142 mètres high, the highest in Europe. The first foundation of this building is said to have been laid in 510 by Chlodwig, but this older structure was destroyed by lightning in 1007. In 1015, Bishop Werner of Hapsburg laid a new foundation, and in 1275 the main building was finished. The tower was commenced in 1277 by Erwin von Steinbach, and completed in 1439 by J. Hültz of Cologne. Among the many curiosities which this building contains is the famous clock (made 1547–80), representing our planetary system and its constellations. Besides the cathedral, the church of St. Thomas, founded in 1031, and containing the monument of Marshal Saxe, and the New Church, are noticeable. Other interesting buildings are—the palace, containing the lecture-rooms of the university, the former palace of the prefect, the exchange, the palace of the commander, the academy, the fruit-hall, the dépôt, the post-office, etc. In the Gutenberg Square stands the statue of Gutenberg; in the Kleber Square, that of Gen. J. B. Kleber. A German university was opened May 1, 1872, and numerous educational and benevolent institutions exist. Commerce and industry flourish in consequence of the favorable situation; by river navigation the city communicates with the Netherlands and Switzerland. Important tobacco-factories are in operation, numerous breweries, printing establishments, oil and saw mills, wool-spinning establishments, manufactures of oilcloth, straw hats, gloves, paper-hangings, chocolate, mustard, goose-liver pies, soap, candles, chemicals, musical instruments, furniture, jewelry, etc. The cultivation of vegetables, fruits, and flowers is considerable. The surrounding country is fertile and beautiful, studded with fine villas. Along the Rhine the city possesses fine forests. The fortifications are very important. Under French dominion the city had a strong bastioned circumvallation, but since it has become part of the German empire a new system of fortification has been applied, consisting of a number of large, strong forts surrounding the inner fortifications, so that an army can encamp between the city and the forts, while the city is entirely protected from the enemy's fire by the outer forts. P. 85,654.

Strasbourg was founded by the Romans under the name of *Argentoratum*. During the Middle Ages it was one of the most powerful free cities of the German empire; its citizens defeated the bishops and lords of the surrounding country in numerous battles. Sept. 30, 1681, Louis XIV. captured it, and by the Peace of Ryswick he retained it. By the Peace of Frankfort (1871) it returned to Germany, and is now the seat of the civil and military government of Alsace-Lorraine. (See BOMBARDMENT and SIEGE.)

AUGUST NIEMANN.

Stras'burg, p.-v., Franklin tp., Tuscarawas co., O., on Sugar Creek. P. 142.

Strasburg, p.-b. and tp., Lancaster co., Pa., at S. terminus of Strasburg branch of Pennsylvania R. R., has several manufactories, a thriving trade, and 1 weekly newspaper. P. of b. 1008; of tp. 1864.

Strasburg, p.-v., Davis tp., Shenandoah co., Va., on N. branch of Shenandoah River, at the junction of Harper's Ferry and Valley branch of Baltimore and Ohio R. R. with Manassas division of Washington City Virginia Midland and Great Southern R. R.; was the scene of a notable defeat of the Union forces under Gen. Banks by "Stonewall" Jackson, May 24, 1862. P. 580.

Strassburg. See STRASBOURG.

Strat'egy [Fr. *stratégie*] is, in general terms, the science of military command; or, in a more precise technology of military art and science, it is the art of directing troops upon decisive points, or of manœuvring armies within a theatre of war, but beyond the range of an enemy's cannon. Including all combinations which may lead to the profitable display of tactical skill or win a campaign without joining issue in battle, this is obviously the most important branch of the military art. Its principles are well established, but only superior generalship can under the varying conditions of actual warfare so reconcile its requirements with those of the other branches of the art — engineering, logistics, and tactics—as to derive the maximum advantage from a campaign. A fault in tactics may forfeit strategic advantages, or the display of the most faultless skill on the field of battle may lead to no decisive result where strategic considerations have been neglected. Strategic points, in military parlance, are simply such objects and localities as have for the time being an important or decisive influence upon military operations, either from their military strength or geographical location, or for political considerations. Strategic lines are in a like technical sense the routes of communication from bases of operation upon the objective points. These "points" may therefore embrace large areas of country, and the "lines" may be many miles in width. (See WAR.) R. N. SCOTT.

Strat'ford, town of England, county of Essex, on the Lea, 4 miles N. E. of London, has several breweries, corn-mills, shipbuilding slips, and manufactories of chemicals and carriages. P. 15,994.

Stratford, p.-v., cap. of Perth co., Ont., Canada, on the river Avon, at the crossing of Grand Trunk Railway and its Buffalo and Goderich division. It has extensive repair-shops, a fine railway-station, good water-power, extensive manufactures, a town-hall, and 3 weekly newspapers. It is an inland port of entry. P. 4313.

Stratford, p.-v. and tp., Fairfield co., Conn., on Long Island Sound, at the mouth of Housatonic River and at junction of Naugatuck with New York and New Haven R. R., is one of the oldest towns of the State, and is noted for beautiful rural scenery, for refined society, and as the birth-place or residence of several persons distinguished in the history of Connecticut. P. 3032.

Stratford, p.-v. and tp., Coos co., N. H., on Connecticut River and on Grand Trunk R. R. P. 886.

Stratford, p.-v. and tp., Fulton co., N. Y., on Canada Creek, includes v. of Nicholsville. P. 1163.

Stratford de Redcliffe (STRATFORD CANNING), VISCOUNT, b. in London Jan. 6, 1788; was educated at Eton and Cambridge; in 1807, while still an undergraduate, received an appointment in the foreign office, and in 1809 was made secretary of embassy at Constantinople. Returning to England, he re-entered the university, and in 1813 took his degree of M. A. In 1814 he was sent as minister to Switzerland, in 1820 on a special mission to the U. S., in 1824 to Russia, and in 1825 as ambassador to Turkey. Diplomatic intercourse having been interrupted by the naval battle of Navarino, he returned to England; was returned to the House of Commons for government boroughs until 1841, when he was again sent as ambassador to Turkey, retaining that position till 1858, during which time his influence at the Ottoman court was very great, and always exercised in favor of reforms, especially those involving the amelioration of the condition of the Christian population of Turkey. He was raised to the peerage in 1852, and was made knight of the Garter in 1869. He has published an essay, *Why am I a Christian?* (1873), and a drama, *Alfred the Great in Athelney* (1876).

Stratford-on-Avon, town of England, county of Warwick, on the Avon, has 3872 inhabitants. The house in which Shakspeare was born is still preserved; that in which he died has been razed.

Strath'am, p.-v. and tp., Rockingham co., N. H., on Grand Bay and on Concord and Portsmouth R. R. P. 769.

Strath'clyde, or **Scottish Cumbria,** an independent kingdom formed in S. W. Scotland at the dissolution of the ancient Britannic confederacy, and consisting chiefly, as its name imports, of the broad valley or dale of Clyde. The capital was the fortress of Alclyde, now Dumbarton. The annals of its sovereigns are involved in deep obscurity, little more than their names being known. It fell to the crown of Scotland early in the twelfth century, was held for some years by Prince David as an independent kingdom, and was permanently united to Scotland on his accession to the throne in 1124.

Strathnairn' (Right Hon. HUGH HENRY ROSE), BARON, son of the late Right Hon. Sir George H. Rose, b. in 1803; educated at Berlin (his father being British minister there), and entered the British army as ensign in 1820; attained the rank of lieutenant-colonel (by purchase) in 1839; served in the Syrian campaign 1840–41, in the Eastern campaign 1854–55, and as queen's commissioner at the head-quarters of the French army, and wounded before Sebastopol. Throughout the Indian mutiny (1857–58) he commanded the Central India field force, making extended marches and fighting many successful actions, receiving for his eminent services the thanks of Parliament and promotion to the rank of lieutenant-general 1860, besides the order of G. C. B. He subsequently succeeded Lord Clyde as commander-in-chief in India, and during his term the queen's forces were united with those of the late East India Company. In 1865 he took command of the British forces in Ireland; was raised to the peerage in 1866; promoted to be general in 1867, and in 1869 was appointed to the command of the Royal Horse Guards. In 1870 he resigned his command in Ireland.

Strath'roy, p.-v., Middlesex co., Ont., Canada, on the river Sydenham and on Great Western Railway, 40 miles E. of Sarnia. It has manufactures of woollens, castings, agricultural tools, etc., and supports 3 weekly newspapers. P. 3232.

Stratification and **Stratum.** See Geology, by Prof. J. W. Dawson, LL.D., and Geology, Chemical, by Prof. T. Sterry Hunt, LL.D.

Strat'ton, tp., Edgar co., Ill. P. 1621.

Stratton, p.-v. and tp., Windham co., Vt., at the head of Deerfield River. P. 294.

Strat'tonville, p.-b., Clarion tp., Clarion co., Pa. P. 356.

Strau'bing, town of Bavaria, on the Danube, has several good educational institutions and an active trade in corn and cattle. P. 11,480.

Strauss (David Friedrich), b. in Ludwigsburg, Würtemberg, Jan. 27, 1808. His parents lived in moderate circumstances; his chief talent seems to have been inherited from his mother. As a child he was retiring and of weak constitution, but fond of study and thorough in his acquisitions. At an excellent school in Blaubeuren and at the University of Tübingen he pursued his classical and theological course with zeal and independence; Baur was one of his teachers in both places. In philosophy he was at first repelled by Kant, but attracted by Schelling, Jacobi, and the famous German mystic Jacob Böhme, following also with eagerness the new revelations of Kerner and others on "the dark side of nature" and in the sphere of the so-called animal magnetism. In the latter part of his course he was strongly influenced first by Schleiermacher, but chiefly by Hegel, whose severe and comprehensive system, sufficient, as was supposed, for all things, was just coming into general notice. Schleiermacher's lectures on the life of Jesus, which Strauss heard in Berlin in 1831, and Hegel's logic, were the preludes to the *Leben Jesu* of Strauss, which, published in 1835, made an epoch in the history of German theology. This work was written in the course of a year, while he was *Repetent* at Tübingen (since 1832), when the author was only twenty-seven years of age. In the learned world of Germany it brought matters to a crisis, both in respect to biblical criticism and the relations of faith to speculation (4th ed. 1840; translated into English by Marian Evans (George Eliot), Lond., 1846; New York, 1850; into French, by Littré, 4 vols., 1840). Strauss lays down in the preface the general principle that nothing which is supernatural, neither prophecy nor miracle, can be historical. The force of his criticism of details rests on this assumption. He resolves all the supernatural elements of the gospel story into myths; his hypothesis is known as the "mythical theory"—that is, the transforming of popular religious beliefs into facts supposed to have been realized in the life of Christ. The work had the merit of bringing together all the scattered objections to the life of Christ, and shaping them into a theory. But unless the supernatural cannot be manifested, the underlying theory falls to the ground. In his concluding essay he applies the Hegelian logic to the life of Christ in such a way that, though he denies the facts as historical, he yet admits that there are certain essential ideas at their basis. Historical Christianity is true, not as history, but as idea. The Hegelian philosophy is to be substituted for Christianity. The work was written in a clear and trenchant style, at once popular and scientific. It was replied to by some of the most eminent divines in Germany (such as Neander and Tholuck) and in other countries. In 1837–38, Strauss replied to his critics in several *Streitschriften* (3 vols.) and in 1838 in *Zwei friedliche Blätter*. He lost his theological position at Tübingen (a full account of the ecclesiastical proceedings, including the letters of Strauss, is given by Weizsäcker in the *Jahrbücher f. deutsche Theologie*, 1875, 4th part), and became a teacher in Ludwigsburg and Stuttgart. He was called to be professor of dogmatics and church history in Zurich in 1839, but was deprived of his chair by a popular insurrection, though retaining for life half his salary. In 1839 he published a volume of *Charakteristiken und Kritiken*, embracing essays on Schleiermacher, Daub, and Kerner, on animal magnetism and modern possessions, etc. In 1841 he was married to a once-celebrated actress, Agnese Schebest, but their characters, says Zeller, were so incompatible and the marriage so unhappy that they separated by mutual consent after five years. The wife lived in Stuttgart until her decease, Dec. 22, 1870. In 1840–41 he attempted to do for theology what he supposed he had accomplished for the life of Christ. Under the title *Die christliche Glaubenslehre in ihrer geschichtlichen Entwickelung, etc.* (2 vols., which reached a second edition) he tried to resolve the whole of theology into philosophy. But this work, though learned and acute, made a comparatively slight impression. Having thus, in his opinion, disposed of historical and dogmatic Christianity, he betook himself for twenty years to general literature, interspersed with political speeches and action, leading the life of a wanderer from city to city. In 1847 he published a pamphlet, *Der Romantiker auf dem Throne der Cäsaren*, an ingenious parallel between Julian the Apostate and King Frederick William IV. of Prussia, made up chiefly of apt and sharp citations. In the revolutionary period of 1848 he failed in an attempt to be elected to the noted Frankfort Parliament, but he was chosen to represent his native town in the diet of Würtemberg, where, to the surprise of his adherents, he denounced democracy, and in his very latest work he takes special pains to disparage republican institutions. His political views are contained in *Sechs Theologisch-politische Volksreden* (1848). In 1849 he published *Schubart's Leben in seinen Briefen* (2 vols.). In 1851 appeared a memorial of one of his friends, Christian Märklin; in 1855, the *Life and Writings of Nicodemus Frischlin*, representing the German culture of the sixteenth century. In 1857 he produced a more important work, the *Life of Ulrich von Hutten* (2 vols.; an abridged ed. 1871), prepared for Böcking's edition of Hutten's works; and in 1860 a volume of Hutten's *Conversations*. It was here first that he so highly eulogized and vindicated the German nationality, which he afterward advocated in such a brilliant style in his correspondence with Renan (1870). In 1862 he revived the memory of a German rationalist of high critical attainments—a forerunner of Lessing—Hermann Samuel Reimarus. These and other literary and biographical works, all wrought out with æsthetic care, added to his reputation for general scholarship. In 1864 he returned to theology in the attempt at writing another life of Christ under the title *Das Leben Jesu für das deutsche Volk bearbeitet*. The school of Baur of Tübingen and the progress of historical criticism had effectually supplanted the mythical theory of Strauss's first *Leben Jesu*. His object in the second work is, in general, to show what remains of Christ for the people after German criticism has had its full course. And he still grants that "Christianity is a moral and spiritual power in the earth;" that "we cannot do without it, nor can it be lost;" that Jesus "stands foremost among those who have given a higher ideal to humanity." In 1865 he reviewed Schleiermacher's *Life of Christ*, then first published, in a work entitled *Der Christus des Glaubens und der Christus der Geschichte*. In 1866, under the title *Die Halben und die Ganzen*, he criticises the half-theology of Schenkel even more severely than he does the unbending orthodoxy of Hengstenberg. His essays on *Voltaire* (1870; 3d ed. 1872) were prepared for the Princess Alice, and are praised for their critical skill and elegant diction as standing by the side of Göthe's *Wahrheit und Dichtung*. His last work, *The Old Faith and the New, a Confession*, appeared in Oct., 1872. It is intended to give the result of his life's thought and work. It rapidly went through 7 eds. in Germany, was published in French, and in an English version by Mathilde Blind in London and in New York (1873). It has been fully reviewed by Prof. Vera of Naples, Prof. Huber of Munich, Dr. Rauwenhoff, professor at Leyden, and Dr. Nippold of Berne. From the philosophical side it was most ably criticised by Prof. Ulrici of Halle in his *Zeitschrift für Philosophie* (vol. xvi., 1873; translated and edited with full notes by Dr. Krauth, provost of the University of Pennsylvania, Philadelphia, 1874; comp. *Presbyterian Quarterly*, Apr., 1874). The *Old Faith and the New* undertakes to answer four questions—viz. (1) "Are we still Christians?" (2) "Have we still a religion?" (3) "What is our conception of the universe?" (4) "What is our rule of life?" On the first of these questions the answer is in the negative: "We must acknowledge that we are no longer Christians." By the "we" he, of course, means those who are avowed pantheists and materialists. His former veneration for Christ as a religious genius is specifically repudiated, and he asserts that, so far as we can know anything about him, his chief characteristic is a "fantastic fanaticism." The resurrection of Jesus is stigmatized as a "world-historical humbug." All Christian doctrines, even the hope of immortality, are denied. His reply to the second question, "Have we still any religion?" is that we can only believe in an absolute dependence upon the universe; an absolute being cannot be conscious or personal. To the third question he says that the only idea of the universe we can frame is that of a development from a blind force or law, without any foreseen end. The special point in his theory is that materialism and pantheism are really at one, having the same ultimate ideas, and equally opposed to Christianity. The contest between them is not essential. They ought to work together, for they equally deny all that is supernatural. Christianity must henceforth take its place with the heathen mythologies, and a materialistic or pantheistic evolution is the only idea of the universe which we can retain. From all which it follows that in answer to his fourth inquiry, "What is our rule of life?" he can only say that we must live for this world and for the human race—for the good we can find here, for science and for art. We must aban-

don ourselves to destiny, and find our happiness in resignation to an unknown, unconscious, and unfathomable power.

Strauss founded no school, either in philosophy or theology. He was a critic, learned, sagacious, yet without any well-defined ultimate system. His life is a reflex of the most extreme anti-Christian theory of human life. He began as an idealist and ended as a materialist. He gave up his early Hegelian pantheism to the latest theory of atheistic evolution. (His friend, Prof. Eduard Zeller of Berlin, has described his life and writings in a short, critical, and finished memorial (Bonn, 1874). Dr. A. Hausrath, in his work on *Strauss and the Theology of his Times*, of which only the first volume has been published, gives an able and detailed review of his whole career.) D. at his native place of cancer, after long and patient suffering, Feb. 9, 1874, and was buried, by his own direction, without any church service. H. B. SMITH.

Strauss (JOHANN), b. at Vienna Mar. 14, 1804; was first apprenticed to a bookbinder, but early gave up this profession from love to music, entered the orchestra of Lanner; began to compose dancing music; and became soon a favorite among the Viennese, whom he almost intoxicated with his rich and original melodies, his graceful and charming rhythms, and his varied and piquant instrumentation. In 1824 he formed an orchestra of his own, with which he made a concert-tour through Europe 1833–37, and d. at Vienna Sept. 24, 1849, as music director at the court balls. On the social life of Vienna he exercised no small influence, inducing by his music the higher classes to visit those music-halls which hitherto had been frequented only by the middle classes, and elevating the tone of the numerous dancing-halls of a lower order.—His three sons, JOHANN, JOSEPH, and EDWARD, have formed orchestras, made concert-tours, and acquired celebrity as composers of dancing music.

Straw'berry [Ang.-Sax. *streaw-berige*], a well-known plant of the genus *Fragaria* and of the family Rosaceæ, found wild throughout most of the northern temperate zone, but more commonly in a cultivated state, is a stemless perennial herb, throwing out runners to form new plants, bearing on long stalks, with compound leaves made up of three obovate, wedge-shaped, deeply-serrated leaflets. The calyx is 10-cleft, with the segments alternately smaller, five petals, many stamens, and simple pistils seated upon a convex receptacle, which at the ripening of the ovaries rapidly increases in size and becomes the delicious edible berry popularly but incorrectly regarded as the fruit, the real fruit, in the botanical sense, being the small seed-like *achenia* or ripened ovaries scattered over the surface of the berry. The species are very numerous, and improve or degenerate rapidly under domestication, so that new varieties are constantly appearing in the market-gardens, and it is very difficult to determine the original species to which the cultivated berries belong. The best-known and most widely-spread species are the Alpine (*F. vesca*), called in England the wood-strawberry, and the Virginian (*F. Virginiana*), or common wild strawberry of the U. S., supposed to be indigenous to America, being found E. of the Rocky Mountains from the Arctic Ocean to the Gulf of Mexico; on the Pacific slope, from British Columbia nearly to Cape Horn southward, the Chilian strawberry (*F. Chilensis*), a robust, large-leaved species, bearing a yellowish-white or rose-colored berry, often as large as a small hen's egg. Among the delicious varieties largely grown for the markets of the Atlantic cities of the U. S. are "Hovey's Seedling," "Wilson's Albany," "Agriculturist," and "Monarch of the West." They are planted in rows two feet apart, require careful cutting and a highly fertilized soil, are often grown in hot-houses, and require in winter a covering of straw, whence the name.

Strawberry, tp., Lawrence co., Ark. P. 1144.

Strawberry Point, p.-v., Clayton co., Ia., on Davenport and St. Paul R. R., 50 miles W. of Dubuque, has 3 churches, excellent schools, 1 newspaper, 1 bank, 3 hotels, a cheese-factory, and 1 machine-shop. It is an extensive grain and produce mart. P. about 1200.

G. E. DELAVAN, ED. "FREE PRESS."

Straw [Ang.-Sax.], **Manufacture of.** The braiding or plaiting of slender vegetable stalks, leaves, and filaments, so as to form tissues, is one of the primitive arts. In its simplest stages it is purely manual, requiring the use of no artificial implement. It is therefore suited to tribes in the earliest phases of social life, and it is accordingly found among the rudest tribes, as well as among those more advanced in civilization and art. The stems and leaves of grasses are commonly the material employed, and mats for sleeping upon seem to be generally the earliest domestic fabrics to which the art is applied. The fragility and perishable nature of the vegetable filaments used for plaiting ensure the rapid decay of the tissue, and consequently few if any very ancient specimens of braided work are extant. We know, however, that straw hats were worn in summer by the lower, if not sometimes by the higher, classes of the Romans, and it is presumable that like manufactures existed among other ancient and cultivated peoples. The semi-barbarous tribes of our own time exhibit great dexterity in the fabrication of braided articles, which, according to the use for which they are intended, are of loose or of firm texture. Thus, the poisonous juice of the cassava is extracted by filling long, flexible, loosely-plaited cylinders with the pulp, and then squeezing the fluid through the interstices of the cylinders by pulling, rolling, and pressing. On the other hand, some of the South Sea islanders braid baskets (or rather bags) of native grasses so close in texture as, though still very flexible, to be impervious to fluids and to serve for water-buckets. The exquisitely fine hats and cigar-cases of Panama work are indeed in forms dictated by European taste, but the fabric is of native origin.

The manufacture of this sort which has the greatest economical importance is from the straw or stem of the cereals, especially wheat and rye, which is employed either in its natural form—*i. e.* whole—or split into slips according to the size of the straw and the particular tissue designed, a single straw sometimes being divided into as many as fifteen slips. Wheat straw is preferred, but rye straw has longer stems and can be braided into more delicate and even tissues. It is, however, less durable, and does not wash so well as wheat. The hats which are exported from Italy under the name of *rice* straw are not manufactured from the stem of that plant, but from the bark of a variety of willow found abundantly near Modena. Tuscany was long almost the sole seat of this industry, and the Leghorn hats, as they are called, are still preferred in most foreign markets. A grand-ducal decree of 1575 enumerated the dealers in straw hats among the Tuscan traders liable to a matriculation tax; but according to a monumental inscription in the church of San Miniato at Signa, near Florence, Sebastiano Michelacci di Bologna, who died in 1739, was the first to export straw hats to England, and he is hence regarded as the founder of that branch of national commerce. The hats exported at that time were of coarse fabric, and designed only for the use of the laboring classes. The manufacture of fine hats for the English market is said not to have commenced until the year 1800, or, according to some, 1825. The latter date is certainly erroneous, for a ballad called *The Straw Hat*, satirizing the fashionable use of this headgear, was in popular circulation some years earlier; and even 1800 is apparently too late a date, for Lastri in his georgic poem, *Il Cappello di Paglia*, printed in 1801, says that the finer qualities "had the honor of passing the columns of Hercules and reaching the shores of the richer hemisphere." This might, indeed, refer to the trade with Spanish America, but it probably included England also. The Tuscan produce and exportation has fallen off, because other Italian provinces have entered into competition in both the domestic and the foreign market, and other countries also have engaged largely in this industry, and have introduced new processes in the formation and finish of the *bodies*. Hence, Tuscany, which formerly sent abroad only the completely manufactured product, now exports considerable quantities of braid, and even of straw, which is wrought after patterns suited to the local taste, and not easily imitated in Italy. The first fine Tuscan hats sent to England were simply such as were worn by the *contadine* or female peasants, and still are in common use. These are very broad-brimmed, plain hats, finely braided, but of flexible texture. They sold—and the best, called *fioretti*, still sell—at high prices, \$100, and even more, being sometimes paid for the labor on a single hat. Straw is employed not only for the bodies or forms of hats, but for rosettes, borders, and other trimmings, as well as for baskets and other fanciful objects, in the manufacture of which the women of Fiesole exhibit much ingenuity and taste. In these fabrics silk or other fine thread or hair often forms a part of the tissue, and machinery is employed for certain purposes in the work, though plain *braid* is always made by hand, and in general no implements are used except the needle for sewing the long strips of narrow braid together, a tool in the shape of a short cylinder with sharp projecting ribs for splitting the straw into slips, and a species of sieve for sorting the straw according to size. Work of this sort demands little or no muscular effort, nor is it so complicated as to be beyond the capacity of very young persons. Hence a great deal of the Tuscan straw braid is the work of the merest children. Their gains are indeed small, but as they could in general earn absolutely nothing by any other industry, the straw manufacture is a valuable resource to the poorer classes in Italy. The straw industry of Tuscany has been minutely described in all its

processes by Lastri in the poem above referred to. Further information may be found in the later treatises of Jacopo Ricci, *Catechismo agrario* (Firenze, 1815); Ricci di Lapo, *Antologia* (No. 58, Oct., 1825); Bettoni, *Notizie sulla Cultura della Paglia da Cappelli* (Firenze, 1826); Francalanci, *Sulla Cultura della Paglia da Cappelli* (Firenze, 1825); Mariotti, *Notizie Storiche ecc. intorno all' arte della Paglia in Toscana*. The various reports of the universal expositions of the last twenty-five years at London, Paris, Vienna, etc. may also be consulted.

The beauty of the straw tissue has led to many imitations, in the fabrication of which machinery is largely employed. Many species of palm leaf are used advantageously, and chip hats, called *navarinos*, in compliment to the great battle fought about the time of this invention, in which thin and narrow slips of birch, poplar, and other woods take the place of straw, have been manufactured on a great scale. Stamped paper, too, can be made to imitate the texture and color of straw hats to great perfection.

The best straw is that of a variety of spring wheat—*grano da paglia*, as it is called in Tuscany—thickly sown, preferably on sandy, hilly ground, in February or March, according to season and local climate, and harvested by *pulling*, like flax, as soon as the stalk begins to turn. The straw is left spread upon clean ground or grass for some days, for the sake of the action of the dew in bleaching it; it is then gathered into sheaves, from which the laborers draw out the stalks, breaking them at the joints and breaking off the heads. They are then sorted by a species of sieve composed generally of sixteen tin plates pierced with holes of different diameters and briskly moved by a wheel. Three workmen can sort about seventy-five pounds a day. The straw is now bleached by sulphur, and stored for working up at a convenient season. The peasantry braid it into narrow strips, which are flattened by pressure and sewed together, with an almost imperceptible seam, at the edges, and the hat, already nearly in its proper shape, is sent to the straw-factories in the towns, where breaks and other defects are remedied, the projecting points of the straw inside broken off, and discolored straws removed. It is now plunged for some time in a warm weak solution of acetate of lead, and then ironed with a hollow flat-iron containing charcoal to keep it hot. Straw hats, however, are by no means always manufactured from braided strips, but often plaited directly with the stalks, in which case, as also often when formed of braids, the straw is whole or unsplit, and consequently produces a much stronger tissue.

Tuscany exports not only hats, but braid to be wrought elsewhere. In the years 1851–55 the exportation rose from $1,600,000 to $3,700,000 in value, of which about two-thirds consisted in finished hats and nearly one-third in braid, besides $5000 in unwrought sorted straw. From 1863 to 1869 the exportation fell off greatly, but has since risen very considerably, especially in finished hats. Belgium, Holland, Switzerland, and Germany are powerful competitors with Tuscany in this industry, and some of the Swiss wares are scarcely inferior to the best Italian.

George P. Marsh.

Straw-Work in the U. S. Straw-work as a domestic industry, limited to the wants and conveniences of the household, was a characteristic of New England and Northern social life generally from the founding of the colonies, but under these conditions little was attempted in the selection of fine materials or in the preparation of graceful forms. Nor was there any general purchase or sale of straw or its manufactures as merchandise until a comparatively recent period; like many other domestic industries, the supply required by the family was carefully provided, and both the materials and the finished articles cost much time and care in excess of that required to produce superior fabrics now. During this early period fine straw hats were imported for the wealthy, however, and the luxuries of Tuscan straw were enjoyed by a favored few, without thought on the part of the people generally that they could be imitated or made available to persons of moderate means. Some effort in this direction was made, however, at the time of the great efforts made in England to develop the straw-industry, the long European wars having cut off the supply from Italy. The celebrated Dunstable straws were the fruit of those efforts in England, and they became as much the fashionable attraction as the Leghorn or Tuscan straws had been. The British Society of Arts made great efforts to sustain this industry after peace was restored, and in 1822 this society awarded a silver medal and twenty guineas to Miss Sophia Woodhouse of Connecticut for a new material for fine plaits, the *Poa pratensis*, then supposed to be equal to the Italian straw for making fine braids. At this time there was some successful straw-industry in the U. S., but the finer hats could only be made from Italian material, which began to be imported both in flats and in braids. The precise source or mode of preparation of this fine Tuscan material is imperfectly known,* but its excellence and cheapness in time reduced the consumption of Dunstable straw, and developed an extensive system of manufacture in the U. S. from imported braids. Nearly thirty years since the more enterprising local dealers in the small towns of Massachusetts and New York began the collection of straw manufactures, both of the coarser and finer forms, for sale and general distribution to localities where the manufacture did not exist; and out of this an immense business has been developed. For a long period the braiding and sewing were done by members of families as incidents of other household occupations, the coarser straws being prepared at home, and the finer being purchased at the stores where the finished products were disposed of. Establishments for stamping and shaping soon grew up, some of which attained to a large business twenty years ago in Eastern Massachusetts. Then began very large importations of Tuscan braid, with some from Switzerland and Germany, and more recently very large quantities from Canton and other ports of China. In 1860 the census reports several establishments for straw-work in Massachusetts, producing goods to the value of $150,000 to $400,000 each, and in the entire State there were 26 establishments, employing 6218 persons, and producing goods to the value of $3,398,406. In the entire U. S. there were 39 establishments, employing 801 men and 6802 females, and producing straw goods to the value of $4,395,616. The steady growth of this industry is shown by the returns of the census of 1870, there being then 75 establishments, with $2,119,350 capital, employing 24 steam-engines of 341 horse-power, 1988 men, 12,594 females, 343 youths, paying $2,122,870 in wages, and making straw goods to the value of $7,282,086. Since 1870 the growth has been even more rapid, and the product is now largely in excess of that reported for that year. Since the establishment of steam pressing and moulding establishments, some fifteen years ago, the general business has been conducted by an association of the manufacturers, who regulate prices and endeavor to give stability to the trade. Within five years steam-power has been applied to sewing the braids, the Bosworth and the Knowlton sewing-machines being first and most generally used, but several others have recently been adapted to the work. These adaptations have now been introduced in England from the U. S. Hydraulic power is also applied to the moulding or shaping blocks, some of these machines, to each of which several blocks may be attached, being capable of stamping 300 dozen in a day. For this vast industry the supply of material is now chiefly from foreign countries, almost all the material for ladies' and children's hats being foreign, though much of that used for men's hats is from American straw. The importations of straw braid from foreign countries in 1874–75 were as follows: From China, direct, $637,355; from England, in part Chinese and in part Italian, $310,995; from France, $968,455; Italy, direct, $189,810; Germany, $113,684; all other countries, $105,240; total value imported, $2,325,539. A part of this, perhaps $150,000 in value from France, is in finished hats, and about $100,000 in value is of palm-leaf: the exact divisions are not given in the official returns. The average value of braids imported has been about $2,000,000 annually for five years. A small export of domestic straw hats, etc. exists, reaching $68,425 in 1874–75, and of foreign re-exports the value was $70,328. In consequence of the great cheapness and skill of the labor employed in braiding straw in Europe and China, work of this character is here chiefly confined to coarse straw for men's hats. At one time the English success in Dunstable straws was copied here, and at intervals within twenty years braiding of fine split straw has been successfully attempted in Massachusetts, but it is now practically given up. Children and females prepare the straw and braid it in the mountainous districts of Italy, Bohemia, and Switzerland with extraordinary skill and rapidity, and the straw grown there is admitted to be superior to any other known. The sewing of braids is now performed by lapping, and with the added pressure of the moulding-machines the requisite smoothness of the work is secured almost as well as by the joining at the edges, which was once considered essential. Still, the finest Tuscan hats are only made of braids united at the edge, and imported in the form of flats when not in finished shapes. The commercial character which the straw-

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* The Austrian official reports of the Vienna Exhibition represent the source of the finest straw plaits to be the districts of Bohemia at the foot of the Erz Mountains, where the best wheaten straw is grown, the upper part only being taken for the fine plaits, and other parts for coarser plaits. Women and children are trained to this industry from an early age, and attain great proficiency in making plaits, children of eight to thirteen years of age making pieces of twenty-four ells in length in ten to forty-three minutes. The straw is first bleached, then split by using an iron instrument with sharp teeth, and scraped smooth in pieces about six inches long. (See vol. i. p. 702 of *British Official Reports, Vienna Exhibition*.)

industry of the U. S. has recently attained constitutes its leading feature. Large establishments, with much machinery and employing steam-power, now control the production of all forms of straw-work entering into general trade. It is energetically directed, producing and selling products to the value of about $10,000,000 yearly. There still remains a share of the former domestic production of men's hats which does not enter into this general trade, but is made for and sold in local markets; and there is also a share of the former household work of Massachusetts made in families for the factories of the vicinity, but very much less than was so made ten and fifteen years ago, the tendency recently being to bring the sewing into the factory building, where it is made efficient by improved machinery and steam-power. LORIN BLODGET.

Strays. See ESTRAY.

Straznicky (EDWARD R.), M. D., Ph. D., b. in Moravia in 1820; graduated at one of the principal universities of Vienna. While there, in addition to the German language, he acquired a speaking knowledge of the Russian and modern Greek. On the completion of his studies he made a pedestrian tour of a large portion of the continent of Europe, and as he made it his habit to study the languages of the various countries which he visited, he thus at length acquired a general knowledge of linguistics. He was also a good classical scholar, and on the completion of his university course he took his degrees of M. D. and Ph. D. On the breaking out of the Austro-Hungarian war he sided with the Hungarians, and held a commission in the army. The Hungarian defeat compelled him to leave his country, with the forfeiture of his property. He lived for a short time in London, and then came to this country. On his arrival in the U. S. he became connected with a mercantile establishment in Philadelphia, and subsequently, in 1859, coming to New York, he obtained his appointment as assistant librarian in the Astor Library. On the retirement of Mr. Schroeder from the office of its superintendent, Dr. Straznicky became the incumbent. He was also secretary to the American Geographical Society. His death, which was rather sudden, took place on Feb. 9, 1876. F. SAUNDERS.

Streat'or, p.-v., La Salle co., Ill., on Chicago and Alton, Chicago Burlington and Quincy, Chicago Pekin and South-western, and Chicago and Paducah R. Rs., 100 miles W. of Chicago, has 8 churches, 3 public schools, 2 newspapers, 2 banks, a fire department, and 3 factories. The head-quarters of the Vermilion coal-fields are located here. P. 1486. FREDERICK D. DALTON, ED. "MONITOR."

Street (ALFRED BILLINGS), b. at Poughkeepsie, N. Y., Dec. 18, 1811; studied law with his father, and commenced practice at Monticello, N. Y., but removed to Albany in 1839, and was for many years State librarian. He contributed largely, both in prose and verse, to periodicals. He has published in verse *The Burning of Schenectady, and other Poems* (1842), *Drawings and Tintings* (1844), *Fugitive Poems* (1846), *Frontenac* (1849). Collected editions of his poems appeared in 1847 and 1866. His prose-works were *The Council of Revision of the State of New York* (1859), *Woods and Waters, or the Saranacs and the Racket* (1860), *Digest of Taxation in the U. S.* (1863), and *The Indian Pass* (1869).

Street (AUGUSTUS RUSSELL), b. in New Haven, Conn., Nov. 5, 1792; was graduated from Yale College in 1812; studied law, but never practised his profession. Poor health from youth upward precluded the pursuits of active life. He was a man of scholarly tastes, and, possessing wealth, increased his culture by travel and observation. He founded the Yale School of the Fine Arts in Mar., 1864, erecting at his sole expense a very costly building. He also endowed the Street professorship of modern languages and the Titus Street professorship in Yale Theological School. His gifts to the university and his endowments were marked by a liberality, sagacity, and wisdom in advance of his times in regard to educational matters. D. in New Haven June 12, 1866, aged seventy four. J. M. HOPPIN.

Street (GEORGE EDMUND), b. at Woodford, Essex, in 1824; was educated at the collegiate school, Camberwell, and afterward studied architecture under able instructors. In 1850 he was appointed architect for the diocese of Oxford, and subsequently for those of York, Ripon, and Winchester. His predilection is mainly for the Gothic style, and he has written numerous essays and papers in support of his views. His architectural structures are very numerous and important; among them are churches in Garden street, Westminster; Sts. Philip and James, Oxford; All Saints, Clifton; St. Margaret, Liverpool; St. Mary, Paddington; the Crimean Memorial church, Constantinople; and the new nave and the two western steeples of Bristol cathedral. Among his church restorations are, Eccleshall; Jesus College chapel, Cambridge; Uffington, Berkshire; Stone, Kent; Wendover, Buckinghamshire; and the nave and choir of Christ church cathedral, Dublin. In 1847 he won one of the £100 prizes for a design for a new foreign office, and in 1868 was appointed architect of the buildings for the new courts of law, but his original design was sharply criticised, and afterward considerably modified. He is the architect of the mansion of the earl of Crawford and Balcarras at Dunecht, New Brunswick. He is a member of the British Institute of Architects, of the Vienna Imperial Academy of Fine Arts, of the American Institute of Architects, an associate of the Royal Academy (1866), and a royal academician (1871). Besides numerous essays and lectures upon architecture, he has published *The Brick and Marble Architecture of North Italy in the Middle Ages* (1855) and *Some Account of Gothic Architecture in Spain* (1865).

Street Road, p.-v., West Town tp., Chester co., Pa., on West Chester and Philadelphia R. R.

Streets'borough, p.-v. and tp., Portage co., O. P. 706.

Strel'itz [Russ. *Streltzi*, "arquebusiers"], an ancient and famous Russian corps of troops, originated in the militia of Ivan the Terrible, organized about 1546. They became the *élite* of the Russian army, but they were induced in 1689 to revolt in favor of the grand duchess Sophia. In consequence, Peter the Great decimated them in 1698, and banished the rest to Astrakhan, where the whole were executed for disloyal conduct in 1705.

Strength of Materials, or, more comprehensively, the **Resistance of Materials.** Whenever any solid body is acted on by an external force, and is at the same time connected with one or more fixed points of support, it will yield more or less to the action of the force, and become changed in form or dimensions or in its line of position. In the act of yielding it will oppose a resistance, increasing with the amount of the distortion, until the external force is effectually counteracted. This is called the property of *elastic resistance*. Thus, if a weight be suspended from a fixed point by an iron rod, the rod will be elongated until an elastic resistance is developed that will sustain the weight; or if a beam resting horizontally on two points of support be loaded at its middle, it will bend under the load, and in so doing may oppose an elastic resistance equal in intensity to the load. Such effects are the result of displacements occurring in the relative positions of the ultimate parts of the body, and are limited in amount by the resisting forces developed by these displacements. These internal resisting forces are called *forces of elastic resistance*. The external applied force is termed a *stress*, and takes its special designation from the particular circumstances of its action. When its line of direction passes through a point of support, it is called a *tensile stress*, or *pull*, if it tends to elongate the piece, as in the case of a suspension rod; and a *compressive stress*, or *push*, if it has the opposite tendency, as in the case of a pillar supporting a weight. If the applied force is not directed through an immediate point of support, it acts *transversely* to the piece, and is called a *transverse* stress. Transverse stresses are ordinarily perpendicular to the length of the piece. When the active force causes a twisting of the body, it is called a *torsive stress*. Every external stress that takes effect on a body gives rise to internal forces which constrain the particles to occupy new relative positions. These constraining forces are called *strains*. They are immediately counteracted by the elastic resistances to the displacements they produce. In speaking of the effect of the load or other external stress on the piece as a whole, a tensile stress is said to produce a *tensile strain*; a compressive stress, a *compressive strain*; a transverse stress, a *bending strain*; and a torsive stress, a *torsive strain*. But at any point within the piece there are but three possible varieties of strain—a tensile strain, or a forcible separation of contiguous particles; a compressive strain, or a forced diminution of the distance between them; and a *shearing strain*, or a constrained movement of one line or plane of particles parallel to another line or plane. The load or other stress applied to a piece may produce a certain definite amount of distortion, or it may be so great as to produce rupture. Accordingly, the resistance of materials comprises two general problems—the problem of *elastic resistance*, or *resistance to distortion*, and that of *ultimate resistance*, or *resistance to rupture*. The load required to produce fracture is called *the breaking load*, and measures the *ultimate strength* of the piece supported and loaded in the manner supposed. In practice, beams and other parts of structures are not loaded or strained to the point of incipient rupture. The design is that they shall never be subjected to a stress sufficient to occasion a distortion increasing with the duration of the stress or with each renewal of it. The *safe load* indicated by this criterion, when ascertained by actual trial, is called *the proof load* or *proof strength*. The actual

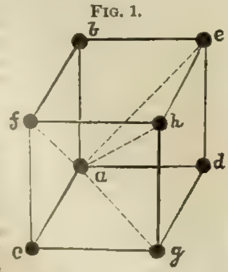
strain which the piece is intended to bear is, however, but a fraction of the safe or proof load, termed *the working load*.

With the view of determining the laws of the elastic resistance of materials many extensive series of experiments have been made by engineers and mechanicians, on a great variety of materials, subjected to every variety of stress, and supported in diverse ways. These experiments have conducted to the following

Fundamental Principles of Elastic Resistance.—(1) All bodies are made up of innumerable ultimate parts or particles. These are termed *molecules*, or often *particles* simply. (2) When, as the result of the action of an external force, the distance between two contiguous molecules of a body is altered, an effective resistance to the change of distance is developed, which consists in an effective action of the one molecule on the other. This effective action is an attraction if the distance is increased, and a repulsion if the distance is diminished. It is the elastic resistance opposed by a single pair of molecules to their relative displacement. (3) The intensity of this elastic resistance is proportional to the amount of the displacement, within certain limits. (4) If the applied load be removed, the piece will tend to return to its previous condition under the operation of the mutual actions of its displaced particles, which are now left unopposed. The property of *elasticity* in bodies involves both that of elastic resistance to a force of stress and that of undergoing an *elastic recoil* after the stress is withdrawn. (5) When the restoration to the former condition is complete, the piece is said to be *perfectly elastic* under the degree of stress applied. If the recoil is only partial, the elasticity is imperfect under the strains experienced. (6) As a matter of fact, all bodies may, from a practical point of view, be regarded as perfectly elastic within certain moderate limits of strain. But in every instance there exists a limit of strain beyond which the piece obviously ceases to recover itself. This is called the *limit of elasticity*. The residual elongation, compression, or deflection that obtains after the stress is withdrawn is termed the *set* of the piece. The experiments of Hodgkinson in England and of Chevandier and Wertheim in France in the cases of tensile and compressive stresses, and of the writer in the case of a transverse stress, have established that, however small may be the stress applied, the piece seldom, if ever, when relieved of the stress, recovers at once its precise original condition. Strictly speaking, then, there is no precise limit of elasticity—that is, no limit of strain within which the elasticity is perfect, and consequently no set exists immediately after the stress is withdrawn. It appears from this that when any solid piece has been subjected to a stress, its displaced molecules no longer exercise on each other, at the same distance, the same intensity of action as before, and hence do not return precisely to their original relative positions. This must be true of the displaced particles in general or of a portion of them. In this fundamental fact must lie the origin of the imperfect elasticity of solids.

The simplest general conception of the mechanical condition of a solid that can be formed from which a consistent theoretical exposition of the facts and laws of elastic resistance can be given, that fully accords with the entire range of experimental facts, is, that the molecules occupy the angular points of a series of geometrical cubes, and that within every elementary cube each pair of its eight molecules is, by itself, habitually in equilibrium under the action of opposing attractions and repulsions. But when an external stress takes effect, each elementary cube suffers a change of dimensions or of form, and between any two of its molecules that become relatively displaced a force of elastic resistance is developed. The effective molecular force exerted in the direction of either diagonal should be less, for an equal displacement, than that which takes effect in the direction of one of the sides, since the separating distance is greater. In this sense, of exerting unequal effective forces in different directions, the molecule may be said to have *polarity*. Let the effective force developed between the molecules a and b, c, or d (Fig. 1), by a minute change in the length of a side of the cube, be denoted by f, the corresponding force between a and e, f, or g, resulting from an equal change in the length of a face diagonal, by f', and the corresponding force between a and h, separated by a long diagonal of the cube, by f''. If we have regard to the several cubes that have a common point a, and consider all the resisting molecular actions that can ensue when a is displaced in any direction, it may be readily shown that the entire elastic resistance developed by the displacement of a is expressed by $f + 2f' + 1\frac{1}{3}f''$, whatever may be the direction of the displacement, provided it is in the direct line of an external reaction. The cubical arrangement of particles here conceived must be regarded as the normal type, from which there may be greater or less deviations in different materials and in different parts of the same body; but such deviations are seldom of such a nature as to give rise to an essential disagreement with the general theory based upon an ideal uniformity.

FIG. 1.



TENSION.—Let a weight P be suspended from a point by means of a homogeneous prismatic bar. Experiment has established that under the ordinary circumstances of such suspension the elongation produced by the weight will vary directly as the length of the bar, and be the same for each unit of its length, and will be inversely proportional to its cross-section. We may conclude, therefore, that all the vertical filaments or lines of particles of which the bar may be conceived to be made up are equally strained, and that the vertical distances between the successive particles in each filament is increased by a fractional amount equal to that of the elongation of the entire bar, and hence that the strain is the same at all points of its length. Every cross-section of the bar is separated an equal amount from that above it, and the entire elastic resistance to this separation is equal, at all points of the length, to the weight. We here, and in what follows, disregard the weight of the bar itself. Within the elastic limits the elongation is proportional to the weight suspended. It will also obviously be less in proportion as a greater elastic resistance is offered by the material to the separation of its parts. If we divide the portion of the suspended weight P that takes effect on each square inch of section of the bar by the elongation of each inch of its length, the ratio obtained is called the *coefficient of elasticity*, or, by many writers, the *modulus of elasticity*. It is invariably denoted by E. It is also defined as the weight that would be required to extend a bar that is one square inch in section and one inch in length by the amount of one inch if the elasticity continued perfect. It is expressed in pounds, and is far greater than the greatest actual load that a square inch of the bar is capable of sustaining, since no bar, of any ordinary material, can be extended beyond a very small fraction of its length without breaking. The coefficient of elasticity of wrought iron is no less than 25,000,000 pounds, while its tensile strength is only about 56,000 pounds. When the elongation of a bar of any material one square inch in cross-section, produced by a given weight, has been experimentally determined, the coefficient of elasticity of the material may be obtained by observing that it bears the same ratio to the weight that the length of the bar bears to the measured elongation. (See 5th column of Table III., p. 565.) The comparative values of E for different materials serve as a measure of the comparative *stiffness* under a tensile strain, and $\frac{1}{E}$ is a measure of the comparative extensibility.

Elongation of a Bar of Uniform Cross-section.—Let l denote the length of the bar in inches, K its cross-section in square inches, E the coefficient of elasticity as given by Table III., P the suspended weight in pounds, and λ the elongation produced by the weight P; then, by the definition above given of E, $E = \frac{P}{K} \div \frac{\lambda}{l}$, from which we derive

$$\lambda = \frac{P\,l}{E\,K}, \quad . \ . \ . \qquad (1)$$

and

$$P = \frac{\lambda}{l} E\,K. \quad . \ . \ . \qquad (2)$$

The elongation of a bar of uniform section that results from its own weight is the same as would be produced by half its weight suspended from its lower end.

When the weight is suddenly brought into action, as when a support underneath it is suddenly withdrawn, the elongation and strain may be twice as great as when it is applied gradually. If a weight is hanging from a suspension-rod and another weight falls upon it, the force of the shock will of itself produce a certain elongation and strain. If W is the permanent weight suspended, and the weight P descends upon it from a height h, and l denotes the length, K the cross-section, and E the coefficient of elasticity of the rod, the elongation λ resulting from the shock is approximately given by the equation

$$\lambda = \frac{P}{W + P}\sqrt{\frac{2\,h\,l}{E\,K}}. \quad . \ . \ . \qquad (3)$$

When the rod has experienced its maximum extension from the combined effect of the shock and the newly-added weight P, it will suffer contraction, then undergo another elonga-

tion, and alternate contractions and elongations, gradually diminishing in extent, will ensue, until the movement ceases with the bar at the point of permanent elongation due to the two weights P and W. The longitudinal vibrations of the bar, and the attendant vertical oscillations of the suspended mass, P + W, are isochronous. The continued diminution in the amplitude of the vibrations, and their final suppression, result from some change experienced in the effective resistances to the molecular displacements within the bar, which is designated the *viscosity* of solids.

Lateral Contraction, resulting from Longitudinal Tension.—If a bar or rod be subjected to a tensile stress, the distances between its contiguous particles will be increased not only in the longitudinal direction, but also in oblique directions. Cohesive attractions will thus come into operation between these particles, which will have the effect to compress the particles upon one another in the lateral direction. It thus happens that the diameter of a rod is diminished by a longitudinal tensile stress. According to the experiments of Cagnard Latour, Wertheim, and Kirchhoff, with rods of various materials, the fractional diminution of the diameter falls between one-fourth and two-fifths of the fractional elongation. This result of experiment is in accordance with the general conception of the mechanical condition of solids before stated, if we suppose the tensile stress to be exerted in the direction of the side of an elementary cube. This gives for the ratio of the lateral compressive action to the direct resistance to tension, for a single molecule, the expression

$$\frac{f' + 1\tfrac{1}{3}f''}{f + 2f' + 1\tfrac{1}{3}f''}.$$

The value of this for all admissible values of f' and f'', as compared with f, lies between the limits $\frac{1}{4}$ and $\frac{2}{5}$.

Resistance to Rupture by Tension.—The resistance of a bar or rod to rupture by tension is the same for every square inch of its section. The ultimate resistance per square inch is called the *modulus of tenacity*, or simply *the tenacity*. In formulas it is denoted by T. The total resistance, or the breaking load, is equal to the tenacity multiplied by the number of square inches in the cross-section of the bar. The moduli of tenacity of various materials are given in Table III. The tenacity of steel exceeds that of all other substances. Specimens of cast steel have been obtained having a tenacity of over 170,000 pounds; the higher grades of steel have a tensile strength of over 100,000 pounds; the tenacity of good bar iron is from 50,000 to 70,000 pounds; iron wire has a tensile strength of 70,000 to 100,000 pounds; the average tensile strength of cast iron is 16,500 pounds, but by a special process a specimen has been obtained that had a tension of 46,000 pounds. The tenacity of the different kinds of wood varies between wide limits. The strongest kinds, as locust, box, ash, and beech, have a tenacity of 20,000 to 17,000 pounds; the weakest, as white pine and poplar, of 4000 to 7000 pounds. These statements refer to thoroughly-seasoned timber, and to tensile strains exerted in the direction of the fibres. The tenacity of unseasoned timber is much less. The tenacity at right angles to the fibres is many times less. Careful experiments made at Woolwich dockyard, England, have shown that good bar iron is not weakened by strains even up to the point of rupture. Its strength is, in fact, apparently greater after having been subjected to great strains than before. Wrought iron offers a remarkable exception to the general fact that heat diminishes tenacity. In a series of experiments made by Fairbairn upon rolled plates of iron it was found that the strength remained nearly the same up to 395° F. Beyond this temperature it decreased, and was reduced 25 per cent. at a red heat. In similar experiments with rivet iron the strength was found to increase up to 325° F.; the increase at that temperature amounted to nearly 30 per cent.

Resistance of Cylinders to an Internal Pressure (as water-pipes and cylindrical boilers).—A cylinder exposed to an internal pressure of water or steam is more liable to be torn asunder longitudinally than at any cross-section. The thickness at which rupture is liable to occur may be calculated by the formula $2\mathrm{T}\,t = p\,d$, in which t denotes the thickness, and d the internal diameter of the hollow cylinder, both in inches, T the tenacity of the material (Table III. p. 565), and p the internal pressure in pounds per square inch. If the thickness is any considerable fraction of the diameter, the following more accurate formula may be used: $2(\mathrm{T} - p)\,t = p\,d$. In calculations of safe thickness for wrought-iron steam-boilers, joints double riveted (according to Fairbairn), T should be taken as low as 4250 pounds, or one-eighth the actual tensile strength of double-riveted plates. That a cast-iron water-pipe may have the requisite strength to resist the strains to which it may be exposed from its own weight and external causes, the calculated thickness has to be increased. The following is the formula in general use for determining the proper thickness of cast-iron water pipes: $t = 4 \times \frac{150\text{ lbs.} \times d}{2 \times 16{,}500} + 0.40$ in. The tenacity is taken at 16,500 pounds, and a factor of safety, 4, used. The pressure p is taken at 150 pounds. This formula gives almost the exact thicknesses of the cast-iron main pipes, of various diameters, laid down in New York City. In the U. S. all pipes that are to be subjected to an internal pressure of water or steam are tested by the hydraulic press at 300 pounds. The formula used in the establishment of the water-supply of Paris is equivalent to

$$t = 3.55 \times \frac{150\text{ lbs.} \times d}{2 \times 16{,}500\text{ lbs.}} + 0.315\text{ in.},$$

$$\text{or to } t = 4 \times \frac{150\text{ lbs.} \times d}{2 \times 18{,}600\text{ lbs.}} + 0.315\text{ in.}$$

COMPRESSION.—When a downward pressure from a superincumbent weight is exerted equally upon all parts of the upper face of a prismatic block standing firmly on its base, it has been experimentally ascertained that the fractional diminution of its height is directly proportional to the pressure, and inversely proportional to the area of the base, unless the height be so great that the block has a tendency to bend under the pressure. We must conclude, then, that all the vertical filaments of the mass are compressed equally at all points of the height, and that the resulting elastic resistances are equal at all points to the vertical pressures on the various points of the upper face. The coefficient of elasticity E is found to have nearly the same value for small compressions as for small tensions. Formulas 1 and 2 apply, then, as well to compression as to tension, and the values of E given by Table III. may be used.

Resistance to Crushing.—The ultimate resistance of a short block to crushing under a uniformly-distributed pressure varies as the area of the base or transverse section. The ultimate resistance per square inch is called the *crushing strength* of the material, or modulus of crushing strength. It is designated by C in formulas. Table III. gives its value as experimentally determined for various materials. The crushing strength of a prismatic block of any material may be obtained by multiplying the value of C by the number of square inches in the base. As rupture by crushing is a separation of parts, it cannot be a direct consequence of the compression experienced in the line of direction of the pressure. It immediately results from attendant compressive actions that take effect obliquely to the line of pressure. These occasion an expansive tendency at right angles to this line. When this expansive tendency prevails over the lateral cohesion, rupture must occur. It is in this way that rupture occurs, except in the case of materials of a granular texture, like cast iron, stone, and brick. Hard, homogeneous substances of a glassy texture, like vitrified bricks, crush under a vertical load by *splitting* in the vertical direction into several fragments. Ductile and tough materials, like wrought iron, are crushed by *bulging* or lateral swelling. In the case of wood and other fibrous substances the lateral adhesion of the fibres is overcome, and what is called *buckling* or crippling ensues. When blocks of a granular material are crushed, they give way along lines or planes inclined somewhat more than 45° to the base, and passing through the edge of the base or outside of it. This is the result of a shearing strain developed along such lines by the vertical pressure, which produces rupture before the lateral tenacity is overcome. The crushing strength of steel far exceeds that of all other substances. Some specimens of cast steel have resisted a pressure of nearly 400,000 pounds to the square inch. The crushing strength of cast iron averages about six times its tenacity. That of a good quality of cast iron is about 100,000 pounds; that of the strongest specimens is nearly 150,000 pounds. The crushing strength of a medium quality of wrought iron is less than 50,000 pounds. The crushing strength of most kinds of timber when dry is from one-half to two-thirds its tenacity. Moisture in timber weakens the lateral adhesion of the fibres, and reduces the resistance to crushing to about half its amount in the dry state. The average compressive strength of good building-stone is about 12,000 pounds.

Strength of Pillars.—Ordinary pillars or columns are of such length compared with their diameter that they tend to bend under a load, and, if the load be sufficiently great, break by bending or suffer *cross-fracture*. The laws of variation of their strength have been experimentally determined by Hodgkinson. He found that when both ends of a pillar are flat, its strength is about three times as great as when both ends are rounded, and when both ends are firmly fixed, it is about four times as great. The other laws are embodied in the following formulas, by means of which calculations can be made for special cases:

Column.	Rounded ends. Length more than fifteen times the diameter.	Flat ends. Length more than thirty times the diameter.
Solid cylindrical column of cast iron	$P = 14.9 \frac{d^{3.76}}{l^{1.7}}$.	$P = 44.26 \frac{d^{3.55}}{l^{1.7}}$.
Hollow cylindrical col. of cast iron,	$P = 13 \frac{d^{3.76} - d_1^{3.76}}{l^{1.7}}$.	$P = 44.3 \frac{d^{3.55} - d_1^{3.55}}{l^{1.7}}$.
Solid cylindrical column of wrought iron	$P = 42 \frac{d^{3.76}}{l^2}$.	$P = 133.7 \frac{d^{3.55}}{l^2}$.
Solid square pillar of Dantzic oak,	....	$P = 10.9 \frac{d^4}{l^2}$.
Solid square pillar of red dry deal,	....	$P = 7.8 \frac{d^4}{l^2}$.

P = crushing weight in gross tons; d = external diameter, or side of column, in inches; d_1 = internal diameter of hollow columns in inches; l = length of column in feet. If the length of the column fall below the limit given in the table, and is more than four or five times the diameter, the strength is approximately given by the formula $W = \frac{P.CK}{P + \frac{3}{4}CK}$, in which P = the breaking weight by preceding formulas for long columns; C = crushing strength of the material, given by Table III., expressed in gross tons; and K = transverse section of column, in square inches.

The following formula, derived from Hodgkinson's experiments, known as "Gordon's formula," is that most frequently used in the calculation of the ultimate strength of struts and pillars:

$$P = \frac{fS}{1 + a\frac{l^2}{d^2}}.$$

P = crushing load in pounds, S = sec. area in inches, l = length, and d = external diameter (or extreme breadth), both in terms of the same linear unit; f and a are coefficients. Their values for pillars fixed at both ends, by having flat capitals and bases, are given in the following table, for cast iron, wrought iron, and timber, and for pillars of diverse forms:

Material.	Value of f.	Value of a.	Form of pillar.
	Pounds.		
Cast iron............	80,000	$\frac{1}{400}$	Hollow cylindrical.
" "	80,000	$\frac{1}{533}$	Hollow square.
" "	80,000	$\frac{1}{266}$	Solid.
Wrought iron......	36,000	$\frac{1}{4500}$	Hollow cylinder, thin.
" "	36,000	$\frac{1}{6000}$	Hollow square, thin.
" "	36,000	$\frac{1}{3000}$	Solid rectangular.
" "	36,000	$\frac{1}{2250}$	Solid cylinder.
" "	36,000	$\frac{1}{1500}$	Angle iron, of equal ribs.
" "	36,000	$\frac{1}{1500}$	+ form.
Timber	7,000	$\frac{1}{250}$	Rectangular.

The values of a given in the table must be multiplied by 4 for pillars or struts rounded or jointed at both ends, and by 2 for those fixed at one end and jointed at the other. Connecting-rods of steam-engines are jointed at both ends, and piston- and pump-rods are fixed at one end and jointed at the other. Gordon's formula, with the above values of f and a for a hollow cylinder of cast iron, gives the crushing load for columns with flat ends from 5 to 25 per cent. less than that derived from Hodgkinson's formula, and for columns with round ends from 25 to 50 per cent. less, the percentage of difference varying with the length and diameter of the column. Neither formula accords exactly with the results of Hodgkinson's experiments, but in the case of columns with round ends—which pillars and struts are generally assumed to be—the disagreement is much the greatest with Gordon's formula, but the errors lie on the safe side.

Collapse of Tubes under External Pressure.—The tubular flues of a steam-boiler are subjected to such an external pressure. According to Fairbairn, the resistance of a tube to collapsing is inversely proportional to the diameter and length of the tube, and increases nearly as the square of the thickness. He gives the following formula for calculating the strength of wrought-iron tubes subjected to external pressure:

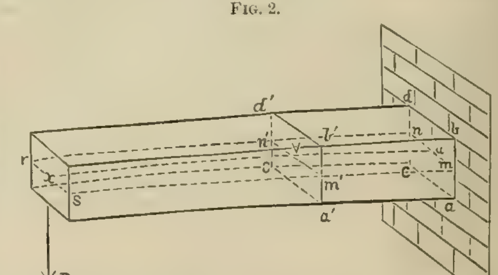
$$P = 806{,}300 \frac{k^{2.19}}{L\,d};$$

in which L is the length of the tube in feet, d its diameter, and k its thickness, both in inches, and P the ultimate resistance to compression, in pounds per square inch. For logarithmic computation we have $\log.P = 1.5265 + 2.19 \log.100\,k - \log.(L.d)$. To find the thickness k, in inches, of a wrought-iron tube to resist collapsing under a known pressure P, we have $\log.100\,k = \frac{\log.P + \log.(L.d)}{2.19} - 1.203$. In this formula, L is to be taken in inches. For each thickness of tube there is a certain length beyond which the resistance to external pressure is less than that to internal pressure. If the thickness of the sheet-iron tube is $\frac{1}{4}$ inch, this limiting length is 2.59 feet.

SHEARING.—Shearing is a forced sliding movement of one part of a body over an adjacent part, as occurs in the action of a pair of shears, when the two blades urge adjacent portions of the material in parallel and opposite directions, and sever them along the section between the blades. That shearing may take place, it is not necessary that the tendencies to parallel and opposite motions should be directly communicated to contiguous parts of a body, as in the operation of shears. The two external actions may be exerted in parallel planes separated by a small or a considerable distance, and the shearing tendency will exist at all intermediate points. Also, one of the actions here referred to may be a force of reaction taking effect at a fixed point of support. Thus, when a beam resting horizontally on two props is loaded at the middle, there will be a shearing strain at all cross-sections between the middle and each prop, equal to the reaction of the prop, or half the weight. In this case the shearing is said to be *transverse*. Rivets, pins, and keys used in fastening joints, and tenons of beams inserted in mortises, are liable to a transverse stress, and so to transverse shearing. *Longitudinal shearing* will take place if a longitudinal stress is exerted along a line not directed through a point of support. When a beam supported horizontally at one or at two points is loaded with weights, the shearing is at right angles to its length, and the shearing strain at any cross-section is equal to the reaction of the point of support on either side of the section, minus the sum of all the weights on that side intercepted between the section and the point of support. A similar rule applies to all cases of direct transverse shearing. For any section of a loaded beam the shearing strain will then be as follows: When the beam is fixed at one end, it will be the weight at the free end, or if it is uniformly loaded, the weight between the section and the free end; when the beam rests on two points, it will be half the load if this is at the middle, and the load between the section and the middle if the beam is uniformly loaded. The resistance to shearing strain per square inch of section is called the *modulus of shearing*. The following are the values of the modulus of shearing for some of the principal materials in use: cast iron, 30,000 to 40,000 pounds; wrought iron, 40,000 to 60,000 pounds; steel, 60,000 to 90,000 pounds; wood, with the fibres, 500 to 1200 pounds; wood, across the fibres, 500 to 2000 pounds; treenails of English oak, across the fibres, 4000 to 5000 pounds. The shearing strength of wrought iron is practically equal to its tensile strength; that of cast iron is double its tenacity, and that of steel about three-fourths its tenacity.

FLEXURE.—When a beam is bent by a transverse stress, the fibres on the convex side are extended and those on the concave side compressed. Between the extended and compressed fibres there is a surface in which the fibres are neither extended nor compressed, but retain their original length. This is called the *neutral surface*; it is nearly a plane when the beam is slightly bent. If we consider only a medial longitudinal section of the beam, we have a neutral line or filament simply, which is called the *neutral axis* of the beam. If a cross-section of the beam be taken at any point, it will intersect the neutral surface in a horizontal line, termed the *neutral axis of the section*. It passes through the centre of gravity of the section, and the neutral axis of the beam passes through the centres of gravity

FIG. 2.



of all transverse sections. In Fig. 2, $m\ n\ r\ s$ represents the neutral surface, $u\ r\ x$ the neutral axis of the beam, and m'

n' the neutral axis of the section $a'\ b'\ d'\ c'$. The curve assumed by the neutral axis of the bent beam is called the *elastic curve*. The depression of the lowest point of this curve is the *linear deflection* of the beam. The comparative deflections for beams variously loaded and supported are given in Table II., p. 564.

According to the received theory, the following are the general laws of the deflection of rectangular beams: It is directly proportional to the load and the cube of the length, and inversely proportional to the breadth and the cube of the depth. But an extensive series of experiments made by the writer on the deflection of rectangular bars of wood, iron, and steel of moderate dimensions, loaded at the middle, have established that in pieces of such dimensions, and presumably in beams of similar relative dimensions, the deflection neither varies directly as the cube of the length nor inversely as the cube of the depth, but in ratios less rapid than these laws give. The length of the bars used in the experiments varied from 2 feet to 6 feet, and the breadths and depths of the wooden pieces from 1 inch to 6 inches, and those of the bars of iron and steel from $\frac{1}{4}$ inch to 1 inch. The entire series of experiments are accurately represented by the formula

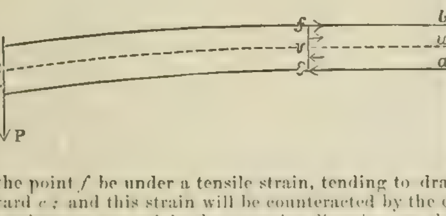
$$\Delta = \frac{m}{8\,E} \cdot \frac{P\,l^2}{b\,d} + \frac{P\,l^3}{6\,E\,b\,d^3}, \quad . \ . \ . \qquad (4)$$

in which P denotes the applied weight or pressure, l the length, b the breadth, and d the depth of the piece, E the coefficient of elasticity, and m the ratio $\frac{E}{G}$ of the coefficient of elastic resistance to shearing to that of elastic resistance to tension or compression. The value of m varies with the position of the layers of fibres in the piece. For the white pine sticks used, m has the value 4 when the layers are horizontal, and 2 when they are vertical. For the wrought-iron and steel bars, m is a little less than 2 when the bar rests edgewise on its supports, and 4 when it rests flatwise.

Comparative Stiffness of Beams of same length and same quantity of material.—The rigidity of such rectangular beams is proportional to the square of the depth. Hollow rectangular or cylindrical beams are more rigid than solid ones. The I and ⊥ form of iron beam and rail in common use is much more rigid than the solid rectangular bar. The general principle is, that fibres impart stiffness, as well as strength, under a transverse stress, in proportion as they are more remote from the neutral axis of the cross-section. With horizontal beams under a vertical load, the neutral axis of the cross-section is horizontal; it is in all cases perpendicular to the direction of the bending force.

Ultimate Resistance to Flexure, or *Strength of Beams under a Transverse Stress.*—Let the beam be fastened at one end and loaded at the other, as shown in Fig. 3, and consider any cross-section, as $e\ f$. The upper fibre $b\ f\ c$ will

FIG. 3.



at the point f be under a tensile strain, tending to draw f toward c; and this strain will be counteracted by the elastic resistance exerted in the opposite direction, as shown by the arrow. The same will be true of every fibre above the neutral axis $u\ v\ x$; only that the strain will decrease with the distance from the neutral axis. Below this axis the strains will be compressive, or acting toward the fixed end of the beam, and will be counteracted by the elastic reactions, as shown by the arrows. Accordingly, the part $d\ c\ f\ e$ of the beam is essentially in the condition of a bent lever, of which the axis or fulcrum is at v; and the weight P is held in equilibrium by the elastic resistances of all the fibres above and below the axis to the strains they undergo. If we take the sum of the moments about v of all these resistances at all points of the section considered, we shall have what is called the *moment of resistance*, or resisting moment, of the section. The equilibrium, on the principle of the lever, requires that this moment of resistance shall be equal to the moment $P \times x\,v$ of the weight P about the same point. This latter moment is called the *moment of stress*, or bending moment. Accordingly, the general equation of equilibrium between the external and internal forces, is

Moment of stress = moment of resistance of cross-section.

For beams loaded or supported in any other way the same general equation of equilibrium holds good. The moment of stress in each case is obtained by considering all the external forces, reactions included, that are in operation on one side of the cross-section considered. It is the sum of the statical moments of all of these forces that tend to produce a rotation in one direction about the neutral axis of the section regarded as an axis of rotation, minus the sum of the moments of those which tend to produce a rotation in the opposite direction. Practically, that ideal cross section is taken at which the moment of stress has its maximum value, and so the longitudinal strains on the fibres are the greatest. This is called the *dangerous section*. In the case of a beam fastened at one end, however it may be loaded, the dangerous section is at the fixed end. If a beam rests on two supports, and is loaded at the middle, or uniformly, the dangerous section is at the middle. If it is fixed at both ends, under similar circumstances the section of greatest strain is at the fixed ends. When the load applied to a beam is sufficient to produce rupture, the rupture begins in the dangerous section, and with the fibres most remote from the neutral axis, on the side on which the ultimate resistance to the longitudinal strain is first reached. With rectangular beams of wrought iron and wood, as the crushing strength is less than the tenacity, the rupture begins on the compressed or concave side. With rectangular beams of cast iron the tenacity is much less than the crushing strength, and the outer fibres rupture first on the convex side. The ultimate resistance of the outer fibres for a square inch in section, on the side which first ruptures, is called the *modulus of rupture*, and is represented by R. The values of R, as determined experimentally for a great variety of materials, are given in Table III. The moment of stress, answering to the dangerous section, which results from the breaking load, is termed the *maximum moment of stress*, or the moment of rupture. (See 3d column of Table II. For the expressions for the moment of resistance of various forms of cross-section see Table I.) By putting the maximum moment of stress for a beam loaded and supported in the manner supposed, equal to the moment of resistance for the supposed form of cross-section, and taking the proper value of R from Table III., we may readily determine the breaking load when the dimensions of the beam are given, or find what dimensions a beam should have not to suffer fracture under a given load. When there is occasion to take the weight of the beam into account, it is to be regarded as a uniformly distributed load W, and the maximum moment of stress for such a load added to that of the applied load.

Comparative Transverse Strengths of Beams of different forms or dimensions, but of uniform cross-section.—(1) If the beams differ only in length, the breaking load is inversely proportional to the length. (2) If the length and form are the same, but the transverse dimensions different, and the cross-section either a rectangle, circle, or triangle, the breaking load is proportional to the area of the cross-section multiplied by the depth. Thus, for rectangular or triangular beams of the same length and sectional area, the strength increases as the depth. The same proportion holds very nearly for hollow rectangular or circular beams if the thickness of the solid part is small in comparison with the exterior dimensions; also for beams and bars of the I or ⊥ form, in ordinary use, in which the vertical rib is comparatively small, and the quantity of material in the two flanges is the same or has a definite ratio. (3) The breaking load of rectangular beams of the same length varies directly as the breadth and the square of the depth. Such beams are then strongest with their greatest transverse dimension vertical. The strength of circular beams of the same length increases as the cube of the diameter. (4) Beams of different forms, with the same section of material, differ in strength. A square beam is nearly one-fifth stronger than a circular one of the same sectional area. Rectangular beams of equal sections are stronger in proportion as their breadth is less and depth greater. Hollow beams are stronger than solid ones, and those of the I or ⊥ form are stronger than rectangular beams.

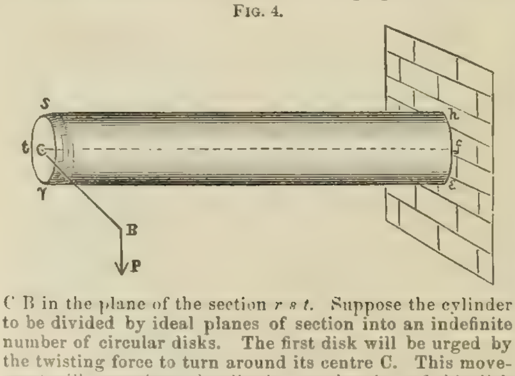
Section of Greatest Strength.—According to the experiments of Hodgkinson and Fairbairn, the strongest form of cross section for an iron beam is that consisting of a vertical rib uniting two horizontal flanges, the areas of which bear to each other the inverse ratio of the ultimate resistances of the material to extension and compression. In the case of the cast-iron beam of strongest form, resting on two supports, the sectional area of the lower flange is six times that of the upper flange. With the steel beam the same flanges bear the ratio of 2 to 1. In the wrought-iron beam of strongest section the area of the upper flange is nearly double that of the lower flange. The formula for

the breaking weight is $W = c\frac{a d}{l}$, in which a is the area of a section of the bottom flange in square inches; d, the depth of the beam in inches; l, the length, or distance between the supports in inches; and c, a coefficient. The value of c for the cast iron beam is 26 gross tons, and for the wrought iron beam is 60 gross tons. In the I or ⊥ form of beams or rails in general use, the angles are rounded off, and the vertical rib has sufficient thickness to resist the shearing strain and vertical and lateral shocks. Recent experiments have shown that when a cast-iron ⊥ beam is loaded only on one side of the flange, the area of the lower flange should be three times that of the upper, instead of six times.

Beams of Uniform Strength.—A beam of uniform strength is one in which an applied weight occasions the same strain on the outer fibres at all points of the length; and hence the liability to break is theoretically the same at all cross-sections. Every such beam, if the cross-section be rectangular, decreases either in breadth or depth, or both, from the section of greatest to that of least strain. The precise form and varying dimensions in any particular case can be obtained by placing the moment of stress for any section equal to the general expression for the moment of resistance of the section—viz. $\frac{R u y^2}{6}$, in which u denotes the breadth and y the depth of the section. Either of these may be supposed to have a constant value, and the varying value of the other may be obtained by the equation. Thus, if the beam be fastened at one end, and support a weight P at the other, and x represent the distance from P to any one of the rectangular cross-sections, the equation will be $Px = \frac{R u y^2}{6}$. If the breadth be constant, the outline of the vertical longitudinal section will be parabolic in form. If the depth be constant, the beam will be wedge-shaped in horizontal outline. Under similar circumstances, if the load were uniformly distributed, to be of uniform strength, with a constant breadth, the beam would have to be wedge-shaped in vertical outline. If the beam be supported at the ends and loaded at the middle, or supported at the middle and loaded at the ends like the beam of a balance, and the breadth be constant, to be of uniform strength it must taper from the middle toward either end in a parabolic curve.

Torsion.—Let $e\ h\ s\ r$ represent a cylindrical shaft, one of whose transverse sections, $e\ f\ h$, is immovably fixed, and let P be the twisting force acting perpendicularly to

Fig. 4.



C B in the plane of the section $r\ s\ t$. Suppose the cylinder to be divided by ideal planes of section into an indefinite number of circular disks. The first disk will be urged by the twisting force to turn around its centre C. This movement will necessitate the slipping or shearing of this disk upon the next, which will develop a force of shearing strain and an opposing elastic resistance. The shearing action of the first disk on the second will cause the second disk to turn around its centre, and slip or shear upon the third; and this will be made to turn upon the fourth, and so on to the fixed end of the shaft. When the final equilibrium obtains between the successive shearing actions propagated from P and the reactions that return from the fixed end, each disk will have turned by the same amount upon the next, and the consequent shearing action will be counteracted by the elastic resistance to the same. From this state of things we may draw the following conclusions: (1) The entire shearing strains are equal at all sections. (2) Throughout any one section the strains increase proportionally to the distance from the axis of the shaft. (3) The angular movement of the free end of the shaft, at which the twisting force acts, is proportional to the distance between the free and fixed ends, or the length of the shaft. This angle is called *the total angle of torsion*. The corresponding angle for a unit of distance along the shaft is called *the angle of torsion*. (4) Every longitudinal fibre or filament is twisted into a uniform spiral line.

Angle of Torsion.—Let t^0 denote the angle of torsion, expressed in degrees and fractional parts of a degree. The theoretical expression for it is

$$t^0 = 36.474 \frac{P a}{G r^4}; \quad . \quad . \quad . \qquad (5)$$

in which P is the twisting force, a its lever-arm C B, r the radius of the shaft, and G the coefficient of elastic resistance to shearing. If t^0 be multiplied by the length of the shaft, the result will be the total angle of torsion. What is called the length of the shaft must be understood to be the distance between the sectional plane in which the twisting force acts and that in which the external reactions to this force occur. In wheelwork the reactions occur at the section where the shaft is connected with the gearing that is driven by the revolving shaft. The following mean values of G are adopted by Morin in his *Resistance of Materials*: soft iron, 8,530,680 pounds; iron bars, 9,480,918 pounds; German steel, 8,533,680; cast steel, very fine, 14,222,800; cast iron, 2,844,560; copper, 6,209,670; bronze, 1,516,150; oak, 568,912; fir, 615,850.

Rupture by Torsion.—When the internal elastic resistances of the shaft just suffice to prevent rupture, an equilibrium subsists between the twisting force and the entire shearing resistance to the turning of any one material cross-section around its centre. The centre of motion or tendency to motion is the centre of the section, and all the resistances act in the plane of the section, and tangentially around its centre. Accordingly, the equation of equilibrium between the external and internal forces is

Moment of twisting force = moment of resistance of section.

The moments are taken with respect to the centre of the section. This gives for circular shafts,

$$P a = 1.5708\ J\ r^3, \quad . \quad . \quad . \qquad (6)$$

P, a, and r stand for the same quantities as in equation (5), and J is the *modulus of torsion*. For approximate calculations J may be taken at four-fifths of the value of R given in Table III. For square shafts the formula is

$$P a = 0.2356\ J b^3, \quad . \quad . \quad . \qquad (7)$$

in which b is the side of the square section. In calculating by either of these formulæ the proper dimensions to be assigned to a shaft that is to receive a torsive strain, the known twisting force P should be multiplied by 4 or 5 for iron shafts, and by 8 or 10 for wooden shafts, the larger factors being taken if the shaft is to be exposed to shocks.

Testing the Strength and Elasticity of Materials.—The component parts of structures, such as bridge-trusses, railways, etc., are not only exposed to strain from a constant load, but are also liable to strain from the action of a passing load or transient pressure. The operation of a passing load is attended, more or less, with shocks which augment the strains experienced. Accordingly, it is the practice to test the capability of the material and form of piece intended to be used to resist strains due both to a dead load and to shocks. The tests applied consist in determining the ultimate resistance to rupture, the resistance to strains within the practical limit of elasticity, the position of this limit, the amount of permanent elongation, deflection, or other distortion produced by a transient pressure or shock above this limit, and the actual distortions from given loads or shocks. Shocks definite in amount are experimentally obtained by allowing a given weight to fall through a given height. The product of the weight by the height of fall is the measure of the energy of the shock. The energy of the resistance which neutralizes the shock is called the *resilience*, or spring of the piece. It is measured by the product of the alteration of figure by the mean resistance that comes into operation during the change. If the shock just suffices to produce rupture, the *ultimate resilience* of the piece is brought into operation. The value of this is given in inch-pounds for various materials, as experimentally determined by Prof. Thurston of the Stevens Technological Institute, in Table IV. The shock is neutralized by the tensile resistance of a suspension-bar of the material experimented on, and the number of inch-pounds given in the table expresses the ultimate resilience for a square inch of section and one foot of length. This multiplied by the number of square inches in the cross-section of the suspension-bar, and by its length in feet, will give the resilience of the whole bar in inch-pounds. The ultimate resilience shows the capability to resist shocks without rupture. It depends not only on the tenacity, but also on the amount of extension at the point of rupture. Thus, the specimens of iron or steel which have the greatest resilience are those which have at the same time a high tenacity and are especially ductile or tough. If the maximum strain resulting from the shock falls just below the limit of elasticity, the proof resilience is experienced. The proof resilience of a suspension-bar

may be obtained from the expression $\frac{f^2}{E} \cdot \frac{Kl}{2}$, in which K is the cross-section, and l the length of the bar, f the proof tenacity, and E the coefficient of elasticity of the material. The fraction $\frac{f^2}{E}$ is called the *modulus of resilience.* It is given in inch-pounds in Table IV. This modulus, multiplied by the square inches of cross-section of the bar, and half its length in feet, will give the entire proof resilience of the bar. The corresponding result obtained for a rectangular beam resting horizontally on two supports, if divided by 9, will give the proof resilience of the beam —that is, the energy of the greatest transverse shock it can receive without injury. If this be divided by a given weight, the quotient will be the height in inches through which the weight must fall to produce the shock supposed.

The effects of dead loads are experimentally ascertained by *testing-machines.* For tensile and compressive stresses the requisite power is obtained by a combination of levers or by the hydrostatic press. One of the best testing-machines, of moderate power, is Riehlé's longitudinal testing-machine. The straining force is obtained by means of a hydrostatic press, and its intensity is measured up to 4000 pounds by a differential lever. Much more powerful machines have been constructed, capable of applying and measuring a stress of even 500 tons. Prof. Thurston's autographic recording testing-machine measures and records the resistance to a torsive stress, and has been successfully employed not only in testing the strength of materials, but also in investigating their diverse mechanical qualities. In the testing apparatus devised by the writer, and used in making experiments on the deflection and set of bars from a transverse stress, the stress is applied by means of a vertical screw, and measured up to 1000 pounds by a Fairbanks dynamometer, and the depression of the middle of the bar is measured to the $\frac{1}{25000}$th of an inch by means of a lever and micrometer-screw.

As a specimen of the process of testing in a given case, we shall cite the tests applied to iron rails used by the Northern and Orleans R. R. of France. Each of the rails selected for trial, weighing 75 pounds per yard, is placed on supports 3.6 feet apart, and must sustain in the middle between the supports 26,400 pounds for five minutes without preserving any sensible set. The same rail in the same position must support for five minutes, without breaking, a load of 66,000 pounds. The rail is then broken by an increase of load, and each of the broken pieces is placed on two very firm supports 3.6 feet apart, and should support without breaking the shock of a weight of 660 pounds falling from a height of 6.56 feet. In the case of steel rails of the same weight, the pressure tests are 44,000 pounds and 77,000 pounds, and the shock test is with a weight of 660 pounds falling through 8.2 feet. Another mode of testing for cases in which pieces are to be subjected to strains indefinitely repeated is to apply pressures and shocks with a great number of repetitions, and so ascertain the stress which may be indefinitely repeated without injury. A. Wohler of Germany has kept up such a series of experimental trials of iron and steel for a period of twelve years, from which he concludes that the safe working-strain for wrought iron, strained alternately in opposite directions like a piston-rod, is 8800 pounds, and when strained repeatedly in one direction, 16,500 pounds; and for steel rods, not hardened, under corresponding circumstances, is 13,200 pounds and 24,200 pounds.

Remarks on the Use of the Tables.—Tables I., II., III., and IV. furnish the data and expressions to be introduced in the general formulæ already given when special calculations are to be made. If it is proposed to calculate the safe or *working load*, certain fractional parts of T, C, or R, as the case may be, must be used, called *moduli of safety.* The following values are generally assumed for the moduli of safety, which we shall denote by T′, C′, and R′: wrought iron (T′, C′, or R′), 10,000 to 12,000 pounds; cast iron (T′) 3000 to 4000; (C′) 15,000 to 20,000; (R′) 6000 to 8000; wood (T′) 1200; (C′) 800; (R′) 1000; stone (C′), granite, 800 to 1200; limestone, 600 to 1200; sandstone, 300 to 800.

If calculations for the case of a transverse stress are made with the formula, max. moment of stress = coefficient of rupture × area of cross-section × depth, the value of S given in Table IV. should be divided by 5 for iron or steel, and 10 for wood. (See Tables I. and II.) In calculating the proper dimensions to be assigned to a tie, strut, or beam in a frame, as a bridge or roof-truss, the greatest stress that can actually come upon the piece is to be multiplied by a factor of safety. This factor is generally taken at from 4 to 6 for wrought or cast iron, 10 for wood, and 10 to 15 for stone. The other process of calculation for the case of a transverse stress is by means of the general equation: Maximum moment of stress = moment of resistance of cross-section. The expressions for these moments may be taken from Tables I. and II., and the value of R from Table III. If the strains are not to exceed the safe limit, then R′ (= R divided by the factor of safety) is to be used, or the known maximum load is to be multiplied by the factor of safety.

Rectangular, square, and triangular cross-sections, b = breadth, d = depth. Hollow rectangular, square, and I form, b = extreme breadth, d = extreme depth, b' = breadth of vacant portion, d' = depth of vacant portion, and t = thickness of material. Circular form, r = radius, π = 3.1416. Hollow cylindrical, r = radius of outer circle, r' = radius of inner circle, and t = thickness of material. I cross-

Table I.—*Moments of Inertia and Resistance of Cross-Sections of Beams of Diverse Forms.*

Form of beam.	Moment of inertia, I.	Moment of resistance, M.	Distance of outer fibre from neutral axis, d_1	Coefficient of rupture, u.
Rectangular	$\frac{b\,d^3}{12}$	$\frac{R\,b\,d^2}{6}$	$\frac{d}{2}$	$\frac{1}{6}R\,(=S)$.
Square	$\frac{d^3}{12}$	$\frac{R\,d^3}{6}$	$\frac{d}{2}$	S.
Circular	$\frac{\pi r^4}{4}$	$\frac{R\,\pi r^3}{4}$	r	$\frac{3}{4}$ S.
Triangular	$\frac{b\,d^3}{36}$	$\frac{R\,b\,d^2}{24}$	$\frac{2d}{3}$	$\frac{1}{2}$ S.
Hollow rectangular	$\frac{b\,d^3 - b'd'^3}{12}$	$R\,\frac{b\,d^3 - b'd'^3}{6d}$	$\frac{d}{2}$	$1\frac{3}{4}$ S (wrought-iron box beam).
Hollow square	$\frac{d^4 - d'^4}{12}$	$R\,\frac{d^4 - d'^4}{6d}$	$\frac{d}{2}$	$2\,S(1 - 2\frac{t}{d})$*.
Hollow cylindrical	$\frac{\pi(r^4 - r'^4)}{4}$	$R\,\frac{\pi(r^4 - r'^4)}{4r}$	r	$\frac{3}{2}\,S(1 - 2\frac{t}{d})$.*
I cross-section	$\frac{b\,d^2 - b'd'^3}{12}$	$R\,\frac{b\,d^3 - b'd'^3}{6d}$	$\frac{d}{2}$	1.3 S† (wrought-iron rolled beams).
I cross-section	$\frac{a_1 a_2 d^2}{A}$	....	....	2 S (cast-iron beams). 1.5 S † (wrought-iron rolled beams).

Table II.—*Maximum Moments of Stress, Breaking Loads, etc. of Beams loaded and supported in different manners.*

How supported.	How loaded.	Max. moment of stress.	Breaking load.	Maximum deflection.	Transverse rigidity.
Fixed at one end,	Load at free end,	$P\,l$	$P'\left(=\frac{M}{l}\right)$	$k = \frac{P\,l^3}{3EI}$	$r\left(=\frac{1}{k}\right)$
	Uniform load,	$\frac{1}{2}P\,l$	$2\,P'$	$\frac{3}{8}k$	$2\frac{2}{3}r$.
Supported at the ends,	At the middle,	$\frac{1}{4}P\,l$	$4\,P'$	$\frac{1}{16}k$	$16\,r$.
	Uniform,	$\frac{1}{8}P\,l$	$8\,P'$	$\frac{5}{128}k$	2[illegible] r.
Fixed at one end and supported at the other,	At the middle,	$\frac{3}{16}P\,l$	$5\frac{1}{3}P'$	$\frac{7}{160.5}k$	$23\,r$.
	Uniform,	$\frac{1}{8}P\,l$	$8\,P'$	$\frac{4}{247}k$	$61\frac{3}{4}r$.
Fixed at both ends,	At the middle,	$\frac{1}{8}P\,l$	$8\,P'$	$\frac{1}{64}k$	$64\,r$.
	Uniform,	$\frac{1}{12}P\,l$	$12\,P'$	$\frac{1}{128}k$	$128\,r$.

* These are very nearly the theoretical coefficients of rupture when the thickness of the solid portion is small in comparison with the whole depth or breadth.

† These coefficients of rupture for wrought-iron rolled beams are for beams without bracing to prevent lateral flexure. They have been determined experimentally.

section, a_1 = area of upper flange, a_2 = area of lower flange, A = sum of areas of the two flanges, d = distance between the centres of gravity of the two flanges, or, approximately, the whole depth. The expression for the moment of inertia of the **I** section is only approximate; and is obtained by neglecting the vertical rib, and assuming that the neutral axis passes through the centre of gravity of the two flanges. P = load applied, l = length of beam, M = moment of resistance of cross-section, I = moment of inertia of cross-section, E = coefficient of elasticity of material. The values of E, I, and M may be obtained from Tables I. and III.

TABLE III.—*Moduli and Coefficients of Materials.*

Name of material.	Tenacity per sq. in. in lbs., T.	Crushing load per sq. in. in lbs., C.	Modulus of rupture, R.	Coefficient of elasticity, E.
Cast Iron.				
British, gray	12,700 to 17,800	61,500 to 110,000	33,000 to 43,000	12,000,000 to 18,000,000
" average, 15 spec.	14,750	93,670	36,500	15,000,000
" good medium	16,500	99,000	38,000	16,000,000
" white, Devon, No. 3	22,000	......	43,500	22,474,000
" Stirling's toughened	26,000	125,000		
American, pig and ordinary cast,	13,000 to 20,000	100,000	40,000	16,000,000
" cannon	38,000			
Wrought Iron.				
British, rolled bars, mean of 188	57,560			
" angle, mean of 72	54,730			
" plate, mean of 167	50,740			
" wire 1st quality	100,000			
" 1-10 in diam., medium	81,000	....	....	25,000,000
" rivet, average	65,000			
" hammered bar, good med.	56,000	42,000	51,500	25,000,000
" chain cable	38,000			
Swedish, best rolled bar	73,000	....	....	30,000,000
American, hammered bar, av.	54,700			
" rolled bars and beams } super	60,700 to 67,000	40,000 to 60,000	....	23,000,000 to 29,000,000
" wire, 1-6 in to 1-3 in. dia. Phillipsburg, Pa.	71,000 to 89,000	....	....	
" strongest	100,000	....	....	
" wire rope	51,500	....	....	
" plate, medium	60,500	....	....	
Phœnix columns (length — diameter).	....	55,000 to 67,000		
Steel.				
Eng., Russ., and Swedish cast steel, mean of 30 best spec.	106,850	225,500 +	....	31,000,000
Krupp's, hardened in water	122,000			
" " in oil	173,000			
Bessemer, ham'd, Eng., med.	103,000	225,500 +	....	29,104,000
" Swed., carbon, 0.01	105,000 to 173,000			
" " carbon, 0.003.	71,000	....	....	30,000,000 to 33,000,000
" Amer., ingots, best	87,000	....	....	
" " rolled and ham'd	125,000	....	....	
" " tempered	142,000 to 214,000	186,000 to 338,000	....	
" Swedish, rolled, best	141,000	....	....	
Uchatius, rolled, best	145,000	....	....	
Plates, English and Scotch	68,000 to 112,000	....	....	
" Swedish	64,000 to 109,000	....	....	
" American, Pittsburg	94,000	....	....	
Chrome steel	180,000	195,000 +	....	
Other Metals.				
Copper, cast English	19,000	117,000		
" Lake Superior	24,000			
" wrought, English	33,800	103,000		
" sheet, "	30,000			
" wire	60,000	....	....	17,000,000
Brass, fine yellow, cast	18,000	51,000	....	9,000,000
" wire	91,000	....	....	14,000,000
Gun-metal, bronze, English	36,400	....	....	9,900,000
" " American	30,000 to 52,000			
Lead, cast	1,800	480		
" sheet	3,300	....	....	720,000
Tin, cast	4,700	970	....	4,600,000
Zinc, rolled	15,000	....	....	14,000,000
Speculum metal	7,000			
Silver, standard	41,000			
Stone.				
Granite, English	....	6,300 to 13,400		
" American	....	7,700 to 22,200		
" " Quincy	....	15,000 to 18,000		
Sandstone, English	450 to 1,000	3,000 to 11,000		
" " medium	....	5,000		
" American	....	4,000 to 17,000		
" " brown	....	5,000 to 10,000		
Marble, English	550 to 700	5,000 to 9,000		
" White Italian veined	....	9,700	1,060	25,000,000
" American	....	7,000 to 20,000		
Limestone, English	....	4,000 to 18,000		
" American	....	7,600 to [illegible]	....	25,000,000
Basalt		[illegible] to [illegible]		
Oolite, Portland stone	....	[illegible]		
Slate, Welsh	....	[illegible]	....	16,000,000
Brick	....	[illegible]		
" fire, Stourbridge	....	1,700		
Brick masonry, common	....	400 to 1,000		
Cement, Portland, artificial	440	[illegible]		
" " natural	610 to 710			
Artificial cement and sand (1 to 1)	265 (in 9 months)	4,560 (in 9 months)		
Mortar, ordinary	30	120 to 240		
Concrete (lime 1, gravel 3)	....	620		
Glass, thin plates	5,000			
" rods	2,500	30,000	....	8,000,000

Name of material.	Tenacity per sq. in. in lbs., T.	Crushing load per sq. in. in lbs., C.	Modulus of rupture, R.	Coefficient of elasticity, E.
Timber.				
Ash, foreign	17,000	9,400	12,200	1,645,000
Beech, "	11,500	9,400	9,300	1,350,000
Birch, "	15,000	6,400	11,570	1,645,000
Box, "	20,000	10,300		
Elm, "	13,000	10,300	6,500	1,000,000
Oak, "	11,000	10,000	8,500	1,700,000
Locust, "	20,000	....	11,500	1,940,000
Spruce, "	10,000	6,800		
Chestnut, "	13,000			
Pine, pitch, "	7,650	6,800	......	1,225,000
" red, "	....	5,370 to 6,200	8,000	1,840,000
Walnut, "	8,100	6,100 to 7,200		
Mahogany, Spanish	14,000	8,200	....	1,255,000
Ash, American	8,500			
Beech, "	9,500			
Birch, black, "	7,000			
Elm, Canada, "	13,000			
Hickory, "	11,000			
Oak, white, "	10,000			
Pine, red, "	5,400			
" white, "	3,600	....	....	1,000,000

NOTE.—The coefficients and moduli for timber are those of highly-seasoned timber. The tenacities of different specimens of iron and steel are per square inch of original area of cross-section of material. The results of recent experiments by C. B. Richards, M. E., indicate that the long wrought-iron tie-bars and suspension-bars in ordinary use, when made of the best iron, cannot be relied on as having a greater tensile strength than 50,000 pounds per square inch. Careful experiments have shown that a Phœnix column 18⅝ feet long, 8 inches in diameter, and ⅜ inch in thickness of metal, will bear 33,000 pounds per square inch of solid transverse section. The values of R given in the table are obtained by means of the moment of resistance of rectangular sections, $\frac{R\,b\,d^2}{6}$, but it is certain that the actual strain on the outer fibre at the moment of rupture is often materially different from the value of R thus found. This fact, however, occasions no error in the calculations with the formulæ and coefficients as indicated on page 564.

TABLE IV.—*Additional Coefficients and Moduli.*

Material.	Weight of cubic foot in lbs.	Coefficient S, in Table I.	Modulus of resilience.	Ultimate resilience.
Cast iron, bars	444	6,000	21.4	25
Wrought iron, medium	480	8,600	165.5	15,000
" " 1st quality	486	10,000	......	20,000
Steel	487	30,000	372	10,000
Steel rails	488	....	......	30,000
Copper, cast	540	....	......	200
" forged	552	....	......	40,000
Brass, cast	525	....	......	6,000
Bronze	.....	....	......	6,000
Granite, American	168			
Limestone, "	165			
Sandstone, "	138			
Slate, Welsh	...	1,960		
Ash, American	38.1	1,550		
Beech, "	48.5	1,720		
Black birch, "	42.5	1,850		
Hickory, "	54.3	1,700		
White oak, "	40.2	1,700		
White pine, "	27.0	1,230		
Red pine, "	36.0	1,530		
Yellow pine, "	31.7	1,200		
Canada elm, "	43.7	1,870		

W. A. NORTON.

Strepsip'tera [Gr. στρέψις, "twisting," and πτερόν, "wing"], a group of insects of disputed rank. By the older English entomologists, as well as by some recent authors (*e. g.* Gerstäcker), they were ranked as a peculiar order, but by many recent entomologists, and especially the American ones (*e. g.* Leconte, Packard), they are very decidedly claimed to constitute a simple family of the order Coleoptera and group Heteromera. On the one hand, it is asserted that the forms in question have really no characters exclusively common with the Coleoptera; on the other, it is claimed that "the characters common to a strepsipteron and various Coleoptera are these: (1) Hypermetamorphosis of the larva (Meloidæ); (2) parasitism (*Rhipidius*); retention of the pupa within the skin of the larva (Lampyridæ, tribe Lycini, genus *Calopteron*); (4) unfitness of anterior wings for flight (a character also found in Orthoptera and Hemiptera, which, however, have no metamorphosis); (5) large development of metathoracic segment." (Leconte in *Proc. Acad. Nat. Sci. Phila.*, 1864, p. 50.) In the males the metathorax is excessively large, and its dorsal sutures all distinct; the wings are very large, fan-shaped, and folding like a fan, but with a slight twist (whence the name of the group); the mesothorax is short, and with a pair of slender, coriaceous, club-shaped appendages, whose inner margins are membranous, representing the elytra of typical beetles; the prothorax is very short; the head large, transverse, and pedunculated at the sides, wherein are situated the eyes, which are convex and coarsely granulated; the mouth-parts are atrophied, except

the mandibles and one pair of palpi; the antennæ are frontal; the abdomen is small; the legs short, having tarsi without claws, and joints each with a membranous lobe beneath. The females are sac-like. The species are remarkable not only for their peculiar characters, but for their parasitism. They belong to two genera—*Stylops* and *Xenos*—and constitute the family Stylopidæ. (For illustration of *Stylops Dalii*, see ENTOMOLOGY.) All known are parasites of bees and wasps, and are found between the joints of the abdomen of those insects. The animals thus infested are said to be "stylopized." The females are viviparous. THEODORE GILL.

Strick'land (AGNES), b. at Reydon Hall, Suffolk, July 19, 1796; with her four sisters was carefully educated under the care of her father, and commenced her career of authorship at an early age, in most of her works being assisted by one or the other of her sisters. Her first work, in conjunction with her sister Susannah, was a volume of *Patriotic Songs*, which was followed by *Worcester Field*, an historical poem (1812), after which she appears to have published nothing for more than twenty years, her next work, also a poem, being *Demetrius, a Tale of Modern Greece* (1833), followed by *The Pilgrims of Walsingham*, an historical romance (1835), and at intervals by many other volumes of biography, poetry, and fiction, among which are—*Queen Victoria, from her Birth to her Bridal* (1840), *Alda, the British Captive* (1841), *The Rival Crusoes* (1845), *Historic Scenes and Poetic Fancies* (1850), *Lives of the Bachelor Kings of England* (1861), *How will it End?* a novel (1865), *Lives of the Seven Bishops* (1866), and *Lives of the Tudor Princesses* (1868). Her most important works, both prepared in conjunction with her sister Elizabeth, whose name, at her own desire, did not appear as author, are—*Lives of the Queens of England* (12 vols., 1840–49) and *Lives of the Queens of Scotland* (8 vols., 1850–59)—works based wholly upon original documents. She also put forth a collection of the *Letters of Mary Queen of Scots*, with an historical introduction and notes (1842–43; new ed., with considerable additions, 5 vols., 1864). In 1871 she received a pension of £100 in consideration of her long and valuable literary services. D. in London July 13, 1874.—Her sisters, SUSANNAH (Mrs. Moodie) and CATHARINE (Mrs. Traill), resided for a time in Canada, and published works illustrative of life in the Dominion.

Strickland (HUGH EDWIN), b. at Righton, Yorkshire, Mar. 2, 1811; was a private pupil of Dr. Arnold at Laleham, and graduated in 1832 at Oriel College, Oxford, where, and subsequently while residing with his father at Tewkesbury, he devoted himself especially to geology and ornithology; in 1835 made a tour in Asia Minor, and published in the *Transactions* of the Geological Society papers on the *Geology of the Thracian Bosphorus*, the *Geology of the Neighborhood of Smyrna*, the *Geology of the Island of Zante*, on *Currents of Sea-water running into the Land in Cephalonia*, and a *General Sketch of the Western Part of Asia Minor*. In 1850 he succeeded his former preceptor, Dr. Buckland, as reader in geology in the University of Oxford. He was one of the earliest members of the Geological Society, and one of the founders of the Ray Society, which he induced to undertake the publication of Agassiz's *Bibliographia Zoologiæ et Geologiæ*, which he undertook to edit from the MSS. of Agassiz, making considerable additions of his own. He had completed and published (in 1848) three vols. of this, and a fourth, edited by Sir William Jardine, was issued in 1854, after his death. He assisted Sir Roderick I. Murchison in the preparation of his *Silurian System* and other works, and contributed 86 papers to scientific periodicals. He published separately *The Dodo and its Kindred* (1848), and after his death was published his *Ornithological Synonymes*, edited by his widow and Sir William Jardine. D. Sept. 14, 1853, being killed by being run over by a railway train while making examinations of a deep cutting near Clarborough Tunnel, on the Great Northern R. R. A *Memoir of H. E. Strickland, with his Scientific Writings*, edited by Sir William Jardine, appeared in 1858.

Strickland (WILLIAM), b. in Philadelphia in 1787; studied architecture; planned the Chestnut Street Theatre, and was for many years employed upon the U. S. Bank, the Merchants' Exchange, the U. S. Mint, the U. S. Naval Asylum, and other public buildings in Philadelphia. In 1825 he went to Europe to study the railway systems of England, and upon his return superintended the construction of the railway between Newcastle and Frenchtown, Md. He designed the State capitol at Nashville, Tenn., which was commenced in 1845, but not completed until 1857, after his death. D. at Nashville Apr. 7, 1854.

Strickland (WILLIAM PETER), D. D., b. in Pittsburg, Pa., Aug. 17, 1809; graduated at the Ohio University; entered the Methodist ministry in 1832; was for several years stationed in Cincinnati, and subsequently became agent for the American Bible Society, and in 1856 removed to New York, where he engaged in literary work, mostly for the Methodist Book Concern; in 1862 was chaplain of a New York regiment stationed at Port Royal, S. C., and in 1866 became pastor of a Presbyterian church at Bridgehampton, L. I. He has published *History of the American Bible Society* (1849; new ed., continued to 1856), *History of Methodist Missions* (1850), *Genius and Mission of Methodism* (1851), *Christianity Demonstrated* (1852), *Memoir of Rev. James B. Finley* (1853), *Manual of Biblical Literature* (1853), *The Light of the Temple* (1854), *The Astrologer of Chaldea* (1856), *Pioneers of the West* (1856), *Life of the Rev. Francis Asbury* (1858), *Life of Jacob Gruber* (1859), *Old Mackinaw* (1860); and edited the *Autobiography of Rev. Peter Cartwright* (1856).

Strickland's, tp., Sandford co., Ala. P. 658.

Stric'ture [Lat. *strictura*; Gr. στεγνωσις], a constriction or compression of the tubiform organs of the body, as the œsophagus, the larynx, the windpipe, the intestines, the anus, the urethra, the lachrymal ducts, and others. Strictures are produced either by new formations on the inside of the tubes, or by pathological changes in the walls and coatings of the same (cicatrization), or by the pressure of new formations or of atrophies outside. Examples of the first class are croup and diphtheria, which by deposition of fibrinous masses on the interior of the larynx and the windpipe narrow in these organs sometimes to suffocation. A stricture of the third class is frequently produced in the œsophagus by a neighboring cancer, which may compress it to impermeability. The most frequent strictures are those of the urethra; they are generally produced by pathological changes in the coatings of the organ. Injuries of the perinæum and the penis, with or without rupture of the urethra, may originate them, but their most general cause is inflammation of the mucous lining of the urethra, gonorrhœa. Inflammation, if it spreads a little beyond the mucous lining, gives rise to new formation of connective tissue, which either directly compresses the urethra, forming a callous ring around it, or contracts it by atrophic cicatrization around the tube. The immediate consequences of urethral stricture are symptoms of impediment to free micturition. The urethra behind the stricture is dilated by the pressure of the accumulated urine. The bladder is not thoroughly emptied, and undergoes inflammatory irritation by chemical decomposition of its contents. The urine becomes alkaline, with a putrid and pungent smell of ammonia. The desire to urinate is very great, and never ceases. In more advanced stages the urine sometimes breaks through the wall of the urethra behind the stricture, and either makes a fistula by breaking also through the skin, or infiltrates the surrounding tissue, and so causes uræmia, and often death. In other cases, inflammation of the bladder extends to the kidneys, and there produces pyelitis and inflammation of the kidney proper. Strictures sometimes close up the urethra entirely, or become so narrow that the urine can only be passed out in single drops by the strongest and most painful efforts. Speedy relief by operation is necessary in such cases to save the life of the patient. The treatment of stricture consists either in gradual dilatation or in external or internal urethrotomy. Gradual dilatation is effected by inserting bougies, or catheters, or sounds of increasing sizes. Every day or less frequently a larger instrument is passed through the stricture to the bladder, until the normal size of the urethra is attained. After this, the last bougie is used occasionally for some time to prevent a relapse. The majority of the authorities now consider gradual dilatation the best, surest, and safest treatment of stricture. In cases where no instrument can be passed through the stricture, or where for other reasons dilatation cannot be resorted to, external urethrotomy is indicated. The operation is performed by cutting into the urethra from the perinæum, thereby opening the stricture lengthwise. It is kept open by regular cathetrization, so that the healing wound leaves a canal of normal size. Internal urethrotomy is only applicable in cases where a sound can still be passed through the narrowed passage large enough to guide a small knife, which cuts and opens the stricture from inside. Another method sometimes resorted to is the rupture of the stricture by forcing through it a large, conically shaped steel sound (forcible dilatation). F. ZINSSER.

Strie'gau, town of Prussia, province of Silesia, on the Striegau Water, manufactures leather, cloth, linens, and tiles. P. 8561.

Stri'gel (VICTORIN), b. at Kaufbeuren, Bavaria, Dec. 26, 1514; studied theology at Wittenberg under Melanchthon, and was appointed professor at the University of Jena in 1548. Entertaining synergistical views of regeneration, he came in conflict with Flacius, at whose instiga-

tion he was for some time kept in prison. Not satisfying his adversaries fully by his retractions, he removed in 1562 to Leipsic, and in 1567, as professor of ethics, to Heidelberg, where he d. June 26, 1569.

Strig'idæ [from *Strix*, the ancient Latin name of the owl, one of the genera], a family of birds embracing the owls. These are all easily recognizable by their peculiar physiognomy. In form generally they agree with the related types of birds (Falconidæ, etc.), but the skull is broad and foreshortened; the eyes directed forward, and each surrounded more or less by radiating feathers (together forming a broad heart-shaped or facial disk or area in front), and the plumage is very lax and soft, and the feathers destitute of an after-shaft; the bill is compressed, short, with the culmen much decurved and the tip hooked; the nostrils basal, and separated by a bony partition; the wings usually short and rounded; tarsi generally short, sometimes rather elongated, extremely flattened, and with strong lateral ridges, usually densely covered with feathers, as are also frequently the toes; toes four, the outer reversible, the posterior well developed and on a level with the others; claws long, decurved, and very acute. The skull is characteristic, according to Huxley, in that the bones enclosing the cerebral cavity have a spongy diploë, and the maxillo-palatines are tumid and spongy, and separated by an interval which may be wide throughout or reduced to a cleft below; the lachrymal is also spongy, and remains for a long time distinct; basipterygoid processes are always developed; "the proximal ends of the clavicles are comparatively little expanded or recurved, and become very slender toward their symphysis; the clavicular process of the coracoid fits into an excavation in the outer surface of the clavicle; the scapular process of the coracoid is prolonged forward to meet the clavicle; the lower larynx possesses one pair of intrinsic muscles." (Huxley, *Proc. Zool. Soc. London*, 1867, p. 463.) Such are the characters common, so far as known, to all the species. The type is manifested, however, under two very decided modifications, which have been deemed by a late writer (R. B. Sharpe) to be of family value, and which are at least of sub-family value. In the Striginæ (Strigidæ proper of Sharpe) the sternum has its hinder margin entire, with an emargination, however, but no distinct cleft, and the furcula is joined to the sternum at its keel; the inner toe is about as long as the middle, and the claw of the latter is serrated. In the Buboninæ (Bubonidæ of Sharpe) the sternum has its hinder margin indented by two or more distinct fissures or clefts, and the furcula is entirely free from it; the inner toe is always shorter than the middle, and the claw of the middle one is never serrated. The Striginæ are represented by only two genera (*Strix* and *Phodilus*) and six species; the Buboninæ are numerous in genera and species, Sharpe recognizing 17 of the former and about 184 of the latter. These are furthermore combinable into two great groups: one sub-family (Buboninæ of Sharpe) has the ear-conch not larger than the eye, without an operculum, and the facial disk unequal, the portion below the eye being always much greater than that above it; the other (sub-family Syrniinæ of Sharpe) has the ear-conch much larger than the eye, with a very large operculum shutting in the ear, and the facial disk is always distinct, and extends as far above as below the eye. The family is cosmopolitan, and is more or less well represented by species in every quarter of the globe. They mostly procure their food during the night, and their eyes are well adapted for nocturnal vision, as is their plumage for carrying them noiselessly after their quarry. Some species are, however, strictly diurnal. They feed chiefly upon small quadrupeds (*e. g.* mice) and birds, as well as reptiles. Eleven generic types are represented in the U. S.—viz. of the Striginæ, *Strix*; of the Buboninæ, *Bubo*, *Nyctea*, *Scops*, *Surnia*, *Speotyto*, *Glaucidium*, and *Micrathene* of the group Bubones, and *Asio* or *Otus* and *Syrnium* of the group Syrnii. The latest authority on the family is R. B. Sharpe (*Catalogue of the Striges, or Nocturnal Birds of Prey, in the Collection of the British Museum*, London, 1875, 8vo). (See further OWL.)

THEODORE GILL.

Strikes [Ang.-Sax. strícan]. The word *strike*, as denoting the refusal of a number of workmen in combination to work on the terms offered by employers, is not in Dr. Johnson's *Dictionary*, nor does it occur in Adam Smith's *Wealth of Nations*, and in the present century English political economists found themselves in the presence of a perplexing phenomenon. Not that strikes took place then for the first time in the history of England; they were known on a tremendous scale five centuries earlier, after the great plague of 1349. The crops then rotted on the ground for lack of reapers; whole flocks and herds perished for want of caretakers; houses were left unfinished by the builders, even the workmen employed at the king's palace deserted their business; and unless for wages which were considered "outrageous" labor was not to be had in country or town. These strikes in the fourteenth century were encountered with measures which illustrate the fundamental difference between mediæval and modern political economy. A "statute of labor" was passed ordaining that every man and woman, free or bond, within the age of threescore years, and not having landed property or other means of livelihood, should work for any employer requiring their labor at the old rate of wages. This statute was followed by a series of enactments, royal mandates, and municipal regulations rigorously suppressing combinations of workmen, and inflicting fines, imprisonment, and the punishment of the stocks on all artificers, laborers, and servants refusing to serve for the ancient wages, or even leaving the hundred or town wherein they had hitherto dwelt.

In our own age a succession of strikes in England has been encountered with a law widely differing in character from Edward III.'s famous "statute of labor." The law enunciated in the nineteenth century was simply an alleged law of political economy, which was supposed to fix the price of labor beyond the control of either laborers or employers. In place of new restraints on the movements and combination of workmen, old restrictions have been repealed, trades-unions have been legalized, and the classes most opposed to strikes have contented themselves with denouncing them as at once mischievous and ineffectual. On the last point the actual results have been conflicting. Many strikes have been successful in raising wages or reducing the hours of work, but, on the other hand, many have failed; in not a few cases it has been demonstrated that the state of trade, prices, and profits left no margin for compliance with the demands of the workmen, and in some it is certain that employers were positive gainers by the suspension of business. These conflicting facts, and the public attention which strikes have engaged, have led to a whole literature on the subject, but the matter of it may be stated in a very few words.

It is urged against strikes that profits in a particular business cannot continue above the average rate, and consequently if the state of trade admits of a rise of wages or other advantages to the workmen, they will come spontaneously from the competition of capitalists; while if they are brought about by a strike, the value of the labor unemployed while it lasts is lost both to the workmen and to the public. Capital, too, is wasted, and the accumulation discouraged, to the detriment of labor. In several cases strikes have contributed to cause the transference of a branch of manufacture to another locality, for trade moves along the lines of least resistance, and its course is easily altered. The emigration of capital from England to the New World proves that profits are already at a minimum in the former, and can bear no further reduction. The ignorance of the real conditions of trade, it is added, which is at the bottom of strikes, has repeatedly been proved by the fact that at the time of their occurrence it was actually an advantage to the capitalists to close their works. Sad evidence, too, is forthcoming in abundance of the misery which strikes have occasioned to working people, and the load of debt and loss of comfort and respectability under which they have had to recommence life, as it were, without furniture and other household articles which it had taken years to accumulate, and which disappeared in a few weeks. On the other hand, it is contended that the equality of profits is a theoretical fiction; that the profits of employers in particular trades are often enormous, and huge fortunes are amassed in a few years; and even if the ultimate notoriety of this fact should at length attract additional capital and competition, the public may then derive some benefit through a fall in prices, but the workmen may obtain none. The occasional failure of strikes, moreover, is no proof of their impolicy; even unsuccessful strikes may act on the minds of employers so as to secure a rise or prevent a fall of wages on a future occasion; and to produce this effect they must actually take place from time to time, whether successful or otherwise. As for the temporary suffering they cause to the workmen, present sacrifices for future gain are in accordance with one of the fundamental principles of the political economy to which employers are so fond of appealing; but, in fact, a multitude of strikes have been crowned with immediate success, and have compelled employers to concede terms which at first they peremptorily refused. As for the emigration of capital from countries like England, it no more proves that profits are at a minimum there than new branches of manufacture and trade, new railways and steamships, new speculations, prove that all earlier investments of capital have become unprofitable; it only proves that the sources of profit have become more numerous. Indeed, Mr. Cairnes, the English economist, who has laid principal stress on

this argument, has admitted that the majority of recent strikes in his own country have been successful. He argues, indeed, that the explanation of their success is to be found in an exceptionably prosperous state of trade, which would before long have attracted additional capital and demand for labor; but the obvious reply is that in the mean time the workmen would have gained nothing but for the strikes, and the ultimate gain, if any, without them might accrue to consumers in a reduction of prices. Mr. Cairnes's argument, moreover, virtually involves the position that profits in the U. S., and other new countries to which British capital is constantly flowing, are high enough to bear a reduction by means of higher wages, even if such a reduction were a necessary consequence; which is far from being the case, since increased efficiency of both capital and labor may follow.

The conclusion to which these arguments on both sides, and a careful consideration of the actual history of strikes, really lead, is, that no universal or unconditional proposition can be laid down with respect to their justice or policy. Some writers have been led by observation of their results to infer that strikes for a rise of wages usually succeed, but strikes to prevent a fall usually fail. The principle underlying this inference is that strikes for higher wages have usually taken place in a time of prosperous trade, when profits were high enough to bear a reduction; whereas employers have seldom if ever attempted to lower wages unless in a time of depression. This empirical generalization, however, affords no foundation for any positive rule for future guidance. The proposition which may with best reason be affirmed is, that the chief benefit to the working classes from past strikes is that they have contributed to bring about measures which, besides other beneficial results, tend to prevent their occurrence in future. Co-operation, industrial partnership of capitalists and workmen in various forms, boards of conciliation and arbitration, wiser rules and policy on the part of trades-unions, all owe something to the lessons learned from strikes. No panacea is likely to be discovered in our age which will put an end altogether to disputes between labor and capital, but something has already been done to render their relations more harmonious in many trades. The subject involves various questions treated of under LABOR, TRADES-UNIONS, and WAGES. T. E. CLIFFE LESLIE.

String'field (THOMAS), b. in Kentucky in 1796; served under Gen. Jackson in the war of 1812, and was wounded in the forehead by an Indian; in 1816 joined the Tennessee conference of the Methodist Episcopal Church, and in that and in the Holston conference he signalized himself as an able polemic. He edited the *South-western Christian Advocate* for five years. D. in Tennessee June 12, 1858.
T. O. SUMMERS.

String'ham (SILAS H.), U. S. N., b. Nov. 7, 1797, in New York; entered the navy as midshipman June 19, 1810; became lieutenant in 1814, commander in 1831, captain in 1841; retired in 1861, and appointed rear-admiral on the retired list in 1862; commandant of the Charlestown navy-yard 1864–66, and port-admiral of New York in 1867. D. Feb. 7, 1876. Served in the last war with Great Britain, in the Algerine war, and in the war with Mexico, and commanded the squadron during the civil war which reduced Forts Hatteras and Clark, and enabled our vessels to get possession of the sounds of North Carolina.
FOXHALL A. PARKER.

String'town, p.-v., Salt Creek tp., Pickaway co., O. P. 71.

Stris'ores, the name applied to a group of birds by some modern systematists, and to which diverse limits have been assigned. They are defined in Baird's *Birds of North America* (1860) as forms with "toes either three anterior and one behind (or lateral), or four anterior; the hinder one is, however, usually versatile, or capable of direction more or less laterally forward; tail-feathers never more than ten; primaries always ten, the first long;" the larynx is destitute of complex vocal muscles, and the species not gifted with the power of true continuous song, but simply capable of emitting unmusical notes or a stridulous noise (whence the name). By some authors the group has been regarded as a peculiar order, and by some as a sub-order of Insessores or Passeres. The chief and generally-accepted members are the Trochilidæ, Cypselidæ, and Caprimulgidæ. Burmeister further includes the Halcyonidæ and Prionitidæ (referred to the Clamatores by others), and Cabanis the Opisthocomidæ and Musophagidæ. The first three are nearly allied, and form a natural group variously named Macrochires, Cypselomorphæ, Cypseli, etc. The others are, however, very unlike, and have affinities with several other groups. The combination of Strisores as a whole is therefore now generally rejected.
THEODORE GILL.

Stromate'idæ [from *Stromateus*—Gr. στρωματεύς, "parti-colored fish"—a generic name], a family of fishes of the order Teleocephali, sub-order Acanthopteri, distinguished by the armature of the œsophagus. The body is compressed and more or less ovate; the scales cycloid, and very small and imbedded; the lateral line simple and continuous; the head ends in a blunt snout; the opercula are unarmed; mouth small, but with a lateral cleft; upper jaw not protractile; teeth minute and conic on the jaws, but none on the palate; branchial apertures confluent below; branchiostegal rays in five to seven pairs; dorsal fin elongated, with a few partially free or enveloped spines in front, and numerous branched rays; anal fin also elongated, and with a few free or enveloped spines and many rays; caudal free and emarginated; pectorals well developed, and with branched rays; ventrals sometimes perfect (*i. e.* with a spine and five rays), but generally more or less reduced and atrophied; the œsophagus is well armed with masses of teeth; the stomach is cæcal, and pyloric appendages are developed in large or moderate number; the air bladder is small or absent; the vertebræ are in moderate number, but generally at least in excess of the typical series (*e. g.* 15 + 21 and 11 + 14). The forms embraced in this family were formerly referred to the Scombridæ, from which they are now known to differ very much. The species are not numerous, but representatives are quite diffused in the various seas. About fifteen species are known, of which three inhabit the eastern American waters (*Peprilus Gardenii*, *Poronotus triacanthus*, and *Palinurichthys perciformis*), and one the California waters. The species are of little or no economical importance. THEODORE GILL.

Stromb'idæ [from *Strombus*—Gr. στρόμβος, a "top"—one of the generic names], a family of gasteropod mollusks

The Stromb.

of the order Pectinibranchiata and sub-order Tænioglossa, containing the giant fountain-shell, so commonly used about gardens and houses, and kindred forms. The animal is entirely retractile within its shell; its mantle is but moderately developed, and not reflectible over the shell; the siphon is well defined, and more or less elongate; the gills are comb-like, and on the left side of the mantle; the head is produced into an elongated muzzle; the eyes are highly organized, and at the ends of long cylindrical pedicels; the tentacles are slender, and arise from the ocular pedicels; the teeth of the lingual ribbon are in seven longitudinal rows, the middle broad and multidentate, the inner lateral rhomboid and denticulated, the two outer lateral of each side claw-like, and denticulated on their outer edges; the foot is compressed and narrow, rather dilated in front, tapering backward; the operculum is claw-shaped, and serrated on the outer edge. The shells vary considerably in superficial character, but all have a more or less conic spire, and in most the outer lip is expanded and deeply notched anteriorly. Species are generally diffused in all tropical seas, and between 70 and 80 are now known. They are divisible among two sub-families—viz. (1) Strombinæ, including the genera *Strombus*, *Pterocerus*, *Harpago*, *Rostellaria*, and related genera; and (2) Seraphyinæ, embracing only *Seraphs* and allied fossil types. They are distinguished by the peculiar form of the foot, which is fitted for leaping rather than the crawling progression common to most gasteropods, and by the pedicels bearing the eyes and tentacles. They are quite active, but are reputed to be chiefly

carrion-feeders. Species are often employed as ornaments in parlors and about houses, and especially is this the case with the *Strombus gigas*, often known as the fountain shell. This is the largest of the family, and sometimes weighs as much as four or five pounds. It is not only used in the manner indicated, but is employed for the manufacture of cameos and for porcelain works in large numbers.

THEODORE GILL.

Strom'boli, one of the Lipari Islands, in the Mediterranean, off the N. coast of Sicily, is 12 miles in circuit and has 1400 inhabitants. It is wholly of volcanic formation, and has a still constantly active volcano 3100 feet high. Cotton, wine, and fruit of superior quality are produced, and sulphur and pumice stone are largely exported. On the E. side lies a small town of the same name.

Stronach, p.-v. and tp., Manistee co., Mich. P. 281.

Strong, p.-v. and tp., Franklin co., Me. P. 634.

Strong (CALEB), b. at Northampton, Mass., Jan. 9, 1745; graduated at Harvard College 1764; studied law, and commenced practice in 1772; took an active part in the cause of liberty; in 1775 was one of the committee of safety, in 1776–80 member of the legislature; in 1787 aided in the formation of the Constitution of the U. S.; in 1789–97 was a Senator in Congress, and governor of Massachusetts in 1800–07 and in 1812–16. D. at Northampton Nov. 7, 1819.

Strong (GEORGE C.), b. at Stockbridge, Vt., in 1833; graduated at the U. S. Military Academy in July, 1857, when appointed brevet second lieutenant in the ordnance corps of the army, second lieutenant 1859, first lieutenant 1861, captain 1863. In the early days of the civil war he commanded, temporarily, at the Watervliet arsenal, West Troy, but seeking active service, was on the staff of Gen. McDowell as ordnance officer at the first battle of Bull Run, and subsequently on similar duty with Gen. McClellan until Sept., 1861, when transferred to the staff of Gen. Butler, and in October appointed assistant adjutant-general of volunteers, with rank of major. He at once entered upon the organization of the New Orleans expedition, which he accompanied, and in Apr., 1862, commanded the successful expedition from Ship Island to Biloxi, Miss. Among the first to enter New Orleans, he shortly after became Gen. Butler's chief of staff, but sickness soon compelled him to return North. Resuming his duties in September, in that month he led the successful expedition to Pontchatoula, resulting in the destruction of a large amount of property and the breaking up of Jeff Thompson's head quarters. In Nov., 1862, he was appointed a brigadier-general of volunteers, and in June, 1863, assigned to command of the brigade which, in the operations about Charleston, effected the landing on Morris Island, July 10, 1863, Gen. Strong leading the successful assaulting column, as also the ineffectual assault on Fort Wagner the following morning. Again, a week later (July 18), his brigade led the second assault on that work, at the head of which Strong fell mortally wounded, after having gained the parapet of the fort. D. in New York City July 30, 1863.

Strong (GEORGE TEMPLETON), b. in New York in 1820; graduated at Columbia College; studied law, and became prominent as a real-estate lawyer. He was a man of high general culture; contributed essays of much merit to leading periodicals; was a trustee of Columbia College, and one of the founders of its School of Mines; was also president of the Philharmonic Society and of the Church Music Association; two years before his death was chosen controller of Trinity church, New York, of which he had been a vestryman for many years. During the civil war he was treasurer of the U. S. Sanitary Commission. D. in New York July 22, 1875.

Strong (JAMES), S. T. D., b. in New York Aug. 14, 1822; graduated at Wesleyan University in 1844; taught in Troy Conference Academy, Poultney, Vt., 1844–46; in 1847 removed to Flushing, L. I., where he became a prominent citizen; projected and built the Flushing R. R., of which he was president; superintended various local improvements, and gave private lessons in Greek and Hebrew. In 1856, although not a clergyman, he received the degree of doctor of sacred theology from Wesleyan University; in 1858–61 was professor of biblical literature and acting president of Troy University, and in 1868 became professor of exegetical theology in Drew Theological Seminary at Madison, N. J. He is a member of the Anglo-American commission for the revision of the English version of the Bible. In 1873 was chosen chairman of the archæological council of the Oriental Topographical Society, and in 1874 made an extended tour in the East; contributed to religious journals; prepared for Lange's Commentary the English translation of the part on the book of Daniel, and published *Harmony and Exposition of the Gospels*, in English (1852), *Harmony of the Gospels*, in Greek (1854), and brief manuals of the Gospels and of Greek and Hebrew grammar. About 1853 he projected, in association with Rev. John McClintock, D. D., a *Cyclopædia of Biblical, Theological, and Ecclesiastical Literature*, upon a scale hitherto unattempted in any language, his associate taking charge of the departments of theological and ecclesiastical literature, and Dr. Strong of that of biblical literature, including not only the books of Scripture, but sacred geography, antiquities, and natural history, he himself writing nearly all the important articles in his department. The first volume appeared in 1867, the sixth in 1876, and three or four more will be required to complete the work. Dr. McClintock died in 1870, since which time Dr. Strong has assumed the general supervision of the entire work.

Strong (JAMES H.), U. S. N., b. Apr. 26, 1814, in Canandaigua, N. Y.; became a lieutenant in 1841, commander in 1861, captain in 1865, commodore in 1870, rear-admiral in 1873. Served on the W. coast of Mexico during our war with that country, and commanded the Monongahela in the battle of Mobile Bay. Commended for gallantry.

FOXHALL A. PARKER.

Strong (NATHAN), D. D., b. at Coventry, Conn., Oct. 5, 1748; graduated at Yale College 1769; was tutor there 1772–73; became pastor of the First Congregational church in Hartford 1774; served as army chaplain in the war of the Revolution, and subsequently held a high place among the clergymen of New England; was editor of the *Evangelical Magazine*, which he originated in 1801, and founder of the missionary society of Connecticut. He contributed to the *Hartford Selection of Hymns* (1799); published a number of occasional discourses, two volumes of *Sermons* (1798 and 1800), and *The Doctrine of Eternal Misery consistent with the Infinite Benevolence of God*. D. at Hartford Dec. 25, 1816.

Strong (THEODORE), LL.D., b. at South Hadley, Mass., July 25, 1790; graduated at Yale College in 1812; was tutor in Hamilton College 1812–16, and professor of mathematics 1816–27, occupying the same position in Rutgers College from 1827 to 1862. He contributed mathematical papers to *Silliman's Journal*; solved by a direct method a problem in cubic equations which had long baffled the best mathematicians; discovered a direct process of extracting the cube root of any integral number; published a *Treatise on Elementary and Higher Algebra* (1859), and at the time of his death was preparing a work on the *Differential and Integral Calculus*. D. at New Brunswick, N. J., Feb. 1, 1869.

Strong (THERON R.), b. at Litchfield, Conn., Nov. 7, 1802; received a good English and classical education; studied law under his father, Judge Martin Strong; settled as a lawyer at Palmyra, N. Y., 1826; was long a master and examiner in chancery; was member of Congress 1839–41, and of the legislature 1842; was judge of the supreme court of New York 1852–60, being for one year of that period a member of the court of appeals; rendered notable decisions from the benches of both those courts; resided at Rochester from 1853 until 1867, when he removed to New York City; established an active practice before the State and U. S. courts, and was frequently called to act as referee. D. in New York May 15, 1873.

Strong (WILLIAM), LL.D., b. at Somers, Conn., May 6, 1808; graduated at Yale College in 1828; was admitted to the bar in 1832, and commenced practice at Reading, Pa.; was Representative in Congress 1849–51; in 1857 was elected a judge of the supreme court of Pennsylvania for fifteen years; resigned the position in 1868, and resumed practice at the bar, and in 1870 was appointed associate justice of the Supreme Court of the U. S.

Strong's Prairie, p.-v. and tp., Adams co., Wis., on Wisconsin River. P. 1043.

Strongs'ville, p.-v. and tp., Cuyahoga co., O. P. 896.

Strongyl'idæ [from *Strongylus*—Gr. στρογγύλος, "round" —a generic name], a family of intestinal nematoid worms. The body is very elongated and round (*i. e.* cylindrical) or filiform; the integuments finally striated crosswise; the mouth at the anterior extremity, and diversiform as to shape and armature, but generally surrounded by papillæ; the œsophagus muscular, but not dilated; the generative organs of the males are toward the posterior extremity of the body in a peculiar pouch, whose margin is surrounded by papillæ terminating in rib-like muscular ridges, and generally two spicules are developed; the vulva of the female is anterior or posterior. Some are oviparous, and others viviparous. The family comprises nine or ten genera, the best known of which are *Strongylus*, *Eustrongylus*, *Ancylostomum*, and *Sclerostomum*, of which the first three are represented by parasites in the human body. THEODORE GILL.

Stron'tium, the metallic basis of strontia, one of the alkaline earths, first obtained from native carbonate of

strontium by Sir Humphry Davy in 1808, is of a pale yellow color, burns with a crimson flame, emitting sparks, decomposes water, liberating hydrogen gas, is hard, ductile, and malleable, and is obtained from the anhydrous chloride by electrolysis. Specific gravity, 2.54; atomic weight, 87.5; symbol, Sr. Its most important compound is the oxide, called strontia, a grayish-white, porous mass, which combines with water to form a white powder, the hydrate of strontium ($SrO.H_2O$), deposited from the hot saturated solution in needle shaped crystals. The principal salts are chloride ($SrCl_2$), iodide (SrI_2), and bromide ($SrBr_2$). The nitrate ($Sr2NO_3$) is much employed for the manufacture of the crimson lights in fireworks. The sulphate ($SrSO_4$) is found native, and is known as a crystalline mineral by the name of celestine, in beds of gypsum, rock-salt, and trap rocks. Fine specimens are found in Trenton limestone on Strontian Island, Lake Huron, also at Schoharie and Lockport, N. Y.

Strophomen′idæ [from Gr. στρόφος, "twisted," and μήνη, "moon"—*i. e.* "crescent"], an extinct family of brachiopods which lived down to the close of the Liassic period. The shell was transverse or elongate; the "valves usually concavo-convex, regularly arched, geniculated or depressed, so that the valve, which is convex in some species, is concave in others, and *vice versâ*;" the hinge-line rectilinear; the ventral valve had the area flat, and a fissure overarched in part by a pseudodeltidium; the dorsal a projecting bifid cardinal process, which filled up almost the entire cavity of the fissure left open by the pseudodeltidium in the opposite valve. THEODORE GILL.

Stroth′er (DAVID HUNTER), b. at Martinsburg, Va., Sept. 26, 1816; studied drawing and painting in New York 1845–49, and in 1853 began to contribute to *Harper's Magazine*, under the signature of "Porte Crayon," a series of illustrated papers, mostly on the South, the drawings being made on the wood by himself; which have been continued at intervals to the present time. Some of the earlier of these papers have been collected into a volume, *Virginia Illustrated* (1857). During the civil war he entered the national service as captain and assistant adjutant-general; became colonel of the 3d West Virginia Cavalry, and resigned Sept., 1864; in 1867 was brevetted brigadier-general "for meritorious services." He resides at Berkeley Springs, West Va.

Stroud, town of England, county of Gloucester, on the Frome, is one of the principal seats of woollen manufactures in Western England, and has 9090 inhabitants.

Stroud, tp., Monroe co., Pa. P. 2160.

Stroud (GEORGE McDOWELL), b. at Stroudsburg, Pa., Oct. 12, 1795; graduated at New Jersey College in 1817; was admitted to the bar in 1819, and was for many years presiding judge of the court of common pleas of Philadelphia. He published pamphlets and contributions to legal journals, and a *Sketch of the Laws relating to Slavery in Several of the States* (1827; enlarged in 1856). D. at Germantown, Pa., June 29, 1875.

Strouds′burg, p.-b., Stroud tp., cap. of Monroe co., Pa., on Delaware Lackawanna and Western R. R., has good water-power, several manufactories, and 3 weekly newspapers. P. 1793.

Stru′ensee (JOHANN FRIEDRICH), b. at Halle, Prussian Saxony, Aug. 5, 1737; studied medicine; took his degree as doctor before he was nineteen years old, and settled as a physician at Altona in the Danish province of Holstein; became intimate with the Holsatian nobility, and was recommended to the Danish king, Christian VII., whom he attended as physician-in-ordinary on his travels through Germany, France, and England in 1768. Christian VII. was by nature kind-hearted and well gifted, but premature dissipation early sunk his mind into fatuity and foolishness, and Struensee was the only man who knew how to direct and command his imbecile soul. The queen, Caroline Mathilde, a sister to George III. of England, was a noble-hearted, high spirited, and passionate woman, and at the Danish court Struensee was the only man in whom the unhappy young wife could put full confidence. Thus he soon acquired an influence, and even a power, which no subject had ever had before in Denmark. In 1771 he was made minister of state, and a royal decree gave full authority to any orders he might issue, whether they were signed by the king or not. But his power was very short lived; it lasted hardly one year. On Apr. 28, 1772, he was beheaded, and he would probably have been forgotten very soon if the enormous reformatory activity which he excited had not given the social development of the country an impulse which no reaction was able afterward to check. Many of his reforms were very beneficial. He made the courts independent of the great landholders among the nobility, who hitherto had held the right of appointing the district judges—which offices they often filled with their lackeys—and in some cases even of exercising the judicial power themselves; as, for instance, in debt cases between themselves and their tenants. He formed a permanent committee for the investigation of the condition of the peasantry and of all agricultural relations, and he started that series of reforms by which, in the last two decades of the eighteenth century, the whole of Danish society was reconstructed on the basis of a free peasantry. He granted liberty of the press and brought order and activity into the administration. But some of his measures, although good in themselves, were introduced in a reckless manner, which made people misunderstand them. Thus, he diminished the number of holidays accompanying the Christian church-festivals from eight to two; and this very sensible reform came to be considered as a "piece of atheism," and excited general indignation. Still greater scandal was caused by his establishing a foundling hospital, which was considered as a direct encouragement of vice; and in some cases his lack of dexterity and regard rose even to clumsy and reckless impertinence. Thus, he ordered that all memorials presented by the Danish people to the Danish government should be written in German, as he did not understand Danish—an order which offended all, and which was obeyed in a somewhat unexpected manner: no more memorials or petitions were presented. A conspiracy was formed against him, and in the night between the 16th and 17th of Jan. the conspirators broke into the bedroom of the crazy king and compelled him to sign orders of arrest against the queen, Struensee, and several of his adherents. The queen was brought to the fortress of Kronborg; Struensee was imprisoned. He was accused of having had criminal intercourse with the queen, and he confessed, but he was threatened with the rack, and he was a coward. From her, too, there exists a sort of confession, but she was told that such a paper from her hand would mitigate Struensee's destiny; and she loved him. Of legal evidence there was none. CLEMENS PETERSEN.

Struthiine. See SAPONINE.

Struthion′idæ [from *Struthio*—Gr. στρουθίων—the ancient name of the ostrich], a family of birds of the group (order or sub-order) Ratitæ, represented at present only by the ostrich of Africa and Arabia, the ostriches of South America belonging to the family Rheidæ, and the cassowaries and emus to the family Casuaridæ. The bill is rather elongated, nearly straight, gradually depressed forward and narrowed toward the extremity, which is rounded, and the culmen is flattened; the nostrils are elongate ovate, and in a broad membranous groove near the middle of the bill; the feathers are destitute of after-shafts; the wings are imperfect, and furnished with long curving soft plumes; the tail is moderate, and consists of curved pendent feathers; the tarsi are elongated, robust, and mostly covered with hexagonal scales, but in front toward the toes with transverse ones; the toes are two in number, with pad-like under surfaces, the inner (third) large, the outer (fourth) small; the claws short, curved, and blunt.

A number of osteological characters support the differentiation of the family from the others of the group, and have been formulated by Prof. Huxley—viz. the maxillary processes of the palatine bones are prolonged forward beneath the maxillo-palatines (as in most birds); the latter are thickened at their inner edges, and articulate with facets upon the sides of the vomer; the vomer is quite short, and does not articulate with either the palatines or pterygoids behind; the prefrontal processes of the primordial cranium are deficient in ossification; the sacral vertebræ are united by their bodies with the anterior ends of the pubes and ischia; the sternum has two shallow notches on each side at the posterior margin; the fore limb is distinguished by its proportions, the humerus being about equal in length to the distance between the pectoral arch and the ilium, and therefore much longer than the scapula; the antebrachium is not half as long as the humerus; the manus possesses the ordinary three digits, and of these the radial and middle have claws; there is a union of the pubes in a symphysis; the hallux is not only aborted, but also the distal end of the metatarsal bone and the phalanges of the second digit of the foot; there are 35 precaudal vertebræ. But one species of this family (the *Struthio camelus* of Linnæus) is generally recognized, and this extends from the Sahara desert to the Cape of Good Hope, as well as into Arabia. It is suggested, however, that several forms may be confounded under one name. There are said, *e. g.*, to be certain marked differences between the Northern and Southern African birds. "The most noticeable differences observable in the living birds are that the naked skin of the Cape examples is bluish (not reddish), and the neck thickly feathered, the top of the head being also covered with hair-like feathers. In the Barbary bird the top of the head is

bare." The eggs of the two birds also differ, those of the northern form being larger and pitted, while those of the southern bird are smaller and almost smooth. (See Sclater in *Trans. Zool. Soc. London*, vol. iv., pp. 354, 355.) The ostrich is the largest of the living birds. It feeds upon the grass and other vegetation of the plains and deserts which it most affects, and has a well-known reputation for voracity and digestibility. Individuals generally associate together in considerable flocks. Its ordinary gait is a stately walk, but it can run with great swiftness, and is then assisted by its wings. The nest is scratched in the sand, and is little more than a slight excavation of about six feet in diameter. Generally, two females lay in the same nest about twenty eggs, while in a surrounding trench several more are deposited, which are believed to be for the use as food of the newly-hatched young. The male sits on the eggs and cares for the young. As is well known, the plumes of the ostrich are much esteemed as ornamental feathers, and of late years birds in large numbers have been reared for their supply. THEODORE GILL.

Strutt (JOSEPH), b. at Springfield, Essexshire, Oct. 27, 1742; was apprenticed to an engraver, but devoted himself specially to the study of British antiquities. His principal works in this department are—*The Regal and Ecclesiastical Antiquities of England* (1773; new ed. by Planché, 1842); *Horda-Angel-Cynnan*, being a view of the customs, arms, etc. of the inhabitants of England from the arrival of the Saxons till the reign of Henry VIII. (1774); *The Chronicle of England*, completed only to the time of the Norman Conquest (1777); *Complete View of the Dress and Habits of the People of England from the Establishment of the Saxons to the Present Time* (1796; new ed. 1875); *The Sports and Pastimes of the People of England* (1801; enlarged by Hone in 1830, and often republished). He also published a *Biographical Dictionary of Engravers* (1785), and left several tales, one of which, *Queen Hoo Hall*, was edited after his death by Sir Walter Scott. D. in London Oct. 16, 1802.

Stru've, von (FRIEDRICH GEORG WILHELM), b. at Altona, Holstein, Apr. 15, 1793; studied first philology, and afterward astronomy, at the University of Dorpat; received an appointment at the observatory in 1813, and became its director in 1817. From 1834 to 1839 he planned and superintended the construction and erection of the observatory at Pulkova, near St. Petersburg, the best in the world, which he has described in his *Description de l'Observatoire central de Russie* (1845), and of which he was director to his death, Nov. 23, 1864. The earlier part of his career was mostly occupied by studies of double stars and of the construction of the Milky Way—*Observationes Dorpatenses* (8 vols., 1817–39), *Catalogus novus Stellarum Duplicium* (1827), *Stellarum Duplicium mensuræ Micrometricæ* (1837), *Stellarum Fixarum, imprimis compositarum positiones mediæ* (1852), and *Études d'Astronomie stellaire* (1847). Subsequently, he undertook several great geodetic works, such as the triangulation of Livonia (1816–19) and the measurement of a meridian arc in the Baltic provinces (1822–27), which he continued to the North Pole in connection with Hansteen, and to the Danube in connection with Gen. Tenner, and which he has described in his *Arc du Meridien entre la Danube et la Mer glaciale* (1861).

Struve (GEORG ADAM), b. at Magdeburg, in the present Prussian province of Saxony, Dec. 27, 1619; studied law at Jena and Helmstedt; held several high positions in the Saxon government, and became known as the author of a great number of juridical works, of which the *Jurisprudentia Romano-Germanica forensis* was the most remarkable. D. at Weimar Sept. 15, 1692.—His son, BURKHARD GOTTHELF STRUVE, b. at Weimar May 26, 1671, studied law at Jena, Helmstedt, and Frankfort-on-the-Oder; travelled much, and was appointed professor at Jena, first in history (1704), then in jurisprudence (1730). D. May 24, 1738. The most remarkable of his numerous writings are—*Corpus Historiæ Germanicæ* (1730), *Bibliotheca Historica* (11 vols.), and *Bibliotheca Historiæ Literariæ Selecta* (3 vols.).

Struve, von (OTTO WILHELM), b. at Dorpat May 7, 1819, son of F. G. W. von Struve, under whom he studied astronomy; succeeded him as director of the observatory of Pulkova, and became known in the history of astronomy by many valuable discoveries, communicated in the memoirs of the Academy of Science of St. Petersburg, and mostly relating to the rings of Saturn and the periodic motions of double stars. He also published a catalogue of the library of the observatory.

Strychnine, or **Strychnia.** See NUX VOMICA.

Strych'nos [Gr. στρύχνος, the deadly nightshade], a genus of trees and climbing woody vines of the order Loganiaceæ, found in the tropical parts of both continents. Most species, but it is said not all, are poisonous. *S. nux-vomica* of India, a tree of moderate size, yields the alkaloids strychnine, brucine, and igasurine, all active poisons in over-doses. So also does *S. Ignatia* of the Philippines, and *S. tieute*, a climbing vine of Java. The East Indian *S. ligustrina* and *S. colubrina* are reputed to afford a cure for snake-bites. *S. pseudo-quina* of Brazil yields copalche-bark, a valued febrifuge; *S. potatorum* of India is the clearing-nut tree; and *S. toxifera* of South America probably affords the dreaded curare (or woorari) poison.

Stry'ker, p.-v., Springfield tp., Williams co., O., on Lake Shore and Michigan Southern R. R. P. 671.

Strymon. See MACEDONIA.

Strype (JOHN), D. D., b. at Stepney, Nov. 12, 1643; was educated at St. Paul's School and at Jesus College, Cambridge, and from 1669 to about 1732 held the living of Low Leyton in Essex. His important works are—*Annals of the Reformation in England* (1709), and lives of *Thomas Cranmer* (1694), *Sir Thomas Smith* (1698), *John Aylmer* (1701), *Sir John Cheke* (1705), *Edmund Grindall* (1710), and *Matthew Parker* (1718). Editions of the *Historical and Biographical Works of John Strype* were issued from the Oxford press in 27 vols. (1827–40). D. Dec. 13, 1737.

Stu'art, p.-v., Penn tp., Guthrie co., Ia., on Iowa division of Chicago Rock Island and Pacific R. R., has several locomotive and machine shops and 1 newspaper.

Stu'art, or **Stewart,** a royal family which has given several sovereigns to Scotland and England, all of whom are mentioned under their proper names—CHARLES, JAMES, MARY, and ROBERT (which see). Tradition affirms that the family is descended from that Banquo who was murdered by Macbeth, but the more probable account is that among the Normans who accompanied William the Conqueror was one Alan, who received large gifts of land in England. His second son went to Scotland, entered the service of King David I. (about 1130), by whom he was made steward of the kingdom, the dignity remaining hereditary in the family, who assumed the title as their family name. The sixth of these Stewards or Stewarts married in 1315 a daughter of Robert Bruce, and his son Robert in 1371 succeeded David Bruce on the throne of Scotland under the title of Robert II. The following are the sovereigns of the Stuart line, with the dates of their accession: ROBERT II. (1371). ROBERT III. (1390), a feeble ruler who left the actual government to his brother, the duke of Albany. JAMES I. (1424) was for many years a prisoner in England, and was assassinated by his subjects in 1437. JAMES II. (1437) was crowned at the age of six, and was killed by the bursting of a gun at the siege of Roxburghe in 1460. JAMES III. (1460) had a troublous reign, embroiled by several revolts of his nobles, and was either killed in battle or murdered afterward in 1488. JAMES IV. (1488) married Margaret Tudor, daughter of Henry VII. of England, and was killed at the battle of Flodden Field in 1513. JAMES V. (1513) was crowned at the age of eighteen months, his mother acting as regent until 1529, when he assumed the government. His whole reign was a series of disasters. He became involved in quarrels with Henry VIII. of England; was defeated in 1542 in an engagement, and soon after died of chagrin, leaving the crown to his infant daughter, then only eight days old. MARY Queen of Scots (1542), daughter of James V. and Mary of Guise, married successively to the dauphin (afterward Francis II.) of France, Henry Darnley, and James Hepburn, duke of Bothwell; was executed in England in 1587. JAMES VI., son of Mary and Darnley (1567), crowned when only a year old, his mother having been deposed by her subjects. Queen Elizabeth dying in 1603, James became king of England in right of his descent from Margaret Tudor, daughter of Henry VII., taking the title of James I. of England. D. in 1625. CHARLES I. (1625) succeeded his father at the age of twenty-five; became involved in disputes with his people, and was beheaded in 1649. CHARLES II. (1649), his reign nominally beginning with the death of his father, although he did not actually ascend the throne until 1660; d. in 1685, without legitimate children. JAMES II., brother of CHARLES II. (1685), deposed in 1688 by the people, who raised to the throne his daughter Mary and her husband, William, prince of Orange. D. in 1701. He had one legitimate son, JAMES FRANCIS EDWARD (which see), who upon the death of his father assumed the title of James III., and is known in history as the Old Pretender; d. in 1765. His eldest son, CHARLES EDWARD (which see), is known as the Young Pretender; d. in 1788. The second son of the Old Pretender, HENRY (see STUART, HENRY BENEDICT MARIA CLEMENT), entered the Roman Catholic priesthood, and rose to the cardinalate under the title of Cardinal York; d. in 1807, and with him ceased the royal line of the Stuarts, perhaps the most unfortunate family which ever sat upon a throne. The present royal family of England are descended only indirectly, and in the female

line, from the Stuarts, through a granddaughter of James I. of England, upon whom the succession was bestowed by the British Parliament. A. H. GUERNSEY.

Stuart (ALEXANDER H. H.), b. at Staunton, Va., Apr. 2, 1807; studied at William and Mary College and at the University of Virginia, and was admitted to the bar in 1828; in 1836–38 was a member of Virginia house of delegates, and in 1841–43 a Representative in Congress; in 1850 was appointed secretary of the interior by Pres. Fillmore; in 1857 was elected to the State senate of Virginia; in 1866 was a delegate to the national Union congress convened at Philadelphia.

Stuart (ARABELLA), b. at Chatsworth about 1575. Her father was Charles Stuart, earl of Lennox, brother of Henry, Lord Darnley, the husband of Mary Queen of Scots, and father of James I. of England. Her great-grandmother was Margaret Tudor, daughter of Henry VII., who had married James IV. of Scotland, and she was therefore in the direct line of descent to the English crown, standing in the same degree of relationship to Elizabeth as did her cousin James, and she became almost from birth a subject of constant intrigues. Upon the death of Elizabeth in 1603, an unsuccessful plot, in which it is said Sir Walter Raleigh was implicated, was formed to place her instead of James upon the throne; and from this moment she became an object of jealousy to her cousin; this was still more inflamed when in 1610 she was secretly married to William Seymour, grandson of the earl of Hertford, who was descended from another daughter of Henry VII., and thus also in the line of descent. Seymour was flung into the Tower, and his wife was placed in the custody of the bishop of Durham. She managed to escape, and made her way to the coast, where a French vessel was waiting for her and her husband, who had escaped from the Tower. He did not succeed in reaching the vessel, which sailed without him, but found another one, by which he reached France. The vessel in which was the Lady Arabella was captured by an English ship, and she was committed to close confinement in the Tower, where she became insane, and d. Sept. 27, 1615.

Stuart (CARLOS D.), b. at Berlin, Washington co., Vt., July 28, 1820; was in early life engaged as clerk in a country store, at the same time devoting himself to study and reading, and writing poems for the local newspapers. In 1840 he came to New York, and became a contributor to journals and periodicals, and soon afterward was for a short time a preacher of the Universalist denomination, but soon devoted himself to journalism, becoming editor of the New York *Sun*; then established the *New Yorker*, and afterward was on the *Mirror*, writing both prose and verse. D. at Northampton, Mass., Feb., 1862.

Stuart (GEORGE HAY), b. at Rose Hall, county Down, Ireland, Apr. 2, 1816; was educated at Bainbridge, Ireland; emigrated to America, taking up his residence in Philadelphia, where he engaged in business, and is president of the Mechanics' National Bank. He is distinguished as one of the most active Christian philanthropists of the day. During the civil war he was president of the U. S. Christian Commission, and subsequently of the Indian commission; is president of the Philadelphia branch of the Evangelical Alliance, a vice-president of the American Sunday-School Union, of the American Bible Society, the American Tract Society, and other philanthropic associations. (For a sketch of his life, by his pastor, Rev. Dr. Wylie, see in Billingsley's *From the Flag to the Cross, or Scenes and Incidents of Christianity in the War* (1872).)

Stuart (GILBERT), b. in Edinburgh in 1742; was educated at the University of Edinburgh; studied jurisprudence, but devoted himself specially to literature, publishing in 1767 an *Historical Disquisition on the Antiquity of the British Constitution*, which gained for him the degree of LL.D., and was followed next year by a *View of Society in Europe, in its Progress from Rudeness to Refinement*. Failing to receive the appointment of professor of law in the university, he went to London, where he wrote for the journals, and returning to Scotland in 1773 commenced the *Edinburgh Magazine and Review*, which was continued for four years, and was noted for its virulent attacks upon Scottish literati. He published *Observations concerning the Public Law and Constitutional History of Scotland* (1789), *History of the Establishment of the Reformation in Scotland* (1780), and *History of Scotland from the Reformation to the Death of Queen Mary* (1782). D. at Musselburgh Aug. 13, 1786.

Stuart (GILBERT CHARLES), b. at Narragansett, R. I., in 1756. His first instructor, Alexander, a Scotch artist, took him to Edinburgh, but soon died, and the youth worked his way back to Newport. Thence he removed to Boston. The stir of the Revolution drove him to New York, and thence in 1778 to London. There, after months of poverty, friendlessness, and ill-success, he became acquainted with Benjamin West, who gave him encouragement, showed him every kindness, and even took him to his home. A full-length portrait of West, now in the National Gallery, gained for him reputation and opportunity. He soon rose to eminence in London, and painted people of rank—George III., the prince of Wales, a duke, an earl, John Kemble, Joshua Reynolds (of whom he was held to be the peer). The duke of Rutland invited him to Dublin, and there he lived in splendor as the artist of the nobility. In Paris he met with similar fortune, having as a sitter the king, Louis XVI. A desire to revisit his native country and to paint the portrait of Washington, whom he profoundly revered, brought him to America in 1793, and led him to Philadelphia without unnecessary delay. The first picture was destroyed as unsatisfactory; the second, the original sketch whereof is in the Boston Athenæum, is the accepted portrait. Besides Washington, Stuart painted John Adams, Jefferson, Madison, Monroe, John Jay, distinguished men and women of the day. The last was John Quincy Adams, which was finished by Sully. From 1806 till his death Stuart resided in Boston, and painted industriously. D. in Boston, Mass., July, 1828. No complete catalogue of his portraits exists. They are very numerous, and are greatly prized. In the painting of heads he rivals Copley, but the details are sketchy. Stuart was a brilliant man, eccentric, sensitive, proud, a wonderful talker, a penetrating observer, a genius in his art. In his early years he was an accomplished musician. His pictures are widely scattered, but may be seen to advantage in Boston, Philadelphia, New York, and Baltimore. O. B. FROTHINGHAM.

Stuart (HENRY BENEDICT MARIA CLEMENT), b. in Rome in 1725, the son of the Pretender, James Francis Stuart, by whom he was created duke of York, and brother of Charles Edward, the Young Pretender; he was the last male descendant of the royal line of the Stuarts. He was preparing to join his brother in the rising of 1745 with a force of French troops when that prince was overthrown at Culloden; subsequently took orders in the Roman Catholic Church, and in 1747 was raised to the cardinalship by Pope Benedict XIV. as Cardinal York, taken from his ducal title. His brother, the Young Pretender, dying in 1788, he assumed the style of Henry IX., king of England—*gratia Dei, non voluntate hominum*, as expressed on a medal struck upon the occasion. When the French troops in 1798 took possession of the Papal States he retired to Venice, and during the later years of his life was maintained by a pension from the British government. D. at Frascati in 1807.

Stuart (ISAAC WILLIAM), son of Moses, b. at New Haven, Conn., in 1809; graduated at Yale College 1828; became a teacher at the Hopkins Grammar School, Hartford; was for some years professor of Greek and Latin in the College of South Carolina; subsequently returned to Hartford, where he acquired and resided upon the Wyllis estate, on which stood the celebrated "Charter Oak;" was several times a member of the Connecticut senate, and was distinguished as an orator. D. at Hartford Oct. 2, 1861. Author of a *Life of Nathan Hale* (1856), *Hartford in the Olden Time* (1853), and a *Life of Jonathan Trumbull* (1857); translated, with notes, Greppo's *Essay on the Hieroglyphic System of Champollion* (1830), and edited, with notes, the *Œdipus Tyrannus* of Sophocles (1837).

Stuart (JAMES), known as "Athenian Stuart," b. in London in 1713; until nearly thirty years of age was a decorator of fans and similar articles; made his way to Rome, where he studied Greek and Latin art and archæology; in 1752 accompanied the antiquarian Nicholas Revett to Athens, where he remained three years, making drawings from the remains of Greek architecture; in 1755 returned to London; became eminent as an architect; was appointed surveyor of Greenwich Hospital, and in conjunction with Revett began the great work, *The Antiquities of Athens, Measured and Delineated* (3 vols., 1762–94; supplementary volume, edited by Joseph Woods, 1816). He also published *Critical Observations on the Buildings and Improvements of London* (1771), and furnished the illustrations for a *Picturesque Tour through part of Europe, Asia, and Africa* (1793). D. Feb. 2, 1788.

Stuart (JAMES E. B.), b. in Patrick co., Va., in 1833; graduated at the U. S. Military Academy July 1, 1854, when appointed a brevet second lieutenant in the regiment of mounted rifles, receiving his full commission in October. In Mar., 1855, he was transferred to the newly-organized 1st Cavalry, in which regiment he attained a first lieutenancy in the following December, and a captaincy Apr. 22, 1861. During the Kansas political troubles of 1855–58 he served with his regiment, and in 1859 was a volunteer aide to Col. R. E. Lee during the John Brown insurrection at

Harper's Ferry. On May 14, 1861, he was appointed colonel of a Virginia cavalry regiment, and was in chief command of the cavalry at the first battle of Bull Run. Promoted to be brigadier-general in the Confederate army in Sept., 1861, and major-general early in 1862, he served thenceforth with the Army of Northern Virginia. Gen. Lee, assuming command of this army (June, 1862), and having reorganized it, determined upon a bold reconnoissance prior to resuming the offensive. Accordingly, on the morning of the 13th of June, Stuart, with some 1500 cavalry and 4 guns, left Richmond, and by daylight of the 15th reached Hanover Court house, where he dispersed two squadrons of the 5th U. S. Cavalry; proceeding down the Pamunkey as far as Old Church, thence toward New Kent Court house, striking the railroad at Tunstall's Station and crossing the Chickahominy at Jones's Bridge the next morning, was safely back in Richmond that night, having made the circuit of McClellan's army with the loss of but one man. It caused much commotion in the Union army, and was the source of valuable information in the subsequent movements of Jackson, where Stuart led the advance. During Pope's campaign in Northern Virginia, Stuart surprised the head-quarters' train of the former near Catlett's Station on the night of Aug. 25, 1862, capturing the personal baggage and official correspondence of Pope, and the next night, in connection with two regiments of infantry, made a descent on Manassas Junction, capturing 8 guns, several hundred prisoners, 10 locomotives, and immense quantities of quartermaster and commissary stores. During the invasion of Maryland by Gen. Lee in September, Stuart covered the Confederate rear, resisting the Union cavalry advance at South Mountain and holding the Confederate left, and engaged at Antietam. During the period of inaction he crossed the Potomac above Williamsport with 1500 cavalry, and passing through Maryland, he entered Pennsylvania and occupied Chambersburg, and recrossed the Potomac below Harper's Ferry. In the battle of Fredericksburg his command formed the extreme right of the Confederate line. At Chancellorsville, after the fall of Stonewall Jackson, and A. P. Hill had been disabled, Stuart succeeded to the temporary command of Jackson's corps, which he led with ability in the severe fighting of Sunday, May 3. In anticipation of the proposed invasion of Pennsylvania, a large cavalry force had been accumulated at Culpeper under command of Stuart, against which Gen. Hooker despatched two divisions of cavalry and two brigades of infantry, which, crossing at Beverley and Kelly's Fords (June 9), soon encountered Stuart advancing to cover the flank of the main movement. A determined engagement between the cavalry on both sides ensued, resulting in a loss to each of 500 or 600. During the subsequent operations of the year, he rendered important service. In the campaign of 1864, Stuart by a wide detour succeeded in interposing himself between the Confederate capital and Sheridan's advancing column. Concentrating all his forces at Yellow Tavern, near Richmond, he was here attacked by his able rival. During the obstinate but ineffectual struggle Gen. Stuart was mortally wounded. D. May 11, 1864, soon after reaching Richmond. G. C. Simmons.

Stuart (John), earl of Bute. See Bute.

Stuart (Moses), b. at Wilton, Conn., Mar. 26, 1780: was graduated at Yale College in 1799: studied law, and was admitted to the bar in 1802, and for two years was tutor in Yale College; afterward studied theology, and in 1806 was ordained pastor of a Congregational church in New Haven. In 1809 he became professor of sacred literature in the theological seminary at Andover, and occupied the chair until 1848. He published several Hebrew and Greek grammars, commentaries on various books of the Bible, and *Elements of Interpretation* from the Latin of Ernesti (1822), *The Sabellian and Athanasian Modes of Representing the Doctrine of the Trinity*, from the German of Schleiermacher (1835), *Philological View of Modern Doctrines of Geology* (1836), *Hints on the Prophecies* (1842), *Critical History and Defence of the Old Testament Canon* (1845), *Conscience and the Constitution* (1851), etc. D. at Andover, Mass., Jan. 4, 1852.

Stubbs (William), D. D., b. at Knaresborough June 21, 1825; was educated at the grammar school at Ripon and at Christ Church, Oxford, where he took a first class in the classics and a third class in mathematics, and was elected to a fellowship in Trinity College; took holy orders in 1848; became vicar of Navestock in 1852; librarian to the archbishop of Canterbury at Lambeth in 1862, and was inspector of schools in the diocese of Rochester 1860–66, when he received the appointment of regius professor of modern history at Oxford, in 1869 that of curator of the Bodleian Library; was chosen as a member of the hebdomadal council in 1872, and in 1875 received the presentation of the rectory of Cholderton, Wiltshire. He has published—*Hymnale secundum Usum Sarum* (1850), *Registrum Sacrum Anglicanum* (1858), *The Foundation of Waltham Abbey* (1861), a new translation, with a continuation to the present time, of Mosheim's *Institutes of Church History* (1863), *Chronicles and Memorials of Richard I.* (1864), the *Chronicle ascribed to Benedict of Peterborough* (1867), the *Chronicle of Roger de Hoveden* (1868), *Select Charters, etc. of English Constitutional History* (1870), *Memorial of Walter of Coventry* (1872), *Memorials of St. Dunstan* (1874), and *The Constitutional History of England* (vol. i., 1875 *seq.*).

Stuc'co [It.], a plastic, adhesive composition applied to walls both internally and externally in order to give them a smooth and even surface, either decorative or plain in color or form. The cementing medium of the composition for inside-work is common lime or calcined gypsum, or a combination of the two, generally mixed with a certain proportion of sand, depending on the special object to be secured. The word *stucco* technically applies to a mixture of lime-putty and white sand or powdered marble, and to a coating produced with this compound. The rudest example of the plasterer's art is the application of a single coat of mortar composed of lime-paste and common sand laid on the surface of a wall with the trowel, while the highest consists in imitating fine marbles and other beautiful building-stones by using pure calcined gypsum, mixed with gum, isinglass, and suitable coloring-matter, laid on in a variety of decorative forms in order to produce panels, pilasters, mouldings, cornices, etc. The implements used by the plasterer are of the simplest kind and few in number. They comprise a lathing-hammer, the hawk, the plastering or laying-on trowel, the float, a brush, and straight-edges and moulds of various kinds, together with a screen, shovel, rake, and hod for his attending laborer. The hawk is used by the plasterer for holding the mortar in his left hand while he applies it with the trowel held in his right hand. It is simply a piece of board about ten to eleven inches square, held by a stout handle fixed on the under side in the centre of the board and at right angles to it. The laying-on trowel is a thin plate of hardened steel or iron about three inches wide and nine to ten inches long, rounded slightly at the front end, square at the other end, and a little convex on the face. It is provided with a handle on the back parallel to the blade. The hand-float is of wood, shaped something like the laying-on trowel. It is used to rub down finished work and give it a hard, smooth, and even face. A cork float is sometimes used upon surfaces which are to receive a high degree of polish. A derby is a long, two-handed float, used principally in forming the floated coat of lime and hair. Jointing-trowels are of steel, the plate being triangular, with an acute angle at the front end, the handle being attached to the heel or base of the tool. They are used about cornices and mouldings in forming the mitres where fine workmanship is desired. Moulds are pieces of hard wood cut to the form of the cornices or mouldings that are to be formed, to assist the workman in securing accuracy and uniformity in his work. They are sometimes made of copper plates inserted in a wooden stock. The plasterer's brush is broad and thin, and is used for keeping the material wet and plastic until it is finished to the required form. The plasterer's materials are lath-nails, laths, lime, calcined gypsum or plaster, hydraulic cement, and sand, together with various pigments for giving the requisite colors.

The mortars used for inside plastering are "coarse stuff," "fine stuff," "gauge stuff," called also "hard finish" and "bastard stucco." Coarse stuff is simply common lime-mortar, of the quality suitable for brick masonry, mixed with well-switched bullock's hair free from all animal and vegetable matter. The proportions of 1 cask of common lime, producing 8 to 9 cubic feet of paste, 16 to 18 cubic feet of clean, sharp sand, and 1½ to 1¾ cubic feet of hair will answer. When rapid hardening is desirable, 12 to 15 per cent. of the lime-paste may be advantageously replaced by an equal volume of calcined plaster or hydraulic cement. Coarse stuff forms the principal mixture for all inside plastering. In three-coat work the proportion of hair in the second coat may be somewhat diminished. Fine stuff is prepared by slaking pure lump-lime with a small quantity of water, and afterward adding water until the paste is diluted to the consistency of cream. It is then allowed to stiffen by evaporation to the proper condition for use. It is then sometimes called "putty." It is used for the finishing coat, but always with some fine sand or calcined plaster, except for what is known as a slipped coat, and even for slipped work fine sand may be added in small quantities. Gauge stuff is composed of putty or fine stuff and calcined gypsum, in the proportion of 3 or 4 of the former to 1 of the latter. It is used for the finishing coat of walls and for mouldings, cornices, and other kinds of ornamentation. As the gypsum renders it very quick setting, it should be mixed in small quantities as required for use. The mixture

called stucco is prepared with lime-putty and white sand, and is used only for a finishing coat. The usual proportions are 3 or 4 parts of sand to 1 of putty.

No description of the process of lathing walls and ceilings is deemed necessary here. It may be stated, however, that the lath-ends should not form a continuous joint on the same joist, and that the spaces between laths should not be less than three-eighths nor exceed half an inch. Preferably, the spaces should be three-eighths of an inch. One coat of plastering on laths is said to be *laid*, and the coat is called a *laying* coat; and work in two coats is said to be *laid* and *set*, and the coats are styled a *laying* coat and a *set* coat. In three-coat work on laths the first is called the *pricked-up* or the *scratch* coat, the second is the *floated* coat, and the third the *set* coat. On masonry, plastering in one coat is styled *rendering*; two-coat work is said to be *rendered* and *set*; and three-coat work *rendered, floated*, and *set*. In good two-coat work upon laths, and also upon uneven masonry, the first coat should be a *screed* coat—that is, laid in *screeds* and "filling out." The screeds are strips or ledges of coarse stuff, six or eight inches in width, applied at the angles of the room, and also in parallel strips three to four feet apart all over the walls and ceiling. They are carefully worked on, so that all those on the same wall or ceiling shall be accurately in the same plan, as determined by the frequent application of the straight-edge in all possible directions. When the screeds have become somewhat firm, the spaces between are filled in flush with the surfaces already established, so as to produce a continuous straight and even surface. In three-coat work the second is the screed coat. One-coat work on either laths or masonry—that is, either *laid* or *rendered*—although an inferior quality of work for walls and ceilings, is in common use for attics, kitchens, cellars, vaults, and places of like character. It is formed of a rather thick layer, say about half an inch, of well-tempered coarse stuff of moderate stiffness, possessing sufficient tenacity to prevent its falling apart. If upon laths, it should be applied with enough pressure from the trowel to force portions of it through the spaces, so that it will bend down of its own weight behind the laths, and thus form a strong key when it shall have set. This is a precaution of special importance on ceilings. If upon masonry, the pressure is necessary to secure intimate contact and adhesion. A light hand-floating adds greatly to the appearance of single-coat work. Two-coat work on laths, if not required to be of the best quality of work, is done in a *laying* coat and *set*, otherwise in a *screed* coat and *set*, when the laying coat becomes a screed coat. In either case the coarse stuff is applied in about the same thickness as in one-coat work, and with the same care to obtain a firm key. The object of a screed coat, as already stated, is to bring the surface to a true plane. When good work is aimed at, the first coat should be hand-floated to give it solidity and density. This is done by using the float in the right hand and a hair-brush holding water in the left. Both implements are passed quickly over the wall simultaneously. The brush precedes the float, and moistens the surface. Hand-floating can be done at a moderate expense, and it adds greatly to the hardness and tenacity of the plastering. It must take place while the mortar is green if intended as a preparation for a setting coat. After the first coat of two-coat work has become partially dry, so that it will not break up under the trowel in the work which follows, it is in readiness for the *set* or finishing coat, which may be in *slipped work, stucco, bastard stucco*, or *hard finish*. In either case the surface should be slightly roughened up with a birch or hickory broom, and moistened if it has become too dry. The application of a slipped coat consists simply in smoothing off the first coat of coarse stuff with the least thickness of lime-putty that will suffice to secure a rather smooth and even surface. It is seldom sufficient to cover up the coarse stuff entirely, but answers very well for surfaces that are to be finished in distemper or covered with paper-hangings of common quality. Four or five per cent. of white sand is sometimes added to the lime-putty to make it work more freely. For slipped work the trowel alone is used. Finishing or setting in stucco is proper for a screed coat, but is not applied upon rough, inferior work, on account of the extra labor which it requires. It is put on with the trowel to the thickness usually of about one-eighth of an inch, bearing in mind that the straight surface secured by previous screeding should be carefully preserved, which can only be done by applying the finishing coat in a layer of uniform thickness. Stucco should be thoroughly hand-floated, with a free use of the water-brush. After the wooden float has been used, it is usual in fine work to float the surface again with a cork float, which on account of its softness leaves the surface in a suitable condition for polishing with the trowel and brush. When the stucco is intended to present a rather rough surface, for ornamentation in any style of distemper or for painting, it should not be polished. Bastard stucco is used in the same manner and for the same purpose as stucco—that is, as a set coat on screed work. It is done in stucco-mortar, in which the proportion of sand is somewhat smaller than in the genuine stucco, and to which a little fine hair is sometimes added. It is not hand floated, and less trowelling is put upon it than upon trowelled stucco. It is superior to ordinary slipped work as a preparation for paper-hangings. Hard finish is applied with the trowel to the depth of an eighth of an inch, and may be polished with the water-brush and trowel, but not hand-floated. It is frequently used as a preparation for painting, although inferior to stuccoed walls for that purpose. It may, however, be well finished in distemper. A suitable mixture for distemper consists of 10 pounds of Paris white and 1 pound of glue, colored as may be required. Hard finish requires less labor than stucco, and is extensively practised in the U. S. In three-coat work on laths, the first coat—the *pricked-up*, the *scratch*, or *brown coat*—is applied in the same way as *laying*, with the exception that inasmuch as it is designed to form merely a good foundation for the *screed* coat, its thickness does not usually exceed one-quarter to three-eighths of an inch. After it has become partially dry, but while still soft, the mortar is *scratched* over nearly to its entire depth with a stick cut on the end into pointed teeth. The scratching is done in two sets of parallel scorings at right angles to each other, each running diagonally across the surface. The lines are about two inches apart, and are designed to assist the adhesion of the screed coat which follows. The second and finishing coats are applied as already described for a screed coat and set.

The estimated cost of labor and materials for 100 square yards of lath-and-plaster work is given below:

Materials.	Three coats—hard-finish work.		Two coats of slipped work.	
Good common lime.........	4 casks	= $4.00	3½ casks	$3.33
Lump lime for fine stuff.	⅔ cask	90		
Plaster of Paris..............	½ cask	75		
Laths..............................	2000	4.00	2000	4.00
Hair................................	4 bushels	60	3 bushels	45
Common sand..................	7 loads	2.00	6 loads	1.75
White sand......................	2½ bushels	20		
Nails................................	13 pounds	60	13 pounds	60
Mason's labor..................	3½ days	8.75	3 days	7.50
Laborer...........................	3 days	3.75	2 days	2.50
Cartage............................		2.00		1.50
Cost of 100 yards		$27.55		$21.63

For *exterior plastering* a mortar composed of common lime and sand is not the most suitable, although frequently used upon the walls of common buildings well protected by projecting eaves. A cheap and useful surfacing of this kind is made by first cleaning off and roughing up the surface, and raking out the joints to the depth of half an inch, and then rendering it with a not very thick coat of lime-paste and hair. When this has set, another coat of the same mixture is laid on evenly with the trowel without floating; and as soon as a few square yards are executed, a semi-fluid and thoroughly-incorporated mixture of strong lime and fine clean gravel is firmly applied. This is at once, while soft, tinted to any desired color with an ochreous mixture put on with a brush. The whole dries and hardens into a compact mass.

Common lime forms the basis of some very good outside stuccoes, which, when properly applied, are very durable. Water holding coarse brown sugar or molasses in solution may be used for mixing the mortar, with beneficial effects on its subsequent induration. One pound of sugar to eight gallons of water will answer for all except the surface coat, which should contain four times this proportion of sugar. Powdered slaked lime, mixed with the scales from a smith's forge and tempered with bullock's blood, produces a moderately hydraulic and durable mortar, frequently used for exterior stucco. The wall should be previously coated over with boiled oil. In the U. S. hydraulic cement and clean, sharp sand, mixed up with fresh water to the consistency of plasterer's mortar, is most commonly used for the exterior coating of walls, more especially of brick walls. Suitable proportions are 1 volume of cement powder to 1½ to 1¾ volumes of damp, compacted sand, mixed in such quantities, from time to time, that it will not set before it is used. The joints of the wall, whether it be of brick or stone, should be previously raked out to the depth of about half an inch, cleansed of dirt and dust, and then thoroughly wetted in order that the mortar shall not be too rapidly deprived of its moisture by absorption, and its density and strength thereby impaired. The mortar is usually applied in two coats in one operation; that is, the second coat is put on while the first is yet soft and plastic, so that the two become one. The workman never covers more than two or three superficial feet at one time, finishing it off

with the second coat as he goes along. The aggregate thickness of both coats should be about half an inch. It should be protected from the direct rays of the sun for some days, and kept moist by sprinkling with a hose or brush. Sometimes the first coat is replaced by a wash of thick cream of pure cement, put on with a brush just in advance of the mortar. Faithful workmanship is most essential in this kind of plastering. The mortar must be put on under a firm pressure with the trowel, in order to secure intimate contact with the wall, and the surface must not be too dry. Deficient adhesion will result from neglect of these precautions. When a cement is too dark to give an agreeable shade of color, a judicious use of white sand, common lime, and ochres, singly or in combination, may generally be depended upon to greatly lessen if not entirely remove the objection. After the stucco has been on a few days, and has become somewhat hard and dry, it should be carefully sounded all over with some small metal implement or a small piece of metal, such as a spike or a small tack-hammer, by which all spots destitute of adhesion will be at once detected by their hollow sound. At these places the coating should be removed, the surface roughened up and wetted, and another application of mortar made.

Certain precautions are indispensable to the durability of stucco upon the exterior faces of walls. In the first place, the sand used must be perfectly clean, and should therefore be washed, repeatedly if necessary, until it will no longer discolor clean water. If this is neglected, the vegetative powers of the earthy impurities will be brought into action in warm weather, and the beauty as well as the strength of the stucco will become impaired. But the most destructive agent to be guarded against is frost, or alternate freezing and thawing, when accompanied by the penetration of moisture between the stucco and the wall, which will inevitably result in throwing off the mortar. Hence the importance of securing intimate and continuous contact and adhesion over the whole surface. In well-trowelled and hand-floated work all the vertical surfaces will shed the water with sufficient promptness to prevent that degree of saturation which would be likely to receive injury from frost. The points to be specially looked to are at the eaves and gables, the projecting portions of a wall, and the jambs of windows and doors. A projecting roof will afford sufficient protection to the upper edge of the stuccoed surface. Where the stucco abuts against a projection like a sill or a lintel, the joint should be cleaned out to the depth of at least three-fourths of an inch, and the mortar firmly calked into it. At the jambs of openings extra care should be taken to secure close adhesion throughout, followed by a careful inspection by sounding and the renewal of all spots where the stucco has failed to unite with the wall. Q. A. GILLMORE.

Stuhlweis'senburg, town of Western Hungary, on a marshy plain, from which a considerable quantity of soda is extracted. It has several fine buildings, a gymnasium, a military academy, a Magyar theatre, manufactures of potash, leather, linen, and woollen fabrics, and extensive trade in oil, wine, corn, cattle, and wool. P. 22,683.

Stuke'ley (WILLIAM), b. at Holbeach, Lincolnshire, in 1687; was educated at Cambridge; devoted himself to medicine; resided in London, and afterward at Grantham, where he acquired high reputation as a physician. Forced by attacks of the gout to abandon his profession, he took holy orders, and was in 1729 presented to the living of All Saints, Stamford, and in 1747 to the rectory of St. George-the-Martyr in London. He was a zealous and diligent, though often fanciful, antiquarian, and published, among other works, *Itinerarium Curiosum*, an account of the antiquities and curiosities of Great Britain (1724); *Palæographia Sacra*, relating to the monuments of antiquity bearing upon sacred history (1736); *An Account of Stonehenge* (1740); *Palæographia Britannica* (1743–52), and *The Medallic History of Carausius, Emperor in Britain* (1757). Of him Gibbon says, "I have used his materials and rejected most of his fanciful conjectures." D. in London in 1765.

Stump Sound, tp., Onslow co., N. C. P. 1515.

Stump'town, v., Taneytown tp., Carroll co., Md. P. 41.

Stu'por [Lat.]. Stupor or coma is that condition in which, when fully developed, the functions of the brain, so far as the mind is concerned, are entirely suspended, and the individual lies unconscious, breathing heavily, and without the power of voluntary motion. It may be induced by pressure upon the brain, as from a depressed piece of bone of the skull or the entrance of some foreign body, as a bullet; by a blow or fall, causing concussion of the brain or compression from extravasated blood; by the rupture of a blood-vessel, causing cerebral hæmorrhage; by the circulation of poisoned blood through the cerebral vessels, as occurs, for instance, when an over-dose of opium or alcohol has been taken. Stupor is to be distinguished from sleep, with which, though sometimes confounded, it has in reality little or no analogy. In the first place, stupor never occurs in the healthy individual, while sleep is a necessity of life. It is easy to awake a person from sleep, while it is often impossible to arouse him from stupor. In sleep the mind may be active; in stupor it is, as it were, dead. An increased amount of blood in the brain will cause stupor, whereas sleep is the result of a diminished quantity of blood in the cerebral tissue.

Stupor is a symptom of serious importance in various injuries and diseases to which the brain is liable. It may exist in all degrees of severity; and in the partial forms the subject is either not entirely unconscious, or, if so, may be roused by impressions made upon the organs of the special senses, though usually only for a short time. There is a form of stupor, met with in certain diseases of the brain, in which the individual, though unconscious, is nevertheless not altogether deprived of the power to think and to move the limbs. There is, in fact, a marked degree of restlessness, though the movements are, as it were, automatic, and the speech is incoherent. This condition is known as "coma vigil." It generally only occurs in cases of great gravity, and it indicates a fatal termination.
WILLIAM A. HAMMOND.

Stur'bridge, p.-v. and tp., Worcester co., Mass., on Quinnebaug River, is noted for romantic mountain-scenery, has 2 cotton and 1 woollen mill, a tool-factory, 2 hotels, 3 churches, and 15 schools. P. 2101.

Sturge (JOSEPH), b. at Elverton, Gloucestershire, England, in 1793; was a member of the Society of Friends; in 1820 established himself as a corn-factor in Birmingham, where he acquired great wealth, and devoted himself especially to the abolition of slavery. With a special view to study the question of slavery, he visited the West Indies, and published *The West Indies in 1837* (1838); four years later he travelled in America, and published *Visit to the United States in 1841* (1842). D. at Birmingham May 1, 1859. His *Memoirs*, by Henry Richard, were published in 1864.

Stur'geon [Lat. *sturio*; Fr. *esturgeon*], the common English name applied to the species of the family Acipenseridæ. This family belongs to the super-order Chondroganoidei and order Chondrostei (see FISHES), and is a very natural group, having no near relations in the existing fauna. All the species have the body elongated and subcylindrical, or slightly compressed and tapering backward into a rather slender caudal peduncle; the skin is generally armed with minute osseous plates, as well as five rows of larger keeled bucklers, one dorsal, one pair lateral, and one pair on the sides of the abdomen; there is no well-defined lateral line; the head is produced into a more or less incurved and projecting snout, which is provided below with four barbels in a transverse row; the opercular apparatus is imperfect, but the operculum proper well developed; the nostrils are double, and in front of the eyes; the mouth is inferior, transverse, protractile, with fleshy lips, and of small size; teeth entirely wanting in the adult; branchial apertures mostly limited to the sides, the branchial membrane being attached below to the isthmus; branchiostegal rays none; fins all composed of numerous fine and closely-approximated rays, and the vertical with fulcra in front; the dorsal far behind, and short; the anal still nearer the tail than the dorsal; the caudal heterocercal—*i. e.* with the upper lobe prolonged and vertebrated; pectoral narrow and low on the scapular arch; ventral behind the centre of gravity. The skeleton is cartilaginous, and has numerous vertebræ. The stomach is not cæcal; the pyloric appendages are numerous; the rectum has a spiral valve; the air-bladder is large and simple, and communicates with the œsophagus through its upper surface; the gills are four in number, and in addition are two accessory gills. Species are found in all the temperate portions of the northern hemisphere. All breed in the fresh water, but some are residents of the sea part of the year, while others are permanent denizens of the lakes and rivers. They nearly agree, in fact, in distribution with the salmonids, save that they are less generally found in streams, on account of their larger size. There are two primary types—(1) *Acipenser*, which embraces several subordinate sub-genera or genera; and (2) *Scaphirhynchops*, of which only two species are known, one (*S. platyrhynchus*) confined to the Mississippi River and its tributaries, and another (*S. Fedtschenkoi*), lately described by Kessler (1872), from Toorkistan. The number of species of *Acipenser* is uncertain, Duméril (1870) recognizing over 80, while Günther (1870) admits only 19. The most common American species are the anadromous *A. brevirostris*, or short-nosed sturgeon, and *A. oxyrhynchus*, or sharp-nosed

sturgeon, which ascend the rivers of the Atlantic slope, and the fresh-water *A. rubicundus* of the great lakes and their tributary rivers. The sturgeons ascend the Hudson River in large numbers, and are called "Albany beef" near the head of navigation. Their flesh is reddish-colored, and is by some highly esteemed. Their eggs are often made into caviare; their air-bladders can yield a kind of isinglass: and a not bad oil may be expressed from them. They are the largest of fresh-water fishes, the *A. huso* sometimes exceeding the length of fifteen feet and the weight of 2000 pounds. (See also STERLET. For illustration see FISH.) THEODORE GILL.

Sturgeon, p.-v., Boone co., Mo., on North Missouri R. R., 130 miles N. W. of St. Louis, has 3 churches, a high school, 1 newspaper, 1 flouring-mill, 2 hotels, and a court-house. Principal business of neighborhood, stock-raising. P. about 800. THOMAS S. CARTER, ED. "LEADER."

Sturgeon (WILLIAM), b. at Whittington, Lancashire, in 1783; was apprenticed to a shoemaker, and subsequently enlisted as a private in the royal artillery. While in this position he began to employ his spare moments in scientific study and experiments, especially in the department of electricity; mastered the discoveries of Oersted, Faraday, Arago, and Ampère, and even made improvements upon the rotary cylinders of Ampère. In 1824 four papers on electricity were furnished by him to the *Philosophical Magazine*, and in 1825 he devised an improved electro-magnetic apparatus, for which the Royal Society awarded him a silver medal and a purse of thirty guineas. He was for many years professor of experimental philosophy in the East India Company's military academy at Addiscombe, and in the latter part of his life lecturer on science at the Royal Victoria Gallery, Manchester. D. at Manchester in Dec., 1850.

Sturgeon Bay, p.-v. and tp., Door co., Wis., located on an arm of Green Bay, 2 miles from Lake Michigan, contains 3 churches, good schools, 2 newspapers, 5 hotels, and 2 saw-mills. Pop. 690. Sturgeon Bay, on which it is situated, is 8 miles long by 2 miles wide, affording an excellent harbor for largest vessels, and is connected with L. Mich. by a ship-canal. H. HARRIS, ED. "DOOR CO. ADVOCATE."

Stur'ges (JONATHAN), b. at Southport, Conn., Mar. 24, 1802; came to New York in 1821; entered as clerk in a mercantile house, in which he became a junior partner in 1828, and senior partner in 1836, remaining until 1868, when he retired from business with a large fortune. He was a director of the Illinois Central R. R., the success of which was in a great measure due to his exertions. During the civil war he gave his earnest support to the national government; was president of the Union League Club in 1863, and was subsequently prominent in the measures to break up the "Tweed Ring" and inaugurate a municipal reform in the city of New York. He was active in religious movements, and gave largely for philanthropic and charitable purposes. D. at New York Nov. 28, 1874.

Stur'gis, p.-v. and tp., St. Joseph co., Mich., at the junction of Lake Shore and Michigan Southern and Grand Rapids and Indiana R. Rs., has 6 churches, a union school, 2 banks, 1 newspaper, 2 hotels, and several manufactories. P. of v. 1768; of tp. 2306.
A. H. WAIT, ED. "JOURNAL."

Sturgis (SAMUEL DAVIS), b. at Shippensburg, Pa., in 1822; graduated at West Point 1846; served as lieutenant of dragoons in the Mexican war; was made prisoner while on a reconnoissance just before the battle of Buena Vista; subsequently served in California, New Mexico, and on the frontiers, and was made captain in 1855. At the breaking out of the civil war he was in command of Fort Smith, Ark.; all his officers resigning, he abandoned the fort, thus saving his command and most of the material. In May, 1861, was made colonel of cavalry, serving in Missouri; in August a brigadier-general, and assigned to the Army of the Tennessee, afterward to the command in Kansas, and in 1862 to that of the fortifications at Washington, subsequently serving in the field at the battle of Fredericksburg and in the South and West; in 1865 he was brevetted brigadier-general and major-general. His rank in the regular army is colonel of cavalry.

Sturleson (SNORRE). See SNORRE STURLESON.

Sturm's Method, or **Sturm's Theorem,** a method for the determination of the number of real roots of a numerical equation which are included between given limits, discovered by J. C. F. Sturm (1803–55), and embodied in a memoir read to the French Academy of Sciences May 23, 1829.

Sturt (Sir CHARLES), b. in England early in the present century; entered the army at an early age, and in 1825, having reached the rank of captain, was stationed at Sydney, New South Wales. In 1828 he was the leader of an expedition organized by government to explore the unknown region of the interior of Australia, during which he discovered the Macquarie, Castlereagh, and Darling rivers, and soon after led another expedition which explored the course of the Murrumbidgee River, and in June, 1830, discovered the great Murray River, which he followed to its mouth in Lake Alexandrina, returning early in 1831. In 1844 he undertook a still more difficult journey, penetrating to the great stony desert nearly in the centre of the continent, and upon his return was made register-general and subsequently colonial secretary of South Australia. In consequence of his exposure in these expeditions he became totally blind, and returned to England, where he was knighted a short time before his death. He published *Two Expeditions into the Interior of Southern Australia in 1828–31* (1833) and *Narrative of an Expedition into Central Australia in 1844–46* (1849). D. at Cheltenham June 16, 1869.

Stur'tevant (JULIAN M.), D. D., b. at Litchfield, Conn., in 1805; became professor of mathematics, and in 1844 president of Illinois College, a position which he still retains. He has contributed through the *Biblical Repository*, *New Englander*, and other journals largely to the theological literature of the day, and published a lecture on *The Present Attitude of England toward the United States* (1864).

Stutsman, county of Dakota, formed since the census of 1870. Cap. Jamestown.

Stuttering. See STAMMERING, by W. A. HAMMOND, M. D.

Stutt'gart, capital of the kingdom of Würtemberg, with 107,273 inhabitants in Dec., 1875, is in a charming valley among hills covered with forests and gardens, and is regularly and beautifully built. The Altstadt, occupying nearly the centre, and grouped around the market-place, contains several small and narrow streets, but the new parts of the city, mostly erected during the nineteenth century, and surpassing the Altstadt twelve times in extent, have broad and beautiful streets and symmetrical squares. The most prominent point is the palace square, ornamented with gardens and fountains, containing the jubilee column, 16 mètres high, and surrounded with magnificent buildings. Among these the new palace is the most remarkable—a very handsome structure, with two projecting wings, the central building bearing an immense gilded crown and containing 365 rooms rich in art-works by Dannecker, Gegenbaur, Thorwaldsen, and others. To the right of this edifice stands the old palace, built 1553–70, a gloomy castle with towers and pinnacles, but containing a beautifully-painted chapel and large halls, the curious Reitschnecke, a spiral horse-path giving access to the third floor, and in the court the equestrian statue of Eberhard, the first duke of Würtemberg. In the left wing of the new palace is the royal theatre, finished in 1846, and opposite the palace is the Königsbau, a beautiful structure with an Ionian colonnade, built by Leins 1855–59, and containing numerous shops, elegant cafés, a concert-hall, and other assembly-rooms. Near the palace square is the new dépôt, an immense building, with a tasteful portal on columns, large, beautiful halls, and rich interior ornamentation; and opposite this is the new post-office, also an elegant structure. In the rear of the old palace is the Schiller Square, containing the statue of the poet, the immense building of the palace of the princes, and the parish church, erected 1436–90, and restored in 1841 by Heideloff. One of the most beautiful and most important streets is the Neckar-strasse, running from the palace square in a north-eastern direction, and containing the museum of natural science with a rich collection of mammals; the national library, comprising 300,000 volumes, 130,000 pamphlets, 3600 manuscripts, 2300 incunabula, and a collection of 8700 Bibles in 89 different languages; the museum of art, containing an art school and collections of paintings and statues, etc. Nearly parallel with the Neckar-strasse runs the Königs-strasse, traversing the palace square, dividing the city into two parts, an eastern and western, and containing the royal stables with many noble horses; the royal central hall for commerce and industry, with a good library and a very complete collection of native and foreign industrial products, models, fabrics, machines, etc. Other remarkable buildings are the museum for Würtembergian antiquities, the polytechnic school, the new market hall; and among the churches, the Leonhard's church, Johannis church, a Roman Catholic and a new English church, and the magnificent synagogue. The finest promenade is the palace garden, a park with lakes, fountains, statues, etc., stretching from the palace for a distance of about 2 miles. In the vicinity are the royal summer palaces, Solitude, Villa Rosenstein,

Wilhelma, and the Villa, and the charming town of Cannstadt on the Neckar, with 12,000 inhabitants, much frequented as a bathing place, connected with the city by a railway, and reached in eight minutes. The industry in woollen manufactures is important: a wholesale cloth-fair is annually held in August. The manufactures of pianofortes, carriages, chocolate, sugar, and machinery are also considerable. The commerce of the city is extensive; the book and art trade are especially important. The name *Stuttgart* first occurs in history in 1229. The city was held by Austria from 1519 to 1534, and occupied by Alba in 1546 in the Schmalkaldian war. In the period from 1634 to 1638 one half of the inhabitants died (8810) from the plague. In the wars of Louis XIV. it was three times taken by the enemy; also several times during the wars of Napoleon. AUGUST NIEMANN.

Stutt's, tp., Lauderdale co., Ala. P. 1028.

Stuy'vesant, p.-v. and tp., Columbia co., N. Y., on Hudson River and Hudson River R. R. P. 2263.

Stuyvesant (PETER), b. in Holland in 1602; served in the West Indies; was director of the colony of Curaçoa; lost a leg in an attack upon the Portuguese island of St. Martin; returned to Holland in 1644, and in 1647 was made director-general of the New Netherlands, retaining the position till 1664, when the colony fell into the hands of the English, who changed its name to New York. Upon his arrival at New Amsterdam (now the city of New York) in May, 1647, he made peace with the Indians, whom his predecessor had provoked to hostility, and in 1650 went to Hartford, Conn., where he arranged with the English commissioners the boundary-line between the Dutch and the English possessions in North America. In 1651 the Dutch had built a fort on Delaware River, then called the South River, in distinction from the Hudson, or North River, which the Swedes claimed to be an encroachment upon their rights; and in 1654 the Swedish governor Rising took possession of the fort, which occupied the site of the present Newcastle. In 1655, Stuyvesant sailed for the Delaware with seven vessels conveying 600 or 700 men, recaptured the fort, and took possession of the entire colony of New Sweden. For nearly ten years there was no trouble from abroad, but discontents had sprung up against the arbitrary administration of the Dutch West India Company. In 1653 a convention of two delegates from each settlement in the colony assembled and demanded that obscure and obsolete laws should not be revived, and that no officer should be appointed except with the approbation of the people. Stuyvesant replied that the magistrates derived their authority from God and the Dutch West India Company, and not from a few ignorant subjects, and ordered the convention to disperse under pain of condign punishment. The embers of discontent, however, still smouldered, and the governor and the people were on ill terms. The English colonies in New England, in spite of the repeated remonstrances of the governor, began to encroach upon the boundaries of New Netherlands. In 1664, Charles II. of England issued a charter to his brother, the duke of York, afterward James II., bestowing upon him all the country between the Hudson and the Delaware, including New Netherlands, as well as some territory which had previously been granted to the New England provinces. In August of that year, although England and Holland were at peace, Col. Nicolls, with an English fleet, appeared in the bay and demanded the surrender of New Amsterdam. Stuyvesant at first refused, but the municipal officers, seeing little hope of successful resistance, and having no very warm attachment to their Dutch masters, insisted that he should yield, and the town was surrendered Sept. 3, 1664, and its name changed to New York—a designation soon extended to the whole province of New Netherlands. Stuyvesant went to Holland the next year to render an account to his superiors of his administration and the loss of the colony, but returned soon after, and passed the remaining eighteen years of his life at his farm, called the *Bouwerij*, which has given its name to the present street called the Bowery, then a quiet country-road, long afterward known as Bowery Lane, which ran past it. A pear tree which he had brought from Holland in 1647, and planted in his garden, was standing at the corner of Thirteenth street and Third avenue and bore fruit until about 1860. He was buried in the vaults of a chapel which he had built at his own expense upon his farm, and dedicated according to the ritual of the Reformed Dutch Church. Its site is now occupied by the Episcopal church of St. Mark's in the Bowery, and the stone which had been placed over his grave is built into the eastern wall of the church. The inscription reads: "In this vault lies buried Petrus Stuyvesant, late captain-general and commander-in-chief of Amsterdam, in New Netherlands, now called New York, and the Dutch West Indies. D. in Aug., A. D. 1682, aged eighty years." A. H. GUERNSEY.

Sty [Ang.-Sax. *stigend*], (*hordeolum*), a small boil which occurs on the edge of the eyelid. It should be treated with a warm-water dressing or light wet poultice; after the discharge of a little pus and a slough, it usually gets well at once. If there be a long succession of sties, as sometimes happens, iron and quinia, with occasional mild laxatives, will be useful.

Style, Old and New. See CALENDAR, by PRES. F. A. P. BARNARD.

Stylites, or PILLAR SAINTS (which see).

Stylites, St. Simeon. See SIMEON STYLITES.

Styptics. See BLEEDING.

Styraca'ceæ [*i. e.* the storax family: from the typical genus, *Styrax*], a small order of trees and shrubs, exogenous and gamopetalous, diplostemonous or polyandrous; the stamens commonly monadelphous or polyadelphous, and adnate to the base of the corolla; the calyx more or less adnate, and the seeds few and large, with a bony coat; the leaves alternate and simple. Mainly tropical or subtropical, Asiatic and American, but with several representatives in the U. S. Two species of *Halesia*, the snowdrop tree, not rare and much prized in ornamental cultivation, grow wild from Virginia to Florida. Our species of *Styrax* are handsome flowering shrubs, but unimportant. Other species yield fragrant gum-resins containing benzoic acid and some aromatic principles. Storax exudes from wounds of the trunk of *Styrax officinale* of Syria, benzoin from *S. Benzoin* of Java, etc.; both are used for incense in the Latin and Greek churches; benzoin also in the preparation of paregoric, in the cosmetic called "virgin's milk," and formerly was an article of considerable repute in medicine. Benzoin in English commerce is called gum-benjamin. The leaves of *Symplocus tinctoria* (called sweet-leaf) are used in Carolina for dyeing yellow. ASA GRAY.

Styrax. See STYRACACEÆ.

Styr'ia [Ger. *Steiermark*], province of Austria, bounded N. by Upper and Lower Austria, E. by Hungary, S. by Croatia, and W. by Illyria. Area, 8658 sq. m. P. 1,137,990, of whom 710,000 are of German and 427,000 of Slavic descent. With the exception of the southern part, where there are some plains, on which and in the valleys are raised wheat, though not enough for home consumption, maize, tobacco, flax, hemp, wine, and fruit, the whole province is mountainous, and cattle-rearing, dairy-farming, mining, and manufactures of metallic wares are the principal branches of industry. The Noric Alps cover the surface between the Ens and the Mur; the Styrian Alps, between the Mur and the Drave; and the Carnic Alps, between the Drave and the Save. These mountains rise to a height of between 7000 and 8000 feet, and are rich in iron, copper, salt, alum, marble, and coal: 516,136 cwts. of iron, 404,986 cwts. of coal, 160,000 cwts. of salt, 4145 cwts. of alum, 1047 cwts. of copper are annually raised, besides some lead, silver, gold, zinc, and vitriol. Cap. Grätz.

Styx [Στύξ, "the Hateful"], in the Greek mythology, was a river of Hades which flowed nine times around the lower world. At the entrance to Hades was the abode of the nymph or goddess Styx, by whom the most solemn oaths of the gods were sworn.—STYX was also the name of the highest waterfall in Greece, near Nonacris in Arcadia. The ancients, like the modern residents of the vicinity, considered its waters fearfully poisonous, and it was believed that no vessel could hold any of it unless made of the hoof of an ass or horse. The ancients associated this waterfall with the mysterious Styx of the lower world.

Suabia. See SWABIA.

Suak'im, town belonging to Turkey on a small island in the Red Sea, near the African coast, in lat. 19° 10′ N., is important as a station for the pilgrims passing from and to Africa. P. about 8000.

Suam'ico, p.-v. and tp., Brown co., Wis., on Green Bay. P. 1074.

Sua'rez (FRANCISCO), b. in Granada, Spain, Jan. 5, 1548; entered the order of Jesuits at an early age; became professor in succession at Alcalá, Salamanca, Rome, and Coimbra. He was a voluminous writer; his complete works, filling 23 folio volumes, were published at Mentz and Lyons (1630 *seq.*); new editions at Venice in 1640, and at Besançon in 1856–62. His *Defensio Fidei* (1613) was ordered by the Parliament of Paris to be burned, because it maintained that the pope had power to coerce kings. D. in Lisbon Sept. 25, 1617.

Suber'ic Acid [from the Lat. *suber*, which designates both "cork" and the "cork tree;" Ger. *Korksäure*]. The name was originally due to the fact that this acid was first obtained by the action of nitric acid on cork. Fats generally, however, yield it by the same treatment, and it is by no means a characteristic product of cork. Suberic

acid is a homologue of oxalic and succinic acids, and its general characters are those of that dibasic family of acids. Its empirical formula is $C_8H_{14}O_4$, and its rational constitution is most likely $O_4.C_2.6H_2C.H_2$, the last H_2 being metalloidal or basic, and replaceable by one metallic dyad or two metallic monads, while the other twelve equivalents of H, being enclosed in the radical or *homologen* molecules (see HOMOLOGY and VOLUMES, MOLECULAR), are not thus replaceable. To obtain suberic acid free from the other acids produced by the action of nitric acid on fats, the mixed product is treated with cold ether, in which this acid is almost insoluble. It is necessary, however, to purify it further by recrystallization. It may be obtained in large needles, which sublime like oxalic acid. It is sparingly soluble in cold, but easily in boiling water, and soluble in alcohol. Density not recorded as yet, so that its molecular volume cannot be compared with that of oxalic acid—a comparison which, when possible, will give us, by simple difference, the volume of the six homologen molecules present. HENRY WURTZ.

Subia'co [anc. *Sublaqueum*], town of Italy, province of Rome, about 44 miles E. N. E. of the city of Rome. It derived its name from its situation below a villa belonging to Nero, in the grounds of which were three lakes. The town stands on a hill on the right of the Teverone, which is overlooked by the Simbruini chain. The views from this town, and especially from the ruins of Nero's villa, 1½ miles higher up the river (where, Tacitus tells us, the table at which the emperor was feasting was once overthrown by lightning), and from the still more elevated monastery of St. Benedict, are of surprising beauty, and draw hither, in spring and early summer, artists from all parts of Europe. The fine old castle, with all its historic associations, the picturesque waterfalls, the grand old monasteries, the superb forests of the neighborhood, all unite to charm the eye and the imagination. Even the dark and gloomy interior of the town pleases the traveller from its mediæval air. The monastery of Santa Scolastica (founded in the fifth and restored in the tenth century) contains much that is worthy of notice, architecturally and otherwise; its once-celebrated library, so rich in MSS., is now dispersed, but it is still remembered with interest as the place where the printing-press was first used in Italy, a *Donatus* and a *Lactantius* (1465) being the first issues. The monastery of St. Benedict, the first founded by the saint himself, was rebuilt in 817; the churches connected with it are of the eleventh, twelfth, and thirteenth centuries, but all are very curious. The modern town is of no special interest. P. 7367.

Sub'lette, p.-v. and tp., Lee co., Ill., on Illinois Central R. R. P. 1300.

Sublimate. See SUBLIMATION.

Sublima'tion [Lat. *sublimatio*]. This is a chemical process of separation and purification, applicable only occasionally in cases in which a volatile substance condenses or crystallizes from the condition of vapor directly to the *solid* condition, and not to the usual liquid form. In such cases this method of obtaining bodies in pure and crystallized form is highly convenient and valuable. Among the more important substances to which this method is applicable are *sulphur, iodine, vermilion, corrosive sublimate, calomel, salts of ammonia, arsenious oxide, oxalic, benzoic, succinic, and pyrogallic acids, camphor, caffeine*, etc. As, while in a state of vapor, those substances which volatilize at low temperatures will readily pass through porous diaphragms like paper, it is often convenient to cover the lower vessel, containing the substance to be volatilized, with paper, which will prevent the crystals that condense in the head or upper inverted vessel from falling back and causing waste of time. In cases of bodies requiring high temperatures wire-gauze screens may be employed in the same way. H. WURTZ.

Sublime' [Lat. *sublimis*], **The.** Contradistinguished from the beautiful, which charms and attracts us, the sublime awes us, moves us with a feeling of pleasure mixed with fear. The sublime in nature is usually found in the boundless expanse of the ocean, in the resistless might of its waves when moved by a storm, or more frequently in the thunderstorm with its threatening look, its vivid and destructive lightnings, and its deafening crashes of thunder. But still more adequate is the manifestation of the sublime in instances of moral heroism—in deeds of daring and self denial; the sublime in art has most frequently made use of this phase. Kant in his *Critique of the Judgment* (§ 23–53) has given the first thorough and systematic treatment of the sublime. According to him, "while the beautiful in nature appertains to the form of an object—hence to its circumscribed limits—the sublime, on the contrary, is to be found also in formless objects: a want of limitation attaches to it. It is, however, represented as a whole, and not as something merely fragmentary. The beautiful may therefore be regarded as the portrayal of an idea of the understanding (not a mere concept), but the sublime is rather the portrayal of an idea of the reason, which from its nature cannot be adequately represented by material things." "The pleasure of the beautiful appertains to the quality of an object, while the sublime is manifested chiefly in the quantitative aspect of it." "To the charm of the beautiful there is frequently joined a sportiveness, but the sublime is always earnest." "The sublime in its proper form is not presented in a sensuous manner, but concerns only ideas of the reason, whose very incommensurability with sensuous forms, being exhibited, stirs the heart." "The beautiful pleases us immediately, but in its presence we feel disinterested; the sublime pleases us, but through its hostility to our sensuous interests." Cousin (*On the True, Beautiful, and Good*, lecture vii.) says: "A beautiful object is something completed, circumscribed, limited, which all our faculties easily embrace, because the different parts are on a somewhat narrow scale. A sublime object is that which, by forms not in themselves disproportional, but less definite and more difficult to seize, awakens in us the sentiment of the infinite." Hegel (*Æsthetics*, 2d part, div. i. chap. ii.) makes the sublime a province of symbolic art, whose chief function is to portray the purification of spirit and its separation from the world of sense and all visible existence. "The highest principle is regarded as existing apart by itself, and as incapable from its very nature of finding adequate expression in the finite appearances of the real world." "The sublime arises in an attempt to express the infinite without finding in the domain of visible phenomena an object capable of representing it. The infinite elevates itself above particular existences, considered either in themselves or in their totality; they are as nothing before it; and the positive relation which sensuous objects have to the beautiful, in the sublime changes to a negative relation which is more in conformity to the divine nature. God is thus represented as purified of all contact and participation with visible appearance." "In the Orient, in India, the One, or Substance, is conceived as immanent in contingent existences created by it; they are portrayed as mere instruments of the divine power, or as mere ornaments for the display of the glory of the Absolute." In the *Bhagavat Gita* (ch. xi.) the vision of the Universal Form of Vishnu furnishes us the highest example of this phase of the sublime. The speech of the *Erd-Geist* in Goethe's *Faust* is an example quite similar in form and content. In Hebrew poetry Hegel finds the highest realization of the sublime: "Jehovah is not 'immanent' in nature but 'transcendent'—lord over the universe—and in his presence the entire creation is devoid of power and sinks into nothingness. The grandeur of the Lord is revealed by the fact that the real world, with all its splendor, pomp, and magnificence, is a mere accident, an instrument, an ephemeral appearance in comparison with the eternal and immutable Being. In the 104th Psalm, God is represented as covering himself with light as with a garment, and as stretching out the heavens like a tent. 'He layeth the beams of his chambers in the waters; he maketh the clouds his chariot; he walketh upon the wings of the wind; he looketh on the earth, and it trembleth; he toucheth the hills, and they smoke. He laid the foundations of the earth, that it should not be removed for ever.' In the psalm of Moses (Ps. xc.) the finitude of man furnishes the contrast which makes the portrayal of the omnipotence of God sublime." For genial essays on this subject the reader is referred to the writings of Burke, Dugald Stewart, and Addison. The famous treatise of Longinus (Περὶ Ὕψους) should not be omitted. WILLIAM T. HARRIS.

Sublime Porte. See PORTE.

Subluxation. See SPRAIN.

Submarine Blasting. See APPENDIX.

Submarine Forests. See FOSSIL BOTANY and FOSSIL FORESTS, by PROF. J. S. NEWBERRY, M. D., LL.D.

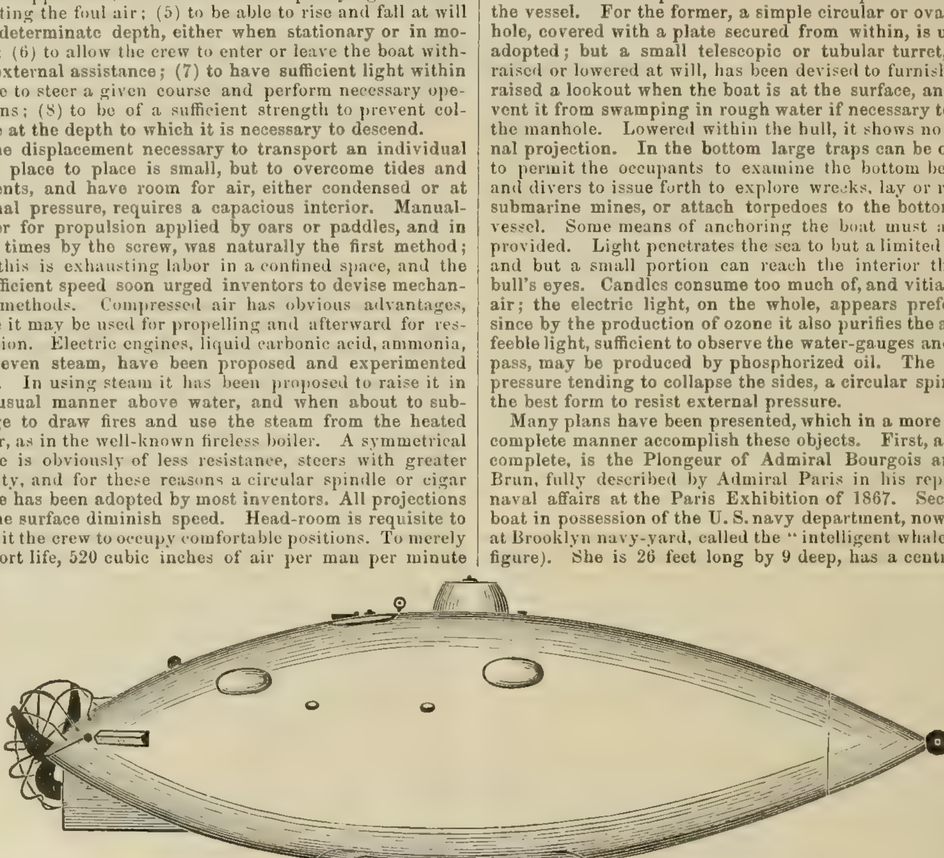
Submarine' Naviga'tion, the art of navigating a submerged vessel. It has been said that man, who was created to live on the surface of the earth, is impelled by thirst of adventure to dig into its bowels, search the depths of its waters, and to raise himself into the clouds. These desires, which date from the most remote times, are further stimulated by the necessities of warfare. Divers were employed at the siege of Syracuse to remove the barriers placed below the surface of the water to obstruct and damage the Grecian vessels which might attempt to enter the harbor. The Syracusans trained persons for the same purpose, and for getting beneath and injuring the enemy's vessels. But as the diver, unaided, cannot usually remain under water more than one minute, and never more than two and a half or three minutes, nor descend to a greater depth than 12 to 20 fathoms, his ingenuity must soon have led him to devise means for prolonging his stay beneath

the water. It is probable that observation of the instinctive action of the elephant, in raising his trunk when swimming across lakes and rivers, first suggested the idea of an air-tube with a floating funnel attached. It is also very probable that the ancients, who built many subaqueous works, such as foundations of piers, bridges, and the like, had some contrivance like the diving-bell, and means for furnishing the workman with air. Finally, the moderns, by the use of an impermeable dress, a regulated supply of air, and the aid of the submarine lamp, remain under water three or four hours, and execute any class of work. All of these contrivances, however, confined the operations of the diver to a limited area and moderate depths, which may be termed submarine exploring.

In submarine navigation, of which authentic accounts do not date more than a couple of centuries, it is requisite that the course shall be held in any direction and at any depth, and with no communication with the surface except at long intervals. To accomplish these objects it is necessary (1) that the boat shall be of sufficient displacement to carry the necessary machinery for propulsion, also men and materials to perform the desired operations; (2) of such form as to be easily propelled and steered; (3) to have space for the crew to operate; (4) to carry a sufficient supply of pure air to support life, or to have means of purifying it and exhausting the foul air; (5) to be able to rise and fall at will to a determinate depth, either when stationary or in motion; (6) to allow the crew to enter or leave the boat without external assistance; (7) to have sufficient light within to see to steer a given course and perform necessary operations; (8) to be of a sufficient strength to prevent collapse at the depth to which it is necessary to descend.

The displacement necessary to transport an individual from place to place is small, but to overcome tides and currents, and have room for air, either condensed or at normal pressure, requires a capacious interior. Manual-power for propulsion applied by oars or paddles, and in later times by the screw, was naturally the first method; but this is exhausting labor in a confined space, and the insufficient speed soon urged inventors to devise mechanical methods. Compressed air has obvious advantages, since it may be used for propelling and afterward for respiration. Electric engines, liquid carbonic acid, ammonia, and even steam, have been proposed and experimented with. In using steam it has been proposed to raise it in the usual manner above water, and when about to submerge to draw fires and use the steam from the heated water, as in the well-known fireless boiler. A symmetrical figure is obviously of less resistance, steers with greater facility, and for these reasons a circular spindle or cigar shape has been adopted by most inventors. All projections on the surface diminish speed. Head-room is requisite to permit the crew to occupy comfortable positions. To merely support life, 520 cubic inches of air per man per minute are required; but the air is further vitiated by carbonic acid exhaled and animal impurities. A supply of compressed air may be carried in suitable tanks, and the foul air permitted to escape by a cock in the upper part of the boat, the carbonic acid being removed by washing the air with a fine spray or absorbing it by suitable chemicals. The same air may continue respirable by supplying the exhausted oxygen from a receiver, and destroying the animal impurities by the introduction of ozone produced in various ways. The displacement of the vessel, with all its permanent weights attached, must obviously be greater than its bulk of water. Therefore, to sink it when stationary, water must be admitted into some of its compartments; this may be done either by pumping in water or by allowing the air to escape and be replaced by water. Provision must be made for automatically adjusting and preserving the boat's horizontality, for when wholly submerged and at rest it is in a state of unstable equilibrium. To rise, the water must be pumped or forced out by compressed air. In motion the boat is made to descend or rise at will by the use of diving-fins or rudders. The depth is ascertained by water-gauges. Since the ultimate object of the voyage is either the exploration of the bottom of the sea, of wrecks, or attacking an enemy, some independent mode of entrance and exit should be provided both at the top and bottom of the vessel. For the former, a simple circular or oval manhole, covered with a plate secured from within, is usually adopted; but a small telescopic or tubular turret, to be raised or lowered at will, has been devised to furnish when raised a lookout when the boat is at the surface, and prevent it from swamping in rough water if necessary to open the manhole. Lowered within the hull, it shows no external projection. In the bottom large traps can be opened to permit the occupants to examine the bottom beneath, and divers to issue forth to explore wrecks, lay or remove submarine mines, or attach torpedoes to the bottom of a vessel. Some means of anchoring the boat must also be provided. Light penetrates the sea to but a limited depth, and but a small portion can reach the interior through bull's eyes. Candles consume too much of, and vitiate, the air; the electric light, on the whole, appears preferable, since by the production of ozone it also purifies the air. A feeble light, sufficient to observe the water-gauges and compass, may be produced by phosphorized oil. The water-pressure tending to collapse the sides, a circular spindle is the best form to resist external pressure.

Many plans have been presented, which in a more or less complete manner accomplish these objects. First, as most complete, is the Plongeur of Admiral Bourgois and M. Brun, fully described by Admiral Paris in his report on naval affairs at the Paris Exhibition of 1867. Second, a boat in possession of the U. S. navy department, now lying at Brooklyn navy-yard, called the "intelligent whale" (see figure). She is 26 feet long by 9 deep, has a centre and bilge keel; propelled by four men; two small tanks contain compressed air; two large tanks, at bottom, contain water for sinking the boat, and communicate with the air-tanks and with the water outside of the boat; steering-rudders and diving-fins are provided; also an iron cupola, having bull's eyes in it for the lookout. A compass to indicate the course, a water-gauge to show the depth, and an air-gauge to show the pressure of air in the boat, are provided; rectangular valves for entrance or exit through the bottom. There is also a circular opening on top. An apparatus is provided for spraying water through the air when it becomes foul, and escape-valves are placed in the top of the boat for the escape of foul air. The water-tanks are filled for sinking the boat by opening a valve, and can be emptied by pumps or forced out by compressed air. Two 15-inch shot are fitted for anchoring with wire rope cables working through water-tight stuffing-boxes. This boat will hold thirteen persons, and has been tried with that number of persons on board. For a short time she can make a speed of 4 miles an hour. To sink, admit water into the bottom tanks until the boat sinks below the surface; the men at the cranks propel the boat, and the man at the lookout works the diving and steering rudder until the proper depth is reached. Having reached the desired position, the boat is anchored, and air let from the tanks into the boat until the air-gauge shows a pressure greater than the water-pressure for that depth. The bottom valves may then be opened, and a diver pass out. Wishing to rise, this valve is closed, communication is opened between the air- and water-tanks, water is driven out, and the boat rises.



Intelligent Whale.

It is apparent to the writer that while short voyages can be performed, and a certain time be spent beneath the water, successful submarine navigation is a chimera. The difficulties of navigation on the surface in a dense fog, even when guided by a compass, are familiar to most persons; but when the fog assumes the density of water, the difficulties are increased tenfold. In fact, with the insufficient speed given to a body wholly submerged it becomes impossible to direct a vessel upon a given object. It is probable that the most successful application of this principle will

be that adopted in the construction of the "fish torpedo-boat" used during the civil war by the Confederates at Charleston, a cigar-shaped boat of galvanized iron, about 35 feet long, 3 feet wide, and 5 feet high in the middle. It was propelled by a screw worked from the inside by seven or eight men. It had two manholes, which could be tightly closed from the inside, when it contained air enough for two or three hours' submersion. It had outside two fins, which caused it to rise and fall when in motion. The manholes were provided with bull's eyes to permit seeing in every direction. The intention of the designer was that it should move to attack just awash, and on approaching an enemy dive, dragging a floating torpedo behind it which should explode as it struck the bottom of a ship under which the fish had passed. While practising to pass under a large receiving-ship in Charleston harbor, it went down with such velocity that it stuck its bow in the mud, and could not rise again by any efforts of its crew. Before it could be found and raised, all on board were asphyxiated, Mr. Hunley, the owner, being of the number and in charge. The same boat afterward, in 1864, sunk the U. S. S. Housatonic with a pole torpedo, but was drawn into the hole occasioned by the torpedo, went down, and drowned the crew. (This information is derived from a letter of Gen. Beauregard to Gen. J. G. Barnard, U. S. corps of engineers, and by him communicated to the writer.) W. N. JEFFERS.

Subpœ'na [Lat. *sub, pœna*, "under a penalty"], in law, is a writ or process by which either parties or witnesses are compelled to appear in court or before a judicial officer and answer or testify, as the case may be, under a penalty for their disobedience. There are several different kinds of this writ. In the courts of chancery it was for a long time the ordinary process, issued upon filing a bill of complaint, for the purpose of procuring the defendants to appear and answer. This use, however, was abolished in England some time before the recent consolidation of the law and equity courts and procedure, and the defendant in a chancery suit was simply served with a copy of the bill, and with a notice or summons endorsed thereon or accompanying the same. The common species of subpœna now used in all the courts, civil and criminal, is the subpœna *ad testificandum*, for the purpose of ordering witnesses to attend upon a trial or other judicial examination, and to give their evidence thereat. It generally purports to be issued by the court, to be signed by its clerk, and sealed with its seal, but in reality, according to the loose practice prevailing in many States, it is issued by the attorney. It commands the person to whom it is addressed to lay aside all excuses and pretences, and to appear before the court or officer at the time and place mentioned, and testify on behalf of the party issuing it, under a penalty in case of a neglect to comply with the order. A variety of this species is termed the subpœna *duces tecum*, and contains an additional clause directing the witness to bring with him into court certain books, papers, etc., in his possession which may be useful as evidence. Both these forms are compulsory; the witness must obey the mandate, and it is for the court alone to decide whether his evidence or the documents he is ordered to produce are material and proper. If the witness violates the command, an action for damages may be maintained against him by the party who is materially injured by his default. The subpœna is served by exhibiting the original to the witness and delivering to him a copy thereof, and paying him his lawful fees for travel and for attendance. Both the subpœna *ad testificandum* and the subpœna *duces tecum* may be used by committees of legislatures and other *quasi* judicial bodies lawfully constituted for the purpose of carrying on investigations, as well as by courts and magistrates.
JOHN NORTON POMEROY.

Subroga'tion [Lat. *subrogare*, to "substitute"], in law, is the substitution of another person in the place of an original creditor, to whose rights and remedies, in respect of the debt and against the debtor, the party thus substituted becomes entitled. The doctrine of subrogation was borrowed from the Roman law by the courts of equity, and is now to some extent recognized and enforced by the courts of law; it is, however, a part of the equity rather than of the common-law jurisprudence. Although the substitution of one creditor for another may be effected by contract, yet the most important cases, and those to which the term "subrogation" is technically applied, result immediately by operation of the law itself from the performance of certain acts which modify the prior relations of all the parties interested. It may be stated, as a general principle, that whenever a person *secondarily* liable for a debt pays the same, the demand is not thereby absolutely discharged, but he at once and by operation of the equitable doctrine succeeds or becomes subrogated to all the rights, remedies, and securities which the creditor held against the debtor primarily liable, and may enforce the same as a creditor against such debtor in order to reimburse himself for the outlay which he has made on behalf of that party. The following are some of the most common and important instances which result from an application of this general principle to different facts and circumstances: (1) When a junior mortgagee pays the debt due to a prior mortgagee of the same land, he becomes entitled to the prior mortgage, is regarded as its equitable assignee, and can compel its actual assignment to himself. The rule applies to all cases where a junior creditor pays the demand of a prior creditor; he succeeds to the latter's claim and is entitled to all the securities held for its enforcement. (2) When one of several joint debtors pays the entire demand, he is entitled to a contribution from the others for their respective shares, and acquires the rights and securities of the creditor against them. (See CONTRIBUTION.) (3) The principle is most frequently applied in the case of the surety who pays the demand primarily owing by his principal debtor. He is entitled to recover their contributory shares from his co-sureties, if any, and the entire amount which he has advanced from his principal. To aid him in enforcing these rights, he is entitled to hold and use all the collateral securities given by the principal debtor to the creditor. For example, if as such surety he pays off a mortgage-debt, he is an equitable assignee of the mortgage itself. If the creditor has recovered a judgment against the principal and surety, or against the principal alone, and the surety pays the demand, he is not only entitled to hold this judgment, but he is permitted to enforce it by execution against the principal. (See the articles SURETYSHIP and SUBSTITUTION.) JOHN NORTON POMEROY.

Subscrip'tion, a legal term denoting a contract by which a person agrees with others to furnish a definite sum of money for a common object. The validity of this class of contracts is of difficult enforcement in the courts, owing to a usual indefiniteness in the statement of the conditions and the lack of evidence of any valid consideration for the promise. Subscriptions for charitable objects have, however, frequently been enforced when their objects are clearly expressed in the paper.

Subsist'ence of Ar'mies. In densely-peopled countries there will almost always be found such a superfluity of supplies beyond the immediate requirements of the population that a great army may subsist upon the country; yet even here the bringing of supplies to a considerable body of men is one of the highest problems of the art of war, for an interruption in the operations of the commissariat department must in a very few days dissolve the bravest and best disciplined army. This difficulty is greatly enhanced when an army is on the march, and as a soldier cannot carry upon his person food for more than about a week, provisions and supplies must be sent after the marching body by means of convoys; and these are always a special object of attack by a vigilant enemy, and their safety is one of the first objects of a commander. In our late civil war the issue of the most important campaigns was decided more by the question of supplies than by actual combat on the battlefield. The Atlanta campaign was a series of movements of which the main object of the Union commander was to interrupt the communication of the enemy with his sources of subsistence, and the Confederate general rarely made a stand except for the purpose of defending his line of supply. So in the final operations before Richmond and Petersburg, nearly all the operations of Gen. Grant had for their object the cutting off of the subsistence of the army under Gen. Lee, who, in fact, only abandoned his intrenchments when he could no longer subsist his army; and the final surrender of the remnant of the Confederate force was mainly owing to the fact that supplies for a few days failed to reach the troops in their retreat, compelling them to halt, and finally to break up into squads to procure food in an exhausted region. With subsistence for a few days within their reach, the Confederates might have made good their retreat into Southern Virginia and North Carolina, where they might have protracted the contest for an indefinite period. So in the Franco-German war, Paris was taken less by force of arms than by starving out the army which defended the city. Since the introduction of railroads the problem of subsisting an army, even at a distance from its great dépôts of supplies, has been greatly simplified. (See ARMY and COMMISSARIAT.)

Sub'stance [Gr. οὐσία; Lat. *substantia*; Ger. *Substanz*] appears as a philosophical term first in Aristotle, who uses it in two senses, between which it has wavered ever since. Logically, it is the first of the categories as opposed to the other nine, which are its accidents (συμβεβηκότα). There are first and second essences, the first always designating singulars—*e. g. a man, a horse*; the second being general terms, as *man, horse* (*Categ.* V.). It is also used in the

sense of εἶδος or constituting essence, in which acceptation it is sometimes rendered into Latin by *essentia* (*Metaph. IV.*, 8). The logical οὐσια is the first of induction (πρῶτον πρὸς ἡμᾶς); the metaphysical οὐσία, the first of deduction (πρῶτον φυσει). None of the post-Aristotelian philosophical schools had profundity enough to require the category of substance until the rise of the Neo-Platonists, who re-established it. Plotinus criticises Aristotle rather severely for not distinguishing between material and spiritual substance (*Enneads*, bk. vi.), as he himself did. Porphyry and Simplicius accepted the Aristotelian doctrine. In the Middle Ages the metaphysical view prevailed, and substance was identified variously with God, person, etc. The same is true of modern times, dating from Descartes. He regarded substance as that which can exist independently of anything else, and Spinoza (*Ethics*, i. def. iii.) as "that which is in itself and is conceived by itself"—a definition which, of course, identifies it with God. Leibnitz identified with substance the monads, whereby he sought to reconcile the dualism of Descartes with the monism of Spinoza. Locke looked upon substance as a mere imagined substratum, holding attributes together, but did not altogether deny its validity, as did Hume (*Human Nature*, pt. i. § 6). Kant classed substance in his Transcendental Table of the Concepts of the Understanding along with Cause and Community under the head of Relation, and defined its scheme as the "permanence of the real in time" (*Critique of Pure Reason*, p. iii., Meiklejohn's translation). Hegel defines substance as the "absolute, as relation to itself" (*Logik*, 2ter Th., S. 185, ed. 1834), and as "the unconditioned essence (*Wesen*) existing in and for itself, as being immediate existence" (*Propædeutik*, p. 105). Mill and the English school mostly follow Locke. In the orthodox doctrine of the Trinity, substance is used of the essential unity of the Divine Being as distinct from the tripersonality.

THOMAS DAVIDSON.

Substitu'tion [Lat. *substitutio*], a term in theoretical chemistry applied alike to a very wide range of phenomena or transformations, whose identity in nature is in some cases more than doubtful. The simplest cases included under the term are those in which one element presented to a compound of another, under appropriate conditions, expels or eliminates that other in the elementary form, taking its place in the new compound formed. Instances of this kind are the precipitation of metals from their solutions by other metals, expulsion of hydrogen from aqueous acids by metals, the decomposition of gaseous or vaporous chlorides by oxygen at elevated temperatures, chlorine being set free; and multitudes of others. These are the simplest cases of substitution, and appear to have suggested the word, which is here decidedly appropriate. On the discovery, however, by Gay-Lussac and Dumas, of the first facts relating to the reactions between elementary chlorine and hydrocarbon compounds—facts which soon multiplied enormously in the hands of Laurent and others—an analogy seems to have been assumed with the above real cases of substitution, and the idea arose that acidic or electro-negative elements could play the part, *when substituted therefor*, of basylic or electro-positive elements. From that time the *electro-chemical* ideas which Berzelius had begun to introduce into the science were dropped, and have been of late almost altogether neglected. Berzelius and his school protested, and urged that in these supposed substitutions there might be really complete molecular metamorphoses, new radicals being formed containing chlorine; but the discovery that the chlorine in chlorinated hydrocarbon compounds might be again removed and replaced by hydrogen, by the action of sodium-amalgam (or *nascent* hydrogen generally) was regarded as establishing the views of Laurent, and hence arose Dumas's grand *type-theory*, according to which, as now interpreted, substitution may take place in any compound, of any one or more of its elements or radicals, by any other elements or radicals, so long as the replacing elements or radicals have, without regard to position in the electro-chemical scale, the same amount of equivalency or atomicity as those displaced. The resulting compound is then maintained to retain the same *type*. (Under VOLUMES, MOLECULAR, some facts will be stated looking to a return, in a certain measure, to the track followed by Berzelius.)

In mineral chemistry the term substitution is applied to designate the admitted fact that a basylic element or metal may be replaced, in equivalent proportions, by certain other basylic elements, without changing the type, so long as the same relations of proportion remain between the aggregate oxygen belonging severally to the acids and to the bases that are present. (See SILICATES, CHEMISTRY OF.) For example, the general formula of *pyroxene* is $MO.SiO_2$, but, according to the views held by Dana and other leaders in mineralogy, a pyroxene might exist having the composition $(Ca.Mg.Mn.Fe.Na_2.K_2.Al^{\frac{2}{3}}.H_2)O.SiO_2$, or even one more complex still, in which the sum of the equivalencies of all the elements enclosed in the brackets would be that of M, or of one equivalent of a dyadic metal. Such a complex compound should still have the crystalline form, cleavage, hardness, and some other characters, of pyroxene. It is not to be denied, however, that several difficulties environ this mode of viewing silicates in the present state of our knowledge. Other similar cases of substitution occur among mineral sulphides and arseniets, in which iron, cobalt, manganese, nickel, and other metals replace each other in equivalent proportions, without alteration of species, while antimony and bismuth also replace arsenic, and selenium and tellurium replace sulphur. HENRY WURTZ.

Substitution, in law, denotes the putting one person in the place of another, so that the rights and powers which had been held by or given to the first may devolve upon the substitute. For example, in powers of attorney the agent appointed thereby is often clothed with an express power of "substitution"—that is, of naming a delegate who can act in his own place. In its more restricted and technical meaning the word belonged originally to the Roman civil law, and whenever thus used at the present day it describes certain legal facts or relations which are borrowed directly from that system of jurisprudence. In such special senses a substitution may occur in several different modes: (1) When through some act or proceeding of his own a person is substituted in place of one who was an original creditor, and assumes his right as creditor in relation to the debtor and the debt. The most familiar example is the case of a surety who pays the demand for which he and his principal are bound, and thereby acquires the position of creditor toward that principal. The name "subrogation" is now more commonly given to this species of substitution. (2) The term denotes certain forms of devises and legacies which were known to the civil law, and signifies the putting one person in place of another, so that the second may receive the testamentary gift instead of the first. A direct substitution occurred when a legacy or estate was given to A, and in case of his failure to take it, then to B. Another form permitted the substituted heir or legatee to take the gift directly from the first beneficiary; and it occurred when the testator gave his estate or a legacy to A, and directed that the latter should at his death or at some other time transfer the same to B. This species of substitution, called "fidei-commissary" (*fidei-commissa*), was undoubtedly the origin of the uses and trusts of the English and American law. JOHN NORTON POMEROY.

Subtrac'tion [Lat. *subtrahere*], the operation of finding from two given quantities a third which added to the second will give the first. The first is called the *minuend*, the second is the *subtrahend*, and the third is the *difference*. In arithmetical subtraction the subtrahend cannot exceed the minuend, but in algebra there is no such limitation. In all cases of algebraic subtraction the difference may be found by changing the sign of the subtrahend, and adding the result to the minuend. To distinguish this result from the arithmetical difference, already explained, it is called the *algebraic difference*. W. G. PECK.

Sub'way, a passage under the streets of a city for the reception of sewer-pipes, water-pipes, gas-pipes, telegraph-wires, etc. Subways were first introduced by J. W. Bazalgette, C. B., and are extensively employed in London and other British towns. They do away with the interruption of travel during the repair of breakages, but the first cost is very considerable. The term has also been made to include passages for underground street railways.

Success', v., Stratford tp., Coos co., N. H. P. 5.

Succes'sion [Lat. *successio*]. (1) As an original technical term of the common law, this word describes the quality or mode by which subsequent members of a corporation acquire the property and other rights which had been held by a different and prior set of persons who were members thereof. The power of perpetual "succession," by which the artificial body is kept in existence as one legal being, and its rights are transmitted through all its changes of membership, is one of the essential attributes of a corporation. (2) An entirely different meaning of the word has been borrowed from the Roman law by many modern English and American text-writers, and is applied by them to describe in a general way the devolution of estates from deceased owners upon the persons who by operation of law or by will become the recipients, and especially such devolution of personal estates. The word was a technical term of the Roman law, and has thence passed into all the systems founded upon that ancient jurisprudence. There is some confusion in this modern use and in the meanings given to the word. Sometimes it denotes the act or process of transmitting the estate from the deceased to the recipients; at others, the right to such transmission held by the recipients; and at others, still, the entire estate to be transmitted, with all its rights and

liabilities, regarded as a single legal entity—"the succession." The two former of these senses were embraced in the *successio* of the Roman law; the latter was expressed by the word *hæreditas*—inheritance. The essential conceptions which entered into the Roman system of succession were the following: Upon the death of a proprietor his physical being alone died; his legal or juridical person survived, and passed to another individual, who became the representative, or, as it were, the continuation of the defunct. This successor, whether a single person or more than one, was called the "heir" (*hæres*). The entire mass of property and other rights held by the deceased, and the entire mass of obligations resting upon him, were considered as one legal entity—a *universum jus*—and constituted the inheritance (*hæreditas*). This inheritance passed to and vested in the heir, and its passage to and acquisition by him was the "succession." The essential notion of a succession consisted, therefore, in there being no change in the legal subject—in the legal relations, rights, and liabilities—but only in the individual to whom that subject and those rights and duties attached. The heir succeeded to the deceased, prolonged his legal existence, and perpetuated his legal condition. The heir thus inherited all the property and claims of the defunct, and became chargeable with all his liabilities. An heir might be appointed in two different ways—either by will, the testamentary heir, or in case of intestacy he was designated by the law the legitimate heir. A Roman will had little resemblance to the English or American testament; it simply named the heir—whether one person or more—and perhaps added some legacies, which were special gifts out of the estate to particular individuals, chargeable upon the heir, and which he was bound to pay. If the deceased died intestate, the heir was selected by the law from among his relatives—first, the children or other descendants, and in their absence the nearest of the collaterals, according to settled rules establishing the degrees of relationship. The Roman law of succession passed through many progressive phases. In the earliest period the heir was bound to accept the inheritance with all its burdens, and thus became liable to pay all the debts of the deceased—a liability from which he could not escape. At a later period the law was modified so as to relieve certain classes of heirs from this forced responsibility. If slaves were named as heirs by will, they were still obliged to accept the inheritance with all its burdens, and were thence denominated "necessary heirs." To all other classes of heirs a certain time was given after the death to examine into the condition of the inheritance, and to elect whether they would accept or reject it. When, however, they once accepted and assumed the character of heirs, the full responsibility for all the obligations of the deceased devolved upon them. The ancient rule was further relaxed by Justinian. To all but the "necessary" heirs was given the benefit of an inventory; in other words, they were released from all responsibility for the debts of the defunct beyond the amount of the property received with the inheritance. After the Code and Pandects had been completed, the emperor Justinian in the 115th, 118th, 127th Novels remodelled the whole system, without, however, abandoning the fundamental conceptions upon which it was based. He determined in particular the heirs in cases of intestacy, ascertained the different degrees among the next of kin, and fixed in detail the portions belonging to each in various contingencies. Although the common-law doctrine of descents and inheritance of land was derived wholly from the feudal institutions, the English statutes of distributions, which regulate the succession to personal property, were largely patterned after this latest legislation of the Roman emperor. The English statutes have in substance, although with variations in detail, been generally adopted through the American States. In the English and American system of successions the administrator or executor, so far as his legal title is concerned, takes the place of the Roman heir. JOHN N. POMEROY.

Succession Wars were the natural result of the absolute monarchy, and became of a portentous frequency in the history of continental Europe in the eighteenth century. The Spanish succession war (1700–13) was followed by the Polish (1733–38), the Austrian (1740–48), the Bavarian (1777–79); and the first and the third of these wars caused an immense loss of life and property, the devastation of some of the most prosperous regions of Europe, and unspeakable sufferings and misery in thousands of families. Subsequently, the nonchalance with which Napoleon treated crowned heads, old dynasties, and their pretended rights opened people's minds to the truth of the ideas of the French revolution, and in the nineteenth century succession wars, in the strict sense of the word—wars for merely dynastic purposes, and devoid of any political, religious, or commercial interest—have become an impossibility.

The Spanish Succession War.—Charles II., king of Spain (1665–1700), had no children and no collateral male heirs, but, according to Castilian law, females were competent of succession, and there existed two female lines of the royal house of Spain, represented by the two most powerful dynasties of Europe, the Bourbon in France and the Hapsburg in Austria. Louis XIV., king of France, was a son of Anne of Austria, the eldest daughter of Philip III., and married Maria Theresa, the eldest daughter of Philip IV.; Leopold I., emperor of Germany, was a son of Maria Anne, the youngest daughter of Philip III., and married Margaret Theresa, the youngest daughter of Philip IV. Thus far, the French line had the preference, being the oldest, but both the Spanish princesses who went to France had formally renounced their claims to the Spanish crown, while those who went to Austria had not—a circumstance which much embarrassed Louis XIV. in his ambitious schemes, though without restraining him from pursuing his goal. To the other European powers the question was also of great interest. The Spanish monarchy comprised, besides Spain, Sicily, Naples, Sardinia, Milan, the Spanish Netherlands, nearly corresponding to the present Belgium, and vast possessions in America. A union between these dominions and either France or Austria would look very much like the beginning of a universal monarchy, and threaten the very existence of the other European powers. Both the candidates were aware of this difficulty, and neither of them put forth his claims in his own name, but both in that of some collateral heir: Louis XIV. contended for his second grandson, Philip of Anjou; Leopold I. for his second son, Archduke Charles. Meanwhile, a solution of the question was found and agreed upon. Leopold I. had a daughter, Maria Antonia, who had married Maximilian II., elector of Bavaria, and borne a son, Joseph Ferdinand, and this son was chosen heir-apparent by Charles II. and the Spanish Cortes, and acknowledged by France and Austria; but on Feb. 6, 1699, he suddenly died, and the question was reopened. In the intrigues which now ensued Louis XIV. was victorious, and on Oct. 2, 1700, Charles II. made a will by which he bequeathed all his dominions to Philip of Anjou. Shortly after (Nov. 1, 1700) he died, and Philip immediately repaired to Spain, and was accepted by the Spanish people as king, and also acknowledged by the other European powers with the exception of Austria, which began hostilities immediately in Northern Italy. But success made Louis XIV. incautious. His most difficult adversary was William III. of England, at once the shrewdest and the most irritated; and him he provoked in a manner which could not be forgiven. When he sent his grandson to Spain, he told him never to forget that he was a Frenchman. Shortly after, he began to regulate his northern frontier, thus approaching Holland, of which William III. was stadtholder. Finally, when the deposed and exiled king, James II., died at St. Germain (Sept. 16, 1701), Louis XIV. formally acknowledged his son, the elder Pretender, as king of England. William III. now formed an alliance between England, Holland, Hanover, and Austria, which was afterward joined by Prussia, the German empire, and Portugal, against France, which found no other allies than the prince-archbishop of Cologne, the elector of Bavaria, and, for a time, the duke of Savoy. For more than ten years the war was carried on in four different places—Catalonia, the valley of the Po, the Rhine countries, and the Spanish Netherlands. In Spain the French were generally successful. In 1704 the archduke Charles landed at Lisbon, and invaded Spain from the W. with an army composed of Dutch, British, and Portuguese troops. At the same time, Mordaunt took Barcelona, and penetrated from the E. into the country. The French were defeated and driven across the Pyrenees. But under the command of the duke of Berwick they soon retrieved their failures, and when (in 1707) Mordaunt, whose vanity and flimsiness provoked the archduke, left Spain, they again became masters of the country after the brilliant victory at Almanza, Apr. 25, 1707. In 1710, Berwick was recalled, and Charles once more succeeded in occupying Madrid and driving the French back across the Pyrenees, but Vendôme now took the command, and in a short and rapid campaign routed the English under Stanhope and the Germans under Starhemberg, carried the king back to Madrid, and put an end to the war in Spain. More dangerous was the struggle at the other points. In Italy the war commenced in 1701, and the Austrians under Prince Eugene conquered Milan and Mantua. But in 1703, Prince Eugene was recalled on account of the rebellion in Hungary under Francis II. Rakoczy, an intriguer of Louis XIV., and Vendôme was placed at the head of the French army. The result was, that in a short time the Austrians lost all their conquests, and were able to hold only a few points on the Po. After the battle of Ramillies, however, Ven-

dôme was removed to the army of the Rhine, and Prince Eugene returned to Italy. A complete change immediately took place in the fortunes of the two armies, and after being totally routed in the battle of Turin (Sept. 7, 1708) the French were compelled to withdraw altogether from Italy. Prince Eugene even penetrated into Southern France and besieged Toulon, though in vain. At the same time the English had conquered Sardinia, the Austrians Naples, and the only one of her great Italian possessions which Spain still retained was Sicily. But the decisive battles were fought on the northern and north-eastern frontiers of France. In 1702 a French army under Villars crossed the Rhine and united with the Bavarian army under the command of the elector himself. But in June, 1703, the elector again separated, having formed a plan of penetrating through the Tyrol and joining Vendôme in Italy. The Tyrolean diversion was very disastrous, and Villars recrossed the Rhine in disgust. Meanwhile, the duke of Marlborough approached at the head of a Dutch-British army, carrying one fortified point in the Spanish Netherlands after another, and defeating the French-Bavarian army at Schnellenberge July 2, 1704, while Prince Eugene forced his way up the plains between the Black Forest and the Rhine. A junction between Eugene and Marlborough was effected, and the French-Bavarian army was completely routed at Höchstädt (or Blenheim) Aug. 13, 1704. Still greater disasters followed. Villeroi was defeated at Ramillies, May 23, 1706; Vendôme at Oudenarde, July 11, 1708; Villars at Malplaquet, Sept. 11, 1709; and the French gained no victories where Marlborough or Eugene commanded. One fortress after another fell, and the French frontier lay open. Under these circumstances Louis XIV. asked for peace, but the demands of the allies were too humiliating; and although France was nearly exhausted, the old king was preparing for a new onset when a series of fortunate circumstances suddenly turned the scales in his favor. In Sept., 1710, the Tories came into power in England with Bolingbroke, and the great Whig general, the duke of Marlborough, was not looked upon with much sympathy by the new government. The emperor Joseph I., the eldest son of Leopold I., died without male issue Apr. 17, 1711, and his brother, Archduke Charles, succeeded him as Charles VI. But a direct union between Austria and Spain was as much dreaded by England and the other European powers as one between Spain and France, and by his accession to the imperial throne Charles lost all his allies. A congress was opened in Utrecht Jan. 29, 1712, and on Apr. 11, 1713, treaties of peace were signed between France, England, Holland, Prussia, Savoy, and Portugal, by which it was stipulated that the two lines of the Bourbon house, the French and the Spanish, should renounce all claims of inheriting from each other, and the two crowns should never be held by the same person. On July 13, 1713, Spain made peace with England and Savoy; June 26, 1714, with Holland; Feb. 6, 1715, with Portugal; and finally, by the treaties of Rastadt (Mar. 6, 1714) and Baden (Sept. 7, 1714), peace was concluded between Spain and France on the one side and Austria on the other. Spain ceded all its Italian and Dutch possessions to Austria, and Gibraltar and Minorca to England.

The Polish Succession War.—After the death of Augustus II., king of Poland and elector of Saxony, Feb. 1, 1733, one party of the Polish people wished to recall Stanislaus Lezczynski, who lived in exile in France, while another declared for the son of the late monarch, Augustus III. The former was supported by France, the latter by Russia and Austria, and the contest was decided by a Russian army which invaded Poland and expelled Stanislaus. By the Peace of Vienna (Oct. 3, 1735) Augustus III. was placed on the Polish throne, and Stanislaus received the duchy of Lorraine as a pension.

The Austrian Succession War.—As the emperor Charles VI. had no male heirs, it was the sole purpose of all his diplomatic negotiations during the latter part of his reign to obtain the accession of all the powers concerned to the Pragmatic Sanction, by which it was stipulated that after his death all the Austrian possessions, comprising, besides Austria proper, Bohemia, Hungary, Northern Italy, and the so-called Spanish Netherlands, should be transferred undivided to his eldest daughter, Maria Theresa, who was married to the grand duke Francis Stephan of Tuscany. The nearest claimant to the Austrian inheritance, the elector of Bavaria, Charles Albert, descending from Anne, a daughter of Ferdinand I., never gave his consent to the Pragmatic Sanction, and when Charles VI. died (Oct. 20, 1740) a general desire was manifested among the other European powers to break up the Austrian state and divide its dominions. Spain demanded the Italian territories; Augustus III., married to the eldest daughter of the emperor Joseph I., demanded Bohemia, etc.; and France was more than willing to see its old enemy, the house of Hapsburg, humiliated. Availing himself of this feeling, Frederick II. of Prussia marched his army into Silesia in Dec., 1740, and began the first Silesian war, which became the signal of a general attack. His claims to Silesia were neither better nor worse than such claims generally are, but the manner in which he enforced them was such that a man who in private life would employ such measures would no doubt soon be put in jail. Even in the diplomatic world his barefaced ambition astonished people, though they did not hesitate to follow his example. On May 18, 1741, a coalition was formed at Nymphenburg, near Munich, between France, Spain, and Bavaria, and soon after Prussia, Saxony, Sardinia, and Naples joined it. A French-Bavarian army under the command of Belleisle invaded Upper Austria and took Linz, and penetrated thence into Bohemia and occupied Prague. Another French army approached the Austrian Netherlands, and a Spanish-Neapolitan army attacked the Austrian possessions in Italy. On Jan. 24, 1742, the elector of Bavaria, Charles Albert, was crowned emperor of Germany in Frankfort, under the name of Charles VII. In Austria the situation was nearly desperate. The finances were in disorder and utterly exhausted; the army was disorganized, and all resistance seemed impossible. In this emergency Maria Theresa, fleeing from Vienna, repaired to Presburg, convoked the Hungarian diet, addressed it in person (Sept. 11, 1741), setting forth in a simple, natural, undiplomatic way how the world treated her, and what she wanted the Hungarians to do for her: and such a yell of enthusiastic cries, such a peal of clanging arms, answered her that the young queen fainted on her throne. But a few weeks later, 50,000 Magyars galloped toward the theatre of war; Upper Austria was cleared; the queen returned safely to Vienna; Bavaria was invaded; and on the very day when the new emperor was crowned, his capital, Munich, was taken and the Magyar horsemen encamped in his bedroom. In England, Maria Theresa found a good ally. The English government immediately furnished her with money, and negotiated a peace between her and her most dangerous enemy, Frederick II., by which she ceded Silesia, but got her armies free to be used against the French. Belleisle was compelled to leave Prague and retreat behind the Eger. An English fleet appeared before Naples and compelled the king to withdraw his troops from the Austrian dominions in Italy. An English-Austrian army was formed in the Netherlands under the command of George II., and defeated the French under Noailles at Dettingen June 27, 1743. In September of the same year Sardinia was bribed to leave the coalition by a promise of a small extension of her territory, and in December, Saxony too joined Austria. The whole of Bavaria was conquered, and in the spring of 1744 the Austrian army crossed the Rhine and penetrated into Alsace. This extraordinary success made Frederick II. uneasy. He knew very well that if Austria came out of the contest completely victorious, he would be called to account for his robbery of Silesia, and he determined to try to turn the scales before it should prove too late. In Aug., 1744, he began the second Silesian war for the "defence of the German empire and its representative." At the same time a reverse took place in the Austrian fortunes at other points of the contest. In Upper Italy a French army joined the Spanish, and fought with great success, and in the Netherlands, Maurice of Saxony (generally known as Marshal Saxe) began his brilliant campaign with the victory at Fontenoy, May 12, 1745. Soon, however, events occurred which gradually prepared people's minds for peace. On Jan. 20, 1745, the unhappy emperor, Charles VII., died; on Apr. 22 his son, Maximilian Joseph, concluded peace with Austria, and renounced all his claims to the Hapsburg inheritance; on Sept. 13 the husband of Maria Theresa was elected emperor of Germany under the name of Francis I. Frederick II. had become thoroughly disgusted with his allies, the French, and in the death of Charles VII. he found an opportunity of retiring from the coalition; peace was concluded between Prussia and Austria on Dec. 25, 1745. On July 9, 1746, Philip V. of Spain died; his wife, Elizabeth of Parma, the "arch-plotter," now lost her influence, and her ambitious desires of forming an Italian principality for her younger son, which hitherto had acted as one of the principal fomentations of the war, found no great sympathy with the new Spanish government. France itself became inclined to peace. Marshal Saxe gained brilliant victories in the Netherlands—at Raucoux, Oct. 11, 1746; at Laffeld, July 2, 1747—and penetrated into Holland, where he took Bergen-op-Zoom and Maestricht. But the English had nearly destroyed the French shipping and conquered many French colonies, and when Russia, in June, 1747, joined Austria and sent an auxiliary army to Germany, France was willing to make peace. A congress was opened at Aix-la-Chapelle in the spring of 1748, and on Oct. 18, 1748, the final treaty of

peace was signed. Elizabeth of Parma carried her point—Austria was compelled to cede Parma, Piacenza, and Guastalla to her son, Don Philip.

The Bavarian Succession War, also called the *Potato War*, because it was carried out without any fighting, took place after the death of the elector Maximilian Joseph, Dec. 30, 1777. He left no male issue, and the Bavarian possessions now fell to a collateral line of the house of Wittelsbach, represented by Charles Theodore of the Palatinate. His claims were contested, however, by Saxony, Mecklenburg, and Austria, and in order to secure at least some portion of the inheritance, Charles Theodore, who had no legitimate children, and chiefly wished to come into power in order to provide for his many illegitimate sons, made an agreement with Austria by which he surrendered to her Lower Bavaria. Against this extension of the Austrian territory in Germany, Frederick II. protested in a most energetic manner, thereby inaugurating that policy which in our days has made Prussia great, and by the Peace of Teschen (May 13, 1779) Austria only retained a few insignificant districts. CLEMENS PETERSEN.

Succin'ic Acid [Lat. *succinum*, "amber;" Ger. *Bernsteinsäure*], one of the dibasic O_4 series of homologues, of which oxalic acid is the first member. Its composition is $C_4H_6O_4$, and in constitution it is probably $O_4.C_2.2H_2C.H_2$, differing from oxalic acid ($O_4.C_2.H_2$) by two molecules of homologen. The difference of molecular volumes confirms this. By Housemann's experimental density of sublimed oxalic acid = 2., this has volume = 45000, and by Richter's figure for succinic acid = 1.55, this has volume = 76129. The difference is 31129, while twice the cube of 25 = 31250. (See VOLUMES, MOLECULAR.) Succinic acid was known to the ancients as *volatile salt of amber*, from which it is obtainable by distillation. It is found ready formed in several plants, and even in animal bodies. It has been identified in the urine of dogs and rabbits. It is formed, with SUBERIC ACID (which see) and others of this homologous series, by the action of nitric acid on fatty substances. Pasteur found that it is an invariable product of the acetic fermentation of alcoholic liquids. Many other organic transformations engender it. It is found in the watery part of the products of the distillation of amber, in solution, and crystallizes out by cooling. Warming with nitric acid will destroy the impurities, and enable pure succinic acid to be obtained by recrystallization. It is, however, obtainable much more cheaply from MALIC ACID (which see), or rather from crude *calcic malate*, prepared from the mountain-ash berries. This is fermented with yeast or rotten cheese, and the calcic succinate formed decomposed by sulphuric acid. Succinic acid crystallizes well, and is soluble in 5 parts of cold water. It melts at 356° F., and boils at 455° F., and is decomposed with formation of water and another body, $C_4H_4O_3$, regarded as anhydrous succinic acid.

Succinates.—There are neutral and acid succinates, formed by the replacement of either both or only one of the two molecules of metalloidal H in the constitutional formula above. The alkalic and magnesic succinates are soluble in water, while those of calcium and other dyads, and of alumina and ferric oxide, are insoluble. The precipitate formed with ferric solutions, when neutral, is very much like that formed by benzoic acid. Succinate of ammonia is a salt used in the laboratory as a reagent, chiefly in certain separations of iron from other substances. Succinic acid and succinates have been used in medicine, but are not now regarded as possessing any marked virtues. HENRY WURTZ.

Succory. See CHICORY.

Suchet' (LOUIS GABRIEL), duke of Albuféra and marshal of the Empire, b. at Lyons Mar. 2, 1770. According to O'Meara, Napoleon, when asked which was the ablest of his generals, replied, "It is hard to answer, but I am inclined to say Suchet." Entering the army in 1792, he served under Bonaparte, Brune, Masséna, Joubert, and Moreau in the campaigns in Italy and Switzerland, passing through the grades of *chef de bataillon* (major), colonel, general of brigade, of division, to that of lieutenant-general before the age of thirty. Subsequently, he distinguished himself at Ulm, Jena, and Austerlitz. Under orders of Lannes he served (with the 5th corps) at the siege of Saragossa, and was designated by him to Napoleon on his departure for the command in Aragon. In this latter capacity he entered on the career which earned him his fame and the appreciation of Napoleon, as above expressed. A series of battles and sieges (of Lérida, Mequinenza, Tortosa, Tarragona) gained for him the baton of *maréchal d'empire* (July 8, 1811), and after the battle of Albuféra (see ALBUFÉRA) and the siege and capture of Valencia (including that of the Spanish army, comprising the best generals and all the regular troops which remained to Spain), he was created duc d'Albuféra (Jan. 24, 1812). The greatness of Suchet as a soldier was equalled by his wisdom as an administrator and ruler of conquered provinces. Napoleon said that if he had had *two* Suchets in Spain, "he would have not only conquered the Peninsula, but preserved it." "It is their misfortune," he added, "that sovereigns cannot improvise for their needs men like him." The *Mémoires du Maréchal Suchet, sur ses Campagnes en Espagne*, form one of the classics of military literature. D. at Marseilles Jan. 3, 1826. J. G. BARNARD.

Suckasun'ny, or **Succasunna,** p.-v., Roxbury tp., Morris co., N. J., on Delaware Lackawanna and Western R. R.

Suck'er, a name given to a number of very different kinds of fishes, and from no resemblance to each other, but simply because they "suck" in some way or other. 1. In the U. S. and Canada in the interior it is applied to members of the family Catastomidæ, which have small mouths, into which they take their food by a kind of suction. The species are quite numerous. (See CATASTOMIDÆ, in APPENDIX.) 2. Along portions of the coast (*e. g.* Buzzard's Bay) the term is applied to the species of Echeneididæ, which are characterized by a flat ovate suctorial disk on the top of the head and front of the back, and which is homologous with the first dorsal fin of other fishes. By means of this disk they suck and cling with great tenacity to other larger fishes (especially species of sharks), and are to some extent parasites. (See REMORA and ECHENEIDÆ, in APPENDIX.) 3. In England the name is given to representatives of the families Cyclopteridæ, Liparididæ, and Gobiesocidæ. These have the ventral fins peculiarly modified and adapted for adhering to rocks and other bodies. The species are quite numerous, and each family is represented on the coast of the U. S., but the American species (except the *Cyclopterus lumpus*) are not known under any popular names. THEODORE GILL.

Suck'ling (Sir JOHN), b. at Whitton, Middlesex, in 1609; was educated at Trinity College, Cambridge, and inherited a great fortune from his father, who had been comptroller of the royal household. In 1631–32 he offered his services as a volunteer to Gustavus Adolphus, king of Sweden, who was waging war against the emperor of Germany. Returning to England, he was attached to the court of Charles I., and in 1639 equipped a troop of horse for the royal service against the Scotch. In 1640 he was elected to the Long Parliament, but was obliged to flee to France in consequence of his complicity in a plot to rescue the earl of Strafford from the Tower. His works, most of them first published after his death, include four plays, a number of songs (of which two or three are among the finest in the language), some letters, and *An Account of Religion by Reason*. A complete edition of his *Poems, Plays, and Remains* was published in 1874. D. in Paris about 1642.

Sucre, cap. of Bolivia. See CHUQUISACA.

Suc're, de (ANTONIO JOSÉ), b. in Cumana, Venezuela, in 1793; was educated at Caracas; joined the revolt against the Spaniards in 1811; was made brigadier-general in 1819, and in May, 1822, won the victory of Pichincha, which compelled the Spaniards to evacuate Quito; in 1823 he led a force from Colombia to Peru; found Lima in possession of the Spaniards, and was shut up in Callao until the successes of Santa Cruz compelled them to abandon Lima. In 1824 he won the victory of Ayacucho, which secured the independence of Peru, and finally of Bolivia, of which he was made president in 1826. An insurrection broke out in 1827, and in 1828, Sucre was driven from the country by Gamarra, but returned at the head of a Colombian army and reinstated himself. In 1830, having apparently pacified Bolivia, he went as commissioner to propose friendly relations with Venezuela, and while on his way back to Quito was assassinated near Pasto, in Ecuador, in June, 1830.

Sudam'ina [plu. of *sudamen*, from the Lat. *sudare*, to "sweat"], a fine eruption of vesicles on the skin. Their appearance is often accompanied by profuse sweating, whence the name. They may appear in comparative health, but are not important except when they are symptoms of some of the fevers.

Sudan. See SOODAN.

Sud'bury, town of England, county of Suffolk, on the Stour, has some manufactures of silk and some malting and brickmaking industry. P. 6908.

Sudbury, p.-v. and tp., Middlesex co., Mass., on Sudbury River and Lowell and Framingham and Massachusetts Central R. Rs., has prosperous manufactures, a lyceum, and a library of 5000 vols., and is celebrated for the battle of Apr. 21, 1676, in which Capt. Wadsworth and

fifty men were killed by the Indians. The bi-centennial anniversary was celebrated 1876. P. 2091.

Sudbury, p.-v. and tp., Rutland co., Vt., on Otter Creek. P. 601.

Su'deten-Gebir'ge, a range of mountains which separates Silesia from Moravia, and connects Riesengebirge with the Carpathian Mountains. They are low, 2000 or 3000 feet high, covered with pine forests, rich in coal and metals, and form plateaus with single peaks, rather than continuous chains.

Sudorif'ics [Lat. *sudor*, "sweat," and *facere*, to "make"], a term used in medicine to refer to such means as produce sweating. Heat is the one all-powerful sudorific, applied externally in the form of the hot-air or vapor bath, and internally as hot drinks. The effect of heat is hastened and intensified by alcoholic and ethereal potions, opium, especially in the form of Dover's powder. (See OPIUM.) The newly-introduced drug *jaborandi* seems to have a decided effect in causing sweating. Sweating is one of the phenomena attending nausea, and hence such drugs as tartar-emetic and ipecac prove sudorific among their other effects. EDWARD CURTIS.

Sudoriparous Glands. See HISTOLOGY and SWEAT.

Sue (MARIE JOSEPH EUGÈNE), b. at Paris Dec. 10, 1804; studied medicine, and held a position as a surgeon first in the army, then in the navy, until 1829, when, having inherited a considerable fortune, he retired and devoted himself to literature. His first novels, *Kernock le Pirate, Plick et Plock, Atar-Gull, La Salamandre, La Coucaratcha, La Vigie de Koatren* (13 vols., 1831–34), are evidently inspired by Cooper. He then turned from the more or less historical to the strictly social novel—*Cécile, Arthur, Le Marquis de Létorière, Jean Cavalier* (4 vols.), *Thérèse Dunoyer, Latréaumont* (1834–41), *Mathilde* (6 vols., 1841), *Les Mystères de Paris* (10 vols., 1842–43), *Le Juif-Errant* (10 vols., 1844–45), *Martin* (12 vols., 1847), *Les Sept Péchés capitaux* (16 vols., 1847–49), *Les Mystères du Peuple* (1849–56). Elected to the Constituent Assembly in 1850, he took his seat among the farthest-going radicals. After the *coup d'état*, he left France and settled at Annecy in Savoy, where he died Aug. 3, 1857. He wrote about 50 vols. of novels which are not mentioned here.

Sue'ca, a rich and well-built town of Spain, province of Valencia, on the Jucar, 4 miles from the Mediterranean, has 11,340 inhabitants.

Su'et [Lat. *sebum*]. The solid fat of the sheep and of beef, and chiefly that from the kidneys and loins, is called *suet*. Mutton suet is the firmest and hardest of the animal fats, melts at 122° F., and being composed chiefly of stearine, with palmatine and but little oleine, it has long been used in domestic economy to produce "dip candles." It is the high melting-point of mutton fat which requires the use of hot plates in serving mutton at table. Beef suet, or ox fat, melts at 116° F. It contains more palmatine than mutton fat. Chemically, there is no distinction between suet and tallow. (See TALLOW, FATS, SOAP, STEARINE, and under OILS.) *Suet Butter*, or "*Oleo-Margarine*," is a substitute for butter, the process for preparing which is described under BUTTER. B. SILLIMAN.

Sueto'nius Tranquillus (CAIUS), probably b. about the beginning of the reign of Vespasian, and educated for the position of a teacher in grammar and rhetoric; enjoyed the patronage and friendship of the younger Pliny, several of whose letters are addressed to him, and who introduced him to the emperors Trajan and Hadrian. The latter employed him for some time as his *magister epistolarum*, but dismissed him, jealous of his too great intimacy with the empress, Sabina. The date of his death is unknown. He wrote several works, some of which have entirely disappeared, while of others portions have been preserved (lives of poets, distinguished grammarians, and rhetoricians, on Roman institutions, etc.). About the authorship of some of the works ascribed to him scholars disagree. His principal work, however, *Duodecim Cæsarum Vitæ*, has come down to us entire and in authentic form. It contains biographies of the first twelve Roman emperors, beginning with C. Julius Cæsar and ending with Domitian, and these biographies, or rather collections of anecdotes from the private lives of the emperors, bear a general character of reliability which makes the work an invaluable historical document. In æsthetic respects it has no merits. Best editions by Baumgarten-Crusius (Leipsic, 1816), C. B. Hase (Paris, 1828), and Roth (Leipsic, 1858). The other writings are best given by Reifferscheid (Leipsic, 1860). English translations by John Clark (London, 1732), and by Thomson and Forrester in Bohn's "Classical Library" (1855).

Sue'vi, originally a collective name, comprising several individual Germanic tribes which formed a kind of union. It is thus used by Cæsar and Tacitus. The Suevi of Cæsar lived between the Rhine and the Weser, where they had 100 towns, though no strongholds, and whence a number of young men emigrated annually to seek occupation in war. To the union belonged the Semnones, the Catti, and other tribes. The Suevi of Tacitus lived farther to the E., from the Danube to the Baltic, and comprised, among other tribes, the Marcomanni and the Quadi. Tacitus calls the Baltic the Suevic Sea, and the Suevus of Ptolemy is probably the Oder. In the fourth century the name was applied to a single tribe, one branch of which settled in the regions along the Neckar, afterward called Suabia, while another branch broke into Gaul, and in 409 crossed the Pyrenees and penetrated into Spain, where they embraced Christianity, conquered Galicia, and formed a kingdom, which in 585 was united with the Visigothic empire.

Su'ez, town of Egypt, at the head of the Gulf of Suez, an inlet of the Red Sea, in lat. 29° 58′ N. and lon. 32° 34′ E. The surrounding country is a complete desert, and provisions and water must be brought to the town from a great distance. Nevertheless, since the opening of the railway from Cairo to Suez, and especially since the construction of the Suez Canal, the city is rapidly progressing, and during the last five years its population is said to have increased from 1500 to 8000.

Suez, p.-v. and tp., Mercer co., Ill. P. 1176.

Suez Canal, connecting the Mediterranean with the Red Sea, and thus greatly abridging the voyage between Europe and India and China. According to Strabo and Pliny, these seas were indirectly joined by a canal as early as 1300 B. C., but it was probably used only for the purpose of irrigation, not for navigation. According to Herodotus, Pharaoh Necho about 600 B. C. projected and partially executed a navigable canal upon the same route. We find mention of this canal for a long course of centuries, until it was finally blocked up by the sands of the desert about 767 A. D. In modern times the first idea of a ship-canal across the isthmus was conceived by Napoleon I. during his invasion of Egypt, but his engineers reported that the surface of the Red Sea was thirty feet above that of the Mediterranean—an error which was not exploded until 1840. In 1847 the project of a canal here was seriously entertained by the European powers, and again in 1853. In the next year, M. Ferdinand de Lesseps, a French diplomatist, obtained a concession from the pasha for this purpose, and succeeded in organizing a company for carrying on the work. The entire length of the canal is about 100 miles, of which 75 miles are actual excavation, the remainder being through shallow lakes which in some places had sufficient depth of water, but usually were to be deepened. The usual width of the excavation is 325 feet at the top and 72 feet at the bottom, with a depth of water of 26 feet. The work was fairly commenced in 1858, and the canal was officially opened Nov. 17, 1869. The capital of the company was originally 200,000,000 francs, which was increased in 1867 to 300,000,000, a considerable portion of which remained in the hands of the Egyptian government; and this was in 1875 purchased by the British government, which thus, directly or indirectly, exercises a controlling influence in its management. The Red-Sea terminus of the canal is at Suez, on the Gulf of Suez; the Mediterranean terminus is at Port Saïd, an artificial harbor, where a considerable town has sprung up. The formation of the harbors at the termini of the canal was in fact a work of greater magnitude than even the excavation of the channel itself. (See SHIP-CANALS, in APPENDIX.)

Suez, Gulf of, the western and larger of the branches into which the Red Sea divides itself, lying between Egypt and the peninsula of Sinai. Its extreme length is about 180 miles, with an average breadth of 20 miles. It was known to the ancients as the Gulf of Heroöpolis, and the generally-received scene of the passage of the Red Sea by the Israelites is a few miles from the present head of the gulf.

Suez, Isthmus of, a neck of land connecting the continents of Asia and Africa, and separating the Mediterranean from the Red Sea. Its extreme breadth from the Gulf of Suez to that of Pelusium is about 72 miles in a straight line, but following the course of the canal the distance is 100 miles. The surface is low and sandy, having an average elevation of not more than 6 or 8 feet above the sea, but in places reaching to 50 or 60 feet. In general, the isthmus is almost a desert; where, however, irrigation has been practised it is quite fertile. It is probable that the whole isthmus was once covered by the waters of the Mediterranean and Red seas, which were then connected.

Suf'fern, p.-v., Ramapo tp., Rockland co., N. Y., at the junction of Piermont branch with the main line of Erie R. R.

Suf'field, p.-v. and tp., Hartford co., Conn., on Suffield branch of New York New Haven and Hartford R. R. P. 3277.

Suffield, p.-v. and tp., Portage co., O. P. 1441.

Suffocation. See ASPHYXIA.

Suf'folk, county of England, bounded N. by the Ouse, S. by the Stour, and E. by the North Sea, comprises an area of 1487 sq. m., with 348,479 inhabitants. The surface is flat, and the soil for the most part very productive and excellently cultivated. Wheat, barley, beans, oats, hemp, and hops are raised, dairy-farming is extensively carried on, and butter is one of the principal products of the county. Cap. Bury St. Edmunds.

Suffolk, county of E. Massachusetts, lying upon Massachusetts Bay, comprising the cities of Boston and Chelsea and the townships of Revere and Winthrop. The manufactures are numerous and important, the number of establishments in 1870 being 2546, with a capital of about $48,000,000, employing 43,550 operatives, using raw material costing nearly $60,000,000, the value of the products being about $112,000,000. The garden and dairy products, especially milk, are very considerable. (For special statistics see BOSTON.) Cap. Boston, which is also the capital of the State. Area, 44 sq. m. By the census of 1870 the pop. of the county was 270,802, but the annexation of Charlestown, Brighton, and West Roxbury from other counties added 41,973 to the number, raising the pop. within the present limits of the county to 312,775; in 1875, according to the State census, it was 364,880.

Suffolk, county of S. E. New York, comprising the E. portion of Long Island, besides several small islets, having the Atlantic Ocean on the E. and S. and Long Island Sound on the N., drained by several small streams, of which the Peconic is the chief, and traversed by Long Island and other railroads. It is hilly in the N., but generally level in other parts. The soil is sandy, but is rendered very productive by the use of fertilizers. The coast is indented by numerous inlets, forming good harbors for small craft; besides several shipyards and flouring-mills, there are considerable manufactures of carriages, cotton and woollen goods, saddlery, paper, brick, sails, and fish oil. Cattle, horses, sheep, and swine are numerous. Staples, potatoes, Indian corn, oats, wheat, hay, wool, and garden and dairy products. Cap. Riverhead. Area, 1200 sq. m. P. 46,924.

Suffolk, p.-v., cap. of Nansemond co., Va., on Atlantic Mississippi and Ohio and Seaboard and Roanoke R. Rs., 22 miles from Norfolk, has 6 churches, 2 high schools, 3 newspapers, 2 steam-factories, 3 hotels, and 6 workshops. P. 930. W. B. WELLONS, ED. "CHRISTIAN SUN."

Suffolk, EARLS AND DUKES OF. These titles have been borne in English history by persons of several different families. Those of importance will here be treated in chronological order: MICHAEL DE LA POLE, EARL, b. about 1330, was the son of Sir William de la Pole (a wealthy merchant of Kingston-upon-Hull, of which town he was the first mayor, and was knighted upon occasion of having sumptuously entertained Edward II. when on his way to Scotland; d. 1366); devoted himself to arms; served in the French wars under the Black Prince and John of Gaunt, and in 1369 was made admiral in the northern seas; was employed in various diplomatic missions, and in 1383 became lord chancellor, being the second layman who attained to that station; in 1385 was created the first earl of Suffolk. In 1386 he was impeached by the Commons for alleged abuses committed as lord chancellor, fined, and imprisoned, but on the dissolution of Parliament was restored to royal favor; in 1388 was attainted of treason, and his estates were confiscated. He made his escape to France, where he d. Sept. 5, 1388.—MICHAEL DE LA POLE, EARL, son of the preceding, b. in 1368; obtained a reversal of his father's attainder in 1398, and in 1403 regained the estates and earldom; accompanied Henry V. to France, and was killed at the storming of Harfleur, Sept. 14, 1415.—WILLIAM DE LA POLE, EARL, MARQUIS, and DUKE, son of the preceding, b. in 1396; served in the French wars, and after the death of the earl of Salisbury, Nov., 1428, commanded in the siege of Orleans; was foiled by Joan of Arc and made prisoner; regaining his liberty, he became a favorite at court, and in 1444 negotiated the marriage of Henry VI. and Margaret of Anjou, for which he was created marquis of Suffolk, and became virtually the first minister of the kingdom. In 1447 he was suspected of complicity in the murder of Humphrey, duke of Gloucester, and became unpopular on account of having surrendered Anjou and Maine to France, but his favor at court was continued, and in 1448 he was created duke of Suffolk. In 1450 he was impeached by the Commons, committed to the Tower, and without trial sentenced to five years' imprisonment, but having been set at liberty upon his own oath of innocence, he embarked for France; was pursued by a vessel belonging to the constable of the Tower, overtaken, and beheaded at sea in May, 1450.—JOHN DE LA POLE, DUKE, son of the preceding, married a sister of Edward IV., by whom he was in 1463 restored to the dukedom. He was one of the three dukes who aided in placing the crown upon the head of Richard III.—EDMUND DE LA POLE, EARL, second son of the preceding, date of birth uncertain; his elder brother, John, earl of Lincoln, supported the pretensions of Lambert Simnel, who claimed to be one of the sons of Edward IV. who were supposed to have been murdered in the Tower by Richard III.; was killed in the battle of Stoke, and his estates attainted. Upon the death of their father in 1491, Edmund succeeded to the ducal title, which he waived in consideration of the restoration by Henry VII. of a part of his estates, and accepted the rank of earl in 1497. He subsequently entered into political intrigues; retired to France in 1502, but in 1507 fell into the hands of Henry VII., who kept him imprisoned in the Tower for seven years, and then caused him to be beheaded, Apr. 30, 1513.—RICHARD DE LA POLE, brother of the preceding, upon the death of Edmund assumed the title of duke of Suffolk; was exiled; entered the service of the king of France, and was killed at the battle of Pavia, Feb. 24, 1525, being the last of his house.—CHARLES BRANDON, duke of Suffolk, b. about 1490, was the nephew of Sir William Brandon, who bore the standard of Henry of Richmond at the battle of Bosworth; was early taken to court, and became the playfellow of Prince Henry, afterward Henry VIII., upon whose accession he was created Viscount L'Isle. A mutual attachment sprang up between him and Mary, the sister of Henry; she was forced, in 1514, to marry the old king Louis XII. of France, her brother having promised her that she should have liberty to please herself next time. Louis died within three months, and Brandon, who had been created duke of Suffolk, was sent over to congratulate Francis I. upon his accession, and was soon after privately married to the young widowed queen. Henry was with some difficulty appeased, but the duke was in time received into favor; commanded an English force in France by which, in 1523, Paris was seriously menaced, and was present at the capture of Boulogne, 1544. D. Aug. 22, 1545. His daughter, the Lady Frances, was the wife of the succeeding.—HENRY GREY, last duke of Suffolk and father of Lady Jane Grey, created duke Oct. 11, 1551; caused his daughter to be crowned July, 1553, and was sent to the Tower by Queen Mary, but was soon pardoned; joined Wyatt's insurrection; was tried for high treason, and beheaded on Tower Hill Feb. 23, 1554.—THOMAS HOWARD, first earl of Suffolk of the present family, b. in 1553; knighted for services against the Spanish Armada 1588; made privy councillor and created earl of Suffolk 1603, lord chamberlain 1604, lord high treasurer 1614, dismissed 1618; arraigned before the Star Chamber, and with his wife sent to the Tower 1619; liberated and restored to royal favor 1620. D. May 28, 1626.—CHARLES JOHN HOWARD, seventeenth earl of the present line, b. Nov. 7, 1804; was a member of the House of Commons 1832–41; succeeded his father as earl Dec. 4, 1851. A. H. GUERNSEY.

Suf'fragan [from the Lat. *suffragans*, "to support with one's vote," "to be favorable to;" hence, "an assistant or a subordinate"]. (1) Bishops of simple dioceses in an ecclesiastical province are suffragan to the metropolitan of that province—that is, subject to his ecclesiastical authority. (2) A coadjutor is sometimes said to be suffragan to his superior bishop. A bishop of a limited part of a diocese is a suffragan to the bishop of the diocese. For instance, the bishop of Dover Precincts is a suffragan of the archbishop of Canterbury, while all bishops of the province of Canterbury are suffragans of the same metropolitan in a different sense.

Suf'frage [Lat. *suffragium*, "vote"], in constitutional law and political science, is the right conferred upon a person to vote at elections of public officers of a nation, State, or municipality. The Constitution of the U. S. provides that "the electors in each State shall have the qualifications requisite for electors of the most numerous branch of the State legislature." The XIVth Amendment declares that "No State shall make or enforce any law which shall abridge the privileges and immunities of citizens of the U. S." The XVth Amendment says, "The right of citizens of the U. S. to vote shall not be denied or abridged by the U. S. or by any State on account of race, color, or previous condition of servitude." The Constitution originally placed the regulation of suffrage under the exclusive control of the States. The Supreme Court has recently decided that the XIVth and XVth Amendments have not departed from nor modified this fundamental principle, with the single exception that race, color, or previous con-

dition of servitude cannot be made a ground for withholding the right from U. S. citizens. The principle is also settled that suffrage is not a right, privilege, or immunity inhering in or flowing from U. S. citizenship. A denial of the franchise to any class of citizens, except on account of race, color, etc.—as, for example, to women—is not therefore inhibited by either of these amendments. To the States still belongs, with the single exception made by the XVth Amendment, the sole power of conferring or withholding the electoral right, of determining what classes of persons may or may not enjoy it. In the exercise of this authority the States have, in their constitutions, with great unanimity granted the suffrage to all male citizens of the U. S. who have attained the age of twenty-one years. There are, however, deviations from this general rule. In several Western States male persons of twenty-one years may vote, although they are not yet citizens, provided they are actual residents of the State and have been so for one year or more. In a very few States some discrimination is made against naturalized citizens; as, for example, in New York they must have been citizens at least ten days before voting, and in Rhode Island they must possess a small property-qualification. In one or two of the States—Connecticut and Massachusetts—a literary qualification is required from the elector, and he must be able to read and to write. As the universal rule, convicted felons, lunatics, and public paupers are excepted from the class of voters. The extension of the suffrage to women has been advocated by a considerable number of zealous reformers, chiefly upon the assumption that it is an essential manhood right inherent in the condition of citizenship. Our political institutions, however, are not framed upon this theory, and its adoption would require a radical change in all the existing legislation relating to the subject.

JOHN NORTON POMEROY.

Su'fis [Arab. and Pers. *sûfi*, "wise," "pious;" kindred to Gr. σοφός], a mystical sect among the Mohammedans and their system of belief. The Sufis hold that there are four attainable degrees of sanctity, the lowest involving merely a strict observance of all the precepts and rituals of Islam, ascending by degrees to the last, in which the devotee is admitted into direct communication with the Deity and to a mysterious union with him. The sect was founded in the ninth century by Abul Khair, and exists principally in Persia, and has contained among its members many of the most noted Mohammedan scholars and poets. Schamyl, the famous Circassian leader, is said to have belonged to this sect, and to have given to it a semi-political character, directing it especially against the aggressions of the Russians.

Sufism. See SUFIS.

Su'gar [Fr. *sucre*; Gr. *Zucker*; Lat. *saccharum*; Sansk. *shakará*], a name which is given to a variety of sweet principles found in plants and animals. It does not include, however, all substances possessing a sweet taste. Glycerine, acetate of lead ("sugar of lead"), hyposulphite of silver, and salts of glucinum, though possessing a sweet taste, are not sugars.

I. VARIETIES OF SUGAR.—The sugars are mostly of vegetable origin. They are soluble in water, generally crystallizable, have a sweet taste, are neutral to vegetable colors, and in many cases their solutions rotate the plane of vibration of polarized light to the right or left to a greater or less degree. They are composed of carbon, hydrogen, and oxygen, and most of them are "carbohydrates;" *i. e.* they contain hydrogen and oxygen in the proportions in which they exist in water, 2 atoms of hydrogen to 1 of oxygen; thus, cane-sugar is $C_{12}H_{22}O_{11}$. They are all decomposed by heat, yielding first water, and afterward a variety of products of destructive distillation, as carbonic oxide (CO), carbonic dioxide (CO_2), marsh-gas (CH_4), acetic acid, aldehyde, acetone, furfurol, liquid hydrocarbons, etc. Under the influence of oxidizing agents they yield acids, such as mucic, saccharic, tartaric, formic, oxalic, and carbonic acids. They often act as reducing agents on metallic salts, as those of silver, copper, etc.; the glucoses, more powerfully than cane-sugar and its isomeres. Very strong nitric acid, or a mixture of this with sulphuric acid, generally converts sugars into nitro-substitution products analogous to gun-cotton and nitro-glycerine, nitryl (NO_2) taking the place of H. Cane-sugar yields nitro-saccharose, $C_{12}H_{18}(NO_2)_4O_{11}$. Weaker acid merely oxidizes, yielding saccharic acid ($H_2C_6H_8O_8$), oxalic acid ($H_2C_2O_4$), etc. Dilute acids convert cane-sugar and its isomeres into glucose:

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Dextro-glucose.}}{C_6H_{12}O_6} + \underset{\text{Lævo-glucose.}}{C_6H_{12}O_6}.$$

Concentrated sulphuric acid decomposes cane-sugar and its isomeres, forming a black carbonaceous mass, and liberating sulphurous anhydride (SO_2) and other products. The glucoses are less affected. Toward alkalies, sugars act like weak acids, forming compounds by exchanging hydrogen for metal. Heated with alkalies, they are decomposed, the glucoses most readily, with the production of brown humus-like bodies. Under the influence of ferments most of the sugars undergo fermentation, the products varying with the kind of sugar, the nature of the ferment, and the conditions. The glucoses are directly susceptible of vinous fermentation under suitable conditions, but cane-sugar and its isomeres are first changed to glucose. (See FERMENTATION.)

The chemical relations of the sugars have not been fully established; they are subdivided into—(1) *Alcohols*, as erythrite ($C_4H_6(OH)_4$), pinite and quercite ($C_6H_7(OH)_5$), mannite, dulcite, and isodulcite ($C_6H_8(OH)_6$). (2) *Glucoses* ($C_6H_{12}O_6$), which may be regarded as aldehydes of the hexatomic alcohols ($C_6H_8(OH)_6$), formed by the removal of H_2, thus:

$$\underset{\text{Mannite.}}{C_6H_8(OH)_6} - H_2 = \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

The following are known: dextro-glucose, maltose, lævoglucose, mannitose, galactose, inosite, sorbine, and eucalyn. (3) *Polyglucosic alcohols*, formed by the combination of 2 molecules of glucose and the elimination of 1 molecule of water:

$$\underset{\text{Glucose.}}{2C_6H_{12}O_6} - H_2O = \underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}}.$$

The following are known: cane-sugar, or saccharose, parasaccharose, melitose, melezitose, trehalose, mycose, milk-sugar or lactine or lactose, synanthose.

The sugars are intimately related to the starches, gums, dextrine, and cellulose, which are carbohydrates, and which are capable of conversion into glucose and subsequent fermentation. Gum-arabic (arabine) is believed to be isomeric with cane-sugar ($C_{12}H_{22}O_{11}$). Starch, dextrine, and cellulose ($C_{12}H_{20}O_{10}$ or $C_{18}H_{30}O_{15}$) are considered as anhydrides of the polyglucosic alcohols, thus:

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} - H_2O = C_6H_{10}O_5.$$

$$\underset{\text{Diglucosic alcohol.}}{C_{12}H_{22}O_{11}} - H_2O = C_{12}H_{20}O_{10}.$$

$$\underset{\text{Triglucosic alcohol.}}{C_{18}H_{32}O_{16}} - H_2O = C_{18}H_{30}O_{15}.$$

(1) *Erythrite, Erythro-glucine*, or *Phycite* ($C_4H_{10}O_4 = C_4H_6(OH)_4$ occurs in *Protococcus vulgaris*. It crystallizes in large transparent prisms, has a sweet taste, is readily soluble in water, slightly in alcohol. It does not affect the plane of polarized light, and is not fermentable. It is a tetratomic alcohol.

(2) *Pinite* or *Pine-Sugar* ($C_6H_{12}O_5 = C_6H_7(OH)_5$) occurs in the sap of the California pine (*Pinus Lambertiana*). It forms hard, white, crystalline nodules, as sweet as cane-sugar, very soluble in water, nearly insoluble in alcohol. It rotates the plane of polarization to the right; is not fermentable. It is a pentatomic alcohol.

(3) *Quercite* or *Acorn-Sugar* ($C_6H_{12}O_5 = C_6H_7(OH)_5$) occurs in acorns. It forms hard crystals, soluble in water and in hot dilute alcohol. It has a sweet taste, rotates the plane of polarized light to the right, and is not fermentable. It is a pentatomic alcohol.

(4) *Mannite* or *Manna-Sugar* ($C_6H_{14}O_6 - C_6H_8(OH)_6$) occurs in manna, the concrete juice of two species of ash which grow in Southern Europe and the East, *Fraxinus ornus* and *F. rotundifolia*, in the roots of many plants, as celery, etc., the bark of *Canella alba* (8 per cent.) and of other plants, the leaves and twigs of many plants, in coffee-beans, many fungi (mushrooms), certain algæ (seaweeds), etc. It is formed abundantly during the viscous fermentation of cane-sugar (see FERMENTATION), and also by the action of sodium amalgam on glucose. It crystallizes in thin, four-sided prisms, soluble in 6½ parts of water at 64.4° F., and in 80 parts of alcohol (sp. gr. 0.898). Its solution does not become syrupy by spontaneous evaporation, and its taste is only slightly sweet. It does not affect polarized light except when mixed with boric acid, when its rotation is to the right. It does not ferment except under very unusual conditions; does not darken when boiled with caustic alkalies, nor reduce cupric oxide in alkaline solutions. It is a hexatomic alcohol. By oxidation it yields mannitose ($C_6H_{12}O_6$), isomeric with glucose. Heated with organic acids, it forms compound ethers (after the manner of alcohols), which considerably resemble the fats. (For an account of the different mannas see Johnston's *Chemistry of Common Life*.)

(5) *Dulcite, Dulcose, Dulcine*, or *Melampyrite* ($C_6H_{14}O_6 = C_6H_8(OH)_6$) occurs in a crystalline substance of unknown origin which is brought from Madagascar; also in *Melampyrum nemorosum* and other plants. It is produced by the action of sodium amalgam on milk-sugar, inverted milk-sugar, and galactose. It resembles mannite in many of its properties, but differs in crystalline form, melting-

point, and in yielding mucic acid instead of saccharic when oxidized by nitric acid. It does not ferment with yeast, but, like mannite, may be made to undergo fermentation by contact for several weeks with cheese and chalk, yielding alcohol and lactic and butyric acids. It has no effect on polarized light, is not darkened by caustic alkalies, and does not reduce cupric oxide in alkaline solutions. It is a hexatomic alcohol, and yields compound ethers with acids.

(6) *Isodulcite* ($C_6H_{14}O_6$) is produced by the action of dilute acids on quercitrine. It forms large crystals, like those of cane-sugar, is sweeter than grape-sugar (glucose), is very soluble in water, in 2.08 parts at 64.4°, and in absolute alcohol. It rotates the plane of polarized light to the right, reduces oxides, becomes yellow or brown when boiled with caustic alkalies, and does not undergo fermentation.

(7) *Dextro-glucose, Dextrose, Ordinary Glucose, Grape-Sugar, Fruit-Sugar, Starch-Sugar, Potato-Sugar, Diabetic Sugar*, etc. ($C_6H_{12}O_6$), occurs abundantly in sweet fruits, frequently with cane-sugar, and generally with so much lævo-glucose (levulose) that the mixture rotates the plane of polarized light to the left. It rarely occurs in nature free from lævo-glucose. Cane-sugar, which exhibits right-handed rotation, is changed by acids and other agents to a mixture of dextro- and lævo-glucose, and as the action of the latter predominates, the rotation becomes left-handed; hence this mixture of the two glucoses is called *inverted* sugar:

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Dextro-glucose.}}{C_6H_{12}O_6} + \underset{\text{Lævo-glucose.}}{C_6H_{12}O_6}.$$

The rotation of cane-sugar is +73.8° (right), of dextrose +56°, of levulose −106° (left); $\frac{-106° + 56°}{2} = -25°$; hence the rotatory power of inverted sugar is −25° (left). Honey, especially when long kept, contains dextrose and levulose, produced by the inversion of the cane-sugar originally present. The crystallization of the glucoses causes the granulation so often noticed. Dextrose is also found in the liver, blood, chyle, yolk and white of hens' eggs, and often, to the extent of 8 or 10 per cent., in diabetic urine (free from levulose), and in minute quantity in healthy urine. It is also liberated by the decomposition (fermentation) of bodies called glucosides, such as amygdaline. (See GLUCOSIDES and ALMONDS, OIL OF.) Dextrose is produced by the action of dilute acids, diastase, saliva, pancreatic juice, etc., on starch, dextrine, glycogen, etc. (see DEXTRINE and DIASTASE), by the action of sulphuric acid, hydrochloric acid, or chloride of zinc or cellulose, and, together with levulose, by the action of dilute acids, yeast, and other agents on cane-sugar, as mentioned above. In the manufacture of beer from barley and of alcohol from potatoes, corn, etc., the conversion of the starch into dextrose is one of the steps of the process. (See BEER.) Dextrose is made in large quantities from potato and corn starch, to be added to grape-juice for making wine, as a substitute for a portion of the malt in making beer, for confectionery, and as an addition to sugar-house syrup. In 1873 there were 51 grape-sugar factories in Germany, using potatoes, and making 24,000,000 pounds of solid glucose, 32,500,000 pounds of glucose-syrup, and 3,000,000 pounds of coloring for liquors per annum. Since that time the industry has much increased. The process of manufacture is very simple. A suitable quantity of water is heated to boiling; the sulphuric acid, previously diluted with 3 parts of water, is then added; and finally the starch, reduced with water to the consistency of milk, is run in. The whole is boiled till the conversion of the starch is complete. Chalk is then added to neutralize the acid; the clear liquor is drawn off from the deposit of sulphate of lime, evaporated to about 16° B., filtered over bone-black, and then evaporated to any desired consistency. When sufficiently concentrated it may be run into vats and allowed to crystallize. Suitable proportions are—starch 100, acid, 60° B., 2, and water 300–400 parts. Wagner gives the following analyses of German grape-sugar:

Dextrose	75.8	67.5	62.2
Dextrine	9.0	9.0	8.8
Water	13.1	19.5	24.6
Foreign substances	2.1	4.0	4.4
	100.0	100.0	100.0

In the boiling of solutions of cane-sugar there is always a partial conversion into dextrose and levulose (inversion); and as the latter sugar interferes with the crystallization of the other two, a certain proportion of uncrystallizable molasses is produced. This is the reason that solid sugar is so difficult to obtain from sorghum. From its aqueous solution, dextrose may be obtained in granular masses, consisting of a hydrate ($C_6H_{12}O_6.H_2O$); from alcohol, in anhydrous needles. It is less soluble in water than cane-sugar, requiring 1½ parts of cold water for solution. It forms a sweet syrup, not so ropy as the syrup of cane sugar. It is not as sweet as cane-sugar, 1 part of which sweetens as much as 2 or 2½ parts of dextrose. Heated to 248° F., it loses water and becomes anhydrous ($C_6H_{12}O_6$); heated from 284° to 338° F., it loses a further quantity of water, and forms glucosane ($C_6H_{10}O_5$) and caramel. Heated with caustic alkalies, it is decomposed, with the formation of melassic acid and a brown humus-like substance. A boiling solution of dextrose and caustic potassa reduces copper salts to red suboxide of copper, and silver and gold salts to metallic silver and gold. Dextrose readily undergoes fermentation: (1) vinous, with the production of alcohol and carbonic acid with small quantities of glycerine and succinic acid, etc.; (2) lactous, with the production of lactic acid; (3) viscous, with the production of mannite and gum, or other forms of fermentation according to the conditions. (See FERMENTATION.) Glucose (dextro or lævo) may be detected even in the presence of cane-sugar—(1) by the yellow or brown color produced on boiling it with caustic potassa; (2) by the dark coloration produced by basic nitrate of bismuth in the solution, to which carbonate of soda is previously added; (3) by the reduction of copper salts ("Trommer's test"); (4) by the decoloration of an alkaline solution of ferricyanide of potassium. It is readily distinguished from cane sugar by its not blackening under the influence of strong sulphuric acid. Trommer's test is especially useful for testing urine for grape-sugar. It may be applied in various ways: (1) by adding to the urine in a test-tube a grain of sulphate of copper, then an excess of caustic potassa, and applying heat; the presence of grape-sugar is indicated by the formation of red suboxide of copper; (2) by placing a little sulphate of copper solution in a test-tube, adding a little tartaric acid, then an excess of caustic potassa; this is then heated, and while boiling, the urine, previously diluted, is poured in, a few drops at a time. The formation of a red precipitate indicates the presence of grape-sugar. This test is made quantitative by using a definite amount of the copper salt, and determining how much of the urine or other solution of grape-sugar is required to completely precipitate the copper. The following is a very satisfactory method: A solution of pure sulphate of copper in water is prepared, containing 34.639 grammes in a litre; 10 cubic centimètres of this solution require .05 of grape-sugar for their reduction. This quantity of the solution is measured out with a pipette, and placed in a small flask or evaporating-dish. It is then diluted to three times its volume by the addition of water. A little tartaric acid is now added, and a considerable excess of caustic potassa. This solution is then boiled, and the urine, diluted to one-tenth of its original strength, is added slowly from a graduated burette till the liquid above the red precipitate no longer shows a trace of blue color. If a = the cubic centimètres of diluted urine used, and x the percentage of grape-sugar, then $\frac{a}{10} : .05 = 100 : x$. This equation assumes the cubic centimètre of urine or other liquid to weigh exactly 1 gramme, which is not the case. By dividing the percentage thus obtained by the specific gravity of the urine, the true percentage will result. (For other facts with regard to dextrose see GLUCOSE.)

(8) *Maltose* is a variety of glucose observed by Dubrunfaut (*Ann. Ch. Phys.* [3], xxi. 178). It is produced by the action of malt or diastase on starch-paste, resembles dextrose in crystalline form and most other respects, but its dextro rotatory power is three times as great, and it appears to be less easily altered by alkalies. It is converted into dextrose by boiling with dilute sulphuric acid.

(9) *Lævo-glucose* or *Levulose* ($C_6H_{12}O_6$) occurs associated with dextrose in honey, in many fruits, in molasses, and in other vegetable products. The mixture of the two glucoses in equal quantities constitutes *fruit-sugar* or *inverted sugar*. Some fruits—certain apples and pears—contain an excess of levulose. Icery (*Ann. Ch. Phys.* [4], v. 350; *Jahresb.*, 1869, p. 819) finds this glucose associated with cane-sugar in the sugar-cane, especially in the upper parts of the stem, which are still enveloped by the green leaves, and thereby protected from the light. Here it sometimes amounts to $\frac{1}{6}$th the quantity of the cane-sugar, while in the lower part of the stem it does not exceed the $\frac{1}{[illegible]}$th to the $\frac{1}{30}$th part. As the leaves dry up, and the upper portion of the stem is exposed to the light, it appears to be converted into cane-sugar. Icery infers from this that the cane sugar is a secondary product, formed by the action of light on the levulose. A solution of cane sugar, when left to itself, warmed with dilute acids, or subjected to the action of yeast or pectase, the ferment of fruits, loses its dextro-rotatory power, and acquires lævo-rotatory power. This transformation or inversion amounts when complete

to $-38°$ left for every $+100°$ right of the original rotation. As already mentioned, this is due to the assimilation by the cane-sugar of water (5 per cent.), and its resolution into equal quantities of dextrose and levulose. "To separate the levulose, the inverted sugar obtained from 10 grammes of cane-sugar is mixed with 6 grammes of slaked lime and 100 grammes of water, whereby a solid calcium-compound of levulose is formed, while the whole of the dextro glucose remains in solution, and may be separated from the precipitate by pressure. The calcium salt of levulose suspended in water, and decomposed by carbon dioxide, yields a solution of pure levulose, which may be filtered and concentrated by evaporation." (*Dubrunfaut.*) Pure levulose may be obtained directly by boiling inuline with dilute acids or for a long time with water. Levulose forms a colorless, uncrystallizable syrup or an amorphous solid mass. It is as sweet as cane-sugar, and acts as a purgative. It is more soluble in alcohol than dextrose. Its rotatory power for polarized light is $-106°$ (left). In contact with yeast it readily undergoes fermentation. In most of its properties levulose is similar to dextrose, but it is more easily altered by heat or by acids, but less easily by alkalies or ferments.

(10) *Mannitose* ($C_6H_{12}O_6$) is a glucose produced with mannitic acid when mannite is oxidized with the aid of platinum-black. It is prepared by saturating the liquid with lime, removing the mannitate by adding alcohol, evaporating the solution to a syrup, again adding alcohol, again filtering, and evaporating to dryness. It is syrupy, uncrystallizable, fermentable, and inactive to polarized light, and resembles the other glucoses in its chemical reactions.

(11) *Galactose* ($C_6H_{12}O_6$) is produced by boiling milk-sugar with dilute acids. It is soluble in water, slightly in alcohol, and crystallizes more readily than dextrose. Its dextro-rotatory power is $+83.3°$. It ferments readily, and resembles dextrose in most of its properties. It differs from dextrose, maltose, levulose, and mannitose in yielding mucic instead of saccharic acid when treated with nitric acid.

(12) *Inosite* or *Phaseomannite* ($C_6H_{12}O_6$) occurs in the heart, lungs, kidneys, liver, spleen, and brain, and in urine in case of Bright's disease. It occurs in kidney-beans, peas, cabbage, potato-shoots, asparagus, etc. Hilger (*Ann. Ch. Pharm.*, clx. 333) states that inosite occurs abundantly in the juice of the grape. Jacobsen determined the quantity of inosite in the flesh of animals, finding 0.08 per cent. in the flesh of a young porpoise and 0.30 in horse-flesh.

(13) *Sorbine* ($C_6H_{12}O_6$) is obtained from ripe mountain-ash berries (*Sorbus aucuparia*). The juice of the berries is allowed to undergo fermentation; it is then concentrated, yielding crystals of sorbine, which are purified by solution, filtration over animal charcoal, and recrystallization. As no sorbine is found in the fresh juice, and the malic acid present disappears during the process, Delffs (*Chem. News*, 1854, 664) supposes the sorbine to be derived from the malic acid, perhaps thus:

$$\underset{\text{Acid malic ether.}}{C_2H_5.H.C_4H_4O_5} + H_2O = \underset{\text{Sorbine.}}{C_6H_{12}O_6}.$$

Sorbine appears in beautiful trimetric octahedral crystals, as sweet as cane-sugar. It is readily soluble in water, almost insoluble in alcohol. Its lævo-rotatory power is $-46.9°$ left. It does not undergo fermentation in contact with yeast, but with cheese and chalk, at 104° F., undergoes fermentation, yielding much lactic acid, with some alcohol and butyric acid. The name "sorbite" is sometimes applied to this sugar, but Boussingault (*Compt. rend.*, lxxiv. 939) restricts this name to a non-fermentable sugar ($C_6H_{14}O_6$), isomeric with mannite and dulcite, which exists in the fresh juice. It does not affect the plane of polarized light, nor does it reduce oxide of copper in Trommer's test. It differs from mannite and dulcite in several particulars.

(14) *Eucalyn* ($C_6H_{12}O_6$) is an unfermentable sugar produced by the fermentation of melitose, the sugar of the *Eucalyptus* of Tasmania:

$$\underset{\text{Melitose.}}{C_{12}H_{22}O_{11}} + H_2O = 2CO_2 + \underset{\text{Alcohol.}}{2C_2H_6O} + \underset{\text{Eucalyn.}}{C_6H_{12}O_6}.$$

It is obtained as an uncrystallizable syrup, with a rotatory power of $+50°$. It reduces copper in the Trommer test, and does not ferment, even after treatment with sulphuric acid. In some respects it resembles sorbine.

(15) *Cane-Sugar, Saccharose*, or *Sucrose* ($C_{12}H_{22}O_{11}$) occurs—(1) In the stems and roots of many grasses, especially in the sugar-cane (*Saccharum officinarum*) 18 per cent., Chinese sugar-cane (*Sorghum saccharatum*) 9 to 9½ per cent., Indian corn, the juice of which just after flowering contains 7.4 to 7.9 per cent., etc. (2) In fleshy roots, as the beet (7 to 14 per cent.), carrot, turnip, sweet potato, mallow, etc. Madder-root contains 8 per cent., with nearly as much more inverted sugar. (3) In the stems of many trees, as the date and other palms, and especially in the vernal juices of the sugar-maple (*Acer saccharinum*), the birch, and walnut. (4) In most sweet fruits, often with inverted sugar—pumpkins, melons, bananas, etc. Some, as walnuts, hazel-nuts, almonds, coffee-beans, and St. John's bread, contain only cane-sugar. (5) In the nectar of flowers and in honey, often with inverted sugar; the nectar of cacti is almost wholly cane-sugar; that of *Rhododendron ponticum* shows crystals of cane-sugar, as does also the honey of the American wasp, *Polybia apicipinnis*; the cane-sugar rapidly disappears from honey by inversion under the influence of ferments present, the honey becoming granular from the crystallization of the dextrose. (6) In manna; Sinai manna, from *Tamarix mannifera*, contains 55 per cent. of cane-sugar, 25 of inverted sugar, and 20 of dextrine; Kurdistan manna, 61 of cane-sugar, 16.5 of inverted sugar, and 22.5 of dextrine.

Preparation.—Cane-sugar is prepared by evaporating the vegetable juices, the free acids being neutralized by lime, and the temperature kept as low as possible to prevent inversion. The first product, or *raw sugar*, is purified by dissolving it in water, straining through bag filters, filtering over bone-black to remove color, salts, etc., and boiling down in vacuum-pans to the crystallizing-point. After it has crystallized into loaves, it is washed with a saturated solution of pure sugar in water, to remove the mother-liquor or molasses. The manufacture and refining of sugar are more fully discussed in the latter part of this article.

Properties.—The cane-sugar from the plants mentioned above is all identical when completely purified. The difference in the appearance and apparent sweetness of the sugar from the beet, used on the continent of Europe, and that from the cane, used in England and the U. S., is entirely due to the fashion of the countries, which demands in the former a fine-grained sugar, in the latter a coarse-grained loaf. The Paris refiners boil from the same raw beet-sugar a fine-grained product for home consumption and a coarse-grained product for the English market. Much of the white loaf-sugar used in England is beet-sugar refined in France and Belgium. Cane-sugar crystallizes readily when pure. The individual crystals are colorless and transparent; masses of small crystals, loaf-sugar, appear white, owing to the numberless reflections and refractions of the light by the crystals. When broken or rubbed together in the dark, the sugar emits a phosphorescent light. The specific gravity of cane-sugar is 1.606; it is the heaviest compound of carbon, hydrogen, and oxygen known. (*Wanklyn.*) The sp. gr. of milk-sugar is 1.53; starch, 1.53; cellulose, 1.5; gum-arabic, 1.355; glycerine, 1.27. Heated to 320° F., cane-sugar melts to a clear liquid, which solidifies on cooling to a transparent mass, "barley-sugar," which in time becomes opaque and crystalline. At a higher temperature it gives off water, and probably becomes glucosane, $C_6H_{10}O_5$. At 410° more water is given off, and caramel remains, a mixture of (1) brown caramelane ($C_{12}H_{18}O_9$), soluble in water and alcohol; (2) reddish-brown caramelene ($C_{36}H_{50}O_{25}$), soluble in water, sparingly in strong alcohol; (3) black carameline ($C_{96}H_{102}O_{51}$); three modifications of which are known—A, soluble in water; B, insoluble in water, soluble in other liquids; C, insoluble in all ordinary solvents; and (4) other bodies. After losing 10 per cent. of water the product is nearly pure caramelane; after 14 or 15 per cent., it is rich in caramelene; after a loss of 20 per cent., it consists almost wholly of carameline. At still higher temperatures it undergoes destructive distillation, giving off carbonic oxide, marsh-gas, carbon dioxide (CO_2), acetic acid, acetone, aldehyde, and brown oils, which contain furfurol, a bitter principle, assamar, and other compounds. A considerable residue of brilliant charcoal remains behind. Cane-sugar is very soluble in water, and has a pure sweet taste. It is 2 or 2½ times sweeter than dextrose. Its concentrated solutions are syrupy. Cold water dissolves three times its weight of cane-sugar, hot water larger quantities. It is insoluble in ether and in cold absolute alcohol; boiling alcohol dissolves 1¼ per cent. of it. Aqueous alcohol dissolves it much more readily. C. Scheibler has investigated the solubility of cane-sugar in aqueous alcohol of different strengths and at different temperatures (*Deut. Chem. Ges. Ber.*, v. 343). Gerlach (1864) gives in the following table the specific gravity of sugar solutions, with the corresponding percentage of cane-sugar at 17.5° C.:

Percentage cane-sugar.	Specific gravity sol.	Percentage cane-sugar.	Specific gravity sol.	Percentage cane-sugar.	Specific gravity sol.
75	1.383342	67	1.332370	59	1.284054
74	1.376822	66	1.326188	58	1.278197
73	1.370345	65	1.320046	57	1.272379
72	1.363910	64	1.313946	56	1.266600
71	1.357518	63	1.307887	55	1.260861
70	1.351168	62	1.301868	54	1.255161
69	1.344860	61	1.295890	53	1.249500
68	1.338594	60	1.289952	52	1.243877

Percentage cane-sugar.	Specific gravity sol.	Percentage cane-sugar.	Specific gravity sol.	Percentage cane sugar.	Specific gravity sol.
51	1.238293	33	1.144150	16	1.065636
50	1.232748	32	1.139261	15	1.061278
49	1.227241	31	1.134406	14	1.056982
48	1.221771	30	1.129586	13	1.052746
47	1.216339	29	1.124800	12	1.048482
46	1.210945	28	1.120048	11	1.044278
45	1.205589	27	1.115330	10	1.040104
44	1.200269	26	1.110646	9	1.035961
43	1.194985	25	1.105995	8	1.031848
42	1.189740	24	1.101377	7	1.027764
41	1.184531	23	1.096792	6	1.023710
40	1.179358	22	1.092240	5	1.019686
39	1.174221	21	1.087721	4	1.015691
38	1.169121	20	1.083234	3	1.011725
37	1.164056	19	1.078779	2	1.007788
36	1.159026	18	1.074356	1	1.003880
35	1.154032	17	1.069965	0	1.000000
34	1.149073				

(For the equivalents of the specific gravities in Beaumé degrees see HYDROMETER.)

The aqueous solution of cane-sugar rotates the plane of polarized light to the right; for the transition tint $[\alpha] = +73.8$. The rotatory power varies but little with changes of temperature. This property of cane-sugar is the basis of optical saccharimetry, which is mentioned more fully in the latter part of this article. By prolonged boiling with water, cane-sugar is converted into a mixture of dextrose and levulose, *inverted* sugar. "The action of water and of various saline solutions on cane-sugar has been studied by Clasen (*J. pr. Chem.*, ciii. 449; *Zeitschr. f. Chem.* [2], iv. 604; *Am. Chemist*, iv. 90), with the following results: (1) Cane-sugar in dilute aqueous solution in glasses covered with paper is gradually converted into glucose at ordinary temperatures, *before the formation of fungi takes place on the surface;* but no alteration of the sugar takes place when its dilute solution is boiled for several hours immediately after preparation. (2) The formation of glucose is prevented by gypsum, by a mixture of gypsum and sal-ammoniac, and by nitre; retarded by magnesium sulphate. (3) When a sugar solution mixed with gypsum, potassium nitrate, or magnesium sulphate, after standing for several days at 70° R., is heated for a few hours only, a considerable quantity of glucose is formed. (4) When a sugar solution is mixed with gypsum and sal-ammoniac and heated, ammonia is given off and the solution turns acid. In presence of this saline mixture glucose is formed, even when the sugar solution is recently prepared. (5) In all other cases no acid reaction of the liquid was observed, and the transformation must be ascribed wholly to the action of the water. (6) Whether the product formed was actually grape-sugar or some other kind of sugar which reduces potassio-cupric tartrate, was not determined." (*Watts's Sup.*) (For Maumené's experiments on the action of water and heat see *Bull. Soc. Chim.* [2], xvii. 442.) E. M. Raoult (*Compt. rend.*, lxxiii. 1049) says that a solution of 1 part of sugar in 5 of water, enclosed in a sealed tube from which the air had been expelled by boiling the liquid, after five months' exposure to light was found to be about half converted into glucose (inverted sugar), while a similar solution kept for the same length of time in the dark remained unaltered. U. Kreusler (*Am. Chemist*, vi.) repeated these experiments, and found that access of air is necessary, and that light merely hastens the action of the ferment-germs derived from the air. Cane-sugar is not directly fermentable, but when its dilute solutions are mixed with yeast in considerable quantity, and exposed to a warm atmosphere, the sugar is converted into glucose by the soluble ferment of the yeast, and the glucose undergoes vinous fermentation. Diastase and pectase (fruit ferment) change cane sugar to glucose. Pure solutions of cane sugar in water, when very concentrated, remain unaltered for years; when dilute, they suffer decomposition. (See FERMENTATION.) Saccharine solutions are also liable to undergo viscous fermentation. Strong solutions of sugar are used for preserving fruits, etc. Dilute acids, especially mineral acids—and sulphuric acid most rapidly—convert cane-sugar into glucose—slowly in the cold, rapidly when heated. Acid salts act in the same manner. Long-continued boiling with even very dilute acids results in the formation of brown ulmine, ulmic acid, etc. (See HUMUS.) If the air has access, formic acid is also produced. Grote and Tollens obtained a peculiar acid, levulinic ($C_5H_8O_3$), by heating cane-sugar with sulphuric acid (*Am. Chemist*, v. 424). E. Felz has found (*Am. Chemist*, iv. 317) that certain organic acids—citric, for instance—prevent the inversion of cane sugar by mineral acids. Strong sulphuric acid destroys cane-sugar rapidly, evolving sulphur dioxide (SO_2), and forming a black carbonaceous mass. This reaction distinguishes cane sugar from glucose. Concentrated hydrochloric acid decomposes cane sugar rapidly. Acetic anhydride forms substitution products with cane sugar, in which hydrogen atoms are replaced by acetyl (C_2H_3O), as hepta- and octo-acetyl-saccharose, $C_{12}H_{15}(C_2H_3O)_7O_{11}$ and $C_{12}H_{14}(C_2H_3O)_8O_{11}$. Cane sugar solutions are not decomposed on being heated with caustic alkalies, although a combination takes place between the sugar and alkaline base. This is decomposed by carbon dioxide (CO_2), the sugar having undergone no change. Long boiling with potash-lye results finally in the decomposition of cane-sugar. Glucose is quickly decomposed when heated with alkalies or alkaline earths, forming yellow or brown (humus) solutions.

"Cane sugar is very easily oxidized. It reduces *silver* and *mercury salts* when heated with them, and precipitates *gold* from the chloride. Pure *cupric hydrate* is but slowly reduced by it, even at the boiling heat; in presence of alkali, however, a blue solution is formed, and on boiling the liquid cuprous oxide is precipitated. An alkaline solution of *cupric tartrate* is very slowly reduced by cane-sugar. Cane-sugar takes fire when triturated with 8 parts of *peroxide of lead*, and forms with *chlorate of potassium* a mixture which detonates on percussion, and burns vividly when a drop of oil of vitriol is let fall upon it. Cane sugar, distilled with a mixture of *sulphuric acid* and *manganic peroxide*, yields formic acid. Heated with *dilute nitric acid*, it yields saccharic and oxalic acids. 1 part of sugar mixed with 3 parts of nitric acid of specific gravity 1.25 to 1.30, and heated to 50°, is wholly converted into saccharic acid:

$$C_{12}H_{22}O_{11} + O_6 = 2C_6H_{10}O_8 + H_2O.$$

At the boiling-heat the product consists chiefly of oxalic acid. Sugar is likewise oxidized by *chloride of lime*, but the products have not been examined." (*Watts.*) (See *Am. Chemist*, v. 277, for experiments by J. M. Merrick on the action of chloride of lime on cane sugar.) "Dry *chlorine* does not attack sugar at ordinary temperatures, but at 100° a brown substance is formed, partly soluble in water. On passing chlorine into sugar water, hydrochloric acid is slowly formed, together with carbonic acid, a brown substance, and an uncrystallizable organic acid. *Perchlorides* act upon sugar (and other carbohydrates) in the same manner as free chlorine, producing dark-colored products. This reaction is applied by Maumené (*Compt. rend.*, xxx. 314) to the detection of sugar and analogous substances in liquids. For this purpose a drop of the liquid is placed on a strip of white merino, previously steeped in a solution of stannic chloride and dried, and the strip is warmed over a hot coal or the flame of a lamp; the presence of any saccharine substance will then be indicated by the production of a black spot." (*Watts.*) Hlasiwetz and Habermann (*Ann. Ch. Pharm.*, clv. 120) find the acid produced by chlorine in cane-sugar solutions to be gluconic, $C_6H_{12}O_7$. Nascent hydrogen, produced by sodium amalgam in the aqueous solution, converts cane sugar into mannite or dulcite and monatomic alcohols, ethyl, isopropyl, and hexyl.

Cane sugar, added to a mixture of nitric and sulphuric acids, is converted into *nitro-saccharose*, $C_{12}H_{18}(NO_2)_4O_{11}$?, an explosive compound corresponding to gun-cotton and nitro glycerine. With bases cane-sugar forms definite compounds called *sucrates*. Potassium and sodium compounds ($C_{12}H_{21}KO_{11}$ and $C_{12}H_{21}NaO_{11}$) are obtained as gelatinous precipitates on adding an alcoholic solution of sugar to potash or soda-lye. Cane-sugar solutions dissolve large quantities of magnesia, lime, strontia, baryta, oxides of lead, copper, etc. Carbon dioxide (CO_2) decomposes these sucrates, precipitating carbonates of the metals. The addition of sugar to solutions of many metals prevents their precipitation by alkalies. Citric, tartaric acid, and many other fixed organic bodies possess the same property. This is notably the case with aluminum, chromium, zinc, iron, manganese, cobalt, nickel, copper, etc. (See Grothe, *J. f. pr. Chem.*, xcii. 175.) Lime dissolves readily in solutions of cane sugar, forming a very caustic alkaline solution, having a bitter taste. Compounds of cane sugar with 1, $1\frac{1}{2}$, 2, 3, and 6 molecules of CaO have been observed.

All these compounds are decomposed by carbon dioxide (CO_2), with separation of calcic carbonate and a sugar syrup unimpaired. The tricalcic sucrate is but slightly soluble in water, and separates even from its dilute solutions, on the application of heat, as an amorphous mass. Rousseau proposes converting the sugar of the cane juice into this compound on the plantations, drying it, and exporting it to the countries where it is to be consumed, when it can be refined with much less loss than by the present system of manufacture. When a certain quantity of carbonic acid has been passed into a solution of lime in cane sugar syrup, there is produced a gelatinous magma which contains sugar, lime, and carbon dioxide. Bouvin and Loiseau use this mass in their process of sugar refining as a defecating agent with great success in some of the largest refineries in Paris. There has been considerable discussion with regard to the nature of this precipitate. Bouvin

and Loiseau consider it a definite compound, the *sucrate of hydrocarbonate of lime*, while others consider it a mechanical mixture of carbonate of lime with sucrate of lime. (See the *Am. Chemist*, i. p. 8.) Sugar dissolves oxide of copper as well as the subacetate (verdigris), and, according to Orfila, the poisonous properties of the copper are very much diminished by the presence of the sugar.

Cane sugar unites with some alkaline salts, forming definite crystalline compounds, which have been recently reinvestigated by Gill (*J. Lond. Chem. Soc.*, 1871, 269). He obtained the following definite compounds: (1) $2C_{12}H_{22}O_{11}.3NaCl.4H_2O$, (2) $C_{12}H_{22}O_{11}.NaCl.H_2O$, (3) $2C_{12}H_{22}O_{11}.3NaI.3H_2O$. From the last compound he infers that the formula for cane-sugar should be doubled to $C_{24}H_{44}O_{22}$.

The crystallization of cane-sugar is much hindered by the presence of certain salts, especially sodic chloride, and to a less degree potassic chloride. A. Marschall has carefully studied this subject, using salts which occur in the beet root (*Zeitsch. d. Ver. f. Rüb. Ind.*, 1870, 339, in abstract in *Am. Chemist*, ii. 406). He classifies these salts as follows: (1) salts favoring crystallization: sodic sulphate, nitrate, acetate, butyrate, valerate, and malate; potassic aspartate; magnesic nitrate, sulphate, and chloride; calcic nitrate and chloride; (2) indifferent salts, without influence: sodic carbonate, oxalate, citrate, and aspartate; potassic sulphate, nitrate, and chloride; calcic hydrate; (3) salts preventing crystallization, and consequently favoring the formation of molasses: potassic carbonate, acetate, butyrate, and citrate. Magnesic sulphate promotes the crystallization of 10 times, magnesic chloride of 17 times, calcic chloride of 7½ times, its weight of cane-sugar. The addition of sulphuric acid often promotes the crystallization by converting injurious carbonates, etc., into harmless sulphates. Much remains to be learned on this subject. Dubrunfaut has introduced the process of osmose for the purpose of separating salts from molasses, in order to make it possible to obtain crystallized sugar from it. (See ENDOSMOSE for description of his apparatus.)

(16) *Parasaccharose* ($C_{12}H_{22}O_{11}$), a modification of cane-sugar, produced when a solution of cane-sugar containing ammonic phosphate is allowed to stand, exposed to the air, for several months during the summer. Dextrose is produced at the same time. It can be crystallized, is very soluble in water, nearly insoluble in 90 per cent. alcohol, has a dextro-rotatory power of +108°. It reduces the alkaline copper solution, but only half as strongly as dextrose. It is not perceptibly altered by dilute sulphuric acid, even at 212° F. (Jodin, *Compt. rend.*, liii. 1252; lv. 720; lvii. 434; *Jahresb.*, 1861, 722; 1862, 472; 1863, 572.)

(17) *Melitose* ($C_{12}H_{22}O_{11}$), a sugar found in the manna of *Eucalyptus* species in Tasmania. It crystallizes in slightly sweet needles, soluble in 9 parts of cold water and in boiling water. Its dextro-rotatory power is +102°. It does not reduce the alkaline copper solution, is not altered by boiling alkalies, and is changed by hot dilute sulphuric acid into a fermentable sugar, probably dextrose, and non-fermentable eucalyn, $C_{12}H_6O_{12}$. In contact with yeast it undergoes the same change, the dextrose subsequently undergoing vinous fermentation. (Johnston, *Mem. Chem. Soc.*, i. 159; Berthelot, *Ann. Ch. Phys.* [3], xlvi., 66.)

(18) *Melezitose* ($C_{12}H_{22}O_{11}$) is a sugar which occurs in Briançon manna from the larch (*Larix Europæa*). It crystallizes from the alcoholic extract in small, hard, shining, efflorescent crystals. Its dextro-rotatory power is + 94.1°. It is readily soluble in water, nearly insoluble in cold, slightly soluble in boiling alcohol. Melezitose decomposes at about 392° F. It is carbonized by cold strong sulphuric acid. By an hour's boiling with dilute sulphuric acid it is converted into glucose. In contact with yeast it passes slowly, or sometimes not at all, into vinous fermentation. It is not altered at 212° F. by aqueous alkalies, and scarcely by potassio-cupric tartrate.

(19) *Trehalose* and *Mycose* ($C_{12}H_{22}O_{11}.2H_2O$). Trehalose is a sugar contained in *Trehala manna* from Persia, which consists of the hollow cocoons of a coleopterous insect (*Larinus maculatus*). The larva of this insect feeds upon the branches of *Ethiops persica*, extracting sugar, gum, starch, etc., and forming from them its cocoon. The sugar is extracted by boiling alcohol. Mycose is a sugar found in the ergot of rye. These sugars crystallize in shining rhombic crystals, are very sweet, soluble in water and in boiling alcohol. The dextro-rotatory power of trehalose is +199, of mycose +192.5°. By long boiling with dilute sulphuric acid they are converted into dextrose. They are not altered by boiling with caustic alkalies, nor do they reduce the potassio-cupric tartrate. In contact with yeast they pass slowly and imperfectly into vinous fermentation. They are believed to be identical.

(20) *Lactose, Lactine*, or *Milk-Sugar* ($C_{12}H_{22}O_{11}.H_2O$), an important constituent of the milk of all Mammalia, amounting to one-third or more of the solid constituents. Cow's milk contains from 4 to 5 per cent., human milk more. (See MILK.) It was first prepared by Fabrizio Bartholetti in 1619 from whey, thence called *manna* or *nitrum serilactis*, afterward *galacticum Bartholetti*. Bouchardat has recently examined the saccharine matter obtained from the juice of the sapota tree (*Achras sapota*) of Martinique, and found it to consist of 45 per cent. of milk-sugar and 55 per cent. of cane-sugar. It is prepared from milk by coagulating the caseine with sulphuric acid or rennet, separating the curd, which includes both the caseine and the butter, filtering, and concentrating the whey to the crystallizing-point by evaporation. Sticks are introduced for the crystals to collect upon. By solution, filtration over animal charcoal, and recrystallization, or by repeated precipitation by alcohol, it is obtained pure. Large quantities are prepared in Switzerland from the whey left in making cheese. It forms hard, white hemihedral trimetric crystals, which feel gritty between the teeth, and, dissolving very slowly, have but a faintly-sweet taste. Subjected to a temperature of 266° F., milk-sugar loses 5 per cent. of water, exactly 1 molecule, leaving the anhydrous milk-sugar ($C_{12}H_{22}O_{11}$) as a colorless melted mass, which solidifies in the crystalline state on cooling. It is soluble in 5 or 6 parts of cold, 2½ of boiling water, but does not form a syrup. It is slightly soluble in alcohol. Its dextro-rotatory power is +59.3° (*Berthelot*), + 60.28° (*Biot*). The rotatory power of the solution diminishes on standing or on heating. Heated to 320° F., milk-sugar turns brown, and at 347° is converted into *lacto-caramel* ($C_{12}H_{20}O_{10}$); at a higher temperature it yields a humus-like body. Boiling with dilute sulphuric acid converts it into *galactose* ($C_6H_{12}O_6$), which has been already mentioned. Strong sulphuric and hydrochloric acids and alkalies decompose it, especially when heated, with formation of brown or black products. Milk-sugar is readily oxidized; with nitrate of silver it forms a mirror-like deposit of metallic silver, which has been used as a substitute for the ordinary tin-amalgam mirrors. It decomposes the potassio-cupric tartrate even in the cold, precipitating red cuprous oxide, and giving rise to *galactic* and *pecto-lactic* acids. Alkaline permanganates oxidize it to carbon dioxide (CO_2) and water. Moderately strong nitric acid converts it into mucic, saccharic, tartaric, and racemic acids, and finally oxalic acid. Very strong nitric, or a mixture of nitric and sulphuric acids, converts it into nitro-lactine. Distilled with oxidizing mixtures, such as sulphuric acid and manganese dioxide, it yields formic acid. When yeast is added to a solution of milk-sugar, it gradually passes into a state of vinous fermentation. When cheese or gluten is added, lactous fermentation occurs, with the formation of lactic acid, always, however, with the formation of some alcohol. In the presence of chalk or oxide of zinc this fermentation continues till all the sugar is converted into lactic acid.

The ordinary souring of milk is due to the transformation of the milk-sugar into lactic acid, the curd being precipitated by the free acid produced. Fermented milk is called *koumiss;* when distilled, it yields a kind of spirits called *arraca* or arrack. (See FERMENTATION, MILK, KOUMISS, and LACTIC ACID.) Milk-sugar forms compounds with potassa, soda, lime, and baryta, but not with sodic chloride. Fudakowski announces two new varieties of sugar obtained from milk-sugar. The quantitative determination of milk-sugar may be accomplished with the potassio-cupric tartrate, as in the case of dextrose, etc., or by noting the rotatory power of its solution. (See *Saccharimetry*, further on in this article.)

(21) *Synanthrose* ($C_{12}H_{22}O_{11}$), a variety of sugar which is found in company with inuline in the roots of the dahlia, Jerusalem artichoke, etc. It is deliquescent, readily soluble in water and in dilute alcohol, is optically inactive, does not reduce the copper solution. It has a faint taste, but is not sweet. Dilute acids convert it into dextrose and levulose. Like cane-sugar, when in contact with yeast it does not ferment directly, but is converted into dextrose and levulose, which subsequently undergo fermentation. Caustic alkalies do not turn it brown. (O. Popp, *Ann. Ch. Pharm.*, clvi. 181.)

(22) Several other sugars have been noticed, but have not as yet been fully investigated. *Rhamnegine-sugar* ($C_6H_{14}O_6$), isomeric with mannite, is obtained by boiling rhamnegine with dilute sulphuric acid. *Abietite* ($C_6H_8O_3$), resembling mannite, is obtained from the needle-like leaves of *Abies pectinata*. *Dambornite* ($C_4H_8O_3$) exists in Gaboon caoutchouc, and *dambose* ($C_3H_6O_3$ or $C_6H_{12}O_6$) is formed from it, and *bornesite* ($C_{14}H_{14}O_{12}$) is extracted from Borneo caoutchouc. Dambornite and bornesite are said to be volatile without decomposition. *Pectine-sugar* ($C_6H_{12}O_6$) is a glucose with a greater dextro-rotatory power (+118°) than any other sugar except trehalose and lactose. It was obtained by Scheibler by boiling the metapectic acid of turnips with strong acids (*Deut. Chem. Ges. Ber.*, 1868, pp.

58, 108). It readily reduces copper, but is not brought into vinous fermentation by yeast. It turns brown when heated with alkalies.

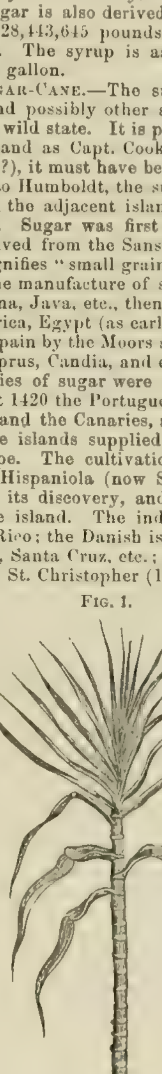
II. The Manufacture of Cane-Sugar.—Although cane-sugar occurs in a great variety of plants, there are very few from which it can be economically manufactured. These are the following:

	Gross tons.	Per cent.
The sugar-cane, supplying	1,700,000	59.34
The beet, "	1,000,000	34.90
The date-palm, "	100,000	3.49
Sorghum (sold as molasses), supplying	50,000	1.75
The maple tree, supplying	15,000	0.52
	2,865,000	100.00

A small quantity of sugar is said to be made in Mexico from maize, but no reliable statistics with regard to it are available. The estimated production from sorghum is based on the census report of the U. S. of 1870, which returns 24 hogsheads of sugar and 16,050,089 gallons of molasses from this plant. In reducing this to sugar, the molasses has been assumed to contain 7 pounds of sugar per gallon, which is probably high. Since 1870 the sorghum crop has fallen off very considerably. The estimated production of maple-sugar is also derived from the census report, which returns 28,443,645 pounds of sugar and 921,057 gallons of syrup. The syrup is assumed to contain 5 pounds of sugar per gallon.

III. Sugar from the Sugar-Cane.—The sugar-cane (*Saccharum officinarum*, L., and possibly other species of *Saccharum*) is not known in a wild state. It is probably a native of South-eastern Asia, and as Capt. Cook found it on the islands of the Pacific (?), it must have been indigenous there also. According to Humboldt, the sugar-cane was unknown in America and the adjacent islands before the advent of the Spaniards. Sugar was first made in Bengal, and the name is derived from the Sanskrit word *shakará* or *sarkará*, which signifies "small grains." The cultivation of the cane and the manufacture of sugar extended over Eastern Asia, China, Java, etc., then to Western Asia, Arabia, Northern Africa, Egypt (as early as 766), Tripoli; was introduced into Spain by the Moors soon after 714; was carried to Malta, Cyprus, Candia, and especially to Sicily, where large quantities of sugar were manufactured as early as 1148. About 1420 the Portuguese introduced the cane into Madeira and the Canaries, and until the discovery of America those islands supplied most of the sugar consumed in Europe. The cultivation of the sugar-cane was established in Hispaniola (now Santo Domingo and Hayti) soon after its discovery, and in 1518 there were 28 factories on the island. The industry extended to Brazil, Cuba, Porto Rico; the Danish islands, St. Thomas (60 factories in 1520), Santa Cruz, etc.; the English islands, Barbadoes (1641), St. Christopher (1643), Antigua, Jamaica, etc.; the French islands, Guadeloupe (1657), Martinique, etc.; the Dutch islands; Mexico, Peru, Chili; the Pacific islands, especially Manila in the Philippines, and the Sandwich Islands; to Louisiana in 1751, and to New South Wales in 1852.

Fig. 1.



Sugar-cane.

The sugar-cane belongs to the family of Gramineæ or grasses. It has a solid stem, from an inch to an inch and a half in thickness, and from eight to twenty feet in height. The stem is jointed about every three to six inches, and sends forth leaves, which fall off with the ripening of the plant. They are three or four feet long, and one to two inches in breadth. In the eleventh or twelfth month of their growth the canes send up at their top a sprout seven or eight feet high, nearly half an inch in diameter, smooth and without joints, called the arrow, which bears an ample panicle about two feet long, divided into numerous ramifications, carrying soft, silky flowers. When ripe, the stem contains a dirty-white pith or open cellular tissue, which is filled with the very pure saccharine juice.

The varieties of the sugar-cane are numerous: some, as the Chinese, *S. sinense*, are thought by many to be distinct species. (1) The creole, Madeira, or common sugar-cane, originally introduced at Madeira, is the longest known. It is distinguished by its thin, very knotty stem and green leaves. It grows freely in every region within the tropics, on a moist soil, as high as 5000 feet above the sea. (2) The Otaheite or Tahiti cane is much cultivated. It is taller, stronger, longer-jointed, quicker in its growth, and more productive in sugar than the creole cane. It matures quickly, yielding four crops, while the creole yields three, and its juice is purer and more easily crystallized. It includes two minor varieties—the ribbon cane, red and green striped, and the Bourbon cane. (3) The Batavia or purple-violet cane from Java. It is covered with purple stripes, grows eight or ten feet high, and has a heavy foliage. The joints are covered with a resinous or waxy film. In Jamaica it is used as a border for other canes to defend them from cattle. (4) The Chinese cane is very hardy, withstanding cold and drought, and with abundant rain sending out as many as thirty shoots. It resists the white ants, which cannot penetrate its hard crust, and the teeth of jackals. It requires a very strong mill. There are numerous other varieties.

The geographical distribution of the sugar-cane has been already indicated; it flourishes best where the mean temperature is from 75° to 77° F., but it thrives and can be economically cultivated where the mean temperature is as low as 66°. While, therefore, it is most productive within the tropics at low elevations, it is extensively cultivated in the warm temperate zones, and even on high table-lands, as at Nepaul in India (4500 feet) and in Mexico (4000–6000 feet above the sea-level).

The propagation is effected by cuttings, as the cane rarely ripens its seed even in the most propitious localities; in fact, the cane is rarely allowed to come to flower. Pieces of cane 15 to 20 inches long, generally taken from the top just below the leaves, are placed in the ground, and germination takes place on opposite sides of alternate joints. The planting takes place in September and October. The creole cane is then ripe for the mill in the beginning of the second year, and the crop may be finished early in June. After the cane is cut the roots or stoles send up sprouts or suckers, which furnish a new crop of canes, ripening in about two years. This process is repeated, so that a single planting may supply canes for many—sometimes even twenty—years before the old roots run out. These canes are called *ratoons*, to distinguish them from the *plant-canes*, the first growth from the cuttings.

The cutting of the canes, when ripe, is effected as close to the root as possible, the lower joints being richest in sugar, and the ratoons growing more vigorously than when the ends of the old canes are left standing above ground. The tops are cut off, and the canes are carried at once to the mill.

The composition of the cane, like that of all other plants, includes a great variety of organic and inorganic principles. The most complete analysis published is the following, by Payen, of Otaheite cane:

Water	71.04
Cane-sugar	18.00
Cellulose, lignine, pectine, and pectic acid	9.56
Albumen, and other nitrogenous principles	0.55
Cerosine wax, fats, resins, coloring-matters, essential oils, etc	0.37
Soluble salts	0.16
Insoluble salts	0.12
Silica	0.20
	100.00

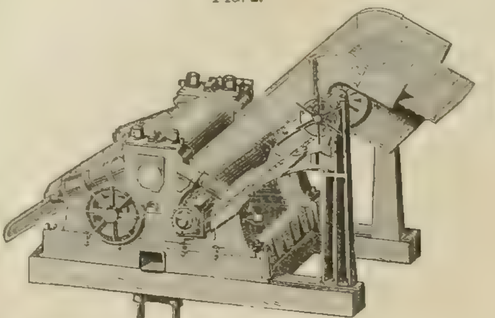
Many partial analyses have been published, from which the following are presented:

	Mauritius, Icery.	Cuba creole, Casaseca.	Martinique, Popp.	Egypt, Popp.
Water	69.	77.	72.22	72.15
Cane-sugar	20.	12.	17.80	16.00
Glucose	...	...	0.28	2.30
Cellulose	10.	11.	9.30	9.20
Salts	0.7 to 1.2	...	0.40	0.35
	100.00	100.00	100.00	100.00

E. Icery (*Ann. Chim. Phys.* [4], v. 350) finds glucose, dextrose, and levulose in the cane. The smallest quantity occurs in the lower ripe, dark-colored, leafless portion of the cane, while the proportion is larger in the upper green end of the cane, which is protected by leaves from the direct rays of the sun. The extremes were $\frac{1}{75}$th to $\frac{1}{50}$th of the whole sugar in the lower joints, to $\frac{1}{6}$th in the shaded, and even to $\frac{1}{3}$ in the imperfectly-developed joints. In young canes, covered with leaves and growing in moist, shady places, he found the fruit-sugar to equal 40 per cent. of the saccharine matter. This sugar disappears as the leaves drop off and the canes ripen, passing from green to dark tints. The ashes of the cane, according to Dr. Stenhouse, yield—

Silica	46.46	41.37	46.48	50.00
Phosphoric acid	8.23	4.59	8.16	6.56
Sulphuric acid	4.65	10.93	7.52	6.40
Lime	8.91	9.11	5.78	5.09
Magnesia	4.50	6.92	15.61	13.01
Potass	10.63	15.99	11.93	13.69
Soda	......	......	0.57	1.33
Chloride of potassium	7.41	8.96		
Chloride of sodium	9.21	2.13	3.95	3.92
	100.00	100.00	100.00	100.00

FIG. 2.



Sugar-mill.

Extracting the Juice.—The canes are cut with a large knife. The leaves and tops are then chopped off and left in the field, while the ripe cane is carried to the factory for the extraction of the juice. This is effected by pressure. The pressure is usually applied by mills; hydraulic presses have been tried, but have not proved advantageous. The sugar-mill usually consists of three horizontal rolls—two below, the third above. The cane is carried by an endless feeder, and passes downward between the upper ("king") roller and the first lower ("side") roll; then upward, and between this upper and second side (or "macasse") roll, being squeezed twice. The rolls are of various sizes, according to the extent of the plantation—from 18 inches in diameter and 3 feet in length to 40 inches in diameter and 8 feet in length. The latter dimensions are those of Fig. 2, the largest mill ever constructed. It was made by Paulding, Kemble & Co. at the West Point Foundry at Cold Spring, N. Y., and is in use at the plantation Las Cañas near Havana. The three rolls alone weighed 59,000 pounds, while the total weight of the mill was 203,310 pounds. It has a capacity of 50 tons of dry sugar per day of twelve hours. Vertical mills have been used, but they are not in favor. The pressed cane or residue after the removal of the juice is known as "bagasse," "megass," "cane-trash," or "straw." It is dried and used under the boilers, often constituting the only fuel employed on the plantation. No system of pressure serves to extract all the juice from the cane, as the moist bagasse always retains a considerable percentage of it. Duprez estimates the average yield of juice at from 56.4 to 61.2 per cent., according to the character of the mill and the power used in driving it. With the best mills and special care, 70, 75, and even 80 per cent. of juice is sometimes obtained. The juice is opaque, frothy, and of a yellowish-green color. The green matter may be filtered out, leaving a clear yellow fluid. It varies in gravity from 1.046 to 1.110, but is generally between 1.070 ($9\frac{1}{2}$° Beaumé) and 1.090 (12° B.). The following analyses of the juice have been published:

Sugar	18.20	20.90
Other organic matters	0.45	0.23
Inorganic matters, salts, etc.	0.35	0.17
Water	81.00	78.70
	100.00	100.00

Peligot finds the following substances in the ash from 100. of cane juice:

Silica	0.01707
Earthy phosphates	0.03604
Calcic carbonate	0.03519
Calcic sulphate	0.01224
Magnesic carbonate	0.02499
Potassic carbonate	0.04537
	0.17100

Beet-juice contains 0.8 to 1.7 per cent. of salts—from five to ten times as much as cane-juice. It also contains 0.8 to 1.2 per cent. of organic matters, besides sugar, while the cane-juice contains only 0.23 (*Peligot*) to 0.43—from one-fourth to one-half as much.

Diffusion.—The loss of sugar which occurs when mills are used, and which amounts to from one-fourth to one-third of the sugar present in the cane, has led to experiments with diffusion. The juice of the cane is contained in cells, the walls of which permit the passage of the juice by liquid diffusion. If these cells are surrounded by water, sugar passes into the water until a uniformity of saccharine contents is established, the percentage of the sugar passing out from the cell depending upon the ratio of water to juice. If a gallon of water is used for every gallon of juice present, then one-half, or 50 per cent., of the sugar would be extracted. By submitting the cells to a second bath of water, one-half of the sugar left would be extracted. Thus, the first treatment would leave $\frac{1}{2}$ of the sugar in the cells, the second $\frac{1}{4}$th, the third $\frac{1}{8}$th, fourth $\frac{1}{16}$th, fifth $\frac{1}{32}$d, sixth $\frac{1}{64}$th, etc. To make the process economical, the water used on the first lot of cells must be applied to a second lot, and thus strengthened in sugar; then to a third, and so on. So, while the cane is passed through successive baths until it is practically exhausted, the baths are applied to successive lots of cane until they become finally nearly as rich in sugar as the juice. Marggraf first called attention to this principle, and in 1830 it was adopted by many manufacturers of beetroot-sugar in Germany, according to the system of Dombasle. Since that time various applications of this principle have been brought out. In some a battery of vessels is employed, so connected by tubes that the liquids can be passed from any one vessel to any other, to secure the application of liquors in the proper order. In others, the beets in slices or ribbons are made to meet and pass through a current of water moving in the opposite direction. (For details see Walkhoff's *Rübenzucker Fabrikant.*) Roberts's system is one of the best known. The cane is cut obliquely into thin slices, and then submitted to the action of water, the slices becoming ultimately reduced to a pulp. The advantage of diffusion is not limited to the extraction of nearly all the sugar in the cane, but results in the production of a purer juice, as the cells are not fractured and the albuminoid and other nitrogenous bodies are not extracted, such bodies not passing readily through the cell-walls. The diffusion process has been introduced at Aska in the Madras presidency with great success. (*Sugar-Cane*, iii. 225.) Six cutting-machines are in use, each capable of cutting 32 tons of cane in twenty-four hours, and each requiring 1 horse-power to run it. An engine of 12 horse-power runs the entire diffusion plant. The average quantity of cane actually cut is 96 tons daily. There is a double battery of diffusion vessels of ten each. The vessels have a capacity of 170 cubic feet each, and are filled twice daily, running day and night. The juice is bright yellow and very pure—gives very little scum in the clarifiers. When the cane is ripe it is not necessary to filter it over bone-black. Its density is 12° to 14° of Balling's saccharimeter, while the juice from the mill is 17° to 19°. This indicates an addition of 20 per cent. of water to the juice. The quantity of cane treated in the years 1868, 1869, and 1870 was 3300, 6739, and 5025 tons. The yield of juice, reduced to the original density, was 84.5, 84, and 81.9 per cent. The highest previous yield of mills was 70 per cent., the gain averaging 19 per cent. Owing to the greater purity of the juice, there was a further gain in the percentage of crystallized sugar. The yield of green sugar, saccharine matter, and salts, was 13 to 14.1 per cent. of the cane; the yield of crystallized sugar 9 to 9.9 per cent.; of sugar in the molasses, 4 to 4.9 per cent. The total gain in crystallized sugar was 43 per cent. over the mill process. Experiments on a large scale, made on the Monrepos plantation in the island of Guadeloupe, with an apparatus composed of six levigators, established the following facts: (1) That by a methodical maceration and washing of the pulp an artificial juice is obtained very nearly equal in density to the natural juice of the cane. (2) That a methodical maceration and washing, continued for one hour and a half, is sufficient to exhaust completely the tissue of the cane of the sugar which it contained. The yield of sugar in these experiments was $12\frac{1}{2}$ to 13 per cent. of the weight of the cane in *white* sugar. Adopting this figure, the results between the process by lamination in mills and diffusion compare as follows (*G. Bouscaren*):

Process by Lamination, as still Applied on a great number of Plantations.

	Pounds.
Crystallized (brown) obtained (which is $\frac{65}{180}$ = 0.36 of the total weight of sugar contained in the cane.)	65
Sugar in the molasses	25
Sugar remaining in the bagasse	90
Sugar contained in 1000 pounds of cane	180

Process by Lamination with all Modern Improvements.

	Pounds.
Crystallized sugar obtained (which is $\frac{108}{180}$ = 0.60 of the total weight of sugar contained in the cane.)	108
Sugar in the molasses	32
Sugar remaining in the bagasse	40
Sugar contained in 1000 pounds of cane	180

Process by Diffusion.

	Pounds.
Crystallized sugar (white) obtained	130
(which is $\frac{130}{180}$ = 0.72 of the total weight of sugar contained in the cane.)	
Sugar in the molasses	40
Lost	10
Sugar contained in 1000 pounds of cane	180

The gain in crystallized sugar may therefore be stated to be—over the present improved mill process, 72 - 60 = 12 per cent.; over the present unimproved mill process, 72 - 36 = 36 per cent. A surplus of from 12 to 36 per cent. of the total weight of sugar in the cane will be obtained in a crystallized state: which means that the production of sugar with the same amount of cane will be increased one-fifth in the first instance, and be doubled in the other. The molasses will be of better quality, being of lighter color and more agreeable to the taste. It is claimed that the surplus profit realized in two years running on a large plantation by the diffusion apparatus will pay its cost.

J. Roberts has introduced a new system of diffusion at his beet-sugar factory in Selowitz in Austria. He employs but a single vessel, the water running in at the top, and the beets being fed up by a mechanical feeder from the bottom, and removed from the top by a mechanical rake. (See *Sugar-Cane*, iii. 225, and *Dingler's Pol. J.*, cci. 257.) (For further details on diffusion see works on beet-sugar at the end of this article; also Walkhoff (*J. pr. Chem.*, clxxxiv. 149); Duquesne and Gill (*Dingl. Pol. J.*, cxcvi. 83); Cech (*Ibid.*, cxcvii. 278, 445); Schultz (*Ibid.*, cci. 262).)

Clarification or Defecation of the Juice.—Owing to the presence of albumen and other nitrogenous bodies, cane-juice, when left to itself, rapidly undergoes fermentation. Sugar is inverted and destroyed, and free acids are developed. Twenty minutes are in some cases sufficient to initiate this change. To prevent this, as well as to free this juice from suspended impurities, such as fragments of tissue, particles of wax, etc., clarification is resorted to. The clarifiers are large hemispherical vessels of iron or copper, holding about 500 gallons, and heated over a free fire, or better by steam coils or jackets. The juice, after passing through copper strainers, is brought to a suitable temperature—some say 104° F., others 122°, 140°, or 150°. A suitable quantity of slaked lime is added, and the whole raised nearly to boiling. The acids are thus neutralized and the albumen is coagulated. The flocks of albumen entangle the suspended impurities and carry them to the surface in the form of a dark-colored scum. The quantity of lime added depends upon the character of the cane, its ripeness, etc., and upon the condition of the juice; enough is generally used to give the juice a faintly alkaline reaction to litmus-paper—from one to 4 pounds to 500 gallons. After an hour's repose the scum is swept off into a gutter on the side of the clarifier, and the clarified juice, called *guarapa*, is either evaporated at once, or first filtered through bone-black. The scum (dried) contains, according to Avequin —

Cerosine, a peculiar wax	50.0
Chlorophyl, etc	10.0
Cellulose, albumen, etc	22.7
Phosphate of lime	3.3
Silica	14.0
	100.0

It is used, on account of the saccharine juice adhering to it, for the manufacture of rum. Sometimes it is pressed to extract the juice. Bag filters are often used to separate the scum, etc., especially when the juice is to be concentrated in the vacuum-pan. The pure juice contains about 81 per cent. of water, 18.20 of sugar, 0.45 of gum, acids, etc., organic matter precipitable by basic acetate of lead, and 0.35 of saline matter. Sulphurous acid and certain sulphites are considerably used to prevent the fermentation of cane juice and to improve its color. It is probably best used in the form of the free gas produced by burning sulphur. In Texas the juice from the mill is passed through strainers, and thence through the "sulphur-box." (J. P. Carson, E. M., *Am. Chemist*, i. 423.) This box, made of cypress-wood, is 12 feet long, 2 feet wide, and 3 feet high, and is provided with a horizontal shaft, bearing agitators, which passes lengthwise through the box. The sulphur is burned in an iron pan, and the gas, often passing through a washer or molasses barrel half filled with water, enters at one end of the box. The juice enters through a perforated plate on the top of the box, and drops down through the gas in spray: 1 barrel of sulphur is sufficient for 1000 hogsheads of sugar (*Carson*), 14 pounds of sulphur for 1000 imperial gallons of juice (*Hjardemaal*). Bisulphate of lime may be added to the juice, but it is not as advantageous as the free gas, and its use has been generally abandoned (*Goessmann*). Sulphite of soda and monosulphite of lime ("Icery process") have also been recommended. (See *Sugar-Cane*, June 1, 1872, p. 301.) Some recommend adding a minimum of lime at first, heating to coagulate the albumen, then skimming, adding an excess of lime, heating and skimming again, and finally carefully neutralizing the excess of lime with hydrochloric acid or phosphoric acid in the form of superphosphate of lime, leaving only a slight alkaline reaction.

Evaporation is conducted in various ways: (1) in open kettles over direct fire; (2) in open (free-fire) kettles to 29° or 30° Beaumé, and then to crystallization in open kettles heated by steam; (3) exclusively in open kettles heated by steam; (4) by the aid of evaporators, which involves blowing heated air through the juice or passing the juice over heated surfaces; (5) in open (free-fire) kettles to 29° or 30° B., and then to crystallization in a vacuum-pan; (6) in open steam-heated kettles to 29° or 30° B., then to crystallization in a vacuum-pan; (7) in vacuum-pans altogether.

Evaporation in open kettles or coppers over the direct fire is the oldest method in use. The series of four or five kettles is called a "battery" or "Jamaica train." The hemispherical kettles are made generally of cast iron, sometimes of wrought iron or copper. They vary in size. In the British colonies an ordinary battery consists of two kettles or pans of 225 gallons capacity, two of 600 gallons, and a clarifier of 650 gallons. These are set in a row in brick-work, the clarifier next to the chimney and farthest from the fire, which is directly under one of the small pans, called the *teache*, *tayche*, or striking pan, in which the concentration is completed. In Louisiana the pans vary from 400 to 100 gallons, the largest being called the *grande*, serving as the clarifier; the second smaller, called the *flambeau*, because it is so situated that the flame of the fire just reaches it; the third, the *sirop*, because the juice is here boiled to a syrup; the fourth, the *batterie* or *striking-pan*. The pans are made of diminishing size, in order that although the juice is reduced in volume by the evaporation, it will still be sufficient in quantity to fill the pan and prevent any portion of the metal becoming overheated, which would result in the caramelization and burning of the liquor. When the contents of the striking pan have become so concentrated that a drop placed between the thumb and forefinger, and pressed, may be drawn into a thread which exhibits a granular appearance, the evaporation is completed, and the contents of the pan are transferred to the cooler to crystallize. The pan is then filled again from the *sirop*, the *sirop* from the *flambeau*, and the *flambeau* from the *grande*. Each pan is kept full from its weaker neighbor. This process of evaporation is very wasteful. It is laborious, requires much fuel, yields a dark colored sugar and an enormous proportion of molasses. Fleischmann says every hogshead of 1000 pounds of sugar yields 55 gallons or 660 pounds of molasses. The chief objection to the open pan evaporation arises from the high temperature required to boil sugar solutions in the open air, which converts the crystallizable sugar into inverted sugar, glucose. The more concentrated the juice becomes, the higher the boiling-point. Gill gives the observed temperatures as follows: in the grande, 210° F.; the second, 212°; the tayche, 225°; and at proof, 233° F. Wray says the temperature at the completion of the boiling is usually from 240° to 250° F. Gill states that as much as 17 per cent. of the cane sugar in the juice is sometimes inverted in the batterie to glucose; and as each per cent. of glucose detains a per cent. of cane-sugar in the molasses, this represents a loss of one third the sugar of the original juice. On another occasion he states that the proportions of glucose to 100 parts of cane sugar were—in the grande, 10.7; the second, 15; the tayche, 22.7; thus demonstrating the change of cane-sugar to glucose during the boiling. The laborious character of the batterie process is due to the constant skimming necessary and the bailing of the juice from one pan to the other. When sufficiently concentrated, about 41° B., the syrup is baled into coolers of wood or iron about 12 feet long, 6 wide, and 1 foot deep. As it cools and the sugar granulates (crystallizes), it is stirred occasionally to make the granulation uniform. The striking pan is emptied several times into the cooler before it is full, each strike being well mixed with the contents of the cooler. When full, it is left to cool and become hard. It is then dug out with shovels and placed in hogsheads having holes in the bottoms loosely stopped with plugs of sugar-cane; through these holes the molasses drains off. The sugar which remains is then sent to market as *muscovado*. A smaller yield of better sugar is obtained by *claying*, the product being called *clayed* sugar. The concentrated juice, boiled somewhat stronger than for muscovado, is ladled into the cooler, which is large enough to hold three or four strikes. Here it is beaten up by a revolving cage to cool it rapidly and to prevent the formation of large crystals. It is then trans-

ferred to conical moulds of pottery or sheet iron, the opening at the tip being carefully plugged. In from twelve to eighteen hours the sugar is set, and the plug is removed to allow the molasses to drain off. Each cone is placed upon an earthen or iron pot which receives the molasses. At the end of twenty-four hours the sugar is sufficiently drained, the cones are transferred to empty pots, and the claying begins. The upper surface of the sugar is cut smooth, and a plaster or magma of wet clay or tenacious loam is applied. The water gradually separates from this, passes down into the sugar, dissolving a portion of it, and displacing the less pure molasses from the interstices of the grains. This is practically washing the sugar with water to free it from molasses, the product being diminished in quantity, but improved in quality. The object of the clay is to let the water upon the sugar very slowly and uniformly, so as to prevent channelling. The writer saw this process in actual use in an Antwerp refinery as recently as 1869. When the clay cover becomes hard from the loss of water, it is readily removed in a sheet, to be replaced by a second, third, and often fourth application of wet clay, until the sugar becomes tolerably white. The claying occupies about three weeks. When the cone of sugar is removed from the mould, it is found that the layer at the base, which was the top during the claying, is white for about two inches, then yellowish or grayish, and lastly, toward the apex, it is brown. This is due to the more complete washing which the upper layers have received during the claying. The cone is cut transversely, so as to separate it into three qualities of sugar, which are dried and boxed separately as *white-clayed*, *yellow* or *gray-clayed*, and *brown-clayed* sugar. Some planters divide into five varieties—*white*, *second white*, *first* and *second yellows*, and *brown*. The drying is conducted either by artificial heat or in the sun. Clayed sugar is made from the juice of the *ripest* canes, as that from other canes contains so much gluten that it is liable to be burned and darkened in boiling, so that it becomes impossible to produce a clayed sugar of good color. Such juice must be made into muscovado. The syrups which run off from the cones during the claying process are boiled separately, and yield a fair grade of sugar, or they are boiled down rapidly to a solidifying point, and sent to market, without separating any molasses, under the name of *clayed melada*. The molasses from the muscovado hogsheads and from the cones is either shipped at once, or boiled again for the production of a second crop of inferior sugar, *molasses sugar*. Sometimes it is even boiled a third time. As the molasses drains from the sugar, it carries with it a small quantity of very fine crystals of sugar: these gradually settle in the molasses-tanks, and form a distinct layer, which is removed when the tanks are emptied and sold under the name of *cistern bottoms*.

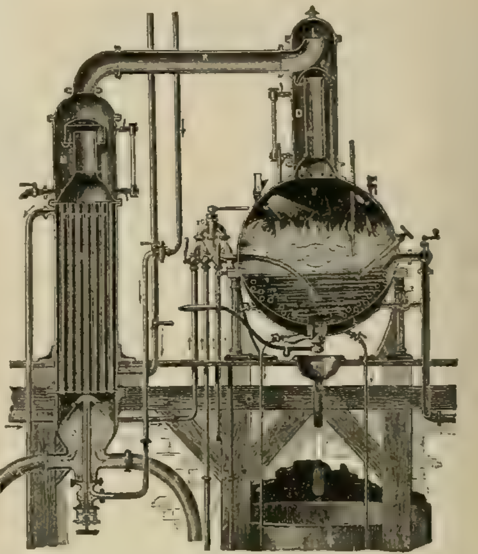
Evaporation in Open Kettles and Steam-Pans.—Open kettles heated by steam-coils are especially useful as clarifiers, and as evaporators they possess the advantage of uniformity of temperature and of permitting the boiling to be stopped instantaneously. Alfred Stillman of New York invented in 1843 a system of evaporation in open kettles and open steam-pans, and in 1846 a steam sugar-pan.

Open High-Pressure Steam-Pans.—Duplessis's system has never been used with any success.

Evaporators for hastening evaporation by securing a larger surface have proved very effective in some cases. Kneller blew air through a copper pipe into the evaporating juice. This reduced the temperature and carried away the vapor of water. Hallète used a cylindrical steam-jacket, and caused the syrup to cover the surface of the inner cylinder. Chevalier combined steam-pipes and air-currents. Modern evaporators are constructed upon the principle of taking up a small quantity of hot liquor and exposing it to the air. In one evaporator there is a revolving drum or reel of steam-pipes half immersed in the liquor. As the drum revolves, one half is in the liquor, while the other half is covered with a thin film of hot liquor. Another consists of a series of flat hollow steam-heated disks, which revolve, one half in the liquor, the other half in the air.

Open Kettles and Vacuum Pans.—In 1813, Edward Charles Howard patented the evaporation of saccharine solutions in the vacuum-pan. (The specification of his patent can be found in the *Sugar Cane* of Sept. 1, 1875, p. 481.) By the use of the vacuum the boiling point is lowered, and it is possible to boil at as low a temperature as 130° F. In practice, this temperature is only sufficient for "clear proof;" good color with small grain can be secured at a temperature not above 140°; but for large, firm grain 170° or 180° is necessary. These temperatures are far below the temperatures of 233° and 250°, reached in the open striking-pan. The vacuum-pan is a closed vessel of copper or iron provided with an air-pump to maintain a vacuum, a condenser to condense the aqueous vapor from the evaporating juice, a steam-jacket, and one or more steam-coils to supply heat to the juice, and a tap-stick to enable the operator to draw a sample without admitting air to the pan. Fig. 3 shows such a pan, complete except the air-pump:

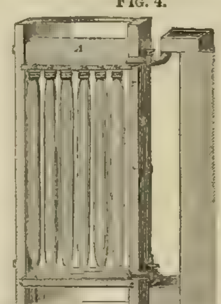
FIG. 3.



Vacuum-pan.

The estimated capacity of a pan 10 feet in diameter is 28,000 pounds daily; 9 feet, 18,000 pounds; 8 feet, 14,000 pounds; 7 feet, 7200 pounds; 6 feet, 5400 pounds; 5 feet, 4600 pounds. A common plan is to boil the juice in open kettles to syrup of about 29° to 30° B., and then finish to grain in the vacuum-pan. In this way the high temperatures of the striking-pan are avoided. As there is no opportunity to skim the liquor in the vacuum-pan, the clarification must be very complete before the juice enters it. Modern improved systems require steam-defecators and bone-black filters; bag-filters are sometimes used in connection with the defecation. The bag-filter is an ample bag of cotton cloth surrounded by a small sheath of twine, which secures a folding of the cotton, which facilitates filtration. These bags are held in position by iron nozzles. (See Fig. 4.) The boiling in the vacuum-pan involves four successive operations: (1) concentrating the syrup; (2) forming the grain; (3) enlarging the grain; (4) increasing the quantity of grain. (For the details of these operations see *American Chemist*, ii. 461.) One of the most important points in the management of the vacuum-pan is the temperature of the steam admitted to the jacket and coil; this should be kept as low as possible to prevent caramelization, which results in darkening of the color and inversion of cane-sugar. The temperature of this steam is often 260° F., while it should not be much above 212°.

FIG. 4.



Bag-filter.

Degrand invented an improvement on the simple vacuum-pan which has been found very useful on sugar-plantations. The condenser of the vacuum-pan is a vertical series of tubes, and the fresh juice is used as the condensing liquid in place of water. The juice is thus concentrated to a certain degree by the waste heat of the vacuum-pan. This apparatus is manufactured by Dérosne & Cail of Paris, and is known as the Dérosne apparatus. The vacuum-pan secures a larger yield of better sugar, which may be simply drained as muscovado or clayed.

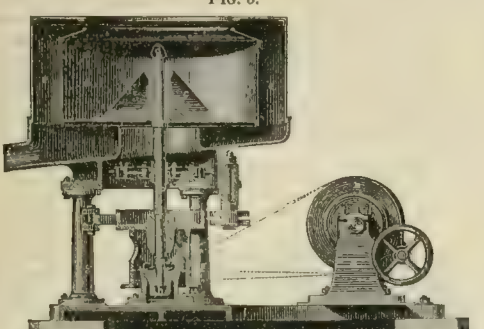
Open high-pressure steam-kettles and the vacuum-pan are sometimes used, but this combination really possesses little advantage, if any, over the previous.

Vacuum-Pans altogether.—In place of the open kettles, the vacuum-pan may be applied to the juice at once. The simplest arrangement consists of two vacuum-pans. The defecated juice is concentrated to 28° or 29° B. in a vac-

uum-pan, then defecated, filtered, passed over bone-black, and finally boiled to grain in a second vacuum-pan, the steam coils and jacket of the first pan being heated by the vapor from the syrup in the second. The idea of thus applying the heat of the escaping vapors originated with Rillieux of New Orleans, who patented a combination of four pans on this system, known as Rillieux's apparatus. At present, the best combination is of three pans, known as the *triple effet*, consisting of three vacuum-pans, the second heated from the first, the third from the second. The first cost of this apparatus is high, but its use results in great economy of fuel, with a marked improvement in the quality and quantity of sugar produced.

Centrifugal machines constitute one of the greatest improvements in the manufacture and refining of sugar. They are designed to separate the molasses from the sugar, and accomplish in a few moments what requires days in the draining of muscovado in hogsheads or of clayed sugars in moulds. The centrifugal machine consists of a round box, supported from above or below, the wall of which is formed of finely-perforated metal, and which is made to revolve in a horizontal plane 1000 to 1700 times a minute. The solid sugar, cut up to a uniform magma by a cutting-machine or "mixer," is introduced into the box of the centrifugal; this is then set in motion, when the sugar quickly rises from the bottom and forms a lining of uniform thickness on the interior, while the molasses is driven through the perforated metal and caught in the surrounding drum. A very small quantity of water is then thrown into the centrifugal with a syringe to wash the sugar. The machine is then stopped, and the sugar scraped out with a trowel. Fig. 5 is a German centrifugal. The suspended centrifugals are preferred in the U. S. in refineries. Four of Hepworth's centrifugals purged 28,000 pounds of sugar in four hours in Cuba with Chinese laborers. Muscovado, clayed, and refined sugars may all be purged in the centrifugal.

FIG. 5.



Centrifugal Machine.

Perhaps the best illustration of the improved modern system of extracting sugar from the cane will be the following description of the outfit for a Cuban plantation, supplied by Cail & Co. of Paris: A 3 roll-mill, rolls 78¾ inches long, 31½ in diameter; 6 clarifiers, 5 feet diameter, 4 feet 7 inches deep, supplied with steam-coils; 10 bone black filters, 3 feet 7 inches diameter, 6 feet 11 inches high, with steam-pressure to force the syrup through the black; a bone-black furnace; 2 condensing evaporators, each consisting of two series of 21 tubes, 6 inches diameter, 13 feet long; 3 vacuum-pans (triple effet), two of which are connected with the condensing evaporators; 9 centrifugal machines; engines 150 horse power, tanks, moulds, etc., etc. The capacity of this plant is 100 tons of cane daily, or 8 tons of sugar. Its cost was £32,000.

The yield of sugar varies from a ½ ton to 2½ tons solid sugar per acre with the variety of the cane, the nature of the soil, the season, and the apparatus and machinery on the plant. The loss of sugar is enormous, owing chiefly to the imperfect method for extracting the juice from the cane and the inversion of crystallizable cane-sugar into glucose. It has been estimated that by the old processes only about one third the sugar of the cane was obtained in crystalline sugar, thus:

Left in the bagasse	6	per cent.
Left in the skimmings	2¼	" "
Left in the molasses	3	" "
Sent to market as sugar	6¾	" "
Total percentage in the cane	18	per cent.

The improved machinery above described has increased the yield to above 8 per cent.

Concreting the Juice of the Cane. Alfred Fryer of Manchester has devised an evaporating apparatus by which the juice is rapidly converted at a low temperature into a solid concrete, ready for shipment at once. The juice flows upon a slightly-inclined iron table about 50 feet long and 6 wide, which is provided with numerous cross-ridges, which compel the juice to flow back and forth from one side of the table to the other about sixty times on its way down the table, thus prolonging the flow. There is a furnace at the upper end of the table, where the juice enters, and the flame travels down to the lower end, where the waste gases are utilized to heat a current of air which passes first through a revolving cylinder, the outside of which is covered with the concentrated juice as it leaves the table, then over the surface of the evaporating liquid in the opposite direction, the current of air being impelled by a fan. The liquor leaves the table at about 25° to 30° B., and on leaving the cylinder cools to a tolerably hard dry cake of *concrete*, containing only 6 to 8 per cent. of water. Dubrunfaut gives the following analysis of the concrete:

Crystallizable cane-sugar	78.00
Uncrystallizable glucose	9.10
Other organic matters	2.40
Ash	2.80
Water	7.70
	100.00

Sucrate-of-Lime Process.—Rousseau and Bonnaterre propose to add a sufficient quantity of lime to the fresh juice to convert all the sugar into an insoluble sucrate of lime—to dry this, and transport it to the refineries, where it could be at once converted into refined loaf-sugar, being readily decomposed into sugar and insoluble carbonate of lime when submitted to the action of carbonic acid gas and water. Although some encouragement was given the inventors by the French government, the process has not proved successful.

The composition of raw sugar is very complex. Many of the minor constituents have not been identified. The following are the most important: (1) cane-sugar; (2) glucose, consisting of dextrose and levulose; (3) mannite; (4) gum; (5) coloring-matter; (6) albuminoids; (7) lactic, acetic, propionic, butyric, and other organic acids, free or in combination; (8) ammoniacal salts, with the organic and inorganic acids; (9) phosphates, sulphates, carbonates, and organic salts of potassa, soda, lime, and magnesia; (10) silica; (11) sand, dirt, fragments of cane, etc.

Mulder gives the following analyses:

	Java, 10 samples	Havana, 6 samples.	Surinam, 4 samples.
Cane-sugar	98.6–83.1	97.0–87.3	92.3–85.4
Glucose	5.5– 0.3	3.7– 0.9	4.4– 1.6
Extractive matter—gum, acids, etc	3.5– 0.5	4.5– 0.4	2.1– 1.1
Ash	1.9– 0.2	1.1– 0.0	1.4– 0.8
Water	6.3– 0.3	3.8– 0.9	6.9– 4.0

Dr. Wallace gives the following table of analyses:

Raw Cane-Sugars.

	Cane-sugar.	Glucose.	Extractive, etc	Soluble salts	Insoluble salts	Water.	Color, Dutch Std.	Cane-sugar obtainable.
Cuba, muscovado	92.35	3.38	0.66	0.62	0.15	2.84	13	85.9
Grenada	92.31	4.06	0.66	0.37	0.04	2.56	13	86.4
Trinidad	90.41	3.84	0.95	0.86	0.22	3.72	10	82.3
Demerara	90.80	4.11	0.77	0.92	0.20	3.20	10	82.1
St. Vincent	89.00	5.85	0.76	0.62	0.05	3.72	10	80.0
Pernambuco	88.31	4.82	0.94	0.80	0.73	4.40	8	79.5
Paraiba	84.90	6.00	1.28	1.20	1.10	5.52	8	72.9
Bahia	86.80	5.03	1.72	1.21	0.92	4.32	7	75.8
Manila, unclayed	79.00	11.76	1.32	1.95	0.63	5.34	6	57.5
Amoy	74.50	16.13	1.70	1.61	0.54	5.52	7	50.4
Formosa	76.53	13.38	2.47	1.86	0.16	5.60	9	53.8
Concrete	84.20	8.45	1.70	1.10	0.00	4.55	12	70.2
Melada	67.00	11.36	1.93	0.76	0.15	18.80	...	51.8

The Dutch standards are an arbitrary series of numbered specimens of raw sugar, selected in Holland and used as standards all over the world.

Three samples of melada gave the writer the following results:

	I.	II.	III.
Cane-sugar	76.5	75.0	73.0
Water	9.7	13.0	13.4
Glucose, ash, etc	13.8	12.0	13.6
	100.0	100.0	100.0

The following partial analyses of low grade raw sugars are given in the *Sugar-Cane*, viii. 397:

	Cane-sugar.	Glucose.	Potassa.
Dutch bastards	84.60	7.81	0.53
Guatemala	88.50	6.12	0.40
Penang	88.03	4.62	0.71
Penang low	74.01	17.44	0.57
Penang (medium	84.93	8.22	0.23

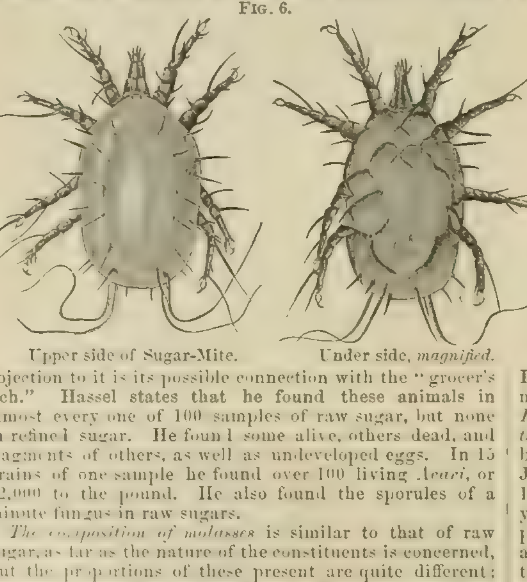
	Cane-sugar.	Glucose.	Potassa.
Egyptian	88.76	7.81	0.63
"	86.00	5.10	0.53
"	85.43	6.58	0.80
Jaggery	78.85	10.42	0.49
Manila, clayed	84.54	8.22	0.23
" Iloilo	82.73	9.46	0.58

The writer had occasion to determine the percentage of chlorides in ten raw sugars from New Orleans, calculated as chloride of sodium: the percentages varied from 0.030 to 0.116, averaging 0.065.

The various qualities of raw sugar have been mentioned in describing the different processes of manufacture. The following list presents the most important: (1) *Ordinary muscovado*, boiled in open kettles and purged in hogsheads. (2) *Centrifugal muscovado*, boiled in open kettles to syrup, and in vacuum-pans to grain, or entirely in vacuum-pans, etc., with or without the use of bone-black filters. (3) *Potted sugars*, boiled in open kettles, crystallized in earthen moulds, drained, but not clayed. (4) *Clayed sugars*, potted sugars clayed. The cones are divided into from three to five qualities—(*a*) white (*florets*), (*b*) second white, (*c*) first yellow, (*d*) second yellow, (*e*) brown (*cocorachers*). (5) *Melada*, muscovado not freed from the molasses by draining. (6) *Concrete*, same as melada, but boiled harder—*i. e.* drier. (7) *Molasses sugar*, made from the molasses, generally boiled in vacuum pans and purged in the centrifugal. (8) *Cistern bottoms*, the sugar deposited in the molasses-tanks. There are several varieties of molasses, corresponding to several of the raw sugars. The most important are—(1) *Muscovado*, which is the richest in crystallizable sugar. (2) *Clayed molasses*, the next richest. (3) *Centrifugal molasses*, the poorest, does not yield any appreciable quantity of sugar when boiled again.

Raw sugar generally contains a living insect in large numbers, the *Acarus sacchari*, or sugar-mite, which belongs to the same genus as the *Acarus scabei*, or itch-insect, and strongly resembles it in appearance. The animal is very small, hardly perceptible to the naked eye, and the only objection to it is its possible connection with the "grocer's itch." Hassel states that he found these animals in almost every one of 100 samples of raw sugar, but none in refined sugar. He found some alive, others dead, and fragments of others, as well as undeveloped eggs. In 15 grains of one sample he found over 100 living *Acari*, or 42,000 to the pound. He also found the sporules of a minute fungus in raw sugars.

FIG. 6.



Upper side of Sugar-Mite. Under side, *magnified.*

The composition of molasses is similar to that of raw sugar, as far as the nature of the constituents is concerned, but the proportions of these present are quite different; the percentage of cane sugar is low, while the percentages of water, glucose, gum, coloring-matter, and salts are high. Dr. Wallace gives the following analysis of West India molasses:

Cane-sugar	47.0
Glucose	20.4
Extractive and coloring-matter, etc	2.7
Salts (ash)	2.6
Water	27.3
	100.00
Specific gravity	1.36

Payne gives the following analysis:

Cane-sugar	63.083
Glucose	13.083
Gum, etc	0.636
Albuminoids	0.420
Acetate of potassa	1.744
Chloride of potassium	0.947
Sulphate of potassa	0.712
Acetate of lime	0.135
Phosphate of lime	0.433
Phosphate of copper	0.018
Silica	0.200
Water	15.000
	96.411

IV. SUGAR FROM THE BEET.—In the year 1747, Andreas Sigismund Marggraf, a chemist in Berlin, examined a variety of roots, and discovered cane-sugar in a number of them. From the beet (*Beta cicla*) he obtained, by means of alcohol, from 4.6 per cent. in the red variety to 6.2 per cent. in the white. This discovery attracted little attention at the time, and it was reserved for a pupil of Marggraf, Franz Carl Achard, forty-nine years later, to demonstrate the possibility of making beet-sugar on a large scale. Achard and Hermbstädt made many experiments on beets, and found them always to contain cane-sugar, obtaining about 6 per cent. of crystallized sugar and 4 per cent. of molasses. In 1796, encouraged with pecuniary aid by Frederick William II. of Prussia, Achard established an experimental factory at Cunern in Lower Silesia. Here he worked up 70 cwt. of beets daily, obtaining 6 per cent. of yellow raw sugar and 3 per cent. of molasses. These results were so satisfactory that Baron von Koppy established a factory at Olbendorf, and Herr Nathusius one at Hohensleben. Factories were established in Bohemia as early as 1802. Louis Napoleon states that while Achard's experiments were going on the British government, alarmed lest the discoveries of Achard should injure the colonial interests of Great Britain, offered him anonymously 50,000 thalers, and subsequently 200,000 thalers, if he would report that his experiments resulted unfavorably. The offer was rejected with contempt, and the successful results of his experiments made public. (*Analyse de Question de Sucre*, 170, 171.) Achard showed that, besides the sugar and molasses, the pulp would be a useful product as food for fattening cattle, whose manure would be of value for other crops; also, that the molasses would serve for the manufacture of spirits and of vinegar. The introduction of beet-sugar did not expand, however, at this time, nor for many years, although the First Napoleon encouraged the industry by having 32,000 hectares of land put to beets, and appropriating 1,000,000 francs for the enterprise (1811). The Russian government also encouraged the cultivation in Thule by a gift of 50,000 rubles and a remission of the taxes on land devoted to beets. The industry was, however, almost entirely abandoned in Germany, but under government encouragement was developed in France, till in 1829 the product amounted to 4,000,000 kilos, or 8,800,000 pounds, and in 1835 to 40,000,000 kilos, or 88,000,000 pounds. The French harvest of 1865–66 yielded from the beet—

Sugar	$31,250,000
Spirits	6,750,000
Potash	2,500,000
Pulp	5,000,000
	$45,500,000

In the mean time, it was revived in Germany and Austria, and extended into Russia, Belgium, Denmark, Holland, and Sweden. At present more than one-third of all the sugar of the world is made on the continent of Europe from the beet. (See statistics at the end of this article.) Efforts have been made with little success to establish the beet-sugar industry in England, Ireland, and the U. S. According to Dr. C. A. Goessmann (*Historical Notes on the Progress of the Sugar-Beet Cultivation for the Manufacture of Sugar within the U. S.*, *Am. Chemist*, July, 1872, p. 18), the first beet-sugar enterprise in the U. S. was started by Messrs. John Vaughn and James Donaldson of Philadelphia in 1830, but failed for want of information. The average yield of sugar from beets was at that time only 4 to 5 per cent. in Europe. In 1838, David Lee Child of Northampton, Mass., made 1300 pounds of beet-sugar. For the next twenty-five years nothing appears to have been done in this direction. In 1863, Gennert Brothers established a large factory at Chatsworth, Ill., which has gone through many discouraging experiences, and was in 1869 moved in part to Freeport, Ill. In 1867 a company was organized at Fond du Lac, Wis., and another in 1870 at Black Hawk in the same State. In 1860 experiments were undertaken in California, which finally resulted in the formation of the Alvarado Sugar Co., which began work in 1870. Two other companies have since been organized in that State. Some of these companies promise to prove successful. The difficulties thus far encountered appear to have resulted from bad locations, want of capital or of practical experience, and the want of much information as to suitable soils, localities, etc., which can only be gained by experience. The development in Europe was hastened by the invention of new processes for treating the beets and the juice; and the business could not exist at the present time had not experience taught the farmers what varieties of the beet, and what soils and fertilizers, were necessary to enable them to produce roots from which the present yield of over 8 per cent. can be obtained. The composition of the beet offers obstacles to the manufacture

of sugar which are never met in treating the cane. The percentage of sugar is only about two-thirds that of the cane, and the juice is highly charged with impurities, which it is necessary to remove before the sugar is merchantable.

The sugar-beet is, like the common mangold-wurzel, derived from the *Beta cicla* and *Beta vulgaris*, which grow wild near the sea-shores of South-western Europe. Cultivation has developed many improved varieties, some of which contain 13, and even 14, per cent. of sugar. The following is a description of the more important varieties:

(1) *The Silesian beet*, a pear-shaped root, white in the body and light green on the top; it is not so rich in sugar as some other varieties, but is much more extensively cultivated in France and Germany, for the reason that it yields a larger weight of roots to the acre, is of vigorous growth, and produces the largest amount of sugar per acre.

(2) *The French or Belgian Vilmorin sugar-beet* has small leaves and a slender spiral root, close in structure, and white in flesh.

FIG. 7.

Best Silesian Sugar-beet; weight 1lb. 5oz.

(3) *The Quedlinburg sugar-beet* is a slender rose-colored root, rich in sugar, and maturing fourteen days before any of the other varieties.

(4) *The Siberian beet*, called also "the white-ribbed beet," a coarse pear-shaped root, leaves abundant, light green, ribs almost white; weight per acre larger than with Silesian, but the percentage of sugar smaller.

(5) *Imperial beet*, slender, pear-shaped, very white, rich in sugar; does not yield as well as the Silesian.

Beets of good quality are firm, brittle, emit a cracking noise when cut, and are perfectly sound within. The 45th degree of latitude appears to be the southern limit of their successful growth for the manufacture of sugar.

Composition of the Beet. -The beet-root consists of a mass of small cells containing a colorless fluid. Scheibler discovered a peculiar base, betaine, $C_5H_{11}NO_2$, in the sugar-beet; young beets contain 0.25, ripe beets 0.10 per cent.; beet-molasses much more. (See the article "Betaine" in the 1st and 2d supplements to *Watts's Dictionary*.) The composition varies considerably, but the following is a fair average:

FIG. 8.

French Vilmorin Sugar-beet; weight 1lb. 4oz.

	Per cent.
Water	82.60
(1) *Insoluble Constituents.*	
Cellulose	0.80
Pectose, pectase, pectic, and pectosic acids; Metarabic acid; Fatty, waxy, and resinous bodies; Albuminoids; Pectates, parapectates, metapectates, pectosates, oxalates, and phosphates of magnesium, calcium, iron, and manganese; Silica,	0.30
(2) *Soluble Constituents.*	
Cane-sugar	11.30
Glucose.	
Albumen, caseine, etc	1.50
Asparagine ($C_4H_8N_2O_3$)	
Betaine ($C_5H_{11}NO_2$)	0.10
Pectine, parapectine, metapectine, and pectase; Gummy bodies; Cromogene; A body which turns black by oxidation; A yellow extractive body; Parapectic, metapectic, aspartic, citric, and malic acids; Pectates, parapectates, metapectates, citrates, malates, oxalates, aspartates, sulphates, phosphates, nitrates, and chlorides of potassium, sodium, rubidium, and ammonium; Citrates, malates, aspartates, sulphates, nitrates, and chlorides of magnesium, calcium, iron, and manganese; Silica,	3.40
	100.00

Near Magdeburg, where the beet is extensively cultivated, the general results give—

The greatest sugar-production as	13.3 per cent.
That from inferior beets	9.2 " "
The average beets	11.2 " "

$12\frac{1}{2}$ tons of beets yield on the average 1 ton of raw sugar.

The following analyses are from S. W. Johnson's *How Crops Grow*:

The Composition of Sugar-Beets.

	Water.	Albuminoids.	Sugar.	Org. acids, pectine, &c.	Crude fibre.	Ash.	Analyst.
Hohenheim	81.5	0.87	11.90	3.47	1.33	0.80	Wolff
Mockern	84.1	0.82	9.10	3.90	1.05	0.99	Ritthausen.
" 2 pounds	81.7	0.84	11.21	3.86	1.36	0.94	"
" ½ "	79.5	0.90	12.07	5.09	1.52	0.88	"
Bickendorf, 1½ pounds	80.0	0.70	12.90	5.00	1.20	0.70	Grouven.
Slanstadt, 2 pounds	80.0	0.68	13.37	5.21		0.74	Stockhardt.
Lockwitz, 1¼ "	79.9	0.65	13.32	5.53		0.60	"
Tharand, 1½ " manured	82.7	0.93	12.34	3.24		0.79	"
" 2 " "	81.8	1.16	10.15	5.77		1.12	"
" 3¼ " "	82.1	1.14	9.25	6.36		1.15	"
" 4 " "	82.5	1.05	8.45	7.07		0.93	"
Silesia, unmanured	84.4	1.14	9.80	3.96		0.69	Bretschneider.
" manured with nit. soda.	82.7	1.42	11.57	5.63		0.68	"
" manured with phos. lime	84.1	1.20	9.82	4.04		0.77	"
Average	81.5	0.95	11.5	3.7	1.3	0.85	

Dr. Voelcker has published in the *J. Roy. Ag. Soc.* [2], v. 347, and vii. 60, numerous analyses of beets grown in England, Ireland, and on the Continent.

The manufacture of sugar from the beet consists of the following operations: (1) washing and cleansing the beets; (2) extracting the juice; (3) defecation by lime and heat; (4) carbonatation, removal of the lime with carbonic acid gas; (5) filtration, to remove suspended impurities; (6) filtration through bone black; (7) evaporation to a thin syrup; (8) second filtration over bone black; (9) evaporation to crystallization; (10) separation of the sugar from the molasses. The first molasses is evaporated again, to furnish a second crop of sugar, and a third and fourth crop are subsequently obtained. The final molasses is too offensive in taste and smell to serve as food, and is diluted and subjected to fermentation and distillation for the production of alcohol, the residue from the distillation being evaporated to dryness and calcined for the production of potash.

Washing and cleansing the beets is effected in a revolving drum of open iron or wood-work placed beneath the surface of water in a long trough.

Extraction of the juice is effected by—(1) Pressing the pulp, (2) macerating the pulp in water, (3) exhausting the pulp in centrifugals, (4) diffusion.

Pressing.—The cleansed roots are reduced to pulp by a rotary rasping machine, which consists of a drum armed with 250 saw blades set on its periphery, parallel with its axis. The drum is from 20 to 24 inches long and 32 to 40 inches in diameter; it revolves from 1000 to 1200 times a minute, and reduces 800 to 1000 cwt. of beets to pulp in twenty-four hours. A little water is generally run into the rasping-machine with the beets. The pulp is then subjected to pressure, either in sacks or bags, between iron plates in the hydraulic press, under a pressure of 500 to 600 pounds, or through a series of linen cloths by means of a stone or iron roller; 100 pounds of beets yield 80 to 85

pounds of juice of the 95 to 96 present. *The residue* or exhausted pulp is largely fed to cattle. The following analysis by Wolff of the residue from the presses at Hohenheim are from Wagner's *Technology:*

	Refuse.		
	Pressed with 20 per cent. of water.	Pressed with 11 per cent. of water.	Pressed without water.
Sugar	7.86	7.58	6.72
Proteine substances	1.05	1.67	1.02
Other nutritious substances	11.36	11.05	14.36
Cellulose	6.25	6.04	6.68
Ash	5.47	5.74	5.28
Water	68.01	67.92	65.94
	100.00	100.00	100.00

The result of the pressing is seen in the following table, which shows what part of each constituent passes into the juice, and what part remains in the residue:

	Fresh roots.	Juice.	Residue.
Sugar	11.88	10.17	1.72
Proteine substances	0.87	0.58	0.28
Other nutritious substances	3.47	0.63	2.84
Cellulose	1.33	......	1.47
Ash	0.89	?	1.27
Water	81.56	65.95	15.61
	100.00	76.80	23.20

Marguerite ferments the press-residue and distils off the alcohol.

Maceration is a system of exhausting the beet-pulp with water. Suppose the beet-pulp contains 96 per cent. of juice, containing 12 per cent. of sugar, and it is mixed with 96 per cent. of water: the juice will then be diluted with an equal bulk of water to half its original strength. If 96 per cent. of this weak juice is drawn off, it will carry half the sugar contained in the beet. On adding another 96 per cent. of water to the half-exhausted pulp, and drawing off an equal volume again, one-half of the remaining half of the sugar, or one-fourth of the original quantity, will be gained. Continuing this washing ten times in succession, there will be removed of the sugar contained in the beet, $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64} + \frac{1}{128} + \frac{1}{256} + \frac{1}{512} + \frac{1}{1024} = \frac{1023}{1024}$, leaving only $\frac{1}{1024}$th of the sugar in the exhausted pulp. Considering the percentage of sugar, there will have been removed, first, 6 of the 12 per cent. in the juice, then 3, 1.5, 0.75, 0.375, 0.1875, 0.09375, 0.046875, 0.0234375; and on the tenth washing 0.01171875 per cent., making a total of 11.98828125 per cent. The resulting solutions would of course be very dilute, but by bringing them in contact with fresh beet-pulp, they would be rendered more concentrated, till they finally almost equal the original juice in strength. The weakest mixed with fresh pulp would yield a juice containing $\frac{12. + 0.01171875}{2} =$ 6.005859375 per cent. of sugar. This mixed with fresh pulp would yield juice containing $\frac{12. + 6.005859375}{2} = 9. +$; and by repeating this process the juices obtained will contain successively 10.5, 11.25, 11.625 per cent., and so on. By this system of maceration the beets are completely exhausted, and at the same time a liquid is obtained nearly as strong as the original juice. The apparatus consists of a series of ten or twelve macerators, vessels provided with rotary stirrers and false bottoms. These are charged successively with fresh pulp, and the liquors pass from one to the other successively, the fresh water coming first in contact with exhausted pulp, and lastly with fresh pulp; the pulp being washed first with a liquor nearly as strong as juice, and lastly with water. Schützenbach has modified this process as follows: "The roots are cleaned, and then cut in slices by a cutting-machine. They are then passed to a drying chamber heated to 50°, and subsequently ground to a meal. Four parts of this meal are allowed to macerate in nine parts of water, to which sometimes sulphuric acid is added. Another method is to moisten the dried beet-meal with milk of lime, and afterward continue the operation in a bath of water heated to 80°. These methods are largely used in Germany, where in general practice it is found that 4.75 cwts. of green roots yield 1 cwt. of dry beet-meal." (*Wagner.*)

Extraction of the juice by centrifugals is practised in some factories. The pulp is placed in the centrifugal machine (Fig. 5), and a considerable portion of the juice is at once thrown out by the rapid rotation. Water is then applied to the still rotating pulp by a sprinkler, and a very considerable portion of the remaining juice is thus displaced. The drum of the centrifugal is usually about 29½ inches high and 25½ inches in diameter. The usual speed is about 1200 revolutions per minute. The pulp is mixed with 40 per cent. of water, and 242 pounds of the mixture, consisting of 176 pounds of pulp and 66 (8 gallons) pounds of water, constitutes a charge. When the flow of juice from the drum slackens, water to the amount of 165 pounds (20 gallons) is introduced through a sprinkler. Three charges per hour can be worked off; so one centrifugal exhausts 176 pounds $\times 3 = 528$ pounds per hour, or 11,616 pounds in twenty-two hours. The yield of juice varies with the amount of water used. Pure pulp yields 65 per cent. of juice, but the application of 45 per cent. of water increases the yield to 87.5 per cent. Of the 45 per cent. of water used, 31 goes into the juice and 14 remains in the residue, which retains also 7.3 of the original 95 per cent. of juice in the pulp. Thus,

$$\left.\begin{array}{ll} \text{Juice...} & 95 \\ \text{Fibre...} & 5 \\ \text{Pulp...} & 100 \\ \text{Water..} & 45 \end{array}\right\} \text{yields...} \left\{\begin{array}{ll} \text{Liquor:} & \\ \quad\text{Juice...} & 87.5, \text{ and} \\ \quad\text{Water..} & 31.0 \\ & 118.5 \end{array}\right. \left\{\begin{array}{ll} \text{Residue:} & \\ \quad\text{Juice....} & 7.5 \\ \quad\text{Water...} & 14.0 \\ \quad\text{Fibre....} & 5.0 \\ & 26.5 \end{array}\right.$$

By increasing the quantity of water, a still larger yield can be obtained, but excessive dilution would result, which is more serious than a small loss of sugar. Stammer gives the following results from 100 pounds of beet-pulp, actually containing 95 pounds of juice, when using different quantities to wash the residue in the centrifugal:

Water used.	Liquor obtained.	Percentage of sugar in the liquor.	Juice in the liquor.	Water in liquor.	Juice in residue.
40 lbs.	115.0	10.2	82.5	32.5	12.5
60 "	129.5	9.8	89.5	40.0	5.5
70 "	136.5	9.4	90.0	46.5	5.0
80 "	144.0	8.9	90.5	53.5	4.5

Walkhoff gives the following as the average composition of the residue from the centrifugal:

Sugar	2.4	to	2.4
Soluble substances	1.5	"	0.6
Fibre	13.5	"	12.0
Water	82.6	"	85.0
	100.0		100.0

Diffusion has been already explained in describing the methods employed in extracting the juice from the cane. It is now very extensively practised in the European beet-sugar factories. The beets are cut into ribbons about $\frac{1}{25}$ inch thick and ¼ to ½ wide. A cutting-machine, the cutter rotating 160 times a minute, will cut 220,000 pounds of beets in twenty-four hours. The diffusion battery consists of ten cylinders, provided with manholes and covers and the necessary series of tubes to carry the liquors to and from each cylinder in the series. The cylinders hold from 2000 to 4000 pounds of beets. Compressed air is used to force the liquors from one cylinder to another. Supposing the battery to be in full operation, eight of the cylinders will be in use, all containing beets; at one end of the series the beets will be nearly exhausted, and the liquor little more than pure water; at the other end the liquor will have nearly reached the strength of real beet-juice, while the beets will as yet have given up very little of their juice. Every hour a fresh cylinder of beets is added at this end of the series, and a cylinder of exhausted beets is thrown off from the other end. The liquor in the last cylinder is run into the warming-kettle and heated to from 170° to 200° F., and then run into the cylinder of fresh beets. After remaining in contact with the beets for twenty or thirty minutes, it is drawn off, and is ready for defecation. Water runs into the exhausted end of the series, and the liquors pass from cylinder to cylinder toward the fresh beets. A small quantity of lime is added to the water used, to neutralize the free acids of the juice and retard fermentation. Care is taken not to add so much lime as to cause an alkaline reaction. Carbolic acid (phenol) is sometimes added in small quantity to prevent fermentation. As water is run in upon the beets until it ceases to extract any more juice, all the juice present is obtained; so diffusion yields about 95 per cent. of juice. As the beets are not reduced to pulp, the cells are not ruptured, and the albuminoids, etc., of the juice are left behind; consequently, a purer juice results than by any of the other methods of extraction.

Choice of Extraction Methods.—Great difference of opinion exists as to the economic advantages of the different methods of extraction. Maceration and diffusion are most effective, as they yield nearly all the juice in beet. Diffu-

	Presses.	Maceration.	Centrifugals.	Diffusion.	Total.
Austria	61	...	1	183	245
Germany	176	27	11	120	334
Russia	225	...	...	42	267
Holland	30	...	...	2	32
Denmark	1	...	...	1	2
Sweden	......	...	...	4	4
Italy	3	...	...	......	3
Total	496	27	12	352	887

sion yields the purest juice. Centrifugals yield the weakest juice, but require the least capital. In the campaign of 1873–74 the 337 factories in Germany were divided as follows on this question: 214 used presses, 31 maceration, 12 centrifugals, and 80 diffusion. (*Wagner's Jahresb.*, 1875, 779.) The *Sugar-Cane*, July, 1876, gives the preceding table of factories, omitting France.

Underground transportation of the juice is now resorted to on large estates. Extraction-works are established at convenient points, and the juice is forced underground in iron or earthen pipes to the central factory, when it is defecated and evaporated.

The juice contains, besides the soluble constituents of the beet, a variable quantity of torn cells and their insoluble contents, by which it is rendered turbid. It contains, therefore, all the substances contained in the original beet, though the insoluble constituents are present in much smaller proportion than the soluble. This statement applies, however, especially to the juice from the presses and centrifugals—less to that from maceration, and still less to that from diffusion. The latter is very free from the insoluble constituents of the beet, and also from the soluble colloids—*i. e.* albuminoids, pectine, etc., gummy bodies, and soluble silica, owing to the fact that, the beets being cut into ribbons, the cells are not ruptured to any great extent. The following is about the average composition of the juice:

Sugar	12.00
Albuminoids	1.25
Salts	0.72
Water	86.03
Total	100.00

Michaelis determined the following substances in 100 parts of juice:

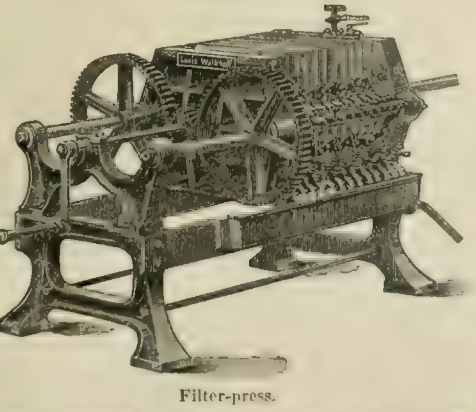
Fat	0.0735
Gluten	0.1154
Legumine	0 2026
Albumen	0 1358
Extractive matters	0.3000
Total	0.8273

Also in—

	Magdeburg beets.		Hung. beets.
Silica	0.0083	0.0069	0.0410
Chlorine	0.0173	0.0279	0.1656
Phosphoric acid	0.0848	0.0827	0.0230
Oxalic acid	0.0545	0.0944	0.0944
Citric acid	0.1743	0 0785	0.0758
A peculiar acid	Not determined.		
Protoxide of manganese	0.0031	0.0019	0.0003
Protoxide of iron	0.0046	0.0133	0.0117
Lime	0.0097	0.0179	0.0300
Magnesia	0.0665	0 0442	0.1109
Soda	0.1876	0.1387	0.1003
Potassa	0 1893	0.2335	0.4556
Total	0.8000	0.7409	1.7088

Defecation of the juice is generally effected by boiling with the addition of ½ to 1 per cent. of lime in jacketed copper kettles holding about 500 gallons. The free acids are neutralized; the albuminoids largely precipitated, as are also the magnesia, iron, manganese, and much of the silica; insoluble phosphates, oxalates, and malates are produced; pectose and pectine, etc., are converted into nearly insoluble lime-salts; the chromogene is converted into insoluble lime-salts of ulmic acid, etc.: the lactic acid formed by fermentation is converted into a soluble lime-salt, as are also the citric, aspartic, and some other acids; the alkalies are set free, and the excess of lime forms an alkaline saccharate with a little of the sugar; the caseine

FIG. 9.



Filter-press.

forms a compound soluble in the now alkaline juice, as does a portion of the albumen, etc.; the betaine is decomposed with the formation of calcic oxalate, and the asparagine with the formation of ammonia. As the temperature rises to about 190° F., large flocks form, which rise to the surface and soon produce a thick, compact scum of a dark color. The juice loses its turbidity and black color, and becomes almost colorless. When the boiling is finished, the clear portion of the juice is drawn off, and the turbid portion, containing the scum and precipitates, and amounting to from 18 to 30 per cent. of the whole, is filtered by bags or presses. Fig. 4 shows bag-filters; Fig. 9 a filter-press, generally used in Germany and France for separating the scums in sugar factories and refineries. The pressed scum is valuable as a fertilizer. It is said to develop a mould or ferment fungus, the spores of which find their way into sugar solutions, syrups, etc., and do much harm; hence it should be removed at once from the factory. The following analysis of the dried scum is interesting, as showing the nature of the substances removed with the lime during defecation:

Carbonate of lime	16.60	50.70	
Lime combined with acids, etc.	17.36		
Magnesia	1 90		
Alumina and oxide of iron	8 00		
Potassa and soda	0.39		
Chlorine	trace		
Sulphuric acid	0.05		
Phosphoric acid	1.90		
Residue	4.50		
Organic matter		44.85	Nitrogen... 1.579; Albumen... 9.995
Water		4 45	
		100.00	

De-liming, or saturating the juice with carbonic acid (*carbonatation*), is the next step in the manufacture of sugar. The object of this treatment is to precipitate the excess of lime, to carbonate the caustic alkalies, and to precipitate soluble organic matters, albuminoids, acids, etc., which are soluble in caustic alkalies, but are precipitated as lime-salts and lakes. The carbonic acid gas is obtained by burning coke or charcoal, or by passing superheated steam over ignited limestone. It is washed and stored in gas-holders, and is bubbled into the defecated juice as long as it is absorbed. The juice is then heated to decompose any soluble bicarbonate of lime that may have been formed, and the precipitate is separated by the filter-press. The bluish-violet coloration which the juice shows after treatment with carbonic acid is said to be due to a compound of glucic acid and iron.

Other Methods of Treating the Juice.—Chloride of calcium has been added to convert the caustic alkalies into chlorides, and reduce their tendency to form molasses to a minimum. (*Balling* and *Michaelis.*) It was added before the lime in defecating. Chloride of aluminum was used for the same purpose, and to remove color. (*Siemens* and *Breunlin.*) Phosphoric acid, acid phosphate of lime, and phosphate of ammonia have been used to remove the free lime after defecation, as have also caseine, soap, fatty acids, sulphate, oxalate, and acetate of alumina, and pectic acid. Hydrofluo-silicic acid has been used to remove potassa.

Frey and Jelinek's process of purification is one of the most important improvements in treating beet juice. The juice is heated to 77° to 100° F., and a large quantity of lime added, 2 to 4 per cent.—more than enough to convert all the sugar present into saccharate of lime and to combine all the acids. Carbonic acid gas is immediately introduced through perforated tubes, and allowed to bubble through the juice. As the saturation of the lime proceeds, the temperature is gradually raised, till, when the saturation is complete, it is about 200° F. The whole is then sent through the filter-press, or, after standing, three-fourths are drawn off clear, and the remaining one fourth sent through the press. Only about 0.05 to 0.07 per cent. of lime remains in the juice. The advantages of this process are (1) one operation completes the purification; (2) the purification is more complete; while the old processes of defecation and carbonatation removed only 20 per cent. of the albuminoids, this process removes 50 per cent.; (3) the increased purity of the juice diminishes the quantity of bone black required for the subsequent filtration; (4) the use of less bone-black leads to the production of less sweet water; (5) the juice is not darkened by being boiled with caustic potassa, soda, and lime; (6) the lime in the scum being all in the form of carbonate, the filtering cloths last longer.

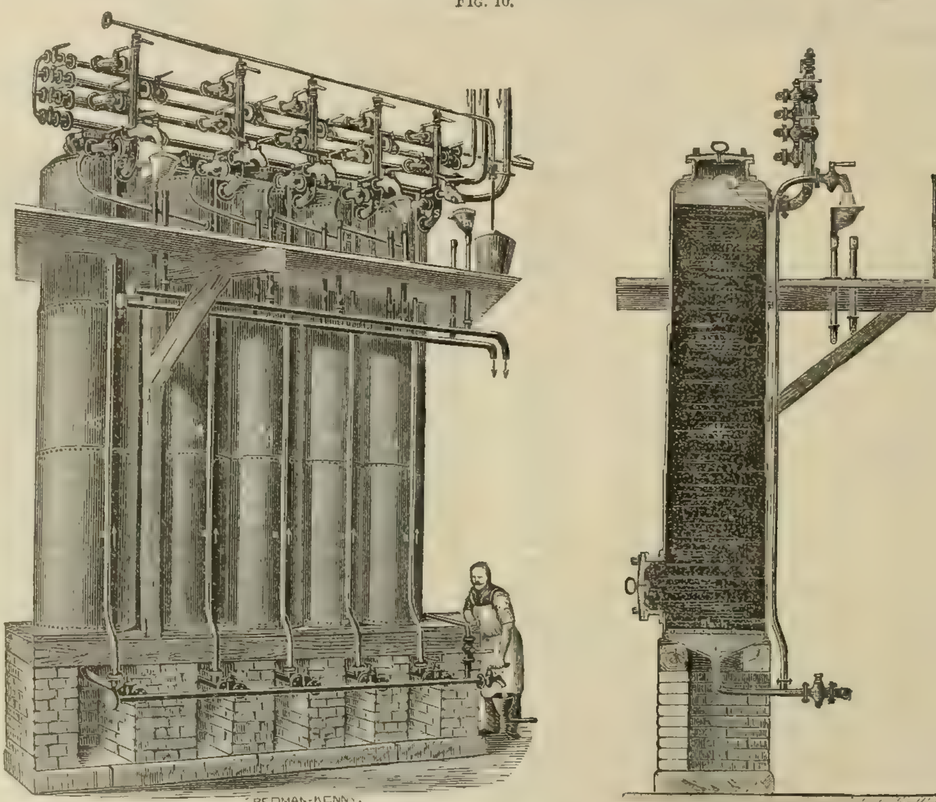
The montejus, or juice-lifter, is employed to raise the juice to the top of the bone-black filters. It takes the place of pumps, which would become sticky and promote the fermentation of the juice. It is simply a closed vessel which is filled with the defecated juice. The entrance tube is closed, steam pressure is admitted at the top, and the juice is forced upward through a tube which descends to

near the bottom of the vessel. The elevating power is equivalent to 29 feet for every 15 pounds of pressure in the boiler.

Filtration over bone black is the next step in the treatment of the juice. Bone black, *bone-coal, animal charcoal, char, spodium*, is the charcoal of bones, which is obtained by heating them in retorts. (See BONE-BLACK.) The decolorizing properties of charcoal were noticed in 1798 (1790? *Stohmann*) by Lowitz of St. Petersburg. In 1809, M. Guillon, a refiner, employed wood-charcoal for decolorizing sugar and syrup. In 1811, M. Figuier of Montpellier published a note on animal charcoal in which he mentioned its wonderful decolorizing power on vinegar and wine. In 1812, Dérosne proposed to use it on sugar solutions. M. Payen, a manufacturer of sal-ammoniac from animal matters, followed out the suggestion, using the bone-charcoal which was produced as a by-product in his factory. The yield of sugar was increased 10 per cent., while the quality of the various grades of refined sugar and syrup was greatly improved. The finely-pulverized bone-black was at first boiled with the sugar solutions in the defecator, but in 1822 the bone-black filter was introduced, in which the sugar solution is made to pass down through a column of bone-black in coarse grains. In the Paris refineries the writer saw in 1869 the use of powdered black in the defecator still continued, although the liquors were afterward sent through the bone-black filters. The powdered black can be used but once, and consequently the quantity used must be small, while the coarse black of the filter can be washed and revivified, and used again and again, which makes it possible to use larger quantities.

The bone-black filter at first used was the Taylor bag-filter (Fig. 4), which was filled with bone-black, the cistern above, A, also containing a layer of black. In 1828, Dumont introduced the filter which bears his name. It consisted of an upright wooden box with a perforated false bottom. The false bottom was covered with cotton cloth; the box was then nearly filled with coarse black, and the hot sugar-liquor was then run in and allowed to filter through. This filter, enlarged and somewhat modified in detail, is the one now used. It is made of boiler plate or cast iron, and is often closed at the top to enable the operator to filter under pressure. In large refineries these filters are now made of enormous dimensions, reaching a diameter of 10 feet and a height of 30 feet. Fig. 10 shows a set of five such filters:

FIG. 10.



Bone-black Filters.

The hot juice is introduced at the top, and passes out at the bottom. It is sometimes raised and sent through a second filter. The effect of the black on the juice is most important. It removes (1) the coloring-matters; (2) other organic substances, such as albumen, gluten, legumen, dextrine, and other gummy bodies and extractive matters; (3) caustic lime, if present; (4) salts, sulphate of lime, potassa, and soda salts; (5) soluble silica. It was at first supposed that the action of the black was limited to the removal of the coloring matter, but it is now known that this is one of the less-important effects of bone-black filtration. The other substances which are removed all interfere with the subsequent crystallization of the sugar, and their removal, though partial, results in a considerable increase in the yield of sugar and a consequent diminution of the quantity of molasses formed. The effect is much greater on hot than on cold liquors, and much greater on the thin juice than on the concentrated juice. Walkhoff gives the following table, showing the effect of each operation on the quantity of inorganic salts (ash), in the juice:

Fresh juice	0.456	100
Defecated juice	0.852	187
Carbonated juice	0.609	132
Juice once filtered over black	0.370	81
Juice twice filtered over black	0.130	29

The increase in defecating is due to the lime used.

Organic Bodies, not Sugar.

Fresh juice	100
Defecated and carbonated	92 to 87
Once filtered	76 to 70
Twice filtered	44 to 24

The black becomes charged with matters removed from the juice, and its action gradually diminishes; but by passing the latter runnings through a second filter, uniformity in the product can be maintained. Walkhoff found that while the partially-concentrated juice running from a freshly-charged filter had lost 55 per cent. of its salts, that running during the sixth hour had lost only 17 per cent. Stamm found that thin juice, which, when the filter first began to run, had lost 42 per cent. of its salts, lost only 27 per cent. toward the end of the filtration.

How the black acts has always been an interesting question. The action is supposed to be chiefly mechanical, due to the porosity of the black, but this theory would hardly account for the apparently discriminating action of the black. Anthon says the lime is held by the free carbonic acid in the pores of the coal, which forms with it an insoluble carbonate. Divés (*Sugar-Cane*, June, 1872, 314) doubts this. Wernekinck thinks the color and some other

organic bodies are destroyed by the free oxygen absorbed by the coal from the air. Scheibler disproves this by successfully using coal which has been ignited and cooled in an atmosphere of hydrogen. (*Dingl. Polyt. J.*, cciv. 236–240.) Divès says color is absorbed, but not destroyed. That the coal exerts a powerful action is shown by the fact that it decomposes saccharate of lime, holding the lime, and that it even decomposes alkaline sulphates and many other metallic salts. Graham says it affects salts in three different ways: (1) it absorbs some unaltered; (2) it reduces some salts to a lower degree of oxidation; (3) it precipitates some as basic salts. Other forms of animal charcoal possess higher decolorizing powers, but bone-black is best adapted to all the requirements in purifying sugar solutions. The following table by Bussey is interesting:

Species of charcoal.	Weight.	Indigo test consumed.	Molasses test consumed.	Blanching by indigo.	Power by molasses.
	gram.	litres			
Crude bone-black	1	0.032	0.009	1	1
Blood calcined with potassa	1	1.60	0.18	50	20
Blood calcined with chalk	1	0.57	0.10	18	11
Blood calcined with phosphate of lime	1	0.38	0.09	12	10
Gelatine calcined with potassa	1	1.15	0.14	36	15.5
Albumen calcined with potassa	1	1.08	0.11	34	15.5
Starch calcined with potassa	1	0.34	0.08	10.6	8.8
Charcoal from acetate of potassa	1	0.18	0.04	5.6	4.4
Charcoal from carbonate of soda by phosphorus	1	0.38	0.08	12	8.8
Calcined lamp-black	1	0.128	0.03	4	3.3
Lamp-black calcined with potassa	1	0.55	0.09	15.2	10.6
Bone-black treated with hydrochloric acid and potassa	1	1.45	0.18	45	20
Bone-black treated with hydrochloric acid	1	0.06	0.015	1.87	1.6
Oil calcined with phosphate of lime	1	0.064	0.017	2	1.9

The composition of bone-black, when new, is shown in the following table:

				Average.
Carbon	6.00	to	12.00	11.00
Nitrogen	1.00	"	1.50	
Phosphate of lime	75.00	"	80.00	80.00
Phosphate of magnesia	1.00	"	1.50	
Carbonate of lime	6.00	"	9.00	8.00
Sulphate of lime	0.11	"	0.59	0.20
Sulphide of calcium	0.01	"	0.07	trace.
Chloride of sodium, etc.	0.77	"	1.29	0.40
Iron	0.10	"	0.30	0.10
Sand, etc	0.30	"	0.80	0.30
				100.00

Bone-black, both new and old, retains appreciable quantities of gases, which are often combustible. These escape when the filters are filled with the liquors, and when mixed with air become explosive. Bone-black contains a variable quantity of moisture, either absorbed from the air or added to cool it.

The active constituents of the black are the porous nitrogenous carbon—which performs all the peculiar work of the coal—and the carbonate of lime, which neutralizes the free acids, often present in the liquors in the case of sugar from the cane.

The subsequent treatment of the black consists in washing with hot water, treating with dilute hydrochloric acid to remove a portion of the carbonate of lime, fermenting either in vats (*wet fermentation*) or in heaps (*dry fermentation*) to destroy organic matters, drying, and reburning in kilns to destroy organic matters. A subsequent washing would be of advantage, and is often resorted to. Some of these processes are often omitted, and additional processes are in use, but the reburning is almost invariably resorted to. Eissfeldt revivifies without reburning, subjecting the coal successively to the action of fermentation, hydrochloric acid, steam, and ammonia-water. (See *Am. Chem.*, i. 216.) The coal is sometimes boiled with caustic soda or carbonate of soda to remove organic matters, and to change the sulphate of lime into carbonate, that it may be removed by hydrochloric acid. It is very important to wash with pure water, as the coal will extract lime salts from impure well-water. Bone-black becomes gradually deteriorated, and, were it not for frequent additions of fresh black to replace that sifted out, would ultimately become almost worthless. Judicious management reduces this deterioration to a minimum, however. (1) Allowing the hot black from the kiln to come in contact with the air causes a loss of carbon and the black becomes gray. (2) Careless washing leaves organic matters in the coal, which are charred in the kiln and fill up the pores, giving the coal a glaze and increasing the percentage of carbon. (3) Carelessness in handling the liquors, allowing them to become acid, may charge the coal with iron: this is specially noticed in some refineries using sugar from the cane. (5) The black may be injuriously enriched or impoverished in carbonate of lime. (6) It may be charged with an excess of sulphate of lime. (7) It may be reburned at too high a temperature, by which a partial fusion of the phosphates results, reducing the porosity of the coal. By this cause, and also by the pulverization of the softer and more porous portions of the coal, the gravity of the coal increases in use. A cubic foot of new coal weighs 37 to 46 pounds, while old coal weighs 48 to 76 pounds. (See Arnot, *Chem. News*, xxi. 1, and Wallace, *Am. Chem.*, i. 139.)

Testing Bone-black.—The quality of bone-black is determined—(1) by testing its decolorizing power on indigo, burnt sugar, or raw sugar (see *Chem. News*, xxi. 31); (2) by determining the quantity of lime absorbed from lime-water or saccharate of lime; (3) by determining the ratio of sugar to the total solids in saccharine solutions before and after filtration: this is the only reliable test of the effective action of the coal; (4) the percentage of moisture, the weight per cubic foot, the color, porosity, average size by sieves, and appearance under the microscope, are also important sources of information.

Evaporation of the juice is effected in a vacuum pan (Fig. 3), or usually in a series of two (*double effect*) or three (*triple effect*) vacuum pans, in which the heat is applied by steam coils or tubes to the one which the juice enters last, while the others are heated by the steam given off by this one. These pans are constructed with vertical tubes. The evaporation is continued till the sp. gr. is about 1.31 or 25° Beaumé. The "thick juice" is then ready for—

The second filtration over bone-black, which is in every respect similar to the first.

The final concentration to the crystallizing point is conducted in a single vacuum-pan, like Fig. 3. The semi-solid mass of crystals is then allowed to cool, and is placed in the centrifugal machines (Fig. 5) to separate the crystals from the mother liquor. The latter is again boiled, and a second crop of crystals of inferior sugar is obtained. A third, a fourth, and often a fifth crop is obtained by repeating the boiling, etc. The latter crops are not boiled to crystals, but are boiled "blank," and the crystals form on standing in cisterns, many weeks being required for the later crops.

Analyses of Raw Beet-Sugar and Molasses.

	Cane-sugar.	Other organic matters.	Ash.	Water.
1. First product	98.00	0.31	0.54	1.15
2. " "	96.00	0.94	1.08	1.98
3. " "	95.10	2.05	1.41	1.44
4. Second "	93.70	1.63	1.67	3.00
5. " "	90.50	2.76	3.66	3.08
6. " "	91.60	1.94	3.69	2.77
7. Third "	92.10	2.24	2.76	2.90
8. " "	90.80	3.27	2.76	3.17
9. " "	87.00	3.98	4.04	4.98
10. Molasses	53.30	15.88	14.78	16.04
11. "	52.39	17.24	16.40	13.97
12. "	46.60	17.19	10.70	24.80

The molasses is so charged with salts and other impurities that it cannot be used as food. It is diluted, fermented, and distilled for spirits, and the liquor left in the still is evaporated, and the residue calcined, yielding crude potash. Dubrunfaut has applied the principle of osmose to the purification of the molasses, removing a portion of the alkaline salts and recovering an additional percentage of crystallized sugar. (His process is described and apparatus figured in the article EXOSMOSE.)

Ashes of Beet Molasses (Stammer).

	I.	II.
Potassa	51.72	47.67
Soda	8.00	11.13
Lime	5.04	3.60
Magnesia	0.18	0.10
Peroxide of iron	0.30	0.18
Alumina	0.17	0.11
Carbonic acid	28.90	27.94
Chlorine	6.05	8.16
Sulphuric acid	1.33	1.52
Phosphoric acid	0.57	0.55
Silica	0.42	0.17
	102.28	101.42
Oxygen counted twice	1.36	1.84
	100.92	99.[illegible]

The yield of sugar in the French factories is estimated as follows by Vivien. Of 100 kilogrammes of sugar in the juice, there is obtained—

Sugar of 1st run	41.0[illegible]	[illegible]
" 2d "	17.[illegible]	
" 3d "	4.88	
Sugar in the molasses		18.50
Sugar lost by transformation into various compounds.		1.[illegible]
		100.00

The beet-sugar establishment is often of great magnitude. The following description is by Waldron Shapleigh in the *Am. Chem.*, iv. 281:

"*The Cambrai Central Beet-Sugar Works in France.*

"The râperies are at distances varying from 4 to 20 miles from the central usine, and are seventeen in number, having in all 87½ miles of tubing, varying from 90 to 250 millimètres in diameter; it is intended to increase the râperies to twenty-five and the length of tubing to 95 miles, in order to supply the works with the juice of 250 million kilos. of beets per season, for which they were constructed. Each râperie has a force pump to give sufficient pressure to send the juice to the works; previous to its departure it is charged with 1 per cent. of lime, in the form of milk of lime of 22° B., to prevent any change. At a distance of 400 mètres from the works is a large reservoir of boiler iron, holding 5000 hectolitres, to receive any surplus and allow short stoppages for clearing, etc. Near this receiver is the lime-quarry, connected with the furnace by a horse railroad. The main buildings are of brick, covered with an iron roof, and consisting of a main building in the form of a grand saloon 100 mètres long by 18 wide and 30 high; extending from one side are four small buildings—one for the repairing-shop and milk-of lime vats below, and the filter-presses above; one for the steam-boilers; one for the revivifying furnaces for the bone-black; and the fourth containing, below, the tanks for the second and third products, forty-five in number, each holding 1000 hectolitres; above is the packing and storing-room for sugar, of 1800 square mètres area. At a short distance from this main building are the gas-works, furnishing 500 cubic mètres per day, and the furnace for the carbonic acid gas, built of brick and iron, and holding 500 cubic mètres, and fed by an elevator. The steam boiler-room contains sixteen boilers, having a heating surface of 200 square mètres each, the total horse-power being 2400. The building for revivification of bone-black is furnished with two Schreiber's furnaces, each supplying 150 hectolitres per day. In the main building are the machines and apparatus for working the juice proper. On the ground floor are the engines and turbines, and running along one side, on platforms, are the tanks for the first and second carbonatations, the 'triple effet,' and vacuum-pans.

"The juice, arriving from the râperies, first passes into a heating tubular boiler of 400 square mètres surface, supplied with the waste steam from the 'triple effet,' previous to its passing into the condensing apparatus, then into the tanks for the first carbonatation; these are four in number, each holding 500 hectolitres; here 1½ per cent. of lime is added, and after the carbonatation the liquid is passed into corresponding settling-tanks of boiler iron immediately below, and allowed to settle, the clear liquid drawn off into the two tanks for the second carbonatation, while the turbid juice is forced by two 'montejus' into the filter-presses, eighteen in number. The first carbonatation requires about two hours—the second about one hour. In the second, ½ per cent. of lime is added, and the process conducted as in the first; the clear juice, however, goes into the bone-black filters. Here an innovation has been made; instead of having a number of small filters, as is customary, there are two large ones, used alternately, each being 3½ mètres in diameter by 3 mètres high; these are working very satisfactorily. The juice is pumped from these filters into the 'triple effet' by a pumping arrangement connected with an engine of 70 horse-power that produces the vacuum in the 'triple effet;' the arrangement consists of two pumps connected by the same piston-rod—a larger one to force the juice into the first boiler of the 'triple effet,' and a smaller to remove it from the third after it has been evaporated to a syrup of 20° to 25° B., forcing it into a tank where it is heated previous to passing into the filters for the second filtration; these filters are three in number, much smaller than those for the first.

"The 'triple effet' is a grand piece of apparatus, built of copper, encased in iron, and is a vacuum-evaporating apparatus of treble action, consisting of three boilers, the lower half of which is tubular, the juice circulating through the tubes, which are surrounded by steam. The first, into which the juice passes, is heated by steam from the boilers; the steam arising from the boiling syrup passes into the second, while the excess is condensed by the engine; the steam from the second into the third, and that from the third, after passing through the boiler that heats the juice on its arrival from the râperies, is condensed; the temperature of the second and third is not as great as in the first, but the vacuum produced by the engine assists the evaporation. The water condensed from the steam is returned to the steam-boilers by a pump. The three boilers of the 'triple effet' are respectively 4.50 m., 5 m., and 5.60 m. in diameter, and are capable of working 20,000 hectolitres of juice per twenty-four hours.

"After the syrup passes the filters for the second filtration, it passes into a tank that supplies the vacuum-pan, which is also an apparatus of grand proportions, similar in appearance to one of the boilers of the 'triple effet,' but is heated by three banks of steam-coils; like the former, it is of copper encased in iron, and is of sufficient size to furnish 600 to 700 hectolitres of crystallized mass or 'cuite' for ten hours, having a diameter of 5.50 m. and 4 mètres high. The 'cuite' passes into a large tank immediately below; after cooling, it is shovelled into a mixing-apparatus, and sufficient diluted syrup of the first run is added to make it turbine easily; it is then conveyed by a small wagon on an elevated track to the hoppers of the turbines. These are twenty-four in number, six being used for the second and third products; the turbines will be increased to forty-five. The second and third products are boiled in a vacuum-pan like the former, but much smaller. The sugar of the first product is exceedingly fine in appearance, being very white, the grain even in size, and hard.

"Sixty thousand kilos., or sixty-six tons, are manufactured daily—about sixty-six hundred tons per year; as the second and third products have not been worked this year, it would be difficult to say what will be the total yield of sugar and molasses. The works proper give employment to 400 men, or, including the râperies, to about 1500 men and women."

The following estimate for a factory capable of making 12,000 to 15,000 tons of beet-sugar per annum is from Dr. Cameron's pamphlet *On the Cultivation of the Silesian Beet*: *Steam-power.*—4 Cornish steam boilers of 75 horse-power each; 1 2-horse-power engine; 1 cylinder or reservoir to receive the condensed steam. *Washing, Cutting of Roots, etc.*—1 8-horse-power engine, to drive the pump and machinery for lifting beet-roots to the washers and cutting-machine; 1 mechanical beet-root lifter; 2 beet-root washers; 1 cutting-machine; 2 patent iron wagons for bringing beet-root slices to the diffusion-apparatus; 12 diffusion-vessels, complete; 2 iron wagons, for removing pulp to presses; 2 presses (Klüzeman's system); 2 tanks for providing hot water; 2 tanks for providing cold water. *Defecation, Charcoal Filters, etc.*—6 copper defecation-pans; 16 iron tanks, of which 8 are provided with copper tubes (*serpentins*) for providing steam and carbonic gas; 1 12-horse-power engine (*pompe à gaz*), to pump the carbonic gas into above tanks; 2 montejus for ditto; 1 apparatus for making carbonic gas, complete; 4 filter-presses, to extract the juice remaining in the refuse after defecation; 10 filters (charcoal); 1 evaporating apparatus, consisting of three iron cylinders, provided with tubes, complete, called in French factories *triple effet*; 1 condenser, for ditto; 1 engine, 12-horse-power, for ditto (*pompe à vide*); 1 apparatus for boiling the sugar (vacuum-pan), with condenser, complete; 1 10-horse-power engine, for ditto (*pompe à vide*); 6 montejus, in connection with the different parts of the manufacture, and sundry tanks. *Production of (grain) Sugar.*—4 centrifugal machines, complete: 1 6-horse-power engine for driving the above, etc.; 1 montejus; 2 tanks for receiving the syrup from the vacuum-pan; a number of tanks to contain the second and third products; copper pipes, etc., for conducting the juice to different parts of machinery; tanks for storing water, preparing lime, etc.; charcoal furnace and charcoal-washers; sundry small apparatus, used in the second and third processes.

V. Sugar from the Maple.—The sugar-maple (*Acer saccharinum*) grows abundantly in Northern New England, New York, Michigan, Wisconsin, and Canada. Two varieties are selected for the manufacture of sugar, the rock-maple and the black sugar-maple. As soon as the frost begins to leave the ground the sap begins to ascend, and as the first sap is richest in sugar and freest from other substances, the farmer hastens to tap the trees as soon as the snow melts around the stems. This is toward the end of February, in March, or early in April, according to the season. Trees twenty or thirty years old give the best yield. Two holes, three-fourths of an inch in diameter, are bored on the S. side of the trunk, about five inches apart, and eighteen or twenty inches from the ground, about one-half an inch into the alburnum or white bark. Spouts of elder or sumach, eight or ten inches long, are then driven in, and a trough or pail is placed below to receive the sap. The sap continues to run for three or four weeks, but finally deteriorates very much in quality. The trees are tapped year after year without injury. The sap contains from 2 to 2½ per cent. of sugar, or from 2¾ to 3¼ ounces per gallon. The sap is collected every day, and carried to the sugar-camp, where it is poured into a cask to be evaporated. If neglected a day or two, it is liable to undergo fermentation. It is boiled down in shallow iron or copper pans to the consistency of honey, then strained, and allowed to stand eight or ten hours to deposit suspended impurities. To clarify it, the white of egg or milk is added, the whole boiled and skimmed.

Much of the product is sold without further concentration as *maple-syrup*. For the production of solid sugar the evaporation is continued until the syrup is very thick, when it is carried to the farm house and boiled to semi-solidity, and then poured into moulds to cool. Maple-syrup and sugar are prized on account of the peculiar flavor which they possess. By refining this is lost, when the sugar cannot be distinguished from that from the cane or the beet. The yield of sugar is variable: 1150 trees in Canterbury, Vt., gave one season 618 barrels of sap, or 19,776 gallons, from which 4000 pounds of sugar were obtained: this is 1 pound of sugar to five gallons of sap, or 3¼ ounces per gallon, and is equivalent to 3½ pounds per tree; 75,730 trees in Cambridge, Vt., gave, in 1869, 221,350 pounds of sugar, which sold for $26,500; 100 trees in Berkshire, Mass., are said to have yielded 500 pounds of sugar in the first five days, or a pound of sugar per tree per day.

Dr. Wallace gives the following analysis of maple-sugar:

Cane-sugar	72.60
Glucose	13.95
Extractive matter, etc.	2.11
Soluble salts	1.35
Insoluble salts	0.03
Water	9.96
	100.00
Cane-sugar obtainable	51.90

VI. Sugar from the Palm.—Most palm trees yield a sweet juice when the top shoot or spadix is cut or bruised. Enormous quantities of sugar are made from this juice in the East. In Bengal the *Phœnix sylvestris*, either growing wild or cultivated in large plantations, furnishes the largest supply of sugar. The trees are tapped, a bamboo spout is inserted, and a pail suspended to receive the sap, which must be frequently collected, and boiled at once to prevent its undergoing fermentation. It is boiled down to a solid, and sold as a dark, deliquescent mass under the name of *goor*. A purer product, called *kham*, is obtained by pressing the molasses out of the blocks of goor. By applying wet grass to the kham contained in baskets, a kind of *claying* occurs, by which the sugar is rendered tolerably white and pure. The sugar is generally sold, however, in the crude form under the name of *jaggery*. Sugar is also made from the wild date-palm (*Phœnix dactylifera*) and other species of *Phœnix*. In the Philippine and Molucca islands much sugar is made from the gommerto palm (*Saguerus saccharifer*), in the South Sea islands from the cocoanut palm, and in Ceylon from the kitul tree (*Caryota urens*), the palmyra tree (*Borassus flabelliformis*), and the *Cocos nucifera*. Dr. Wallace gives the following analyses of palm-sugar:

	Calcutta date.	Jaggery.
Cane-sugar	86.05	86.73
Glucose	6.95	6.04
Extractive matter	0.65	1.29
Soluble salts	0.68	0.88
Insoluble salts	0.56	2.01
Water	4.10	3.04
	98.99	99.99
Color by Dutch standard	8.	6.
Cane-sugar obtainable	76.7	76.3

Fig. 12.

Chinese Sugar-cane.

VII. Sugar from the Chinese Sugar-Cane.—The Chinese sugar-cane is a name given to shaloo or sugar grass (*Sorghum saccharatum*, W., or *Holcus saccharatus*, L.), a species of durra millet. The sorghum species are coarse grasses, with thickly-crowded panicles. The seed is round, and somewhat larger than mustard-seed. They are natives of the East Indies, and are extensively cultivated in Asia and Africa, particularly *Sorghum vulgare*, common durra, which is the principal cereal of Africa. *S. saccharatum* is cultivated in warm portions of Asia and Africa. Its seeds are pleasanter to the taste than those of common durra. The durra does not make good meal, but is used as a substitute for rice. The sweet pith of the culm is eaten, and is valuable as a source of sugar. Both the leaves and stems of the durra are valuable as food for cattle and horses. Some years ago a French missionary saw the sorghum used in the interior of China for the manufacture of sugar. The French consul-general procured seed, and sent them to France in 1851. Since that time the plant has been extensively used for the production of alcohol. D. G. Brown, travelling for the U. S. patent-office, saw a field of sorghum in the S. of France, and induced the office to order a quantity of the seed for experiment in the U. S. The success of the experiment is proved by the statistics at the end of this article, by which it appears that, in 1870, 16,000,000 gallons of sorghum-molasses were made in the U. S. Since 1857 the plant has been cultivated in all parts of the U. S., even as far N. as Maine. There are several varieties of *S. saccharatum*. The *sorgho*, *sorgo*, or common *sorghum* is from the Chinese seed; the *imphee*, from African seed. The former variety is found to give the best results in the U. S. Rich land is best suited for it, and deep ploughing is very important. Calcareous soils furnish the best syrup. It does not flourish on soils abounding in black muck, on soils standing over cold, wet subsoils, upon undrained lands, nor on soils rich in soluble saline matters. Before the seeds are fully ripe the leaves of the plant are stripped off, the top piece cut off for 2½ to 3 feet, and the stem cut 6 or 8 inches above the root. The average weight of the stems or canes is 1½ to 2 pounds. They yield 65 to 70 per cent. of juice. Dr. C. A. Goessmann, in his important paper on sorghum (*Trans. N. Y. State Ag. Soc.*, 1861), gives the following analysis of the fresh sorghum-cane:

Water	78.94
Sugar	9.25
Gum, salts, and other soluble matter	0.97
Albuminous bodies	1.40
Cerosine (wax) and insoluble earthy compounds	1.24
Cellulose	8.20
	100.00

"The leaves contain dry matter 73 per cent., water 27 per cent.; 100 pounds of fresh leaves are equivalent, as food for cattle, to 80 or 85 pounds of hay. Seven canes furnish a pound of fresh leaves."

In large establishments the cane is crushed between horizontal rolls driven by steam or water, similar to those used for sugar-cane, and the bagasse is used as fuel: in smaller farm-factories a vertical mill, driven by one or two horses, is employed. The outfit for a small "domestic" establishment is very simple. In 1869 the cost of the plant for 40 acres of sorghum was as follows:

1 2-horse vertical mill	$100
3 evaporators	80
Brick, etc., for furnaces	30
Skimmers, etc	30
	$240

The plant for making 1000 gallons of syrup per day of twenty-four hours costs for building and machinery about $3000 (1865). (For details of machinery, etc., see *Report on Sorghum and Beet-Sugar*, by John Stanton Gould, *Trans. N. Y. State Ag. Soc.*, 1865.) The sorghum canes contain 90 per cent. of juice: the actual yield varies from 30 to 70 per cent., according to the mill employed.

The fresh juice is greenish-yellow, of a density of 9° Beaumé, and exhibits a slight acid reaction. On standing it deposits a voluminous slimy sediment consisting of torn cells, chlorophyl, wax, etc. According to Goessmann, the composition of the juice is as follows:

Cane-sugar	9.950
Gum, albumen, etc	1.510
Acids	Not determined.
Ash	0.309
Water	88.231
	100.000

The ash yields—

Phosphate of lime and magnesia, with traces of iron	0.091
Alkaline carbonates, mostly potassic	0.130
Sulphuric acid (SO_3)	0.028
Phosphoric acid (P_2O_5)	0.033
Chlorine	0.027
	0.309

No sugar besides cane-sugar, and no ammonia salts, were found in the juice. The juice is neutralized with slaked lime and boiled in evaporators, with constant skimming, to a density of 18° B. It is then drawn off into a tank and allowed to deposit suspended impurities, and then introduced into a second evaporator and boiled down to from 35° to 40° B. If the herbaceous flavor has not disappeared, a fresh addition of slaked lime is made and boiling repeated. Defecating agents are used by some boilers. Silicate of soda has been used in conjunction with lime and dilute hydrochloric acid to produce a gelatinous precipitate in the syrup, and thus clarify it. With the crude processes employed in the U. S. it is not practicable to make sugar from sorghum: the juice is simply boiled to syrup, and used as such, or sold to the refineries, where it is purified.

The following analysis of sorghum syrup was published in the *Scientific American* in 1862, p. 329:

Cane-sugar	45.00
Glucose	28.00
Gluten &c.	3.50
Other substances	1.50
Water	22.00
	100.00

The yield of syrup varies from 80 to 160 gallons per acre. In 1857, Joseph S. Lovering experimented on sorghum with very flattering results, which he published (*A Detailed Account of Experiments and Observations upon the Sorghum saccharatum*, Philadelphia, 1858). He obtained in one case 625½ pounds of sugar and 123¾ gallons of syrup per acre; in another, 1222 pounds of sugar and 74¼ gallons of syrup. Such results have never been obtained on a large scale.

VIII. Sugar from other Plants.—*Sugar and Starch from Sweet Potatoes.*—According to Mr. Henry Bartol (*J. Frank. Inst.*, 1869), the juice of the North Carolina sweet potato contains:

Sugar	10.50
Starch	6.00
Gum, etc.	0.33
Salts	1.17
Water	82.00
	100.00

The density of the juice is 10.5° Beaumé. He thinks powerful presses would give a yield of 90 per cent. of juice, and yield over 6 per cent. of sugar, with a production of 9 tons of potatoes per acre. *The common pumpkin* (*Cucurbita pepo*) is said to yield a saccharine juice of 10° to 11° Beaumé. It is even asserted that sugar has been made from pumpkins, on a large scale, in Hungary, in factories designed for beet-sugar. *Sugar from melons* has attracted some attention in California. *Sugar from Maize* (*Indian corn*).—According to Johnston (*Chemistry of Common Life*), sugar was made from maize prior to the Spanish invasion, and has been made successfully by many farmers in the U. S. for domestic consumption. He also mentions a factory near Toulouse in the S. of France where about 20,000 pounds of sugar are annually made from this plant.

IX. Sugar Refining.—The raw sugar from the plantation is not sufficiently pure for use. It contains sand, clay, albuminous matters, coloring-matters, etc., and is not agreeable to the eye or to the taste. Raw beet-sugar is free from sand and clay, but contains, even when quite white and almost chemically pure, a peculiar substance which gives it a most offensive taste and smell. To remove these impurities refining processes are resorted to.

(1) *Refining the Sugar from the Cane.*—The proper selection of raw sugar for refining is a matter of considerable importance. The percentage of crystallizable cane-sugar chiefly determines the refining value, but the glucose and the salts prevent crystallization and cause the production of molasses. Extractive and coloring matters determine chiefly the quantity of char required. Insoluble substances are troublesome to filter. In France the refining value of the raw sugar is determined by subtracting from the percentage of cane-sugar shown by the optical saccharimeter the percentage of glucose and five times the percentage of ash.

(A) *The old sugar-baker's process*, which is now almost entirely abandoned, was carried on at the beginning of this century in Antwerp, Hamburg, and other seaport towns of Europe by a large number of firms. There were at one time 500 or 600 of these small refineries in Hamburg alone. The raw sugar was dissolved in hot water in a copper kettle; a little lime and blood were added: the whole was boiled, filtered through bag filters (Fig. 4), and the clear solution was boiled down in the same kettle over a free fire to the proper degree of concentration, and then transferred either to earthen moulds to solidify in small crystals, or to copper pans, across which strings were stretched, to crystallize slowly in large crystals of *candis* or rock-candy. In the former case, when the loaf had become solid it was allowed to drain into a pot, and was then clayed, as already described, the loaf being afterward dried and turned down to proper form and size for market. The liquors draining from the loaf were again boiled and crystallized in the mould, yielding a moist, colored, pulverulent sugar, called *bastards*. The thick, dark, almost black, liquor which drained from the bastards was known as sugar-baker's molasses. The writer found several of these establishments still in operation as recently as 1869 in the above-named cities, all engaged, however, in the manufacture of candis on a very small scale, each treating only from 60,000 to 1,000,000 pounds of raw sugar annually.

(B) *Mould-houses.*—The introduction of steam, bone-black filters, and vacuum-pans has made a complete revolution in sugar refining, and has concentrated the business in a few large establishments. Notwithstanding the enormous increase in the consumption of sugar, there are not now 300 refineries in the world, but some of these have a capacity of 1,000,000 pounds of raw sugar daily. *The melting* of the raw sugar is effected most advantageously on the ground floor of the refinery. The melter is an iron vessel with an agitator and a steam coil, into which the raw sugar is thrown, with about 30 per cent. of water, and sometimes a little lime-water to neutralize the free acids present and prevent the inversion of cane-sugar—*i. e.* its conversion into glucose. In some establishments the *sweet water*, the washings from the bone-black filters, is used to dissolve the raw sugar. But this is a most objectionable practice, as these waters are charged with sulphate of lime and other substances which interfere with the subsequent crystallization. They should be treated separately or added to inferior liquors at a later stage of the process.

Defecation.—The liquor from the melter is forced to the upper story of the house to cisterns, and thence drawn into the "blow-ups," large iron vessels provided with steam coils. Here the liquor is diluted and heated to about 180° F. Lime is often added, and sometimes blood, to aid, by the flocculent precipitate of albumen which it produces when heated, in clarifying the solution. Both the lime and blood are omitted by some refiners, as they necessitate an increase in the amount of bone black required, and render the molasses impure. The temperature should not be higher than is necessary, as over-heating darkens the color and increases the amount of molasses. A scum rises to the surface, which is very voluminous when blood is used, and a flocculent precipitate is produced at the same time. The liquor is brought as nearly as possible to a density of 1.225, or 28° Beaumé. After standing a few minutes the scum is removed, and the liquor is run hot upon the bag-filters (Fig. 4). To avoid the injurious action which lime exerts upon the glucose, decomposing it with formation of dark-colored products, Kessler (*Rep. Chim.*, App. 1863, 252) substituted magnesia, which has been used to some extent. Sulphate of alumina has been used with lime, but is objectionable, as it produces sulphate of lime and gives the black more work to perform. Fine bone-black has been recommended, and is generally used, in defecating beet-sugar. Phosphate of ammonia has also been suggested. (*Am. Chem.*, iii. 57.) Lagrange advises the use of this salt, together with baryta. (*Am. Chem.*, iv., 410.) *The bag-filters* are hung in iron boxes, containing about 200 each, and are kept hot by steam. *The scum and sediments* from the bags are blown up with water, folded in cloths, and pressed to recover the sugar they contain, the runnings from them being added to the second or third product of the house. *The bone-black filters* (Fig. 10) next receive the liquor. It is very important that this filtration should be carried on at a high temperature, about 155° F.—never below 150°. At lower temperatures fermentation is liable to set in—either lactous fermentation, which produces sour liquors, changes cane-sugar to glucose, and dissolves iron, or viscous fermentation, which produces "smear." (See Fermentation.) If passing through a single filter does not sufficiently remove the coloring and other matters from the liquor, it is sent through a second filter. A pound or more of black is required for each pound of sugar filtered. When the black is exhausted, hot water is run upon the filters, and drives out the saccharine liquor. The coal is then washed with hot water. When the liquor from the filters is reduced by the wash-water to 15° B., it is collected in a separate cistern as "sweet water," and not allowed to dilute the strong solution. The washing is then continued. It is very important that the black should be washed with water which is boiling hot; and the purest available water should be used, as the black will absorb lime salts from impure well-waters. Washing-machines are often used to secure the complete cleansing of the coal. The coal is then removed from the filters and subjected to revivification. Some treat it with dilute hydrochloric acid to remove carbonate of lime, and then allow it to undergo fermentation to destroy organic matters. It is then dried and passed through the kilns, where it is exposed for a short time to a red heat. When sufficiently cooled, it is ready for use again. The action of the black has been explained in speaking of beet-sugar.

Boiling in the Vacuum-Pan.—The decolorized and purified liquor is now introduced into the vacuum-pan (Fig. 3), and rapidly boiled at temperatures ranging from 120° to 150° F.—the lower the better. At first, the liquor is run in sufficient quantity to cover the lowest coil or worm; steam is admitted to this coil, and when the liquor has been somewhat concentrated, a little more is let in, and so on. When the second coil is covered by liquor, steam is admitted to it: and so with the third coil. At the outset the liquor is boiled to grain—that is, until it is filled with microscopic crystals of sugar. These are gradually enlarged to the desired size as the boiling proceeds. When

the proper degree of concentration is reached, the contents of the pan are dropped into the *agitator*, which keeps the crystals in suspension till the mass can be filled into the moulds. These are of several sizes, according to the disposition to be made of the sugar—*loaf moulds*, the smaller, employed when the sugar is to be sent to market in loaves; *tittlers*, when the sugar is to be broken or cut; *bastards*, when it is to be used for making white liquor. The moulds are mounted on wagons, and are drawn successively under the spout of the agitator and filled with the hot, semi-solid mass of crystallized sugar. In a few hours the mass becomes perfectly solid. The plug is removed from the bottom of each mould, and it is placed upon an iron pot to drain. When the mother-liquor, "first greens," has run out, the rough top of the loaf is cut out, the mould is placed on a fresh pot, and a quantity of "white liquor" is poured upon it. The white liquor is a saturated solution of pure sugar, which is prepared by dissolving the tips of the loaves and the bastards made from the last runnings of the filters. The white liquor passes down through the loaf, and presses out the colored mother-liquor, leaving the loaf perfectly white; the liquor which drains from it during this "claying" is called "drips," and is added to the next solution of raw sugar. When the white liquor has all disappeared, the loaf is taken out of the mould, and the wet tip is cut off, to be used for making white liquor. If the sugar is to be sent to market in loaves, the moulds are placed in rubber sockets on pipes connected with the air-pump, and the last portion of the white liquor is drawn out of the tips. These loaves are turned in a kind of lathe, then dried and packed in papers. The loaves from the tittlers may be shaved on a cutting machine, and sent to market as (1) moist white "A sugar;" or dried on a granulating table, and sifted out from the powder, and sent out as (2) granulated sugar; or the loaves may be dried in a hot-air chamber, and then broken in a crushing-mill, and separated by a sieve into coarse (3) "crushed sugar" and (4) "powdered sugar," or cut into (5) "cube sugar." The greens or mother-liquor from the first crystallization are diluted, blown up, filtered through bag-filters and over bone-black, and again boiled in the vacuum-pan. The concentrated mass is drawn from the agitator either into bastards or into large iron wagons. When cold and solid, it may be drained in the bastards into pots, or it may be thrown into a mixer, which is provided with revolving knives, and when homogeneous sent into centrifugal machines (Fig. 5) to be freed from the "second greens." This second crystallization is of a light buff color, and is sold moist as "C" or "coffee" sugar. The second greens are diluted, defecated, filtered over bone-black, boiled blank, run into wagons, and allowed to crystallize, and then separated by the centrifugals into moist "X" or "yellow sugar" and "green syrup." The green syrup is diluted, blown up, run over bone black, concentrated to from 39° to 40° B., and sold as "golden syrup."

The composition of the products is about as follows:

	A. First product, dry.	C. Second product, moist.	X. Third product, moist.	Syrup.
Cane-sugar	100.	87.00	83.00	34.
Glucose	.....	3.85	4.90	28.
Organic matters	.....	4.60	5.44	8.
Ash	.....	0.55	0.66	2.
Water	.....	4.00	6.00	28.
	100.	100.	100.	100.

Considerable variations from the above routine prevail among refiners, as far as the production of special grades is concerned. Some take out a fourth crystallization: some boil the last runnings from the black separately as an inferior quality of first crystallization, etc.

The above described process, which is practised in mould houses, requires time and space. Several weeks elapse before the last product is ready for market, and room must be provided for the thousands of tittlers and bastards. This and other considerations have led to the adoption of

(C) *The Scotch or Greenock System.* In this system no moulds are used. The sugar is dissolved in the melter, and immediately run through the bags without any addition of lime, blood, or anything else; run through the black, boiled down in the vacuum pan, run warm into the centrifugal, cooled, and barrelled for shipment in forty-eight hours after it entered the refinery. Another peculiarity of this system is that no syrup is made; it is all sent to market as part of the second and third products, the little syrup that drains from the third product being added to the melter. These moist centrifugal sugars are known as "pieces" in England.

(D) *Molasses houses* are devoted to the extraction of a small percentage of yellow C sugar, from raw muscovado molasses from Cuba. The molasses has a gravity of about 38° B., and contains about 50 per cent. of cane-sugar. From 2½ to 3½ pounds of extra yellow C sugar are obtained from the gallon, and the mother-liquor is either sold as "treacle" for shipment to England or refined and sold here as syrup.

(2) *The refining of beet-sugar* differs but little from that of the sugar from the cane in mould houses. Powdered bone-black and blood are generally added in defecating, and only the first product is sufficiently pure for consumption. The second *bastardes*, third *vergeoises*, fourth *cuviers*, fifth *cuves*, and the molasses, are all too offensive to be used, and must be again refined. There is a limited demand for bastardes and vergeoises among the manufacturers of chocolate. The bastardes stand two days to crystallize, the vergeoises five, the cuviers three weeks, and the cuves three months.

Owing to the richness and purity of the raw beet sugars, the loss is small. In one of the Paris refineries the yield for a year was, after working over the second, third, etc., products—

White loaf-sugar	89.
Molasses, 41½° B	9.5
Loss	1.5
	100.0

In another Paris refinery the yield was for six months—

White loaf	76.31	90.67
Bastardes, vergeoises, cuviers, and cuves	14.36	
Molasses		7.86
Loss		1.47
		100.00

The average composition of all the raw sugar refined during this period was as follows:

Cane-sugar	95.495
Glucose	.086
Extractive matter, gum, etc	1.022
Salts	1.139
Water	2.258
	100.000

The following analyses of molasses of the Paris refineries are by Dubrunfaut (*Sugar-Cane*, iii. 91):

Maker's name.	Density, Beaumé.	Cane-sugar.	Glucose	Salts.
Lebaudy Frères	44°	44.50	5.47	8.95
Jeante et Provost	44.1°	45.25	6.30	9.80
Moitessier	43.9	44.50	5.50	10.07

The molasses is sold to special houses, where it is refined. For clarification, 1000 kilogrammes of molasses receive an addition of 50 kilos. of fine bone black and 20 kilos. of blood, and water sufficient to reduce it to 24° B. There is also added a quantity of glucose syrup made from potato-starch, varying from 50 to 100 per cent. of the molasses. The whole is blown up, filtered through bags and over bone black, and boiled down in vacuum pans.

(3) *New processes* have been suggested for refining raw sugar, more or less comprehensive in their details. (1) Dr. August Seyferth uses sulphurous acid in the vacuum pan on the second and third products and on the syrup. This process has been extensively introduced. (*Chem. News*, xxii. 248, and Wagner's *Jahresb.*) (2) Marguerite proposes to remove the coloring-matters and other impurities with acidulated alcohol. (*Chem. News*, xix. 197; *Am. Chem.*, ii. 366.) (3) Boivin and Loiseau prepare a curious gelatinous compound of sugar, lime, carbonic acid, and water—the *hydrosucrocarbonate of lime*—which they use as a defecating agent. The process has been adopted in two large refineries in Paris and in one in England. (*Am. Chem.*, i. 8; ii. 286.) (4) Marix proposes to use hydrofluosilicic acid and chalk to remove potassa from sugar solutions. (*Bull. Soc. Chim.*, xi. 346.) (5) Tamin-Despalles proposes to use the ammonium salt of this acid for the same purpose. (6) Duncan and Newlands propose sulphate of alumina for the same purpose. (*Sugar-Cane*, v. 539; viii. 395.)

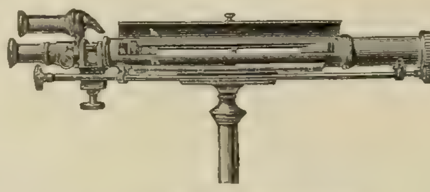
(4) *The adulteration of refined sugar and syrup* has often been alleged. The idea is very prevalent that marble dust is added to powdered sugar, and that poisonous metals are used in the refineries and left in the sugars. There is no foundation whatever for this belief. The writer has examined a great number and variety of sugars sold at retail in New York, and has never found an adulterated or unwholesome specimen. A similar idea is entertained with regard to syrup. The only foundation for this is the fact that (1) one or two establishments prepare a syrup by combining sugar-house molasses with glucose syrup prepared from Indian corn, which is entirely harmless; and (2) some refiners have used minute quantities of a tin salt and free acid to improve the color of syrup, but the quantities employed were too small to give any cause for alarm. (3) The fact that the coffee and yellow sugars and the syrup

often produce an inky color with tea has been supposed by many to indicate adulteration. But this is due to the presence of a very small quantity of iron, which is dissolved by the sugar solutions from the tanks, blow-ups, and tubes of the factory or refinery, and is entirely unobjectionable, perhaps useful.

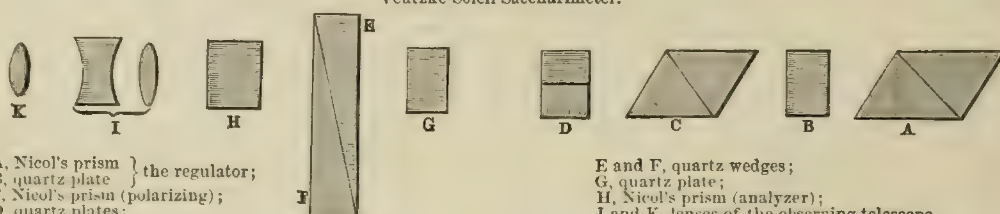
X. SACCHARIMETRY, or the determination of the composition of impure sugars, has acquired great importance in connection with the manufacture of beet-sugar and sugar refining. It involves not only the determination of the cane-sugar, but also of the glucose, salts, water, etc.

(1) *The determination of cane-sugar* is effected by a variety of methods: (*a*) If the solution contains no other substance, it may be determined by observing the density and consulting the tables which have been carefully prepared, showing the relation between density and percentage. (*b*) If other bodies are present, which is usually the case, the cane-sugar may be determined by the aid of polarized light; by dissolving out the impurities with alcohol; by determining by a standard acid the amount of lime dissolved by the solution; by converting it into glucose, and determining its reducing power on an alkaline solution of cupric oxide (Trommer's test); by fermenting the solution and measuring the carbonic acid gas set free. *The optical method* was devised by Biot, and depends upon the fact that a solution of cane-sugar rotates the plane of polarized light. (See POLARIZED LIGHT.) He constructed a simple *saccharimeter*, by which he could place a glass tube containing a solution of the sugar to be tested in the path of a beam of polarized light, and measure the amount of rotation which it suffered. By comparing the result with observations on solutions of known strength, he ascertained the percentage. The instrument was greatly improved by Soleil, who introduced a second active substance (quartz) as a compensator. This rotates the plane in an opposite direction. As the quartz is in two wedge-shaped pieces, the thickness of quartz interposed can be increased or diminished by sliding them over each other until they exactly neutralize the effect of the sugar. A scale is connected with the quartz on which the percentage of sugar corresponding to their positions can be read off at once.

FIG. 12.



Veutzke-Soleil Saccharimeter.



A, Nicol's prism } the regulator;
B, quartz plate }
C, Nicol's prism (polarizing);
D, quartz plates;
E and F, quartz wedges;
G, quartz plate;
H, Nicol's prism (analyzer);
I and K, lenses of the observing telescope.

Fig. 12 is Veutzke's improved Soleil instrument. The compensator is so connected with the scale that when the tube R is filled with water, and the wedges are drawn apart till they just cease to rotate the plane of polarized light to the left, the scale stands at zero. When the glass tube is filled with an aqueous solution containing 26.05 grammes of pure cane-sugar in 100 cubic centimètres, it is necessary to slide the quartz wedges over each other to neutralize the right-handed rotation of the sugar till the scale marks 100. To make a test, we have only to weigh out 26.05 grammes of the sugar to be examined, dissolve it to 100 c. c., fill the tube with the solution, and set the compensator at the point where it just neutralizes the action of the sugar, and read off the percentage of cane-sugar in the sample. If the solution is turbid or colored, it must be decolorized and filtered before placing it in the tube. (For details and very important considerations relating to this test see Ganot's *Physics*; *Am. Chem.*, iii. 356; *Sugar-Cane*, v. 309, 373, 490. Also on Jellett's saccharimeter see *Sugar-Cane*, ii. 71; iv. 484, 495, 550, 576: on use of bone-black in purifying the solution see *Am. Chem.*, i. 378; ii. 167: *Pharm. J.* and *Trans.* [2], i. 926. The other methods for analyzing sugars can be found as follows: Payen's, in *Am. Chem.*, i. 302; Peligot's, *Am. Chem.*, i. 345; *Chem. News*, xx. 159; Apjohn's, *Chem. News*, xxi. 86; Dupré's, *Chem. News*, xxi. 97; Scheibler's, *Am. Chem.*, iii. 330; iv. 85. General discussion of methods: Landolt, *Am. Chem.*, iv. 16; P. Casamajor, *Am. Chem.*, iv. 127, 161, 447; Violette, *Am. Chem.*, v. 296; Humphrey, *Am. Chem.*, vi. 204; Nicol, *Am. Chem.*, vi. 218.) Scheibler's process for valuing raw sugars has attracted considerable attention, and is considered by many chemists to be of the greatest value, as the pure white sugar is actually separated and weighed. The apparatus is simple; the time required for the analysis is short—about two hours: and several analyses can be carried on at the same time. Twenty grammes of the sample are placed in a tube and washed with a mixture of absolute alcohol and ether, to remove water and precipitate dissolved sugar. It is then washed successively with 96, 92, and 86 per-cent. alcohol, each saturated with pure sugar, by which all soluble substances save pure sugar are removed. The residue is then dried by a current of air, weighed, and its percentage of sugar determined by polarization. The last portions of the wash-liquors are drawn from the tube by a Bunsen pump or a Scheibler exhauster. All the air admitted to the tubes is first dried by passing over chloride of calcium.

XI. STATISTICS.—*Sugar and Molasses produced in the U. S. in 1870 (U. S. Census Report).*

	Sugar.			Molasses.		
	Cane.	Sorghum.	Maple.	Cane.	Sorghum.	Maple.
	Hhds.	Hhds.	Pounds.	Gallons.	Gallons.	Gallons.
Alabama	31	..	....	166,003	267,269	3
Arkansas	92	..	1,185	72,008	147,203	75
California	....	..	....	....	333	
Connecticut	....	..	14,266	....	6,832	168
Dakota	....	..	....	....	1,230	
Delaware	....	..	....	....	65,908	
Florida	952	..	....	344,339		
Georgia	644	..	....	553,192	374,027	
Illinois	....	..	136,873	....	1,960,473	10,378
Indiana	....	..	1,332,332	....	2 026,212	227,880
Iowa	....	15	146,490	....	1,218,636	9,315
Kansas	....	..	938	....	449,409	212
Kentucky	....	..	269,416	....	1,740,453	49,093
Louisiana	80,700	..	....	4,585,150	180	
Maine	....	..	160,805	....	....	28,470
Maryland	....	..	70,464	....	28,563	374
Massachusetts	....	..	399,800	....	....	2,326
Michigan	....	..	1,781 855	....	94,686	23 637
Minnesota	....	..	210,467	....	38,735	12,722
Mississippi	49	..	125	152,164	67,509	
Missouri	49	..	116,980	....	1,730,171	16,317
Nebraska	....	..	10	....	77,598	
Nevada	....	..	....	....	3,651	
New Hampshire	....	..	1,800,704	....	....	16,884
New Jersey	....	..	419	....	17,424	5
New Mexico	....	..	....	....	1,765	
New York	....	..	6,692,040	....	7,832	46,048
North Carolina	35	..	21,257	33,888	621,855	418
Ohio	....	..	3,469,128	....	2,023,427	352,612
Oregon	...	..	11	....	....	30
Pennsylvania	....	9	1,545,917	....	213,373	30,385
Rhode Island	....	..	....	....	20	
South Carolina	1,055	..	2	436,882	183,585	
Tennessee	1,410	..	134,968	3,629	1,254,701	4,843
Texas	2,020	..	....	246,062	174,509	5,032
Utah	....	..	....	....	67,446	
Vermont	....	..	8,894,302	....	....	12,023
Virginia	....	..	245,093	....	329,155	11,400
Washington	....	..	....	....	612	
West Virginia	....	..	490,606	....	780,829	20,209
Wisconsin	....	..	507,192	....	74,478	31,218
Totals	87,043	24	28,443,645	6,593,323	16,050,089	921,057

Raw Sugar and Molasses from the Cane, 1870 (U. S. Census Report).

	Florida.	Louisiana.	Total.
Establishments	27	686	713
Hands employed	143	21,156	21,299
Capital	$8,950	$10,239,525	$10,248,475
Raw sugar produced (hhds.)	407	76,910	77,317
" " " (value)	$40,760	$8,076,748	$8,117,508
Molasses (gals.)	1,500	4,367,187	4,368,687
" (value)	$750	$2,265,110	$2,265,800
Total product, value	$41,510	$10,341,858	$10,383,368

Sugar and Molasses (Cane) refined 1870 (U. S. Census Report).

	Establishments.	Hands employed.	Capital.	Wages.	Materials. Molasses.	Materials. Sugar.	Products. Molasses.	Products. Sugar.	Products. Syrup.	Value of products.
					Gallons.	Pounds.	Gallons.	Pounds.	Gallons.	
California........	3	255	$1,300,000	$166,000	....	35,000,000	....	28,176,618	572,711	$3,904,045
Louisiana........	3	141	365,000	75,000	630,000	3,971,125	810,000	1,758,900	....	643,085
Maine.............	3	185	775,000	117,000	3,470,000	13,931,260	....	19,027,376	847,062	3,142,132
Maryland	4	437	958,000	198,551	1,324,121	52,398,951	....	49,416,750	1,018,163	7,007,857
Massachusetts.	4	460	2,200,000	226,848	....	62,479,008	....	50,971,600	1,723,945	7,665,485
Missouri	1	302	2,000,000	175,000	60,000	39,960,000	....	24,455,500	547,000	4,135,250
New Jersey.....	3	404	645,000	272,000	1,267,597	100,000,000	....	84,202,000	1,571,000	11,199,740
New York	18	864	6,375,000	1,229,956	5,416,000	342,957,409	....	297,749,314	3,591,095	42,837,184
Pennsylvania ..	15	1,241	5,619,000	663,408	11,438,333	161,410,674	....	186,365,593	8,052,863	26,731,016
Rhode Island...	2	153	258,000	46,560	346,080	1,300,000	....	11,189,000	244,440	1,600,980
Texas.............	3	155	50,220	7,025	....	....	29,560	398,300	....	75,137
	59	4,597	$20,545,220	$3,177,288	23,952,131	804,408,427	839,560	....	....	$108,941,911

The European Sugar-Industry in 1875 (from the Sugar-Cane, July 1, 1876).

France..........................	552 beet-root factories,	49 refineries.
Austria and Hungary..	245 " "	6 "
Germany......................	339 " "	68 "
Belgium........................	151 " "	37 "
Holland........................	32 " "	15 "
Russia	267 " "	10 "
Denmark......................	2 " "	3 "
Sweden........................	4 " "	7 "
Italy............................	3 " "	2 "
Spain............	20 cane-sugar factories,	0 "
Great Britain...............	0 " " "	62 "
Portugal......................	0 " " "	7 "
	1615 beet-root factories,	217 refineries.

Wagner's *Jahresbericht* for 1875 gives the number of beet-sugar factories actually in operation in Germany during the winter of 1873–74 at 337, using 3,500,000 tons (of 2240 pounds) of beets, and producing 290,000 tons (638,000,000 pounds) of raw sugar, equal to 8.21 per cent.

Production of Beet-Sugar in Europe (Licht's Monthly Circular).

1874–75..........................	2,318,921,990 pounds.
1873–74..........................	2,442,365,420 "
1872–73..........................	2,513,272,850 "
1871–72..........................	1,921,215,340 "
1870–71..........................	2,073,695,140 "
1869–70..........................	1,861,577,850 "
1868–69..........................	1,448,091,920 "
1867–68..........................	1,462,753,820 "
1866–67..........................	1,505,317,110 "
1865–66..........................	1,481,490,560 "
1864–65..........................	1,199,102,850 "
1863–64..........................	971,639,130 "
1862–63..........................	1,074,367,030 "
1861–62..........................	918,600,430 "
1860–61..........................	851,288,680 "

Estimated Crop of Beet-root Sugar on the Continent of Europe for the Ensuing Season, compared with that of the Three Previous Seasons (from Licht's Monthly Circular).

	1875–76. Tons.	1874–75. Tons.	1873–74. Tons.	1872–73. Tons.
France..........................	475,000	460,000	396,578	408,649
Germany (Zollverein)	305,000	345,000	288,972	258,663
Austro-Hungary........	170,000	155,000	169,250	214,107
Russia and Poland......	150,000	150,000	150,000	150,000
Belgium.......................	75,000	80,000	70,366	75,978
Holland and other countries................	30,000	30,000	35,000	35,000
Total....................	1,205,000	1,220,000	1,110,166	1,142,397

Total Production of Sugar in 1867.

	Kilogrammes.	Pounds.	Per cent.
Cuba (exportation)..................	530,000,000	1,168,448,600	22.72
Porto Rico (exportation).......	60,000,000	132,277,200	2.57
Antilles, Eng., Danish Guiana	250,000,000	551,155,000	10.72
French colonies	150,000,000	330,693,000	6.43
Louisiana...............................	30,000,000	66,138,600	1.28
Mexico...................................	32,000,000	70,547,840	1.37
Peru (exportation)................	1,000,000	2,204,620	0.04
Brazil......................................	130,000,000	286,600,600	5.57
Sandwich Islands..................	10,000,000	22,046,200	0.42
Spain	5,600,000	12,345,872	0.24
Port Natal.............................	6,000,000	13,227,720	0.25
Queensland	500,000	1,102,310	0.02
China......................................	14,200,000	31,305,604	0.61
Penang (exportation)...........	3,000,000	6,613,860	0.12
Siam..	5,200,000	11,464,024	0.22
Java...	130,000,000	286,600,600	5.57
East Indies (exportation)......	24,000,000	52,909,880	1.03
Mauritius................................	100,000,000	220,462,000	4.29
Manila (exportation)............	60,000,000	132,277,200	2.57
Egypt (exportation)..............	10,000,000	22,046,200	0.43
Cane-sugar...........................	1,551,500,000	3,420,467,930	66.47
Beet-sugar, Europe...............	650,000,000	1,433,003,000	27.87
Palm- or date-sugar	100,000,000	220,462,000	4.29
Maple-sugar, North America .	30,000,000	66,138,600	1.28
Total sugar........................	2,331,500,000	5,140,071,530	100.00
Sorghum-syrup, gallons.........	18,000,000		

M. B. Dureau, editor of the *Journal des Fabricants de Sucre*, gives the preceding table in his *État de l'Industrie du Sucre*, one of the jury reports of the Exposition Universelle of 1867.

The Average Sugar-Crop of the World, 1869–73 (the Sugar-Cane).

Cuba..	701,431 tons.
Java	175,623 "
Brazil...	136,000 "
Mauritius...	118,126 "
Porto Rico...	95,532 "
Manila...	81,816 "
British Guiana...	63,922 "
Louisiana...	61,863 "
Trinidad...	51,199 "
Jamaica, Barbadoes, Martinique, Guadeloupe, Réunion, Peru, Mexico, Egypt, etc.	178,189 "
Total from the cane..................................	1,663,701 tons.
Europe, beet-sugar....................................	946,000 "
Total...	2,609,701 tons.

Consumption of Sugar in the World (Journal des Fabricants de Sucre, 1875).

	Consumption. Pounds.	Pounds per head.
England	1,826,000,000	50.6
United States..............................	1,694,000,000	44.0
Holland.......................................	88,000,000	24.2
Belgium......................................	110,000,000	22.0
Germany.....................................	673,000,000	16.5
Sweden.......................................	121,000,000	15.6
France...	550,000,000	15.4
Austria and Hungary..................	374,000,000	10.5
Argentine Republic....................	66,000,000	9.8
Switzerland.................................	24,200,000	9.0
Portugal......................................	33,000,000	6.0
Italy...	220,000,000	5.9
Spain...	110,000,000	6.6
Russia..	330,000,000	6.0
Turkey...	55,000,000	3.3

Imports of Foreign Sugar into the U. S. (in tons).

	1862.	1865.	1868.	1871.
At New York.....................	166,920	229,591	259,073	313,609
Boston................................	28,366	39,298	62,237	81,679
Philadelphia.......................	29,741	40,210	66,121	55,918
Baltimore...........................	16,658	27,655	53,458	84,675
New Orleans......................	....	14,469	19,706	13,331
Other ports.........................	5,330	11,020	10,380	13,885
Total imports..............	247,015	362,243	470,975	563,097

Refined Sugar exported from U. S. in 1875 (in pounds).

	Great Britain.	Canada.	Other countries.	Total.
March	....	299,668	863,081	1,163,749
April......................	515,714	1,467,204	1,155,604	3,168,592
May........................	3,331,001	792,742	2,845,631	6,969,374
June........................	5,803,730	455,684	885,025	7,144,439
July.........................	1,486,065	351,898	1,949,268	3,788,921
August	1,586,225	210,998	2,795,063	4,592,276
September..	1,327,376	381,914	4,012,836	5,722,126
October......	3,167,646	229,113	858,517	4,255,506
November............	2,977,768	1,116,861	1,886,702	5,981,331
December.............	3,409,268	568,055	1,734,111	5,711,434

The Glucose Industry of Germany (Deutsche Industrie Zeitung, 1875, No. 31).

	1873.	1874.
Number of factories........	51	47
Glucose, solid..................	24,733,280 pounds.	24,733,280 pounds.
Glucose-syrup	32,522,380 "	32,632,600 "
Coloring, for liquors, etc..	3,189,150 "	2,873,200 "

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Sugar-Cane and Culture. See SUGAR.

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Sugar Grove, p.-v., Warren co., Pa., 37 miles S. of Dunkirk, N. Y., has 7 churches, good schools, 1 newspaper, 2 medicine-factories, 1 hotel, 5 saw, 3 shingle, 2 stave, and 2 planing mills. Principal business, farming and dairying. P. 1729. JACOB HORTON, ED. "HOME JOURNAL."

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Sugar-Molasses. See SUGAR.

Sugar, Mountain-Ash. See SORBITE.

Sugar Notch, p.-b. and tp., Luzerne co., Pa. P. 724.

Sugar of Lead. See LEAD, by H. WURTZ, A. M.

Sugar of Milk. See MILK, by PROF. C. F. CHANDLER.

Sugar Ridge, tp., Clay co., Ind. P. 1140.

Su'gartree Bottom, tp., Carroll co., Mo. P. 2186.

Sugar Tree Ridge, p.-v., Concord tp., Highland co., O. P. 88.

Suggestion. See ASSOCIATION OF IDEAS.

Suggs'ville, p.-v and tp., Clarke co., Ala. P. 935.

Suhl, town of Prussia, province of Saxony, on the Hasel, is famous for its manufactures of steel and iron goods, and has very rich iron-mines in its vicinity. P. 8987.

Suhm (PETER FREDERIK), b. at Copenhagen Oct. 18, 1728; studied law and philology at the university of his native city; settled in 1751 in Trondhjem in Norway, where he lived till 1765, devoting himself to the study of Danish and Norwegian history and antiquities; returned in the latter year to Copenhagen, and d. there Sept. 7, 1798. His many writings relating to the history of Denmark—*Forsög til Forbedringer i den gamle danske og norske Historie* (1757), *Om de nordiske Folks ældste Oprindelse* (1770), *Om Odin* (1771), *Critisk Historie af Danmark i den hedenske Tid* (4 vols., 1774–81), *Danmarks Historie* (14 vols., 1782–1828)—exercised a great influence on the Danish civilization, and he spent a large part of his fortune in order to encourage studies and literature. His magnificent library, containing 100,000 vols., he bequeathed to the Royal Library. Of *Scriptores Rerum Danicarum Medii Ævi* he edited vols. iv.–vii. (1776–92).

Su'icide [Lat. *sui*, "one's self," and *cædere*, to "kill"] is the deliberate intentional act of self-destruction by a person of sound mind and having attained to years of discretion. The taking of one's own life as the result of an insane delusion or impulse is not suicide in a legal sense, although the term is sometimes popularly applied to the act when done under such circumstances. At the common law, suicide was a felony. If any one counselled or advised the deceased to commit the crime of self-destruction, and was present at its consummation, he was held guilty as a principal of murder. The deceased himself was punished by the forfeiture of all his goods and chattels real, and various other kinds of property, and by denying to his body a Christian burial—that is, a burial in consecrated ground with the appointed rites of the Church. To stamp the offence with peculiar abhorrence, the body was buried in the night-time and at the crossing of two highways. These severities, or rather brutalities, of the old law were, however, generally avoided by the verdicts of the coroners' juries, which almost invariably found that the deceased was insane. The criminal law of the U. S. does not inflict any forfeiture or penalty upon the one who takes his own life, but a person who aided and abetted the act would be guilty of murder in some one of its degrees, or of manslaughter. Suicide may also produce some direct effects upon civil rights. By the ancient common law a will of personal property was made void by the testator's act of self-destruction. A different and more reasonable doctrine has been established by the modern decisions. The testator's suicide immediately subsequent to the making of his will does not necessarily show that he was insane at the time of its execution; in other words, the insanity which will avoid the will must be established by other evidence than the mere fact of his having taken his own life. How far life-insurance policies are affected by a suicide of the person insured is a question which has given rise to much forensic discussion and conflict of judicial opinion. All policies now contain provisions, varying somewhat in form, that if the person whose life is insured shall commit suicide,

or shall take his own life, or shall die by his own hand, the contract shall thereby become void. If such person should intentionally destroy himself while in the full possession of his mental faculties, the policy would of course be avoided. The difficulty arises when the act is the result of insanity. Two widely-different conclusions have been reached by the courts. It has been held by some of them that, although the person might be so insane that he was unable to appreciate the moral quality of his act, and although he might be laboring under an irresistible insane impulse, still, if he was able to form an intention to take his own life, and possessed sufficient reason to know that in carrying out this intention the physical acts done by him would result in his own death, then his act of self destruction would come within the terms of the contract and would render it void. Other courts have applied the test which determines the degree of criminal responsibility in cases of insanity, and have held that if the person was incapable of distinguishing between right and wrong in relation to his act, however much he might have intended to produce his own death, the self-destruction would not be *his* within the meaning of the policy, and the contract would remain binding upon the insurers. The former rule is supported by the decisions in England, in Massachusetts, and New York, while the Supreme Court of the U. S. and the courts of many States maintain and enforce the latter doctrine. JOHN NORTON POMEROY.

Suicide. Among the ancients suicide was considered neither a crime nor dishonorable, Demosthenes, Themistocles, Mark Antony, Cleopatra, Hannibal, and many others having chosen this way of ending their days. The Scriptures and the Apocrypha furnish many examples: as, Samson, Eleazar, and Judas Iscariot. In modern times history furnishes numerous striking suicides. The famous suicides among the ancients followed various motives, the vindication of honor being a common object. Mithridates and Hannibal died in this way, rather than be taken prisoners. Others have committed suicide through false pride or timidity: a striking case in point was the death of Cato; determined not to live under the despotism of Cæsar, he stabbed himself, but having fainted, his wound was dressed. When he recovered he tore off the bandages, let out his entrails, and expired.

Many writers have defended this crime, the most able of whom were Madame de Staël, Gibbon, and Hume. Suicide is never committed except when the functions of the brain are impaired, and the action of the mind perverted and directed in improper channels. It stands hand in hand with murder, and in many cases the two crimes are committed at the same time. In many instances the crime has been greatly palliated, and almost seemed justifiable, so carefully and sensibly (?) did the suicide complete his task, and so logically did he state his reasons.

Suicide has sometimes been epidemic in character. A remarkable epidemic prevailed in Versailles in the year 1793. The number of suicides in that year reached 1300, a number greatly disproportionate to the population. Instances have been cited where children have followed the example of one of their number and have taken their own lives. An epidemic of this character took place in the army of the First Napoleon, and it was only after a strong appeal made by the emperor to the pride and courage of the men in the ranks that it was finally stopped. One of these outbreaks followed the suicide of a convict, who hanged himself to the cross-bar of his cell. Five others hanged themselves on the same bar within two weeks. The public prints probably have much to do with the increase of suicide. A morbid person who reads the account of such a case will very often have a train of thought started that will crop out in the commission of the act. Favorable opportunities for the accomplishment of self-murder will also produce a sudden irresistible impulse. People who have gone up into towers and monuments, or above precipices, have often refrained with difficulty from casting themselves down. The writer has known a case where the sight of razors and other sharp cutting instruments excited a suicidal desire. The manner of execution of the suicide's purpose is worthy of study. If marked insanity is at the bottom of it, we find a romantic state of affairs. An interesting case was that of the young woman who a few years ago, in an attack of religious melancholia, while imagining that she was fated to sacrifice herself in a truly classical manner, built a funeral pyre, upon which she laid herself after setting fire to some brushwood beneath. Instances are mentioned in the books where several different plans have been adopted effectually to destroy life. In one of these the victim first took poison, then suspended himself, and finally blew out his brains. It is a curious fact that many suicides repent of the act when it is too late. An illustration of this occurred in the case of Romilly, who cut his throat during an attack of cerebral congestion. The loss of blood relieved the congestion of the brain, and the normal self-restraint, before lost, now asserted itself when the deed was committed. The medico-legal points in certain cases are of great interest. It is often difficult to tell whether the body found is that of a suicide or of some person murdered and afterward arranged by the assassin to give the impression that he had taken his own life. The non-existence of evidence of asphyxia, should the patient be found suspended, will clearly point to homicide. The direction and character of the wound or bullet hole will sometimes clear up the question whether death has occurred by self inflicted cutting or shooting. People who have drowned themselves have been known to tie their hands to prevent an involuntary act of swimming and thus to save life.

The literature of suicide is extremely interesting. The French, noted for this proclivity, choose the most romantic and dramatic methods of self-destruction. A case is related of two young lovers whose match had been opposed by their parents. They went out into a lonely copse, drew two daggers, the handles of which were tied to the ends of a long band of blue ribbon, and at a signal plunged the bright blades into each other's breasts. A case related by the late Forbes Winslow is striking on account of its originality. A shoemaker named Lovat, when suffering from an attack of religious insanity, determined to crucify himself. Procuring a large cross, which he balanced in a large window of his house, facing a public square, he proceeded with the horrible details of his work. He made a large net, which he fastened beneath the cross. Lying at full length, he placed a crown of thorns on his head, and next, striking his hand against the floor, managed to drive a large nail through the palm into the cross. He then placed his feet on the bracket prepared at the foot of the cross. A nail was driven through them with the free hand, and he next wounded himself in the side with a knife. He was unable to nail the other hand. Next edging himself to the window, he overcame the balance of the cross, which slid out of the window, and remained suspended in view of the street. The ropes above held it in place, and the net below prevented him from slipping. He was rescued by people who saw him, and ultimately recovered. The proportion of suicides in this country is increasing very rapidly, and this depends to a great extent upon the cosmopolitan character of the population. The greatest number of suicides are committed by the Germans, who either from loneliness and homesickness or other reasons find life distasteful. The form of death they choose is usually poisoning, and Paris green is the favorite with them. Druggists and photographers use the chemicals they are most familiar with, and cyanide of potassium in the hands of the latter is a common form of poisoning. Hanging and shooting are also often resorted to, but find more favor with other nationalities than with the Germans. The common time of life for this crime is the period between the twentieth and the fortieth year, although cases have been known to occur among young children and at the age of seventy. Suicide is more common in the country, and in this respect it resembles insanity. We do not hear of all the cases that occur in the country, while those in the cities are registered.

As causes of suicide, depression, failure, delusion, unrequited love, drunkenness, and disease may be enumerated. The insane neurosis predisposes to it, and probably there is a nervous history in most of the cases. The time of year in which the greatest number of suicides occurs is the spring abroad, while in this country the summer months are those chosen. Foggy or dark weather does not increase the statistics, although Montesquieu insisted that the English were a suicidal race on account of their fogs. Statistics prove this to be a mistake. ALLAN McL. HAMILTON.

Suidæ. This family is described under SUS.

Su'idas [Σουίδας], a Greek lexicographer of whose life nothing is known; even the age in which he lived is uncertain, though it may be fixed not later than the twelfth century. His book contains explanations and notices of Greek words and names, illustrated by extracts from older Greek writers. It has evidently gone through many hands before it reached the form in which we now possess it, and it is generally of very little critical value; but as many of the works from which it quotes passages are lost, it has great historical interest. Editions by Gaisford (Oxford, 1834), Bernhardy (Halle, 1834), and Bekker (Berlin, 1854).

Suisun', p.-v. and tp., cap. of Solano co., Cal., on California and Oregon R. R., 40 miles S. W. of Sacramento, on an arm of Suisun Bay, has an excellent harbor, 3 churches, good schools, 1 bank, 1 newspaper, and 3 hotels. The surrounding country comprises one of the richest agricultural districts of California. Large shipments are made to San Francisco by the bay. P. of v. 462; of tp. 1842.

C. F. MONTGOMERY, ED. "SOLANO REPUBLICAN."

Sul'idæ [*Sula*, the Latin name of the gannet, the generic type], a family of swimming birds of the minor group or super-family Steganopodes or Dysporomorphæ, limited to the gannets. The form is not essentially different from that of its allies, the pelicans and cormorants; the neck is moderately elongated; the bill about as long as the head, straight, but with the tip decurved, with the lateral grooves well defined, composite as in the other members of the group, and with the edges serrate; nostrils linear and in the lateral grooves; no gular pouch developed; wings moderately long and pointed; tail long and cuneate, and with twelve to fourteen feathers; legs inserted normally backward, and with the tarsi moderately short; toes (four, as in all Steganopodes) well developed, and connected by a full membrane. The skull is of the desmognathous type, and exhibits modifications co-ordinate with the external characteristics. The species are almost exclusively marine, and one or other is found on the sea-coast of every country. Nine species are recognized by G. R. Gray, but several are imperfectly known. (See also GANNET.) THEO. GILL.

Suliman' Mountains, forming the boundary between India and Iran, range from N. to S., and reach their greatest height, 11,300 feet, in Takht-i-Suliman, in lat. 31° 25' N. They connect S. with the Kurlekhi Mountains of Kelat, and N. with the Safed Koh, which is 15,622 feet high and ranges from E. to W. The descent toward India is steep, but gentle toward the Afghan plateaus; the valleys drain eastward to the Indus. The most convenient ascent to Kandahar is effected along the Gomal from Dera Ismael Khan on the Indus. Climate and products are Indian; conifers occur on the northern slope. The inhabitants are Afghans, divided into many tribes and jealous of their independence; no Europeans have ever entered their villages. E. SCHLAGINTWEIT.

Suli'na, the name of one of the delta-branches of the river Danube. The Danube divides at about 50 miles from the coast into the Kilia and Toultcha branches, of which the former conveys two-thirds (about) of the entire discharge. The latter and more southern branch again divides into the St. George and Sulina arms, the latter running eastward nearly. The St. George conveys nearly one-third, leaving to the Sulina but two twenty-sevenths. The mouth of the Kilia and St. George are about 40 miles separated, the Sulina mouth nearly midway between them, the trend of the coast-line being N. and S. The ratio of the discharge of this arm to the total discharge of the Danube is about the same as that of the S. Pass of the Mississippi to *its* total discharge. (For an account of the improvement of the Sulina mouth, by which it has been made the main entrance to the Danube, see HARBOR.) J. G. BARNARD.

Su'liotes [from *Suli*, one of their former villages in the Cassopeian Mountains], a Greco-Albanian people whose ancestors in the seventeenth century fled from Turkish oppression to the almost inaccessible mountains of the Epirus, where they maintained for more than 100 years a democratic government. In consequence of their hostility to the Turkish government, Ali Pasha made several attempts to exterminate them, and in 1803 a large proportion were put to the sword, some 4000 retiring to Parga, whence they were finally driven to the Ionian Islands. Recalled in 1820 by Ali Pasha, they took a prominent part under Marco Bozzaris in the war of Greek independence; but Suli, their chief village, in 1822 was taken by the Turks, and when the boundary-line between Greece and Turkey was established the Suliote Mountains remained a part of Turkey. Most of the Suliotes, however, became citizens of Greece.

Sul'la (a word of doubtful etymology), the surname of a patrician family in ancient Rome, belonging to the Cornelia gens. The family was poor, and the only member of it who attained historical importance, LUCIUS CORNELIUS SULLA FELIX, the dictator, b. 138 B.C., grew up in rather pinched circumstances. He contrived, nevertheless, to acquire a brilliant education and to lead a very gay life. While still a youth he was well known in Roman circles as a man thoroughly initiated in all the arts and refinements, in all the vices and profligacies, of Greek civilization. A courtesan, Nicopolis, left him her fortune, and thereby enabled him to aspire to the honors of the state. In 107 he was elected quæstor, and sent at the head of a squadron of cavalry to the camp of the consul, Caius Marius, commanding in Africa in the war against Jugurtha. The rough and boorish leader of the radical party despised his new quæstor, whom a sensuous and lazy temperament, a fastidious and voluptuous taste, seemed to make entirely unfit for war. But Sulla turned out to be an excellent general of cavalry, active, audacious, equal to any emergency, a born commander, the idol of his soldiers; and when Marius sent him to negotiate with King Bocchus for the surrender of Jugurtha, he proved to be a master in diplomacy. He made such an impression on the mind of Bocchus that this man became his friend for life, and he returned to the Roman camp with Jugurtha in chains. From this moment the spite of Marius turned into jealousy, and as time went on the jealousy grew into a deadly hatred. In the war against the Cimbri and Teutones (104–101), Sulla commanded with distinction, first under Marius, then under Lutatius Catulus, and in 92 he was sent as proprætor to Cilicia, where he defeated Gordius, the general of Mithridates, reinstated Ariobarzanes as king of Cappadocia, and received an embassy from Arsaces, king of Parthia. There was in all he did something which caught the imagination of the people—Jugurtha, the most obstinate enemy of the republic, in chains, the embassy from Parthia, a name never heard before in Rome, etc.—and Marius felt that as the leader of the patrician or aristocratic party, which he now had become, Sulla was a most formidable rival. In the Social war both commanded with success, but it was Sulla who defeated Papius Mutilus, the chief of the Samnites, and took Bovianum, their capital. His star was rising, that of Marius setting. For the year 88 he was elected consul almost unanimously, and, to the deep mortification of Marius, appointed commander in the Mithridatic war. Marius had no political talents; he needed war in order to sustain his position, and he had in many ways instigated this war, sure to be chosen general. By various means, exceedingly violent, though in form legal, Marius succeeded in subverting the appointment of Sulla and getting himself appointed, but during the riot which took place in Rome, Sulla escaped, fled to Nola in Campania, where his army was stationed; and now he did what no Roman had ever done before, what no Roman suspected that a citizen would ever venture to do: he marched against Rome. His officers left him, but the rank and file followed him. Marius fled to Africa; all the leaders of the popular party dispersed; the city was terrorstruck, and Sulla was perfect master of the situation. At the bottom of his character lay a peculiar indifference—neither stoical nor cynical, neither to be admired nor to be abhorred—which enabled him always to do that which he considered necessary, whether it was to keep quiet and bide his time or to leap to the point and deal an atrocious blow. He showed this peculiar disposition by marching against Rome, to a Roman citizen the holiest which existed; and he showed it again by leaving the city almost immediately after the victory. He knew that without the army he was nothing, and he knew that the soldiers thirsted feverishly after the war in Greece and Asia, the old countries, where the work of millions of hands through thousands of years was treasured up, and plunder was plenty. He consequently took such precautions as he could, and then proceeded with the army to Greece. He stayed away four years (87–83). Shortly after his departure he was declared a public enemy; his property was confiscated; his friends were persecuted or slain. Marius returned, and the Marian party domineered in Rome and Italy. But of all this Sulla took no notice; he simply prosecuted the war. It had originated from the avaricious schemes of the legates in the Roman province of Asia. Provoked in many ways, Mithridates at last sent an army into the province which easily overran the whole country, and so hated were the Romans by the Greeks in the Asiatic cities that Mithridates' order, that on a certain day all Romans and Italians in Asia should be massacred, was literally carried out by the inhabitants. Mithridates, who liked to appear as the leader and protector of the Greek nation, induced several cities of Greece to join him, and sent two powerful armies into that country. But Sulla took Athens by storm Mar. 1, 86, and gave it up to plunder. Shortly after, he routed one of the hostile armies at Chæronea; next year he totally destroyed another at Orchomenus, and having expelled Mithridates' troops from Greece and pacified the country, he crossed the Hellespont in 84. Pressed at the same time by another Roman army sent out by the Marian party under Flaccus and Fimbria, ill supported by his Greek subjects in Asia, who found him as unamiable as the Romans, and nearly exhausted by his enormous losses in Greece, Mithridates now sued for peace, and after a personal interview between him and Sulla a treaty was concluded, according to which he returned all his conquests in Asia, surrendered a fleet of 70 large vessels, and paid 2000 talents. Sulla now turned against Fimbria, whose soldiers deserted him, and who committed suicide; he then regulated the affairs of the province of Asia, from whose cities he made enormous conscriptions, and finally set sail for Italy, where he landed at Brundusium in the spring of 83. His soldiers were now rich, and they knew that the final success of their general was a condition of the enjoyment of their riches; they clung firmly to him, and he acted cautiously. Marius was dead, but his son was consul and his party in power, strengthened by an alliance with the discontented Italian nations. The final battle was at the Colline gates, where Sulla's veterans struggled desperately

with the Samnites under Marian leaders: 50,000 are said to have fallen on each side, and those of the Samnites who outlived the battle were driven the next day to the Campus Martius and massacred. Sulla was made dictator for life; that is, absolute power over the life and property of all Roman citizens was given him. It was not his purpose, however, to establish a monarchical constitution in Rome. The legislation which he enacted as dictator, the so-called *Leges Corneliæ*, aimed simply at the restoration of the old aristocratic constitution, the extension of the authority of the senate, the restriction of the power of the tribunes, etc. In order to establish this constitution firmly and safely, he first determined to extirpate its adversaries, the Marian party. Thousands of men fell under his *proscriptio*; that is, they were outlawed and slain, and their property was confiscated and given to somebody else. He then attempted to form a steady support for it by settling his veterans in military colonies on such Italian soil as had been confiscated in the Social war or afterward, and by organizing a body-guard stationed at Rome. When he considered his work finished, he assembled the people, abdicated the dictatorship, retired to his villa at Puteoli, and returned to the lazy, voluptuous habits of his youth. He was writing his memoirs, which have perished, when in 78 the bursting of a blood-vessel caused his death. CLEMENS PETERSEN.

Sul'livan, county of S. W. Indiana, separated from Illinois by Wabash River, and traversed by Evansville and Crawfordsville R. R., which passes through the capital. The surface is generally level, the soil fertile and well wooded. There are large numbers of cattle, horses, sheep, and swine. Staples, Indian corn, wheat, oats, maple-sugar, sorghum-molasses, wool, lumber, and dairy products. Cap. Sullivan. Area, 430 sq. m. P. 18,453.

Sullivan, county of N. Missouri, watered by tributaries of Grand River. The soil is fertile, about one-third being wooded, the remainder prairie; bituminous coal is found. There are numerous cattle and horses, and very many sheep and swine. Staples, Indian corn, wheat, oats, rye, hay, tobacco, wool, lumber, and dairy products. Cap. Milan. Area, 648 sq. m. P. 11,907.

Sullivan, county of W. New Hampshire, drained by affluents of Connecticut River, and traversed by several railroads. The valley of the Connecticut is level and fertile, the other parts hilly and rugged, but well adapted to grazing and sheep-raising, cattle and sheep being very numerous. There are manufactures of cotton and woollen goods, wooden ware, paper, machinery, leather, and lumber. Staples, Indian corn, oats, potatoes, hay, butter and cheese, wool, and maple-sugar. Cap. Newport. Area, 820 sq. m. P. 18,508.

Sullivan, county of W. New York, separated from Pennsylvania by Delaware River, watered by numerous streams, and traversed by Delaware and Hudson Canal and by several railroads. It is crossed N. E. and S. W. by several elevated ridges, with fertile valleys between. There are many manufactories of leather, carriages, and sawed lumber. Cap. Monticello. Area, 880 sq. m. P. 34,550.

Sullivan, county of N. E. Pennsylvania, watered by tributaries of Susquehanna River. The surface is hilly, but adapted to grazing. Staples, Indian corn, oats, potatoes, buckwheat, wool, hay, and butter. Cap. Laporte. Area, 450 sq. m. P. 6191.

Sullivan, county of N. E. Tennessee, bordering on Virginia, intersected by Holston River and traversed by East Tennessee Virginia and Georgia R. R. The surface is extremely hilly, but well timbered and fertile. Coal and iron are found. Cattle, sheep, and swine are numerous. Staples, Indian corn, wheat, oats, some tobacco, sorghum-molasses, butter, and wool. Cap. Blountsville. Area, about 300 sq. m. P. 13,136.

Sullivan, tp., Livingston co., Ill. P. 921.

Sullivan, p.-v. and tp., cap. of Moultrie co., Ill., on Chicago and Paducah and Terre Haute Paris and Decatur R. Rs., has 3 churches, a fine public-school building, 1 newspaper, an opera-house, a woollen and soap factory, 2 banks, and a machine-shop. P. of v. 742; of tp. 2658.
SMYSER & MIZE, EDS. "PROGRESS."

Sullivan, p.-v., cap. of Sullivan co., Ind., on Evansville and Crawfordsville R. R., 26 miles S. of Terre Haute, has excellent schools, 1 bank, 3 weekly newspapers, and 3 boot and shoe manufactories. Rich deposits of coal exist here. P. 1396.
JAMES A. HAYS, ED. "SULLIVAN CO. UNION."

Sullivan, p.-v. and tp., Hancock co., Me. P. 796.

Sullivan, p.-v. and tp., Cheshire co., N. H. P. 317.

Sullivan, tp., Madison co., N. Y. P. 4921.

Sullivan, p.-v. and tp., Ashland co., O. P. 825.

Sullivan, p.-v. and tp., Tioga co., Pa. P. 1637.

Sullivan, tp., Laurens co., S. C. P. 2132.

Sullivan, p.-v. and tp., Jefferson co., Wis. P. 1556.

Sullivan (ALEXANDER MARTIN), b. at Bantry, Ireland, in 1830; commenced studying for an artist, but became connected with journalism, and in 1855 with the Dublin *Nation*, of which he is now editor and proprietor. In 1868 he was indicted for sedition in consequence of articles referring to the Manchester executions, and sentenced to four months' imprisonment. During this period he was nominated for lord mayor of Dublin, but declined the honor. Upon his release a committee was formed to present him with a national testimonial, but he declined to accept anything of pecuniary value, and a sum of £300 which had been collected was, by his desire, appropriated toward a statue of Henry Grattan, to be erected in Dublin. He was returned to Parliament in 1874 in the Home Rule interest, a movement with which he has been especially identified. He has published several works, among which is a pamphlet descriptive of a tour in America made in 1857.

Sullivan (ARTHUR S.), b. in London in 1844, the son of a teacher of music; was early trained in the art, singing when a mere child in the chapel-royal; at the age of fourteen gained the Mendelssohn scholarship, which enabled him to pursue his studies under the best masters at home and abroad. For *The Tempest* of Shakspeare he composed incidental music, which was performed for the first time at the Crystal Palace in 1862. His compositions include overtures, symphonies, songs, and piano music; the operettas *Box and Cox*, *Thespis*, and *Contrabandista*; the cantatas *The Bride of Neath Valley*, *Kenilworth*, and *On Sea and Land*; the oratorios *The Prodigal Son*, brought out at the Worcester musical festival in 1868, and *The Light of the World*, produced at the Birmingham festival in 1873; and an opera, the libretto by Chorley, entitled *The Sapphire Necklace*, not yet performed.

Sullivan (BARRY), b. in Birmingham, England, in 1824; made a successful début on the stage at Cork in 1840, acting thereafter in the principal towns of Ireland, Scotland, and England, and making his first appearance in London in 1851 as Hamlet. He visited the U. S. in 1857; returned to Great Britain in 1860, and in 1861 made a profitable professional visit to Australia, returning to England in 1866. He subsequently became lessee of the Holborn Theatre, London, and in 1875 made a second and not very successful visit to the U. S.

Sullivan (FRANCIS STOUGHTON), LL.D., b. probably in Ireland near the middle of the last century; became professor of common law in the University of Dublin, and was the author of two legal works of great value, *Historical Treatise on the Feudal Law, and on the Constitution and Laws of England* (1772), and *Lectures on the Constitution and Laws of England* (1776).

Sullivan (JAMES), LL.D., b. at Berwick, Me., Apr. 22, 1744; studied law; practised at Biddeford, and in 1770 was appointed king's attorney for York county. As the Revolution approached, he espoused the patriot cause; was a member of the provincial congress of Massachusetts, of which Maine was then a part, and was one of a commission of three who were in 1775 sent on a secret mission to Ticonderoga. In 1776 he was appointed a judge of the superior court, in 1779-80 a member of the State constitutional convention, and a delegate to Congress in 1784-85. He removed to Boston, for which he was repeatedly chosen representative in the legislature; was a member of the executive council and judge of probate in 1787; attorney-general of the State 1790-1807; elected governor in 1807, and again in 1808. He was the projector of the Middlesex Canal, a member of the American Academy of Arts and Sciences, and for many years president of the Massachusetts Historical Society. Among his works are *Observations on the Government of the United States* (1791), *History of Maine* (1795), *Review of the Causes of the French Revolution* (1798), and *History of Land-Titles in Massachusetts* (1801). D. in Boston Dec. 10, 1808.

Sullivan (JOHN), LL.D., brother of James, b. at Berwick, Me., Feb. 17, 1740; studied law and practised successfully; was a member of the first general congress, and Dec., 1774, led a company which captured a fort near Portsmouth, N. H., and seized 100 barrels of gunpowder and some cannon. In June, 1775, Congress appointed him a brigadier-general, and during the siege of Boston he commanded on the left under Gen. Lee. In the spring of 1776 he was sent to Canada with reinforcements for the invading Northern army in Canada, to the command of which he succeeded on the death of Gen. Thomas, and conducted the retreat from the province after the failure at Trois Rivières. Sullivan received the thanks of Congress for his skilful management, but the command of the army was given to Gen. Gates, and Sullivan was sent to join the army under

Gen. Washington. On Aug. 10, 1776, he was made a major-general, and in the battle of Long Island commanded, temporarily, the division of Gen. Greene, owing to the illness of the latter. He was taken prisoner, but soon afterward exchanged and returned to duty. In December he succeeded to the command of the division of Gen. Lee upon the capture of the latter, and which he led with credit at Trenton and Princeton. He planned the expedition against Staten Island, which under his leadership nearly achieved success in the descent of Aug. 22, 1777. At the battle of Brandywine he commanded the right wing of the army, and defeated the British left at Germantown. Transferred in the winter to command in Rhode Island, he laid siege to Newport in Aug., 1778, expecting to receive the assistance of the French fleet under Count d'Estaing, which failing to co-operate, compelled him to raise the siege and withdraw his forces from the island, after defeating the enemy at Butt's Hill Aug. 29. In the summer of 1779 he led an expedition against the Indians of the Six Nations, and Aug. 29 at Newtown (now Elmira) defeated a body of Indians under Brant, and of Tories under Johnson, Butler, and others, and after dispersing them destroyed their villages, crops, and laid waste the country to prevent their return. Shortly after, he resigned from the army, and in 1780 was again a member of Congress. Resuming the profession of law in New Hampshire, he was attorney-general 1782–86 and president of the State 1786–89, in which station, by his firmness and vigorous efforts, he subdued the insurrectionary spirit existing at the time of the troubles in Massachusetts, and in 1788 his exertions secured the adoption of the Constitution. In Oct., 1789, he was appointed U. S. district judge of New Hampshire. D. at Durham, N. H., Jan. 23, 1795.

Sullivan (John Langdon), M. D., son of James, b. at Saco, Me., Apr. 9, 1777; graduated at Harvard College in 1797; engaged in mercantile business; travelled in Europe to study the modes of construction of canals in England and France, and in 1804 was appointed engineer of the Middlesex Canal, connecting Boston harbor with Merrimack River, the earliest enterprise of the kind in the U. S. He invented a steam towboat, for which he received a patent in 1814, having clearly shown his priority of invention over Robert Fulton, whose application was presented at the same time. In 1824 he was appointed associate civil engineer of the U. S. board of internal improvements, and made a report in favor of the practicability of a canal across the Alleghany Mountains. Subsequently, he studied medicine; began practice in New Haven in 1837; removed to New York in 1847; adopted the homœopathic system, and made some valuable discoveries in his profession. D. in Boston Feb. 9, 1865.

Sullivan (William), LL.D., son of James, b. at Saco, Me., Nov. 30, 1774; graduated at Harvard College in 1792; was admitted to the bar in 1795, and rose to the head of the Suffolk county bar, and for many years was almost constantly a member of one or the other branch of the Massachusetts legislature. He was an excellent scholar, an eloquent pleader, a brigadier-general of militia, and a member of several learned societies. Besides several addresses, he published—*Political Class-Book* (1831), *Moral Class-Book* (1833), *Historical Class-Book* (1833), *Familiar Letters on the Public Men of the Revolution* (1834), republished under the title *The Public Men of the Revolution*, with a biographical sketch by his son (1847), and *Historical Causes and Effects* (1838). D. in Boston Sept. 3, 1839.

Sullivan's Island, a long, narrow island in Charleston co., S. C., 6 miles from Charleston, and on the N. side of the entrance to Charleston harbor. It is the site of Fort Moultrie (which see), and is becoming a fashionable resort for sea-bathing. There are many summer residences. The island is connected with Charleston by steam-ferryboats, which convey some 200,000 passengers annually. The island is 6 miles long, and is separated from the main land by a tidal channel.

Sul'livant, tp., Ford co., Ill. P. 141.

Sullivant (William Starling), LL.D., b. near Columbus, O., Jan. 15, 1803; graduated at Yale College in 1823; took charge of the extensive landed estates left by his father, and devoted himself with great zeal to botany, making the mosses a special subject of study. He published—*Catalogue of Plants Native or Naturalized in the Vicinity of Columbus, O.* (1840), *Musci Alleghanienses*, to produce which he made a journey from Maryland to Georgia (1845), *Musci and Hepaticæ of the United States E. of the Mississippi River* (1856), *Mosses brought Home by Wilkes's Exploring Expedition* (1859), *Mosses and Hepaticæ, collected mostly in Japan* (1860), *Musci Cubenses* (1861), and *Icones Muscorum*, containing representations of most of the mosses peculiar to Eastern North America not previously figured (1864), and a posthumous supplementary volume in 1874, the whole work containing 200 plates from his own sketches, of exquisite execution. He also issued, in conjunction with L. Lesquereux, two series of *Musci Boreali Americani*. The genus *Sullivantia* was founded by Torrey and Gray upon a rare plant of the saxifrage family discovered by him. D. in Columbus Apr. 30, 1873.

Sul'livanville, p.-v., Veteran tp., Chemung co., N. Y. P. 157.

Sul'ly, county of Dakota, formed since the census of 1870. Cap. Fort Sully.

Sully (Alfred), b. in Philadelphia in 1821; graduated at West Point in 1841; served in the Florida and Mexican wars, and was made captain in 1852. During the civil war he was made major, and subsequently colonel; commanded a brigade during the Peninsular campaign, and was present at the battles of Fair Oaks, Malvern Hill, Antietam, Fredericksburg, and Chancellorsville. In 1863–66 commanded a brigade in Dakota, and was brevetted as brigadier-general for services in the campaign against the Indians of the North-west, and in 1870 was assigned as colonel of the 19th Infantry. He published *Manual for the Non-commissioned Officers of Infantry and Riflemen of the U. S. Army* (1861). D. Apr. 27, 1879.

Sully (Maximilien de Béthune), Baron of Rosny, Duke of, b. at Rosny, department of Seine-et-Oise, Dec. 13, 1560, of a Protestant family; was from his eleventh year educated with Henry of Navarre; accompanied him through his shifting fortunes at the court and in the camp, and became his minister of finance and chief adviser in all public and private affairs when he ascended the throne under the name of Henry IV. He was an excellent financier. Although he diminished the taxes, he had always money ready for public undertakings, and amassed a reserve of 40,000,000 livres. His economical views were narrow—he considered agriculture as the only productive source of the wealth of a nation—but they suited the actual state of the country. He also distinguished himself as an engineer—in war by reducing fortresses held to be impregnable, and in peace by constructing roads, canals, harbors, etc. After the assassination of Henry IV., he resigned his offices and retired into private life. D. Dec. 22, 1641. Of his *Memoirs*, 2 vols. were published by himself in 1634, and 2 more in 1662 by Jean le Laboureur; translated into English by Mrs. Lenox (1834).

Sully (Thomas), b. in Horncastle, Lincolnshire, England, June, 1783; came to America with his parents, who were actors, in 1792; lived first in Charleston, next in Richmond, next in New York, and finally in Philadelphia; painted Jefferson, La Fayette, *Washington crossing the Delaware*, Fanny Kemble, Charles Kemble, Mrs. Wood, Cooke the tragedian, and other actors of celebrity. In England he painted a portrait of Queen Victoria for the St. George's Society of Philadelphia. His best pieces are there; the *Jefferson* at West Point, the *Washington* in Boston. Sully did not, like Stuart, confine himself to portraiture. He undertook to illustrate *Robinson Crusoe* and Shakspeare, but this was by no means his best work. D. in Philadelphia Nov. 5, 1872. O. B. Frothingham.

Sulmo'na, the ancient *Sulmo*, town of Italy, province of Abruzzo Ulteriore II., has some manufactures and trade in wine. Ovid was born here. P. 12,594.

Sulphates. See Sulphuric Acid and Sulphates.

Sulphatoxygen. See Salt-Radicals, by Henry Wurtz.

Sul'phides, also called **Sulphurets,** compounds of sulphur with metals, and other elements more basylic or less electro-negative than itself. This class of compounds is probably quite as large in number as the oxides. Indeed, sulphur combines with one element, *fluorine*, which is not known to combine with oxygen at all. There seems a general strict analogy between sulphur and oxygen in combination, running through very extended ranges of compounds. The sulphides of the metals possessing practical importance will generally be found described in this work under the head of each metal. H. Wurtz.

Sulphites. See Sulphurous Acid and Sulphites.

Sulphocar'bonates, compounds belonging to the class of sulphur-salts, formed by sulphocarbonic acid, CS_2, with some metallic sulphides. Some of the sulphocarbonates—namely, those of calcium and barium—have assumed considerable importance of a commercial kind within two or three years from having been brought forward by the French chemist Dumas as remedies for the *Phylloxera*, or parasite that attacks the grapevine. The absorption of bisulphide of carbon in the process of purification of coal-gas by lime is due—as was first shown by the present writer in 1868—to the formation of sulphocarbonate of sulphide of calcium, $CaS.CS_2$. The use of sulphide of calcium for

the special purification of gas, with a view to abstract wholly this very offensive impurity, bisulphide of carbon, has since been made the subject of patents both in Great Britain and the U. S. by Mr. R. H. Patterson. H. WURTZ.

Sulphocarbon'ic Acid, the compound CS_2, also called **Bisulphide of Carbon** and **Disulphide of Carbon.** It is a transparent, colorless liquid, very volatile, like ether, which is formed by the action of sulphur-vapor on carbon at a high red heat. Density (theoretical), 1.291 (Pierre at 0° gives 1.293). Boils at about 116°–117° F.; inflames at an extremely low temperature, much lower than sulphur; has a very offensive odor as found in commerce, but not at all so when carefully purified, which may be effected by redistilling from lime or from a metal. CS_2 has great solvent powers, which give it much commercial value. H. WURTZ.

Sulphocyan'ic Acid, also called **Hydrosulphocyanic Acid** and **Sulphocyanhydric Acid** [Ger. *Schwefelblausäure*; Berzelius called it *Rhodanwasserstoffsäure*], (CNHS), analogous in composition to cyanic acid, CNHO. It occurs in saliva, and in some sulphuretted essential oils of plants, such as *mustard* and *radish*. It may be prepared from *sulphocyanate of mercury*, which is first made by precipitating a mercurous salt with sulphocyanate (sulphocyanide) of potassium, and which is the material of the so-called "Pharaoh's serpents," a dangerous toy much in vogue a few years ago. The mercuric sulphocyanate is heated in a current of dry H_2S or HCl gas, when the sulphocyanic acid distills as a colorless liquid, which may be crystallized. This acid and its compounds are highly interesting to science, and of some practical interest, but for their complete description the chemical textbooks must be resorted to. *Sulphocyanate of potassium* (CNKS) is a salt of much interest from being an important and delicate laboratory reagent for ferric compounds, with which all soluble sulphocyanates strike a deep and characteristic blood-red color. The potassium-salt is prepared by fusing cyanide of potassium and sulphur together, and subsequent purification. HENRY WURTZ.

Sulphovinic Acid, also called **Sulphethylic Acid** and **Ethylsulphuric Acid** ($C_2H_6SO_4$), a compound which is formed by the action of sulphuric acid upon alcohol or ether. Hennel found, as confirmed by Berthelot, that it is formed by the direct combination of oil of vitriol with ethylene gas. It is obtained from sulphovinates, which are produced by saturating with baryta a mixture of equal parts of alcohol and oil of vitriol that has been heated to 212° F. for twenty-four hours, and crystallizing. The crystals are then decomposed by an exact equivalent of sulphuric acid, the liquid filtered from the baric sulphate, and concentrated *in vacuo* over oil of vitriol. Sulphovinic acid, thus obtained, is an oily liquid of density (theoretical) 1.33 at 0°. (It will be further referred to under VOLUMES, MOLECULAR.) H. WURTZ.

Sul'phur [Lat.: Fr. *soufre*: It. *zolfo*: Ger. *Schwefel*], also called **Brimstone,** one of the most important of the elements of matter, very abundantly and almost universally distributed throughout the earth and the sea. It occurs native, as a mineral, in many countries. It is also found in mineral form as GYPSUM (which see), and in a great variety of metallic SULPHIDES (which see); also dissolved in the ocean as sulphates. It is an important essential element of the blood, muscles, skin, hair, and other parts of animals, and exists also in some essential components of plants, though not in the *woody* substance thereof. It is evolved also from volcanoes, both as vapor of sulphur and as sulphuretted hydrogen and sulphurous dioxide gases, these gases being doubtless products of the action of oceanic water, that has penetrated to the volcanic focus, upon metallic sulphides it finds there. Indeed, it is more than probable that such action is itself one *vera causa* of vulcanicity.

Most commercial sulphur is merely the native mineral purified by fusion or further by distillation and sublimation. In Sicily, where the crude sulphur, mixed more or less with other minerals, is very abundant and fuel scarce, the method is often adopted of making a portion of the sulphur of the ore furnish the heat (not very great in amount) necessary to fuse out and separate the rest of the sulphur. The ore is piled in heaps, sometimes in kilns, so constructed that a portion of it can be set on fire and heat the whole mass throughout to the fusing-point of the sulphur. The latter then collects slowly in liquid form in cavities formed for the purpose, and may be ladled out and sold or refined. The Sicilian sulphur, being free from *arsenic*, which is the most objectionable impurity liable to occur, is highly prized for making SULPHURIC ACID (which see). Much sulphur is likely to be furnished to commerce from the western coasts of the U. S. In Lake co., Cal. (with *cinnabar*), Humboldt co., Nev., and numerous other places near these coasts, large deposits are reported, some of which are already worked. The refined sulphur (*brimstone*) of commerce, and the pulverulent material known as *flowers of sulphur*, are products of distillation and sublimation—operations which are often conducted simultaneously, there being duplicate condensing chambers, the first of which, being hot, condenses liquid sulphur, which is drawn off and cast into sticks or cylinders; while in the second, which is kept cool, the vapor precipitates in the form of "flowers," these flowers being, when freshly prepared, composed of a special allotropic modification of sulphur. (See below.)

Sulphur is one of those elements most liable to assume allotropic states when isolated. These are characterized by differences of crystalline form or by amorphous character, different relations to solvents, and different densities, but not so much as in the case of phosphorus allotropes, by differing colors. There are known to be many sulphur allotropes, but their study seems to present many difficulties, so that only a few of them are as yet well identified and characterized. (See *Allotropism*, under ISOMERISM, for some account of the sulphur-allotropes.) Native sulphur often occurs in very beautiful and brilliant transparent yellow crystals, which are orthorhombic in form, with two imperfect cleavages. Among these the densities at 0° C.—2.018 (Karsten 2.05) and 2.088 (Dumas and Roget 2.086)—indicate two distinct modifications. The density of the common opaque brimstone, crystallized from fusion, is lower, and there are several variations in this also. Its crystallization is monoclinic. Very beautiful crystals of this form are easily obtained by breaking the crust upon a cooling mass of melted sulphur and pouring out the liquid interior. On breaking the mass after cooling, the cavity will be found filled with slender brilliant prisms. Sulphur, on heating, passes through a succession of allotropic changes, melting at about 120° C. to a thin yellow liquid, of density (theoretical) at 0° 1.821 (Playfair and Joule found 1.815). If now again cooled, it becomes a permanently *transparent* solid (density unknown). Above 120° the sulphur becomes thick and viscid, losing its fluidity altogether, and assuming a brown color at about 250° C. Heat is absorbed, and becomes latent in the formation of this allotrope. At 300° the mass again becomes liquefied. At 440° C. (822° F.) sulphur boils, forming an orange-yellow vapor. Some of the sulphur-allotropes, including the two crystalline forms above described, are *soluble* in several liquids, such as bisulphide of carbon, oil of turpentine, and others. The bisulphide-of-carbon solution, on evaporation, yields beautiful transparent crystals, similar to those of native sulphur. Flowers of sulphur are composed of an *amorphous* soluble modification, the recorded densities of which vary so widely as to be incomprehensible at present. Sulphur inflames in air at a remarkably low temperature, about 482° F., burning with the well-known blue flame and suffocating evolution of sulphurous oxide gas, SO_2. HENRY WURTZ.

Sulphur, tp., Sebastian co., Ark. P. 713.

Sulphur, Acids of. See SULPHURIC ACID AND SULPHATES.

Sul'phuretted Hydrogen, called also **Hydrosulphuric Acid** and **Sulphohydric Acid** [Fr. *acide sulfhydrique*; Ger. *Schwefelwasserstoff*, or *Hydrothionsäure*], a gas, of composition H_2S, which seems to be a parallel compound to water, H_2O, and might therefore be expected to perform similar or parallel functions, but this latter has not yet been clearly shown. The gas was first discovered by Rouelle the younger, but Scheele first ascertained its nature and properties. Sulphuretted hydrogen is emitted naturally by mineral springs and from volcanoes, and, in combination with ammonia, is evolved in the putrefaction of animal and vegetable matters. The smell of rotten eggs and that of a privy, generally attributed to sulphuretted hydrogen itself, are due chiefly to the compound it forms with ammonia or *sulphide of ammonium*. Artificially, this gas is prepared by the action of a dilute mineral acid on certain metallic sulphides, of which *ferrous sulphide* of commerce is the one generally employed, though the native *sulphide of antimony* may also be used. If hydrogen gas be passed through melted sulphur, this compound is formed; and it has recently been asserted that a convenient way to evolve sulphuretted hydrogen for laboratory use is to melt together in a flask sulphur and *paraffine*. When pure, sulphuretted hydrogen is a colorless gas, of an intense odor, which somewhat recalls that of bitter almonds, which produces immediate vertigo in the case of some persons, and acts as a deadly poison upon some animals, even in very small proportion. Many persons will, however, inhale it in diluted form without much apparent effect for a considerable time, so that it cannot be regarded as necessarily a dangerous poison in the case of mankind, though its unnecessary inhalation in quantity ought to be avoided. The density of the gas is 1.175, air being unity. Faraday reduced it by compression to a

liquid whose density he gives as about .9. The solubility of the gas in water is given by Bunsen as 4.37 per cent. of its volume at freezing, and about 3.2 per cent. at normal temperature. Alcohol takes up about three to four times as much as water. It is combustible, with a blue flame, burning to water and sulphurous dioxide. This gas is a very important reagent in the laboratory for precipitating metals from their solutions in processes of analysis, and in many processes of preparation of organic compounds in pure state; particularly in cases of organic acids, which are first converted into lead-salts, to be decomposed afterward by sulphuretted hydrogen. HENRY WURTZ.

Sulphur Fork, p.-v. and tp., Lafayette co., Ark. P. 1570.

Sul'phuric Acid and Sulphates. Sulphuric acid is called also *oil of vitriol*, from its having been originally obtained by distillation from *vitriol*, or sulphate of iron (Fr. *acide sulfurique*; Ger. *Schwefelsäure* or *Vitriolsäure*). This acid was probably known to the Arabian proto-chemists. Basil Valentine, however, is the first known author who, writing in the fifteenth century, mentions the making of sulphuric acid by distilling iron-sulphate. The manufacture by burning sulphur, as now practised, was introduced in England by Dr. Roebuck about 1720. The general method is to burn sulphur, either as brimstone or in the form of metallic sulphides, as pyrites, in a draught of air, which is passed into very large chambers built of metallic lead, where the sulphurous oxide gas formed by the combustion is mixed with steam, and a quantity of nitrous fumes evolved from a mixture of saltpetre or nitrate of soda with sulphuric acid. The oxides of nitrogen convert the SO_2 into SO_3, the complete reaction, with nitric peroxide, being as follows:

$$N_2O_4 + 2SO_2 + 2H_2O = \underset{\text{Oil of vitriol.}}{2(H_2SO_4)} + \underset{\text{Nitric dioxide.}}{N_2O_2}.$$

The gas N_2O_2, however, combines again at once with oxygen present in the excess of air, to form the red gas N_2O_4 once more, which again reacts with more SO_2, so that the operation of a limited amount of nitrous fumes is continuous, acting as a carrier of oxygen to the sulphurous dioxide without consumption of its own substance. More than 100,000 tons of oil of vitriol are now annually made in this way in England. The product precipitates with condensing steam upon the walls and floors of the leaden chambers as diluted sulphuric acid, which is then concentrated to oil of vitriol—first, in pans of lead, and when it has become strong enough to attack these, the boiling down is completed in large stills made of *platinum*. (For further details regarding this important manufacture, which would occupy too much space, the works upon chemical technology must be resorted to.) The substitution for native sulphur, in this manufacture, of the less expensive mineral sulphides of iron and copper has made much progress in Europe of late years, notwithstanding the fact that the acid thus made is much less pure, and is particularly liable to contain *arsenic* as a contamination, which renders it especially unfit for one of its most extensive applications, that of making *fertilizers*. In America, on the contrary, the utilization in this way of our mineral sulphides does not make much headway; and this notwithstanding the fact that a marked feature of these minerals throughout the Eastern U. S. is a strange and generally an absolute freedom from the presence of arsenic. The present writer urged many years ago that the highly sulphurous coal-seams—almost useless for any other purpose—that lie in the valley of the upper Monongahela alone, in West Virginia, would be adequate to furnish the whole region of the valleys of the Mississippi and its tributaries with cheap sulphuric acid for agricultural purposes, altogether free from arsenic, for centuries to come. These ideas do not appear to have attracted any notice from capitalists. Among other American chemists, Sterry Hunt has likewise urged strenuously a similar utilization of the enormous beds of pyrites so abundant throughout the Carolinas and the East Tennessee region.

Sulphuric acid, or oil of vitriol, when fully concentrated, has a density at 0° C. of 1.846. It is an oily, colorless, inodorous liquid, which boils at 620° F. and freezes at — 31°. It absorbs water rapidly from the air, being one of the most useful agents in the laboratory for drying air and for absorbing moisture from other substances, which are for this purpose simply placed in a confined space with a quantity of oil of vitriol, which, through the medium of the air, will gradually abstract all the moisture from such substances. When mixed with water, great heat is developed, with a great condensation of the molecules of the water. The writer has found, as a result of certain new computations, that the first equivalent of water thus combined with oil of vitriol contracts (after cooling) from its original equivalent volume of 18 to that of 11.408. The vastness of the chemical forces involved may be faintly conceived when we consider what an almost *incalculable* power would be required to compress the water to this extent *mechanically*. The hydrate thus formed, $H_2SO_4.H_2O$, may be crystallized by cold, and is hence called *glacial sulphuric acid*. Its density, according to Wackenröder, is at 8° C. = 1.784 (theoretical at 0° = 1.799).

Nordhausen, or *Fuming Sulphuric Acid*.—This is the acid obtained by distilling ferric sulphate. It has the composition $H_2S_2O_7$, and is considered by some chemists as containing sulphuric trioxide SO_3 or as $H_2SO_4.SO_3$, but this seems hardly in accordance with the fact that it crystallizes as a whole in transparent crystals at zero. When gently heated, however, it breaks up into SULPHURIC OXIDE (which see), which distills over and condenses as a solid body, and ordinary oil of vitriol, which remains behind in the retort. Its name of *fuming* acid comes from the fact of its forming white fumes in the air, due apparently to the evolution of vapor of SO_3 even at ordinary temperatures. Fuming oil of vitriol is used in the laboratory for dissolving indigo and as a reagent in gas analysis, to absorb the *illuminant hydrocarbons* from ordinary coal-gas.

Diluted Sulphuric Acid.—It is very useful in chemical and technical operations to be able to determine the strength of a dilute acid from its density as taken with the hydrometer. The following figures are condensed from the latest tabulated determinations of densities of dilute sulphuric acid by J. Kolb:

Degrees Baumé.	Densities.	SO_3 in 100 parts.
1	1.007	0.7
5	1.037	4.7
10	1.075	8.8
15	1.116	13.2
20	1.162	18.0
25	1.210	23.2
30	1.263	28.3
35	1.320	33.9
40	1.383	39.5
45	1.453	45.2
50	1.530	51.0
55	1.615	57.1
60	1.711	63.8
65	1.819	73.2
66	1.842	81.6

Uses of Sulphuric Acid.—Among those materials and products of science and art that constitute the main pillars of modern civilization sulphuric acid occupies incontestably a first rank. Probably none other except the metal iron could be justly ranged with it in this regard. This will appear on a mere enumeration of some of the principal products necessary to human life, health, comfort, luxury, or necessity which are dependent, directly or indirectly, upon sulphuric acid as an essential agent in their production: *soda* from common salt, and, through this, *glass, soap, sodium, aluminum, magnesium; nitric* and *hydrochloric acids*, upon which depend the arts of *refining gold and silver* for money and jewelry, with the *electroplater's* and *photographer's* arts; artificial *mineral waters*; all the *vegetable acids* and *alkaloids*; *alum*; *ammonia*; *ultramarine*; the *aniline colors*; *bleaching-powder*; *chrome compounds*; *chloroform* and *ether*; *phosphorus* and *matches*; *artificial fertilizers*; and so on almost without end.

Sulphates.—Among the compounds of sulphuric acid with metals are many of commercial value and importance which we can here do little more than enumerate in part. Many of them will be found described under the heads of the different metals.

Aluminum Sulphates.—Of these there are several known, some of which occur as native minerals. The normal sulphate is $O_{12}S_3Al_2.18H_2O$, constituting the mineral *alunogen*. The alums (see ALUM) are double salts of normal aluminum-sulphate with the sulphates of potash, ammonia, or soda, containing 24 equivalents of crystal-water.

Ammonium Sulphate, $O_4S(NH_4)_2$.—A commercial salt of great importance, anhydrous, not deliquescent, made largely from the ammoniacal liquor of the gasworks, and used as a fertilizing agent.

Barium Sulphate, the mineral *barite, barytes*, or *heavy spar* (O_4SBa).—Insoluble in water, very heavy; densities, 4.123 and 4.554. The source of most commercial barium compounds. Is ground, purified, and sold largely as a pigment or inferior substitute for white lead.

Calcium Sulphates; the mineral *anhydrite* is O_4SCa. It is orthorhombic. *Minimum* and *maximum* densities, 2.911 and 3.104. GYPSUM (see this head; also SELENITE) has already been described.

Cobalt Sulphate ($O_4SCo.7H_2O$).—The mineral *bieberite*.

Copper Sulphate ($O_4SCu.5H_2O$).—*Blue vitriol*, an important commercial salt. Crystals triclinic.

Iron Sulphates ($O_4SFe.7H_2O$).—*Copperas* or *green vitriol*. A large article of commerce. Crystals monoclinic. This is

ferrous sulphate. Ferric sulphate (normal) is $O_{12}S_3Fe_2.9H_2O$, as the mineral *coquimbite*. There are many basic ferric sulphates.

Lead Sulphate (O_4SPb).—The mineral *anglesite*. Splendid orthorhombic crystals. *Minimum* and *maximum* densities, 6.2 and 6.42.

Magnesium Sulphate, Epsom Salt ($O_4SMg.7H_2O$). See MAGNESIA.

Manganese Sulphate ($O_4SMg.7H_2O$).—Monoclinic, like green vitriol.

Mercury Sulphates.—Mercurous sulphate is O_4SHg_2, and mercuric sulphate is O_4SHg. The former is insoluble, like calomel or mercurous chloride; the latter soluble, like corrosive sublimate or mercuric chloride. The mercuric salt is obtained by boiling mercury with oil of vitriol.

Nickel Sulphate ($O_4SNi.7H_2O$).—Very beautiful green crystals, right rhombic and isomorphous with Epsom salt. This salt, of much commercial importance now by reason of its large use in nickel-plating, is liable to contain iron and copper as impurities, both wholly destructive to its usefulness. In 1858 the present writer published a general method of separating iron from sulphates, including sulphates of nickel, copper, and others, by oxidizing the iron to ferric oxide and then precipitating with baric carbonate. The French chemist Terreil in 1875, apparently unaware of the previous publication eighteen years before, brought forward this device as new. The writer's mode, specified in 1858, for oxidizing the iron, boiling with dioxide of lead, was much in advance of Terreil's recent specifications. Copper must be separated by precipitation with metallic iron before boiling with the lead dioxide.

Potassium Sulphate (O_4SK_2).—A hard anhydrous salt, crystals trimetric; *minimum* and *maximum* densities, 2.423 and 2.888. Much less soluble than other potash-salts generally. Water at 0° C. dissolves but 8.36 per cent. It is a considerable article of commerce now for fertilizing purposes, for which it has great power.

Silver Sulphate (O_4SAg_2).—Trimetric crystals, turned green by light. Requires as much as 200 parts of cold water for solution.

Soda Sulphate, Glauber's Salt. See SODA.

Strontium Sulphate (O_4SSr) forms the beautiful mineral *cœlestine*; trimetric. Densities, *minimum* and *maximum*, 3.589 and 3.992.

Uranium Sulphate ($O_6SU_2.3H_2O$).—Small lemon-yellow prisms.

Zinc Sulphate ($O_4SZn.7H_2O$), *White Vitriol*, also the mineral species *goslarite*.—Orthorhombic and isomorphous with nickel-sulphate and Epsom salt. HENRY WURTZ.

Sulphuric Ether, an incorrect name given to ordinary ETHER (which see), which, though made usually with the agency of sulphuric acid, contains neither this nor sulphur in any form. It is usually regarded as an oxide of the hypothetical alcohol-radical *ethyl*, as diethylic oxide, or $2(C_2H_5)O$; but under VOLUMES, MOLECULAR, proofs are presented that it has the constitution $H_2O.4H_2C$.

HENRY WURTZ.

Sulphuric Oxide (SO_3), called also **Sulphuric Trioxide, Sulphuric Anhydride, Anhydrous Sulphuric Acid.** Sulphurous oxide, SO_2, mixed with oxygen and subjected to electric sparks, will form SO_3, but it is generally obtained, as mentioned under SULPHURIC ACID, by distilling the fuming or Nordhausen acid. It condenses in crystalline needles, snow-white, resembling asbestos; has a peculiar toughness. It melts at about 64° F., and boils at 95°. Density variable, there being doubtless several allotropes. The approximate range is from 1.94 to 2. It combines greedily with water with a hissing noise, forming oil of vitriol or its hydrates. HENRY WURTZ.

Sulphur, Medicinal Uses of. Taken internally, sulphur produces little effect beyond that of a mild and somewhat slow laxative. Externally, applied in the form of ointment, it is a powerful parasiticide, principally employed to kill the little insect that produces the itch disease. *Potassium sulphide* is a sharp irritant, and in large dose internally a corrosive poison. It may be used instead of the simple sulphur ointment as a local remedy in itch and in other skin diseases, and dissolved in water as a bath is used in skin disease and in lead-poisoning.

EDWARD CURTIS.

Sulphurous Acid and Sulphites. Sulphurous dioxide gas, passed into water, forms sulphurous acid. A crystalline hydrate, $O_3SH_2.8H_2O$, was obtained by Pierre. Döpping obtained the pure acid, O_3SH_2, in cubical crystals; density not determined. Sulphurous acid is a strong reducing agent. It deoxidizes iodic, arsenic, chromic, and permanganic acids and chloride of gold, precipitating metallic gold from the latter.

Sulphites.—Of these the sulphites of calcium and of sodium only are of much practical interest, they being prepared commercially to some extent for bleaching purposes and for the prevention of fermentation of wines, syrups, and other organic liquids. There are two soda-salts—one neutral, O_3SNa_2, and one acid, O_3SNaH. The latter is obtained as a crystalline precipitate on cooling a warm solution of sodic carbonate which has been supersaturated with sulphurous oxide gas. This salt is used in the laboratory as a reagent. HENRY WURTZ.

Sulphurous Oxide, or **Dioxide** (SO_2), also called **Sulphurous Anhydride** [Fr. *acide sulfureux*; Ger. *Schwefligе Säure*], the gaseous substance formed by the combustion of sulphur in the air. Even in pure oxygen the same compound is formed. It is emitted by volcanoes. It may be obtained artificially, in a pure state, by heating oil of vitriol with some metals, copper and mercury being among these. Sulphate of the metal and water are at the same time formed: $Hg + 2(O_4SH_2) = O_4SHg + 2H_2O + SO_2$. It is also obtainable pure by heating together sulphur and sulphuric trioxide, SO_3, in one limb of a sealed U tube. It then appears as a liquid, condensed by the pressure, in the other limb. Sulphurous oxide gas is colorless, with the well-known suffocating odor. Bunsen gives its density as 2.21122 (air being 1), and its solubility in water as about 69 per cent. of the volume of the latter at zero, and 41 per cent. at normal temperature. Alcohol at zero takes up nearly five times as much as water. A pressure of about three atmospheres, or the cold of snow and salt, condenses it to a liquid of density 1.4311 at zero, as shown by volumic molecular computation, which at the same time proves it to be S_2O_4. This liquid produces so much cold in its evaporation as to freeze water when poured upon it. Sulphurous oxide has strong bleaching-power over most vegetable colors, and is therefore used for bleaching straw, wood, etc. HENRY WURTZ.

Sulphur Springs. See WATER.

Sulphur Springs, tp., Calhoun co., Ala. P. 560.

Sulphur Springs, tp., Montgomery co., Ark. P. 192.

Sulphur Springs, tp., Polk co., Ark. P. 768.

Sulphur Springs, tp., Searcy co., Ark. P. 226.

Sulphur Springs, tp., Johnson co., Ill. P. 1197.

Sulphur Springs, tp., Morgan co., Ill. P. 627.

Sulphur Springs, p.-v. and tp., Henry co., Ind. P. 246.

Sulphur Springs, tp., Cleaveland co., N. C. P. 1222.

Sulphur Springs, tp., Rutherford co., N. C. P. 967.

Sulphur Springs, p.-v., cap. of Hopkins co., Tex., has 4 churches, 5 schools, Masonic and Odd Fellows' lodges, 2 newspapers, 3 cotton-gins, 3 flouring mills, and 1 foundry. There are several sulphur springs. P. 921.

FOSTER & RILEY, EDS. "GAZETTE."

Sulphur Springs, tp., Carroll co., Va. P. 1846.

Sulpi'cians, a Roman Catholic congregation of missionary priests founded in Paris in 1642 by Abbé J. J. Olier. They were confirmed in 1645. They have quite a number of European and a few American houses. Their chief work is the training of young men for the priesthood. They are properly called the Congregation of St. Sulpice, from the parish where first organized.

Sulpi'cius Seve'rus, b. in Aquitania about 363 A. D., though the precise date is not known. He was descended from a noble family, and in his youth had a career of distinction at the bar and in public life open before him. The loss of his wife, to whom he was greatly attached, led him to abandon the career on which he had entered about 392 A. D., and to give himself up to solitude and religious meditation. He entered the Church; became a presbyter and a devoted admirer of St. Martin of Tours, whose life he wrote. The date of his death is not known, but it was some years after 400. His chief writings are—*Historia Sacra*, or *Chronica*, in two books, from the Creation to A. D. 400; *Vita S. Martini Episcopi et Confessoris*; *Tres Epistolæ*, all relating to his patron St. Martin, and a sort of continuation of the *Life*; *Dialogi duo* (in some editions *tres*); to these are added *Epistolæ Septem*, though doubtfully ascribed to Sulpicius. The best editions of his collected works are that of De Prato (2 vols. 4to, Verona, 1741-54) and that of Halm (Vienna, 1866, 8vo), in which the seven doubtful epistles are given as an appendix.

H. DRISLER.

Sul, Rio Grande do. See RIO GRANDE DO SUL.

Sul'tan [Arab., "mighty"], the title ordinarily given to the hereditary ruler of the Ottoman empire. It is also assumed by other Mohammedan monarchs, such as the rulers of Acheen, Zanzibar, Borneo, the Maldive Islands, etc. Most of the numerous minor sultanates are over African and Malay states.

Sulu Islands. See SOOLOO ISLANDS.

Su'mach, or **Sumac** [Arab. *summak*], the common name for plants of the genus *Rhus*, which includes the cashew, mango, and other tropical fruits. In the U. S. there are about twelve species of sumachs, all of which are shrubs or small trees: of these the most common is the well known smooth sumach (*Rhus glabra*), which is often found covering large tracts of barren ground, where it grows to a height of from two to twelve feet, with leaves a foot long. The yellowish-green flowers appear in June, and have a fragrant odor. The fruit is in dense crimson clusters with a velvety appearance and a pleasant acid flavor; the leaves are among the earliest to take on their autumn colors of yellow and scarlet. The stag's-horn sumach (*R. typhina*) sometimes reaches the height of thirty feet, and is readily distinguished by the soft down at the extremity of the branches. The dwarf or mountain sumach (*R. copallina*) is rarely more than six or eight feet high, with dark shining leaves, which in autumn become a rich purple. A still more diminutive species (*R. pumila*), erroneously supposed to be poisonous, is found in the pine barrens from North Carolina southward. The fragrant sumach (*R. aromatica*) ranges from Vermont to Florida, and as far westward as the Rocky Mountains; its leaves are among those which are smoked by the Indians in lieu of tobacco under the name of killikinick. The *Toxicodendron* group of the sumach family includes two species, with white or dun berries and a very poisonous foliage. One of these, the poison oak or poison ivy (*R. toxicodendron*), has leaves of three leaflets, flowers in loose slender panicles, fruit smooth and of a pale brown, and is abundant in most shady places, sometimes erect and sometimes creeping or climbing; it is highly poisonous to many persons upon contact, while others are not affected by it. The poison sumach, poison elder, or poison dogwood (*R. venenata*) is a beautiful shrub, from six to eighteen feet high, found from Canada to Louisiana; the fruit is greenish-white, hanging in loose clusters; the juice is milky, and dries to a black varnish; it is still more poisonous than the preceding species. The sumach of commerce formerly consisted of the leaves of the *R. coriaria*, closely resembling our stag's-horn sumach, which is largely cultivated in Sicily, and used in tanning, dyeing, and calico-printing; but it has been proved that our native sumachs are quite as valuable, and the collection and preparation of the leaves has become an important industry in some parts of the South. The Japan wax is yielded by the *R. succedanea*, being prepared from the white coating of the seeds within the capsules. The Japanese lacquer is prepared from the juice of *R. vernicifera*, a shrub closely resembling our poisonous sumach. The Chinese galls are the result of the deposition of the eggs of an insect on the leaf stalks and young shoots of *R. semialata*, and are largely imported into England for dyeing and tanning purposes.

Sumarokoff (Alexei Petrovitch), b. at Moscow Nov. 14, 1718; founded the first Russian theatre in St. Petersburg, and wrote, besides lyrical poems and epics, a number of tragedies and comedies which found favor both at the court and among the people. D. at Moscow Oct. 13, 1777. His works (10 vols., 1787) have been several times reprinted.

Suma'tra (when Australia is not reckoned), the third largest island of the earth, extends from N. W. to S. E., between lat. 5° 45′ N. and 5° 55′ S., and between lon. 90° 40′ and 105° 5′ W., divided by the equator into two equal parts. Its area has been computed at 169,538 sq. m., its population at 2,000,000. Through its whole length it is traversed by a mountain-range, Boukit Barissan, which reaches its greatest height, 9655 feet, in Ophir, in lat. 0° 4½′ N., lon. 100° 1′ E. The range runs as a narrow ridge nearer to the western than to the eastern coast; a true mountain-region is formed only in the centre of the island, where some ranges run transversely. The principal rocks are granite, syenite, gneiss, mica-slate, and red sandstone, none of which are found in Java, whose geological and chorographical formation is entirely different from that of Sumatra. Six volcanoes are known, situated near the equator. The south-eastern part is rich in streams, navigable even for large vessels far into the interior. These streams carry large masses of mud and earth to the sea, the result of which is a considerable extension of the coast-line: at the same time the surface of the island, like that of Java and Borneo, appears to be rising slowly, but steadily. The several river-systems are connected with each other by arms and canals, and on the banks, in the midst of a luxuriant vegetation, stand the towns and villages. The climate is different in the different parts of the island, but generally it is healthy, with the exception of the low coast-regions to the W. The heat varies on the coast between 82° and 86° F., and at an elevation of from 2500 to 3000 feet between 64° and 73°; these highlands are celebrated for their healthy climate. The monsoons are not so steady and regular here as elsewhere. The dry season lasts N. of the equator from October to May, and S., from the end of April to the end of October. The natural productions of Sumatra are more varied and more abundant than those of any other island in the archipelago. Of metals, gold, iron, copper, and tin occur; brown coal occurs, but anthracite is not found. The development of the vegetable kingdom is grand. Rice forms the principal food, then sago, beans, and roots (varieties of jolichos, batatas, and dioscorea). The most palatable among the fruits are the mangosteen, durian, rambutan, rambei, pisang, pineapples, etc., many of which thrive only here, and cannot be introduced into other countries. Of the species of trees, the *Sideroxylon* (justly called *kayu* ("wood") *besi* (iron"); that is, "iron-wood") yields the best wood for shipbuilding, it being so hard that it blunts the sharpest arrow; teak is not found. The most important plants entering into commerce are cotton, black pepper, caoutchouc, benzoin, gutta-percha, various dyestuffs, and camphor, for which the island was celebrated among the ancients. The Dutch have introduced coffee, tobacco, and cacao; the nutmeg-plantations will not thrive. The fauna, Indian in its general character, corresponds nearer to that of Borneo than to that of Java. Of mammals there are 80 species, among which are the elephant, rhinoceros, tapir, tiger, panther, and bear; among the ruminants, the *Cervus equinus* is noticeable; among the many species of apes are the orang-outang and two other anthropoids, the siamang (*Siamanga syndactyla*) and the wau-wau (*Hylobates variegatus*); the buffalo occurs both in a wild state and domesticated; the horse is small, but vigorous, adapted to a mountain country. The population, formerly estimated at 5,000,000, but recently computed at 11 to the sq. m., belongs to the Malayan race, with the exception of 25,000 Europeans, mostly Dutch, some Chinese, and other Asiatic races. Of the native population, the Malays proper form the majority. Sumatra was their cradle as a nation; in the interior they founded the empire of Manang-Kaban, once very powerful. Next to them the Battaks are the most important division; they formerly inhabited the country N. of lat. 1° N., but now the population of Achin has separated from them, and they themselves have decreased in number, and are crowded together in a small space. The Orang Koabos live in the forests; in physical respects they do not differ from the other inhabitants of the island, but they are uncivilized, though harmless; they are agriculturists. The Malays are all Moslems; they write their sonorous language with Arabic letters, have a comprehensive literature, devote themselves less to agriculture than to commerce, navigation, and occasionally to piracy, and are well versed in several kinds of trade, especially in the manufacture of arms. With respect to their character they are said to be unreliable, treacherous, and addicted to sensual enjoyments. The Battaks are fetich-worshippers and addicted to cannibalism—a custom which the Dutch have tried in vain to abolish.

History.—The oldest history is very obscure. Remains of Hindoo temples and Indian idols, and the introduction into the language of numerous words belonging to the Sanskrit, show that the communication with Hindostan must at one time have been very intimate. The celebrated historical work, *Soulâlat* or *Salâthin*, is very untrustworthy; a reliable chronology does not begin until the introduction of Islam. Ptolemy calls the island *Aurea Chersonesus*, the Arabs *Fantsaur*; the name *Sumatra* occurs in 1330, used of the city of Samatrah. The Arabs visited Sumatra about 860 A. D.; Islamism was introduced into Achin in 1205; the Venetian merchant Marco Polo landed here in 1290, the Portuguese under Alvaro Talesso in 1506, the Dutch in 1597; an English squadron appeared before Achin in 1602. At that time the island consisted, in political respects, of three principal divisions—the southern part, called Batangharie, comprised the present Dutch residences of Palembang, Lampong, and Bencoolen, and was subject to Java; the central part was occupied by the Malayan empire of Manang-Kaban; the northern, called collectively Battak, comprised the countries of the Battaks, besides Achin, Pedir, etc., on the north-eastern coast. The Dutch East Indian Company, founded in 1602, rose rapidly to a great commercial and political power. In 1618 it established settlements on the E. coast; in 1646 at Salida on the W. coast; between 1664 and 1670 it extended its power by treaties with the minor chiefs and with the empire of Manang-Kaban, which now began to decay. England tried to compete with Holland, and succeeded on the W. coast, but was compelled in 1783 to return all its possessions in Sumatra to Holland. In 1811 it once more occupied the island, but by the treaty of Mar. 17, 1824, it exchanged all its possessions in the archipelago for the Malayan peninsula, and thus Holland became the only European power holding dominion in Sumatra. Between 1819 and 1845 the Dutch made war on the adherents of the

religious sect Orang-Padri; they succeeded, and transformed the W. coast into the richest and most profitable province—an achievement which was chiefly due to Gen. Michiels, who fell in 1849 in the island of Bali. In 1839–40 war was waged against Achin; it succumbed, but continued to harass the Dutch as their most inveterate enemy. An incorrect wording of the treaty of 1824 made it uncertain whether England could lay claims to Achin or not, but an additional treaty of 1871 gave Holland free hands, and she made no delay, but declared war immediately against Achin on account of piracy and anthropophagy. In the beginning the Dutch were defeated; the war had been commenced in the wrong season and with an inappropriate force. But in the summer of 1873, Van Swieten received the command, and then success followed success. At present, Holland possesses in Sumatra more than one-half of the whole area, with a population of 1,630,000. This part of the island, now perfectly subdued, consists of the government of the W. coast of Sumatra, with its capital, Padang, and a population of 950,000; the residency of Bencoolen, capital of the same name, and a population of 130,000; the residency of Lampong, with a population of 100,000, capital Telok-Betong; and the residency of Palembang, with a population of 450,000, capital Palembang. Holland also exercises authority over the kingdoms of Jambi, Indragiri, Siak, and the minor states of Arsahan, Deli, Serdang, etc., on the E. coast. The extension of the Dutch authority to these regions took place in 1863–65. The chiefs are very closely watched by the Dutch officials, and restrained from all arbitrary use of their power. Independent, and neither directly nor indirectly subject to Dutch authority, are Achin, the country of the Battaks, and the small district of Korintji in the eastern part of Jambi. In Korintji the interior relations are peaceful, equitable, and not unhappy. The same is the case in the country of the Battaks. One would rather like to see them continue independent, were it not for the anthropophagy still existing in them both. In Achin, on the contrary, there has reigned for more than a century a state of affairs which cannot be better described than as a continuous struggle between anarchy from below and despotism from above, now the one, now the other getting the upper hand, but the populace suffering equally in either case. In spite of all the great moral blemishes ascribed to them, the Battaks surpass, nevertheless, the other tribes of Sumatra in courage, valor, and enterprise. It can hardly be doubted that they would improve greatly, both in moral and material respects, under the Dutch sceptre, especially if at the same time their capital could be made prosperous. The influence of European civilization would reach the independent Battaks more rapidly and with greater effect from Achin than from the distant Dutch government of the W. coast of Sumatra, and thus anthropophagy among the Battaks be sooner destroyed. E. SCHLAGINTWEIT.

Sumba'wa, an island of the Malay Archipelago, is bounded N. by the Java Sea, S. by the Indian Ocean, W. by the Strait of Allass, separating it from Lombok, and E. by the Strait of Sappi, separating it from Flores. Area, estimated at 6000 sq. m.; pop. at 80,000. It is high, mountainous, and volcanic. The still active volcano Tomboro, on the N. coast, 8940 feet high, caused a terrible destruction by its eruption in 1815; the ashes fell in Sumatra, 840 miles distant, and in a large part of the island itself all vegetation was completely destroyed. The sea also rose and swept away men and houses. More than 12,000 people are said to have lost their lives. Another eruption, less destructive, occurred in 1836. The principal products are gold, sulphur, saltpetre, rice, various kinds of wood, and a fine breed of horses. The inhabitants, closely allied in habits and manners to those of Celebes, live in six states which are under Dutch authority—namely, Tomboro and Sumbawa on the N. coast; Bima on the E. coast, where the Dutch governor resides; and Dompo, Sangar, and Papekat.

Sum'bul, a drug imported from India and Russia, is the root of some unknown plant, probably umbelliferous. It is used as a substitute for musk, both by perfumers and physicians. It has very nearly the odor of true musk, and as a nerve-stimulant it appears to possess much merit. It is but little used in the U. S.

Summary Proceedings, in law, are proceedings of various kinds, usually judicial in their nature, for the purpose of establishing or protecting some civil right or inflicting some penalty, in which the ancient common-law forms and methods are disregarded. As the name indicates, they are intended to be brief, expeditious, inexpensive, and efficient, and to avoid the delay and trouble which a close adherence to the customary modes of the common law procedure necessarily involves. They are and must be entirely of statutory origin, and in prosecuting them the statutory provisions both as to form and purpose must be accurately followed. The number and objects of the common-law actions were definitely fixed; all their steps, including the commencement, pleadings, issues, trial, and judgments, were well defined. Summary proceedings differ from these actions in many essential features, often in the absence of a jury trial, or in dispensing with the formal pleadings, or in the manner of commencement, or in the tribunals before which they may be brought. The legislation upon this subject greatly varies in the several States, and the number of different proceedings is large. The following instances are examples of the forms which are quite common: A proceeding by which a landlord may dispossess a tenant who holds over after the expiration of his term or who fails to pay his rent; a proceeding to determine the title to chattels levied on under execution which are claimed by a third person; the proceedings by which railroad companies and other corporations may acquire lands under the right of eminent domain; proceedings after an execution has been returned unsatisfied to discover property of the judgment debtor; and in many States the proceedings for forcible entries and detainers, and those to enforce mechanics' liens. The power of legislatures to authorize summary proceedings is very much restricted by the provisions of the State constitutions, which preserve the jury trial in all cases, civil or criminal, where it had formerly been used, and which require "due process of law" to be observed in all means by which a person may be deprived of life, liberty, or property. When the proceedings established by statute violate these constitutional guaranties, the statutes creating them are void. JOHN NORTON POMEROY.

Sum'mer, the warm season of the year, astronomically including the period between the vernal and autumnal equinoxes, from about June 21 to Sept. 22, but popularly, in the northern hemisphere, the months of June, July, and August; in the southern hemisphere the summer months are December, January, and February. Within the tropics there is of course, strictly speaking, no summer season. The so called "Indian summer" (see DARK DAY, in APPENDIX) is a period of warm pleasant weather which is usual in the northern parts of the U. S. after the cessation of the autumnal storms, often continuing for many weeks.

Summer Duck. See WOOD DUCK.

Sum'merfield, p.-v. and tp., Dallas co., Ala. P. 1467.

Summerfield, p.-v. and tp., St. Clair co., Ill. P. 770.

Summerfield, tp., Monroe co., Mich. P. 1464.

Summerfield, p.-v., Marion tp., Noble co., O. P. 170.

Summerfield (JOHN), b. at Preston, England, Jan. 31, 1798; was educated at a Moravian seminary; at the age of fifteen went to Dublin, where he joined the Wesleyan society, and became a preacher in 1818; came to America in 1821, and at once attracted great crowds by his rare eloquence, first in New York, and subsequently in Philadelphia, Baltimore, and Washington. His health failing, he went to Europe in 1822; travelled in England and on the Continent, returning in 1824 to New York, where he d. June 13, 1825. He was the founder of the American Tract Society. During his lifetime he published only a single discourse, in behalf of the New York institution for the deaf and dumb; a collection of 83 of his *Sermons and Sketches of Sermons* was published in 1842. His biography has been written by Rev. John Holland (1829) and by Rev. William M. Willett (1857).

Summer Hill, p.-v. and tp., Cayuga co., N. Y. P. 1036.

Sum'merhill, p.-v. and tp., Cambria co., Pa. P. 752.

Summerhill, tp., Crawford co., Pa. P. 1232.

Sum'mers, county of Central West Virginia, formed since the census of 1870 from a portion of Nicholas county; bounded S. W. by Meadow River, and intersected by Gauley River. It is hilly, with fertile valleys adapted to wheat, Indian corn, and grazing. Cap. Hinton.

Summers, tp., Wilkes co., N. C. P. 760.

Summers (JAMES), M. A., b. in the first quarter of the present century; studied at Magdalen Hall, Cambridge; became an assistant librarian in the British Museum, and subsequently professor of Chinese in King's College, London; edited the *Chinese and Japanese Repository* (1863–64) and the *Flying Dragon*, a Chinese newspaper (1866 [illegible]), and has published *Lectures on the Chinese Language and Literature* (1853) and *Hand Book of the Chinese Language* (1864).

Summers (THOMAS OSMOND), D. D., LL.D., b. near Corte Castle, Isle of Purbeck, Dorsetshire, England, Oct. 11, 1812; came to the U. S. and prepared for the ministry; was "admitted on trial" into the Baltimore conference of the M. E. Church in Mar., 1835, and afterward ordained deacon and elder; was a missionary in Texas 1840 Dec., 1843; was one of the nine preachers who constituted

the Texas conference at its organization, Dec., 1840, and secretary for four sessions; was transferred to the Alabama conference, of which he has continued a member till this time (1876); was stationed at Tuscaloosa in 1844, where and when he married; sent to Livingston station in 1845, and to Mobile in 1846; at the General Conference May, 1846, was sent to Charleston, S. C., as assistant editor of the *Southern Christian Advocate*, with Dr. (now Bishop) Wightman; was secretary of the Louisville convention in 1845, at which the M. E. Church, South, was organized, and has been secretary of all the General Conferences; was chairman of the committee that compiled the hymnbook, which he edited, and has compiled other hymnbooks for the connection, having devoted much attention to hymnology; has been the general book-editor of the Church from its organization; started the *Sunday-School Visitor*, and edited it four years in Charleston and three years (since the war) in Nashville, whither he removed in 1855, the publishing-house being there located; edited the *Quarterly Review of the M. E. Church, South*, for several years immediately preceding and during the war; has revised and edited hundreds of books for the Church, and written introductions, notes, indexes, etc., for many of them—*e. g.* Wesley's *Sermons*, Watson's *Sermons*, *Theological Institutes*, *Biblical and Theological Dictionary* (which he enlarged by adding a great many original articles), *Life of Wesley*, and *Observations on Southey's Life of Wesley*, and the standard Wesleyan *Catechisms*, which were also compiled by Watson. Dr. Summers is the author of *Commentaries on the Gospels, the Acts, and the Ritual of the M. E. Church, South* (6 vols.); a *Treatise on Baptism*, one on *Holiness*, *The Sunday-School Teacher, or the Catechetical Office of the Church; Seasons, Months, and Days; Talks Pleasant and Profitable; Refutation of the Theological Works of Paine* (not answered in Bishop Watson's *Apology*); *The Golden Censer, an Essay on Prayer*, with a collection of forms for all occasions; and sundry pamphlets, tracts, sermons, etc. During the war, he returned (Feb., 1862) to Alabama, and performed pastoral work in Tuscaloosa 1862–65, and in Greensboro' a part of 1866; at the General Conference, which met that year in New Orleans, was re-elected general editor, and editor of the *Sunday-School Visitor*; is also editor of the *Christian Advocate*; is professor of systematic theology in the Vanderbilt University and dean of the theological faculty, and *ex-officio* pastor of that institution, of which his only son is professor of anatomy and histology in the medical department.

Sum'merset, tp., Saline co., Ill. P. 800.

Summerset, tp., Adair co., Ia. P. 439.

Sum'merside, a port of entry, the second town in size in Prince Edward's Island, is in Prince co., and has a good harbor, rather hard of access, a large export trade, considerable shipbuilding, 2 weekly newspapers, 5 churches, a public hall, a market, and several manufactories. It is 40 miles by land W. N. W. of Charlottetown. P. about 1700.

Summers's, tp., Caldwell co., N. C. P. 1353.

Summers's (or **Somers's**) **Islands.** See Bermudas.

Sum'merville, p.-v., cap. of Chattooga co., Ga., 43 miles S. of Chattanooga, has 2 academies, Masonic and Templar halls, 1 newspaper, a cotton-gin, county-seat buildings, and 1 steam saw and grist mill. P. 281.

John A. Henry, Ed. "Gazette."

Summerville, p.-v., Cass co., Mich. P. 184.

Summerville, p.-v., Harnett co., N. C.

Summerville, p.-v., Clover tp., Jefferson co., Pa., on Allegheny Valley R. R.

Summerville, p.-v., Charleston co., S. C.

Summerville, tp., Nicholas co., West Va. P. 645.

Sum'mit, county of N. W. Colorado, bordering on Utah, and watered by Bear, Blue, Grand, and White rivers. The W. portion is densely wooded, and contains large beds of coal, with mines of iron, copper, lead, and zinc; the E. portion includes a portion of the area reserved as the "Middle Park." Almost the entire population is in the S. E. corner, upon the head-waters of Blue River, where there are gold placer-mines. Cap. Breckinridge. Area, about 8500 sq. m. P. 258.

Summit, county of N. E. Ohio, drained by Cuyahoga and head-waters of Tuscarawas rivers, and traversed by several railroads and by Ohio Canal, the highest point of which is in this county. The surface is uneven, abounding in water-power, and having extensive coal-mines. There are many manufactories of agricultural implements, carriages, cooperage, stone and earthenware, leather, machinery, paper, woollen goods, iron castings, and brick. Cattle, sheep, horses, and swine are numerous. Staples, Indian corn, wheat, oats, hay, wool, lumber, butter, and cheese. Cap. Akron. Area, 400 sq. m. P. 34,674.

Summit, county of N. E. Utah, bordering on Wyoming, containing the head-waters of Bear and Weber rivers, and traversed by Union Pacific R. R. It is mountainous, and contains mines of gold, silver, lead, and coal. Staples, wheat, potatoes, hay, and dairy products. Cap. Coalville. Area, 1250 sq. m. P. 2512.

Summit, p.-v. and tp., Blount co., Ala. P. 630.

Summit, tp., Effingham co., Ill. P. 1432.

Summit, v., Prairie tp., Henry co., Ind. P. 108.

Summit, tp., Marion co., Ia. P. 1484.

Summit, tp., Jackson co., Mich. P. 863.

Summit, tp., Mason co., Mich. P. 257.

Summit, tp., Steele co., Minn. P. 322.

Summit, p.-v. and tp., Pike co., Miss., on New Orleans St. Louis and Chicago R. R., has 2 weekly newspapers.

Summit, p.-v. and tp., Union co., N. J. P. 1176.

Summit, p.-v. and tp., Schoharie co., N. Y. P. 1631.

Summit, tp., Monroe co., O. P. 970.

Summit, tp., Butler co., Pa. P. 1304.

Summit, tp., Crawford co., Pa. P. 1034.

Summit, tp., Erie co., Pa. P. 1047.

Summit, tp., Potter co., Pa. P. 145.

Summit, tp., Somerset co., Pa. P. 1493.

Summit, tp., Juneau co., Wis. P. 722.

Summit, tp., Waukesha co., Wis. P. 1358.

Summit Hill, p.-b., Carbon co., Pa., on Central R. R. of New Jersey, has good schools, 1 newspaper, 4 hotels, and rich deposits of coal, from which it derives its principal support. It is a favorite summer resort. P. about 4000.

Robert Harris, Ed. "Weekly Intelligencer."

Summitville, v., Washington tp., Cambria co., Pa. P. 177.

Sum'monsville, tp., Craig co., Va. P. 815.

Sum'ner, county of S. Kansas, bordering on Indian Territory, intersected by Arkansas River, consists mainly of fertile prairies. Cap. Wellington. Area, 1152 sq. m. P. 22.

Sumner, county of Central Mississippi, formed in 1874 from portions of other counties, and drained by Big Black River. The surface is undulating and the soil fertile. Staples, cotton, Indian corn, and sweet potatoes. Cap. Walthall. Area, 408 sq. m. P. in 1875, about 8000.

Sumner, county of N. Tennessee, bordering on Kentucky, drained by branches of Cumberland and Big Barren rivers, and traversed by Louisville Nashville and Great Southern R. R. It has an undulating surface and fertile soil. Horses, cattle, sheep, and swine are very numerous. Staples, Indian corn, tobacco, wheat, oats, hay, sorghum-molasses, wool, and dairy products. Cap. Gallatin. Area, about 500 sq. m. P. 23,711.

Sumner, tp., Kankakee co., Ill. P. 1081.

Sumner, p.-v. and tp., Lawrence co., Ill. P. 672.

Sumner, tp., Warren co., Ill. P. 998.

Sumner, p.-v. and tp., Bremer co., Ia. P. 582.

Sumner, tp., Buchanan co., Ia. P. 550.

Sumner, tp., Iowa co., Ia. P. 692.

Sumner, tp., Webster co., Ia. P. 574.

Sumner, tp., Winneshiek co., Ia. P. 909.

Sumner, p.-v., Sumner co., Kan.

Sumner, p.-v. and tp., Oxford co., Me. P. 1170.

Sumner, p.-v. and tp., Gratiot co., Mich. P. 815.

Sumner, tp., Fillmore co., Minn. P. 988.

Sumner, tp., Guilford co., N. C. P. 1120.

Sumner, tp., Jefferson co., Wis. P. 468.

Sumner, tp., Trempealeau co., Wis. P. 889.

Sumner (Charles), b. in Boston Jan. 6, 1811, the eldest son of Charles Pinckney Sumner (b. in Milton, Mass., Jan. 20, 1776; graduated at Harvard College 1796; d. Apr. 24, 1839) and Relief (Jacobs) Sumner (b. in Hanover, Mass., Feb. 27, 1785; d. in Boston June 15, 1866). His twin sister, Matilda, d. Mar. 6, 1832. The Sumners had long been prominent in Massachusetts. Increase Sumner, governor in 1797, was of this family. Job Sumner, the Senator's grandfather (Harvard College, 1778), was a major in the Revolutionary army. The family was noted for physical as well as intellectual vigor—tall, strong, and stalwart. The Senator's father was, however, a spare man, about the average height. He delivered and published addresses and poems, was a wide student, with fine literary taste, a well-read lawyer, took an active part in politics, and was sheriff of Suffolk county from 1825 till his resignation just before his death; complimented by Hon. Josiah

Quincy as "the only sheriff, except Walter Scott, born on Parnassus." His manners had the exact and formal courtesy of a former generation. He was considered a brilliant man in his youth, and many anecdotes of his rather grim humor are still current in the courts. Charles was educated at the Boston Public Latin School; entered Harvard College 1826, and was graduated there 1830. He was a recluse and studious boy, hardly ever joining in any amusement or athletic games; and this mood lasted through his college years. Though a diligent student at college, he gave more attention to general literature than to the special studies of the university. After his graduation he gave a year to science, belles-lettres, history, and art. In 1831 he joined the Harvard Law School, then under the charge of Judge Story, and entered on the study of law with enthusiasm, renouncing all other subjects, and giving himself, without any relaxation, to a profound study of law. His leisure was devoted to preparing a catalogue, with learned notes, of the law library, and contributing to the *American Jurist*, of which he became chief editor. This devotion gained him the warm friendship of Story, who treated him as a son. Admitted to the bar in 1834, he visited Washington with such earnest letters of introduction from Story as secured him the friendship of Kent, Horace Binney, Judge Marshall, and others, who frankly expressed their wishes that before long he should find his place on the bench. Appointed by Story reporter to his circuit court, he published three volumes of Story's *Decisions*, and often supplied his place as lecturer at the law school, where he was himself lecturer from 1835 to 1837 and in 1843. In 1836 he edited Dunlap's *Admiralty Treatise*. He never had much practice at the bar, and seldom appeared in court. In 1837 he went to Europe with numerous letters of introduction from Story and others to lawyers and judges in England, France, and Germany: was received with most flattering attention, and became personally acquainted with almost every leading man and woman in Europe. But while his days were passed in society and galleries, his nights were spent in diligent study, for he early showed that almost incredible power of working which distinguished him through life. Rest he never needed, and always seemed to scorn. Returning in 1840 from Europe, he again opened a law-office, and, with J. C. Perkins, edited twenty volumes of Vesey's *Reports*. It was during this labor that his health broke down, and an illness followed which nearly proved fatal. He could have had, after Story's death (1845), his professorship at the law school, but declined it. In 1845 he was chosen by the city of Boston to pronounce the Fourth of July oration, and took for his subject the *True Grandeur of Nations*. This was a plea for peace, and was bitterly criticised at home, though welcomed abroad, and pronounced by Cobden "the most noble contribution made by any modern writer to the cause of peace." His protest against war he repeated frequently in later years.

Sumner had returned from Europe the pet of Boston society, more than welcome in its best circles. His choice of the Fourth of July to advocate peace was the first blow at his popularity. His interest in prisons brought him again into collision with Boston feelings. In 1846 and 1847 there was a warm discussion between Dr. S. G. Howe and Mr. Sumner on one side, advocating the Pennsylvania system, and Hon. S. A. Eliot and others, defending the Massachusetts method. Mr. Sumner's arguments were warmly praised by Tocqueville and others in Europe, but his opposition to the Massachusetts method gave another blow to his home popularity. He had planned a lawyer's life, and his highest ambition was to reach the bench. But when (1845) it was proposed to admit Texas to the Union, he turned to politics, speaking and working against such admission, and protesting against the war with Mexico which followed. When the Whigs nominated Gen. Taylor, a slaveholder, for the Presidency, he quitted the Whig party, joined (June, 1848) the Free-Soil party, which he assisted to form, supported its nominee, Van Buren, for President, was chairman of its State central committee, and took an active part in the canvass. In Oct., 1846, he had refused to be a candidate for Congress, but in Oct., 1848, he consented to stand as the candidate of the Free-Soil party in opposition to Mr. R. C. Winthrop. Although he was defeated, this step gave such serious offence to the circle in which he moved, and to the class from which his professional business was to come, that his fees for legal services thenceforth dwindled to almost nothing, and, with the exception of Longfellow, Prescott, and one or two more, all his old acquaintances closed their doors against him. Pet as he had been in society, and with such promise at the bar, his decided anti slavery position created a resolution to crush him socially and professionally. This hostility pervaded Boston society, her merchants, and the Suffolk bar till the rebellion broke out. Sumner valued his social position very highly. He had not inherited it, but had himself achieved it. It is unspeakably to his credit that when he saw this long-coveted and hardly-earned distinction and all his professional prospects crumbling around him, though too fond perhaps of praise and keenly sensitive to blame, he never retreated an inch or remodelled a phrase to regain his place or conciliate opposition. But from this moment he was recognized as the leader of the young men of the Commonwealth, and hidden in their hearts. No matter that in after years the legislature censured, the press abused, and politicians criticised him. He always had, to the day of his death, the hearty, entire, steadfast, and loving confidence of the young men of Massachusetts. This explains his strength and influence in years when, judging of public opinion by the ordinary signs, he seemed to have lost his hold and to be near defeat. His mistakes were more than forgiven: they never checked for a moment the flow of trustful and loving admiration. Whatever party or leader was arrayed against him was sure to be broken to pieces. This unchanging trust was fully deserved by his honesty of purpose, his unselfishness, and by a life guided by a single eye to the public service. But that in such revolutionary times, and girt with such burning questions, this trust never did falter, is proof of the rare quality of his constituency, and gives fresh faith in republics.

In 1849 he maintained before the supreme court of Massachusetts the unconstitutionality of separate schools for whites and blacks. The decision was against him. In this argument he introduced to English speech the phrase "equality before the law," which he afterward traced (Apr., 1864) to the French constitution of 1793, to Voltaire, and Herodotus, and which is the keynote of many of his later arguments. In 1851, by a coalition between Free-Soilers and Democrats, he was elected Senator of the U. S., the first civil office, and the only one, he ever held. Mr. R. C. Winthrop was the Whig candidate. There were twenty-six ballotings, and the struggle lasted three months. He took his seat Dec. 1, 1851. Remembering the scorn with which Southerners affected to treat his cause and its advocates, he adopted the course of never seeking an introduction to any Senators, but waited till they chose to approach him. At that time an anti-slavery speaker was not considered "respectable" by the Senate. His remarks were not so much heresies as blasphemies. Once in the Senate, the force of his will, the almost entire devotion of his time to one cause, the aggressive attitude he took, and the vigor and ability of his incessant assaults, made him indisputably the leader of the political anti-slavery movement. No other man watched every point so vigilantly, no one suggested so many plans of attack, no man did so much to inform and arouse the public mind, no one enriched the treasury of anti-slavery argument more than he did. From this moment his life becomes in a large sense the history of the anti-slavery cause in Congress. While other members were active and efficient, and in some instances outdid him in the sagacity of their methods, the elaborate finish of his speeches, their vast array of facts and copious illustrations from history and science, created an anti-slavery literature, to which his position in the Senate secured prompt attention. He was equally at home in all parts of the subject, and especially vigilant that each step should be thorough and final. Added to this, the unquestioned honesty and fiery enthusiasm of the speaker compelled attention, while the personal peril which constantly surrounded him created the keenest interest in his course.

In Aug., 1852, he began his Congressional assault on slavery by a masterly argument for the repeal of the Fugitive Slave law, entitled *Freedom National—Slavery Sectional*. This phrase became the watchword of his party, and gives the key to most of his later arguments. In May, 1856, he made one of his ablest speeches, *The Crime against Kansas*, advocating the admission of that State to protect it from slavery. His comments on the conduct of several Senators who had taken a part in the debate, especially Butler of South Carolina, Douglas of Illinois, and Mason of Virginia, and his indignant reply to their personal attacks on himself, led to a scene which Sir G. C. Lewis characterized as "the beginning of civil war." On May 22, 1856, Preston S. Brooks, a nephew of Senator Butler, and one of the Representatives from South Carolina, approached Mr. Sumner while seated at his desk in the Senate chamber engaged in writing, and struck him, without warning, repeatedly over the head with a heavy gutta percha cane. Mr. Sumner, blinded by the blows, strove to rise and free himself from the restraint of the desk. He succeeded in wrenching it from the floor to which it was screwed, but fell unconscious from the repeated blows. Keitt, Douglas, Toombs, and other members of Congress looked on the scene in silence. Mason of Virginia, Jefferson Davis, leading Senators, the Southern press, and some of the Northern, applauded the act. The indignation at the North was wide

and hot, but it shows the lines which bounded his popularity that while Massachusetts and the North generally thrilled with indignation, leading citizens of Boston refused to take part in meetings called to protest, and when Mr. Sumner returned to Boston Nov. 3, 1856, though received by crowds in the streets and by the State authorities, the windows of every house in Beacon street, through which he passed, except those of Prescott and Samuel Appleton, had their blinds closed to show indifference or contempt.

His injuries proved more serious than was at first supposed. Illness detained him nearly four years from his seat, with the exception of one brief attempt in the winter of 1857 and 1858 to attend the Senate sessions, to which he found himself unequal. Two visits to Europe, rest, and the best medical skill of both hemispheres enabled him at last to resume his seat on Dec. 5, 1859. During his illness, on Jan. 13, 1857, he had been elected unanimously by the senate, and almost unanimously by the house of representatives of Massachusetts, to the Senatorship. Again in Jan., 1863, and subsequently in 1869, he was re-elected, passing the last twenty-three years of his life in the Senate.

His attention was by no means given exclusively to slavery. His speeches cover all topics of national importance, and are always able. He took a leading part in all great debates. His speech in Jan., 1862, advocating the surrender of Mason and Slidell, taken from the British mail-steamer Trent, is a masterly exhibition of maritime law, and did much to reconcile the country to that distasteful course. His speech on the Alabama claims in 1869, bitterly offensive to all his English friends and severely criticised by John Bright, was undoubtedly a fair representation of American opinion, and was the basis of final settlement. His addresses on the constitutional law respecting rebel States, on reconstruction, the war powers of the government, international relations, internal improvements, etc., exhaust the subjects of which they treat. His sketches of Story, Allston, Granville Sharpe, Lincoln, and La Fayette show rare powers of portraiture. His articles on *White Slavery in the Barbary States*, *Prophetic Voices concerning America*, and other literary efforts, show good taste, ingenious research, and exact scholarship.

He was among the very first to insist that we should seize the opportunity the rebellion gave not only to fortify the Union, but to abolish slavery, and that abolition was inevitable. He early and constantly urged Lincoln to emancipate by proclamation; so of the enlistment of black troops and the recognition of negro citizenship by an amendment of the Constitution. He maintained that under our Constitution, Congress could give the negro the right to vote; hence he gave no support to the Fifteenth amendment, considering it unnecessary. During the session of 1870 he exerted himself vigorously to defeat Grant's St. Domingo policy, criticised the administration and the President severely on that and other grounds, and protested earnestly against the renomination of Grant, quitting the Republican party, and giving his support to the nomination of Mr. Greeley. His friend, Mr. Motley, had been removed in 1870 from the embassy to London, and now, Feb., 1871, he himself ceased to be chairman of the committee on foreign affairs, a post for which he was eminently fitted, and which he had held since 1861.

Worn down by the labor and excitement of the session, and by a return of the illness which Brooks's assault produced, he again sailed for Europe on Sept. 5, 1872, returning in November. In May, 1872, he had moved in the Senate that the names of victories in our civil war should not be inscribed on our regimental flags. Dec. 2, 1872, the first day of the session, he introduced a similar resolve to the Senate. For this he was censured by the legislature of Massachusetts Dec. 18, 1872. But this was rather a political trick than any real expression of Massachusetts feeling. The censure was rescinded the last month of his life. During this session of 1872–73, and the following one, he gave most of his time to his Civil Rights bill, which puts the negro on the exact level of the white in respect to inns, juries, schools, churches, public conveyances, and all civil privileges. But his health was much broken. An attack of his old malady, agony of the chest, in the Senate Mar. 10, 1874, proved fatal in his own house, Washington, on Mar. 11, 1874. Almost his last words were addressed to Judge Hoar: "Take care of my Civil Rights bill." No American, unless Washington and Lincoln, ever received such respect as was paid Mr. Sumner's memory. Cities and States listened to eloquent eulogies, and highways were crowded for scores of miles by sorrowing men and women as his body was borne from Washington to Mount Auburn, near Boston.

His natural powers were not of the highest order. "Industry was his talisman." By an indomitable will and tireless toil he supplied every deficiency and surmounted every obstacle. He knew how to work, and had, as he said of Story, "the genius for labor." In mind he was more like Story, trained to exhaustive research and clear statement, than like Kent and Marshall, born lawyers. In preparing to write or speak he ransacked libraries, laying under contribution all ages and tongues. Besides Latin and Greek, he read German, Italian, Spanish, and French, and spoke the last with facility. He had read everything and listened to everybody. His memory never lost a phrase or a fact he had once heard, and could always recall it at the right moment. His wealth of illustration was no effort, but the natural action of a full and ready mind. When first in the Senate his speeches were carefully prepared and written out. It took him five or seven years to acquire the power of extemporaneous debate. But to the last he usually wrote out his speeches. It has been generally supposed he was a mere scholar, fit only for investigation or debate. In truth, no man in Congress was more methodical, exact, painstaking, prompt, and efficient in attending to the details of business pertaining to his office. His eloquence belongs to the school of Burke, whom he liked to be thought to resemble, as indeed he did, in features. His speeches had more learning than Burke cared to show, but in wealth of illustration, gorgeous rhetoric, lofty tone, and a "gigantic morality which treads all sophistry under foot," the resemblance was close. His real power lay in the sincerity and fiery enthusiasm of the speaker, whose whole soul freighted his words, and in the fact that there was "always a man behind the speech." The massive grandeur of his presence and the dignity of his bearing added largely to the effect of his speech. He had no drop of bitterness in his nature; and no matter how angry the debate, he was the last man to be stirred to any discourtesy. Constantly and malignantly abused, neither in private nor in public could be detected the slightest personal animosity toward any one. Hardly a line that stirs a smile can be found in his speeches, though he enjoyed humor in others. A serious purpose or a lofty indignation writes every word. The imperiousness in debate sometimes charged on him grew out of a nature conscious of its own purity of purpose, terribly in earnest, that would never condescend to trifling, and could not understand it, or from a conscientiousness which had faithfully prepared itself for the discussion by gathering all the help human learning and the most diligent thought could give, and was naturally impatient when superficial opinions, borrowed from a morning-newspaper article, presumed to claim as much influence as his carefully-educated judgment. His alleged want of tact was sometimes a real defect, but it was oftener an unwillingness to compromise absolute justice, and especially in revolutionary times, when compromise is equally out of place and useless.

"History will lay bare no secret that will tarnish the whiteness of his fame." The fact that corruption did not dare even to approach him—"the whitest soul" R. W. Emerson "ever knew"—is proved by the simplicity of the remark Judge Hoar ascribes to him: "People talk about the corruption of Washington: I have lived here all these years, and have seen nothing of it." Though he loved the luxuries of life, money had no temptation for him. He did not know what fear was. Alone in Baltimore on Apr. 18, 1861, he yielded no inch to that mob which the day after shot down the Massachusetts troops. For ten years he walked Washington streets, his life constantly threatened, and well knowing that if a fanatic's or drunkard's hand took his life the assassin would not only be sheltered by the power of ten States, but petted and applauded as a champion. When he entered the Senate, free speech could not be said to exist there. To him, as much as to any man, was due the breaking of that chain. Mr. Sumner was exact in all etiquette, careful in dress, fond of society, easy of access, and had always time for every comer, his hours of study running to midnight and long after. His manner was always courteous, but in his last years had a marked tenderness. To the very last day of his life he was a loving student of the classics of all languages; a "bite of the classics" being his preparation for bed somewhere about two or three o'clock in the morning. He cultivated art, and was a diligent collector of autographs, pictures, rare books, bronzes, and other objects of *virtu*, most of which he bequeathed to the Art Museum of Boston and to Harvard College. To the college library he also gave one-half of his estate. He was married Oct. 17, 1866, to Alice (Mason) Hooper, widow of W. S. Hooper of Boston. They separated very soon, and he was divorced May 10, 1873.

Eleven volumes of his works, with copious notes, have been published under his own supervision (Boston); four more, with a memoir, are expected.

His life may be best summed up in the remark Tocqueville made to him, and which he loved to repeat: "Life is neither a pain nor a pleasure, but serious business, which it is our duty to carry through and conclude with honor."

WENDELL PHILLIPS.

Sumner (Charles Pinckney). See Sumner (Charles).

Sumner (Charles Richard), D. D., b. at Kenilworth, Warwickshire, in 1790; educated at Eton and Cambridge; entered holy orders; became rector of Abingdon, and librarian and historiographer to George IV.; was made prebendary of Worcester in 1822 and of Canterbury in 1825; dean of St. Paul's, prebendary of London, and bishop of Llandaff, all in Apr., 1826; in 1827 was transferred to the more important see of Winchester, which he resigned in 1869 on account of the infirmities of age. He published *Prælectiones Academicæ Oxon. habitæ* and the *Ministerial Character of Christ* (1821), besides several *Charges*, and discovered and translated the long-lost Latin manuscript of Milton, *De Doctrina Christiana* (1827), which gave occasion to Macaulay's brilliant essay on Milton. He was a brother of John Bird Sumner, archbishop of Canterbury. D. Aug. 15, 1874.

Sumner (Edwin Vose), b. in Boston, Mass., in Jan., 1796, where educated; was employed principally in the Indian country until 1846; served during the Mexican war, leading the charge at Cerro Gordo, where severely wounded (brevetted lieutenant-colonel for gallantry), and at Molino del Rey commanded the cavalry, which held in check that of the enemy, for which he was brevetted colonel; was governor of New Mexico 1851–53; in 1857 made a successful expedition against the Cheyennes; in Mar., 1861, appointed brigadier-general in the army in the place of Twiggs, and succeeded A. S. Johnston in command of the Pacific department; recalled to the East, commanded the 1st corps of the Army of the Potomac throughout the Virginia Peninsular campaign of 1862, being twice wounded; appointed major-general of volunteers July 11, 1862, and commanded the 2d corps; also commanded at Fredericksburg Dec. 13, 1862; at his own request was relieved Jan. 25, 1863, and in March ordered to command of the department of the Missouri, but on his way thither was taken ill, and died Mar. 21, 1863, at Syracuse, N. Y.

Sumner (George), brother of Charles, b. in Boston Feb. 5, 1817; studied at Heidelberg and Berlin; travelled extensively in Europe, Asia, and Africa, studying public and international law, and the manners, customs, institutions, and philanthropic organizations of the various peoples, and was often consulted by foreign governments upon points of political economy. To him and Dr. S. G. Howe is especially due the establishment in this country of schools for idiots. He was an accomplished scholar; contributed largely to European and American reviews; lectured extensively in the U. S. on philanthropic topics, and published several valuable addresses and pamphlets, among which are—*Memoirs of the Pilgrims at Leyden* (1845), *The Pennsylvania System of Prison Discipline* (1847), *The Progress of Reform in France* (1853), and an *Oration delivered before the Municipal Authorities of Boston* (1859). D. in Boston Oct. 6, 1863.

Sumner (G. W.), U. S. N., b. Dec. 31, 1841, in Michigan; graduated at the Naval Academy in 1861; became lieutenant in 1862, lieutenant-commander in 1866; served in the mortar flotilla at the bombardment of Forts Jackson and St. Philip and the Vicksburg batteries in 1862, and handsomely mentioned in Lieut.-Com. J. M. Wainwright's official report of Apr. 25, 1862. Foxhall A. Parker.

Sumner (Increase), LL.D., b. at Roxbury, Mass., Nov. 27, 1746; was admitted to the bar in 1770, and commenced practice in his native town: was representative in the legislature 1776–80, State senator 1780–82, associate judge of the supreme court 1782–97, governor of Massachusetts 1797–99, and in 1789 member of the convention for the adoption of the U. S. Constitution. D. June 7, 1799.

Sumner (John Bird), D. D., b. at Kenilworth, Warwickshire, in 1780, of a clerical family, his grandfather having been provost of King's College, his father vicar of Kenilworth, and his younger brother bishop of Winchester; was educated at Eton and at Cambridge, where he took high honors; entered holy orders; became rector of Mapledurham, canon of Durham in 1820, bishop of Chester in 1828, and archbishop of Canterbury and primate of all England in 1848. Besides several volumes of sermons and a number of charges, he published *Essays tending to show that the Prophecies now accomplishing are an Evidence of the Truth of the Christian Religion*, being the Hulse prize essay (1802), *Treatise on the Records of Creation*, which received the Burnet prize of £400 (1816), *The Evidence of Christianity* (1824), *Practical Expositions in the Form of Lectures upon the Gospels and Epistles* (8 vols., 1831–40), and *Practical Reflections* (1859). D. in London Sept. 6, 1862.

Sumner (William Graham), b. at Paterson, N. J., Oct. 30, 1840; prepared for college at the Hartford (Conn.) grammar school; graduated at Yale College 1863; travelled in Europe, residing at Geneva during the winter of 1863–64; studied philosophy at the University of Göttingen 1864–66, and at Oxford, England; was tutor in Yale College 1866–69; took orders in the Protestant Episcopal Church Dec. 29, 1867; was for a time assistant minister of Calvary church, New York; appointed professor of political and social science at Yale College 1872. Author of a *History of American Currency* (1874).

Sumner (William Hyslop), son of Increase, b. in Dorchester, Mass., July 4, 1780; graduated at Harvard College in 1799; was admitted to the bar 1802; member of the State legislature 1808–19; adjutant-general 1818–34. He published *Inquiry into the Importance of the Militia* (1823), *Reminiscences* (1854), *Memoir of Increase Sumner, Governor of Massachusetts* (1854), and *History of East Boston* (1858). D. at Jamaica Plains, Mass., Oct. 24, 1861.

Sump'ter, tp., Cumberland co., Ill. P. 1751.

Sumpter, tp., Wayne co., Mich. P. 1106.

Sumpter, p.-v., Trinity co., Tex. P. 145.

Sumpt'uary Laws are laws to restrict the expenses of citizens within defined limits. They have respect to certain articles of consumption and to the general style of living. Such laws involve always an abridgment of individual liberty and of the natural right of every man to do what he will with his own, provided he works no wrong or ill to his neighbor. They involve the assumption that a government, in the exercise of its paternal authority over its subjects, can judge better than themselves what will best subserve their welfare in the use of what they have. The wasteful extravagance apparent in every community seems to call for the interposition of government to curb the lavish outlays for dress, diet, equipage, etc. Hence, such laws are found on the statute books of almost all nations. Under an aristocratic organization of society such enactments have been made in part for the purpose of maintaining class distinctions, certain features of dress and style being made the symbol of rank. This legislation has, however, almost entirely failed of its object, because it is so easily evaded, and because the laws are so directly at variance with men's common sense of right. This actual experience, and a better understanding of the true functions of government, have led to the abandonment, in modern times, of all sumptuary laws properly so called. Some laws for the regulation of public morals are demanded for the general good. The public liberty in this light may require some limitation of personal rights. For this end, it is both legitimate and wise to restrict the sale and the use of articles which cause disease, pauperism, and misery, and so increase the burdens of a whole community. Yet even for this object laws are found to be of little avail, except as they are sustained by a prevalent public sentiment and usage. A. L. Chapin.

Sum'ter, county of W. Alabama, bordering on Mississippi, drained by Tombigbee and Noxubee rivers, and intersected by Alabama and Chattanooga and a branch of Mobile and Ohio R. Rs. It has an uneven surface and fertile soil. Staples, Indian corn, wheat, and cotton. Cap. Livingston. Area, about 800 sq. m. P. 24,109.

Sumter, county of Central Florida, lying E. of Withlacoochee River. The surface is often swampy, and there are several small lakes. There are many swine and large herds of cattle. Staples, sweet potatoes, Indian corn, and some cotton. Cap. Leesburg. Area, 1370 sq. m. P. 2952.

Sumter, county of S. W. Georgia, lying W. of Flint River, and traversed by South-western R. R. It has a level surface and fertile soil. Staples, cotton, Indian corn, and sweet potatoes. Cap. Americus. Area, 600 sq. m. P. 16,559.

Sumter, county of E. South Carolina, bounded W. by Wateree River, drained by Black River and its branches, and traversed by Wilmington Columbia and Augusta R. R. The surface is generally undulating, with extensive pine forests. Staples, cotton, Indian corn, rice, lumber, tar, pitch, and turpentine. Cap. Sumter, or Sumter Courthouse. Area, about 900 sq. m. P. 25,268.

Sumter, tp., McLeod co., Minn. P. 315.

Sumter, p.-v. and tp., cap. of Sumter co., S. C., on Wilmington Columbia and Augusta R. R., 145 miles from the former place, contains 8 churches (3 colored), 2 female academies, 3 public schools, an opera-house, 2 newspapers, and a cotton-factory. About 10,000 bales of cotton are shipped annually from this place. P. of v. 1807; of tp. 3659. Darr & Osteen, Props. "True Southron."

Sumter, tp., Williamsburg co., S. C. P. 1679.

Sumter, tp., Sauk co., Wis. P. 847.

Sumter (Thomas), b. in Virginia in 1734; removed in early life to South Carolina; participated in the Cherokee war, and was a prominent actor in the events which preceded the Revolution; was appointed lieutenant-colonel of the 2d regiment of riflemen in Mar., 1776, of which he became colonel; served in the interior of the State until

the fall of Charleston; went to North Carolina and raised a large force, with which he defeated (July 12, 1780) a force of British and Tories; made an unsuccessful attack on the post at Rocky Mount Aug. 1, but Aug. 6 he defeated and routed the Prince of Wales regiment at Hanging Rock, and dispersed a large body of Tories; captured a valuable convoy Aug. 16, but was in turn defeated and routed by Tarleton on the 18th at Fishing Creek; a few days later was again in the field at the head of a considerable force, with which he scoured the country; gained a victory at Broad River Nov. 12, and on the 20th defeated Tarleton at Blackstocks, and was severely wounded; had previously been appointed brigadier-general of South Carolina militia, and Congress in Jan., 1781, passed a vote of thanks for his eminent services; in February was again in the field, and the following month, having raised three regiments of rangers, co-operated with Marion, Pickens, and other partisan leaders; was member of the convention which adopted the Federal Constitution; was member of Congress 1789–93 and 1797–1802, U. S. Senator 1801–10, and U. S. minister to Brazil 1809–11. D. at South Mount, near Camden, S. C., June 1, 1832.

Sumter, Fort. See Fort Sumter.

Sum′terville, p.-v. and tp., Sumter co., Ala. P. 1577.

Sun [Ang.-Sax. *sunna*]. The sun is the centre of the solar system, controls by its attraction the motions of the planets, and by its heat is the prime mover and maintainer of all activity upon their surfaces. Hence it has always been to astronomers a subject of earnest and careful study, never more so than at present, and to mankind in general an object of admiration, and sometimes, as with the Peruvians and ancient Persians, of worship. The principal numerical facts relating to it are the following:

Mean equatorial horizontal parallax	8.86″ ± 0.05″
Mean distance from the earth, miles	92,260,000 ± 500,000
Difference between greatest and least distance, miles	3,100,000
Mean apparent diameter	32′ 3.6″
Diameter in miles	860,000
Diameter (earth's taken as unity)	108.7
Mass, " " "	320,000
Density, " " "	$\frac{1}{4}$
Specific gravity	1.42
Force of gravity at sun's surface (earth's as 1)	27.1
Inclination of sun's equator to the ecliptic	7° 15′
Longitude of node of sun's equator	73° 57′
Mean time of rotation on its axis	25.38*d.*

Radiation of heat per second, sufficient to melt 287,200,000 cubic miles of ice.

Nearly all the above given data depend upon the first as a foundation, and since the parallax, as at present known, is itself subject to a probable error of at least $\frac{1}{200}$th of its whole amount, a corresponding uncertainty affects all the rest.

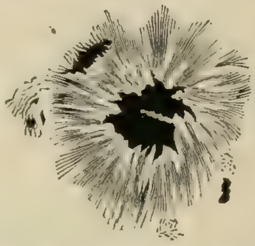
The problem of the solar parallax is accessible by many different methods, each of course liable to its own peculiar difficulties. The following are the principal ones hitherto employed: (1) Observations of the transits of Venus; (2) observations of the oppositions of Mars; (3) calculation from lunar irregularities; (4) experimental measurements of the velocity of light, combined with observations of the eclipses of Jupiter's satellites; (5) calculations based on the secular perturbations of the orbits of the planets. Of these, the first is considered capable of giving the most precise results, and hence the greatest interest was felt in the transit of 1874 and in the approaching one of 1882, and very extensive preparations were made for the observation of the first with all the accuracy and completeness possible in the present state of science. The reduction of the observations is now (1876) in process, and will require not less than another year. It is confidently expected that as a result the margin of error will be reduced at least one-half. From the transits of 1761 and 1769, Encke in 1824 deduced for the parallax of the sun 8.58″, corresponding to a distance of a little more than 95,000,000 miles; and this value remained generally accepted until about fifteen years ago, when the evidence of its incorrectness became overwhelming. Grave doubts were first suggested by Foucault's experiments on the velocity of light in 1852; and these were greatly strengthened by Hansen's investigations on the moon's motions, made public in 1853. Within a very few years after this, the researches of Powalky in Germany, Stone in England, Leverrier in France, and Newcomb in this country settled the matter completely.

A good deal has been said by some who do not very well understand the limits of astronomical accuracy about this long-standing error of 3,000,000 miles in the sun's distance. The remark of Sir John Herschel is in point: "The recent correction of the solar parallax corresponds to the apparent breadth of a human hair at a distance of 125 feet; . . . and moreover *the error has been detected and the correction applied*, and the detection and correction have originated with the friends and not with the enemies of science."

The distance of the sun, 92,000,000 miles, is so great that a railroad train travelling without stops at the rate of 40 miles an hour would require 263 years to accomplish it. Sound, moving with the same velocity as on the earth, would be fourteen years on the way.

When examined by the telescope (which requires for the purpose an eyepiece so constructed that most of the light is rejected, while only a small percentage is sent to the eye) the surface of the sun presents a peculiar curdled or mottled appearance, much like that of coarse-grained drawing-paper. Near the edge the disk is noticeably darker than at the centre, and is marked here and there with long, irregular streaks of light, called faculæ, which closely resemble the flecks of foam floating on the surface of an eddy below a cascade. But the most striking objects are the *spots*, of which there are usually several visible at once. Fig. 1 gives a very good idea of their general appearance. They consist of a nearly black central portion, called the nucleus or umbra, of irregular form, and around it a fringe less deeply dark, called the penumbra. In magnitude they vary greatly, from minute black pores to blotches which are even visible to the naked eye and have a diameter of nearly 100,000 miles. They generally go in groups, and are distributed in two zones upon the solar surface, on each side of the equator and parallel to it, being seldom found very near the equator itself, and almost never as distant from it as 40° of solar latitude. Their forms and dimensions are no more permanent than those of our clouds, but are continually changing, old spots closing up and disappearing, while new ones break out to take their place. One group maintained its existence for eighteen months in 1840–41, but this is extreme: many last only a few days. The changes of form and appearance which they undergo when they approach the edge of the disk prove them to be *hollows* in the luminous surface of the sun, and the spectroscopic phenomena show that these hollows are filled with dense light-absorbing gases and vapors. Their depth appears to be somewhere between 3000 and 10,000 miles, at least usually. By watching them we are able to ascertain the period of the sun's rotation and the position of its equator as given in the table of numerical data. But it is a most important fact that they show the surface of the sun to move, not like that of a solid globe, but in such a way that while near the equator the time of rotation slightly exceeds 25 days, at a solar latitude of 44° it is 28 days. The formula which Faye gives to express the velocity of the rotation at any latitude is $R = 862' - 186' \sin^2 l$, where R is the daily angular motion, and l the solar latitude in question. No satisfactory explanation of this peculiar law of rotation has yet been reached, and it is at present one of the most fundamental and important of all the problems of solar physics. Besides this systematic difference between the velocities of spots according to their distance from the equator, it is also found that they have proper motions of their own. Any great change in magnitude or form, especially any separation into two or more, is generally accompanied by a sudden forward movement in the direction of the sun's rotation.

Fig. 1.



But the most singular fact about the spots remains to be stated. Their number is periodically variable, the periodicity being somewhat irregular, but the time not differing much from eleven years. This discovery was first announced by Schwabe in 1851, and has since been abundantly verified. The number of different spot-groups observed during a year sometimes rises as high as 350, or nearly one new one every day, and sometimes falls as low as 24, or only two a month. 1828, 1837, 1848, 1860, and 1871 were years of spot-maximum; equally-marked minima occurred in 1833, 1844, 1855, and 1867. It is found that, during the years of maximum, the magnetic disturbances on the earth are also at a maximum, and *vice versâ*. Very recently also Hornstein announces a variation in the average *height of the barometer* and its daily range following the same law, and Meldrum, Lockyer, and Symons think they find a relation between the annual amount of *rainfall* on the earth's surface and the number of the spots; the rainfall, according to their calculations, being some 20 per cent. greater during the years of spot-maximum than at the minimum. Jelinek, however, denies this as the result of his investigations, and the fact can by no means be regarded as established.

As to the constitution of the sun, and the cause and nature of the spots, opinion is still much divided. The small

specific gravity of the whole mass, however, is greatly in favor of the present prevailing doctrine that the sun is mainly gaseous, but covered by a sort of luminous shell of cloud formed by the precipitation of the vapors which are cooled by external radiation. According to this view—of which Faye claims to be the originator and is the main defender—the central core of the sun is only feebly luminous because purely gaseous, while the dazzling surface, or *photosphere*, as it is called, owes its brilliance to the minute liquid incandescent particles which result from condensation. The spots are supposed to be cavities in this cloud-layer, which according to Faye are caused, like eddies in a river, by the unequal velocities of neighboring portions of the photosphere, resulting from the peculiar law of the sun's rotation which has been already stated. These eddies, Faye supposes, would form funnel-shaped hollows into which the cooler overlying atmosphere—of which more anon—would settle, and by its absorption produce the observed darkening. According to this view, of course the spots ought to be nearly round, and to exhibit a marked gyratory movement, which, unfortunately, is seldom the case. And yet no other theory seems to be on the whole more satisfactory, or even as much so. Secchi maintained for a time that they were openings formed by explosions from below, a view much resembling that proposed by Herschel long ago; and Zöllner, who, however, considers the body of the sun to be *liquid*, sees in them slags or scoriæ floating on a molten surface and surrounded by clouds; and Vicaire substantially agrees with him. As matters stand, it must be admitted that no theory yet proposed meets all the conditions.

As to the periodicity of the spots, Carrington and De la Rue consider that their observations show a connection between the positions of the planets and the number of spots: this, however, remains very doubtful, and it is difficult to imagine what can be the bond of connection.

The amount of heat radiated by the sun per minute admits of pretty accurate measurement, and was determined many years ago by Pouillet and Sir John Herschel, whose results have since been verified and slightly corrected. It is found that the sun's radiation would melt a shell of ice covering its own surface to a depth of between 39 and 40 feet in one minute of time. This, however, gives us no knowledge of the *temperature* of the solar surface, which as yet is entirely undetermined, and probably undeterminable, for there is no reason whatever to assume that it is anything like uniform throughout. At any rate, the estimates of different authorities are discrepant. Secchi sets it at 20,000,000° F., Ericsson at 7,000,000, Zöllner as 60,000, and Vicaire at 4000 to 6000, and Violle, the most recent and thorough investigator of the subject, agrees with him. The temperature and amount of radiation have not materially changed for the last 2000 years, as evidenced by terrestrial climatology. According to Faye, the expenditure of heat is supplied by the passing of portions of its mass from the gaseous state to the liquid or solid, with a corresponding diminution in its bulk. A contraction of about 125 feet per year in the solar radius would satisfactorily account for the whole.

The photosphere is overlaid by an atmosphere containing in its lower regions nearly all the materials which enter into the composition of the sun, while higher up the lighter gases alone prevail, the distribution not following, however, the laws of gases in equilibrium, but being largely dependent on dynamical actions. This atmosphere is of course invisible under ordinary circumstances, but reveals itself to the spectroscope, and at an eclipse forms the so-called *corona*, the most beautiful of all the spectacles ever seen in the heavens.

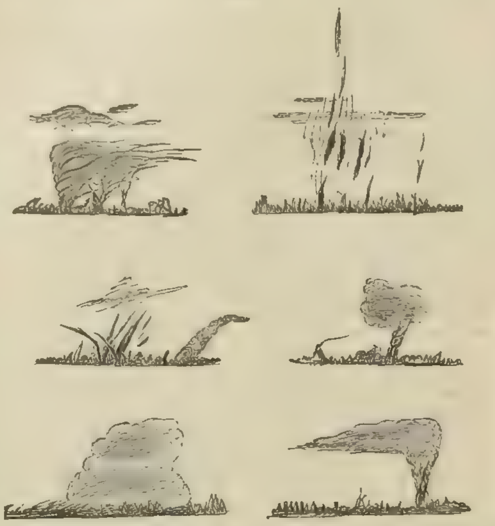
As every one now knows, the spectrum of sunlight is a continuous band of color crossed by numerous black lines, which are especially crowded and intense in the indigo and violet. The cause of these lines remained a mystery until, in 1859, Kirchhoff explained it by showing that they are due to the filtration, so to speak, of the light from the photosphere through an atmosphere containing metallic vapors. He showed that while such a vapor by itself would give a characteristic spectrum of bright lines, this spectrum would be *reversed*, and show itself as a spectrum of black lines, whenever a light of sufficient intensity was made to traverse the vapor from behind. Thus, in the lines of the spectrum is found certain proof of the existence in the solar atmosphere of the following substances—viz. iron, titanium, calcium, manganese, nickel, cobalt, chromium, barium, sodium, magnesium, copper, hydrogen, zinc, sulphur, cerium, strontium, and potassium. The portion of the solar atmosphere containing these substances, at least in quantity and condition to be accessible to spectroscopic observation, does not extend more than from 500 to 1500 miles above the photosphere. For a few moments at an eclipse, when the last segment of the sun has just vanished, the spectrum of this lower atmosphere becomes visible: the lines, which we are accustomed to see intensely black, flash out brilliant with color, and then as the moon moves on fade rapidly away, enduring only for two or three seconds.

During an eclipse also certain other very beautiful and singular appearances present themselves. Hanging on the edge of the moon there are usually several rose-colored "prominences" or "protuberances," to use the non-committal names by which they were first described in 1842. After their nature had been long debated, the spectroscope was applied to them in 1868, and at once showed them to be great clouds or flames (mainly composed of hydrogen, though also containing other elements) which seem to float above the sun in some upper atmosphere like our terrestrial clouds. Immediately afterward, almost simultaneously, but independently, Janssen and Lockyer made their elegant discovery, that with the spectroscope these objects can be observed without an eclipse, and Lockyer showed them to be mere extensions of a stratum of incandescent hydrogen which overlies the photosphere and atmosphere of metallic vapors. To this rose-colored stratum, whose existence, however, had been recognized before by Arago, Grant, and others, he gave the name of "chromosphere." As seen with the spectroscope, it is found to have an average depth of from 3000 to 8000 miles, but its upper surface, though well defined, is exceedingly irregular, resembling a sheet of flame tormented and driven by the wind. It seems to be not a continuous *layer* of gas, but rather to be made up of countless jets and flames, expelled through spiracles and vents in the photosphere. Its spectrum shows, besides the four bright lines of hydrogen, a brilliant line of unknown origin in the yellow, designated as D_3 from its being very near to the so-called D lines of sodium, but a little more refrangible: also a line about two thirds of the way from F toward G, which Lorenzoni has called *f*, and which coincides with one of the lines of cerium, and a seventh faint line of unknown origin about one-third of the way from *a* (not A) toward B. In addition to these seven lines, those of magnesium, sodium, barium, and many others are *generally* present, and at times the number becomes very great. The writer has published a catalogue of 273. The protuberances are mere extensions of this chromosphere: here and there, especially in the neighborhood of spots, the chromospheric jets ascend to a great altitude, and the incandescent hydrogen spreads out into enormous clouds, of forms as beautiful, varied, and changeable as those to which we are accustomed in our terrestrial sky. It is customary to distinguish them into two classes, the cloud-formed and the eruptive. The former are comparatively permanent, floating often for days over the same region, usually connected by slender filaments to the chromosphere below, but sometimes free; generally cirrous in their texture, but sometimes rounded in outline like a cumulus. They are often enormous in their dimensions, attaining altitudes of from 30,000 to 100,000 miles, and a horizontal extent twice as great. They are found alike in the polar and equatorial regions, and seem generally to indicate comparative quiet in that portion of the solar atmosphere where they happen to be lying. The eruptive prominences, on the other hand, are generally composed of comparatively short and nearly vertical jets and filaments, of vivid brightness, and the most vivacious instability of form and motion. Velocities of 20, 50, and even 200 miles per second are often observed. These phenomena are especially common *around* (not *in*) the spots. When a spot approaches the limb of the sun, the whole neighboring region is usually found to be alive with jets and eruptions. Faye accounts for this by supposing that the chromospheric hydrogen is sucked down by the vortex which he considers to constitute the nucleus of the spot, and then being liberated rises from below through the photosphere immediately surrounding. Directly over the centre of the spot, according to Respighi, the chromosphere is somewhat depressed, but Secchi denies this. The changes in the appearance of the eruptive prominences are exceedingly rapid. They have been known to attain an elevation of 200,000 miles in twenty minutes of time, and then entirely disappear within half an hour. Fig. 2 illustrates some of the different prevailing forms.

The corona with which the sun is surrounded during a total eclipse was long a subject of hot dispute. Its appearance is much like the "glory" with which the old painters encircled the heads of saints. Close to the sun is a ring of pearl-colored dazzling light, which rapidly decreases in brightness as the distance from the sun increases, and assumes a distinctly radiated structure. Its rays, with here and there distinct dark gaps between them, extend to a distance equalling the radius of the sun, and sometimes its diameter, and are terminated by an irregular outline somewhat star-like in form, having from four to six points, but not symmetrically placed. Some held that it was caused

by the action of a lunar atmosphere, long since, however, proved not to exist, at least in extent and quantity to account for the observed appearances. Others, and notably

Fig. 2.



Mr. Lockyer, contended almost obstinately that it was mainly if not wholly a phenomenon of our own atmosphere, being led to this belief by the fact that the appearance of the F line in the spectrum of the chromosphere shows that at the surface of the sun the pressure of the solar atmosphere is very small (not more than three or four inches of mercury). It is of course a natural inference that the solar atmosphere cannot be very extensive; and yet it is a mistaken conclusion. Whether the smallness of the pressure exerted by the "coronal atmosphere," as Janssen calls it, upon the underlying strata is due to its intrinsic and almost inconceivable rarity, like that of comets' tails, or whether it is due to the possible fact that its particles do not rest at all upon what is below them, but are flying out into space, repelled by some unknown force, or whether the difficulty is to be removed by some as yet unimagined explanation, is not certain; but that this "coronal atmosphere" exists, and is the principal cause of the phenomena described, is beyond doubt. Its existence was first demonstrated by the observations of Prof. Harkness and the writer at the eclipse of 1869, when they found the spectrum of the corona to be characterized by a bright line in the green, at 1474 of Kirchhoff's scale. The observation, conclusive if correct, was for a time discredited in some quarters, but was fully confirmed at the eclipse of 1870; and in 1871, photography finally, and to the satisfaction of all, completely settled the matter by showing the identity in extent and details of the phenomena visible at stations many hundred miles apart along the track of the shadow. Of what material this coronal atmosphere is composed is still uncertain. The line 1474, with an ordinary spectroscope, appears to coincide exactly with a line in the spectrum of iron; but with a powerful diffraction spectroscope the writer has recently found that the corresponding dark line in the ordinary solar spectrum is *double*, the less refrangible component being due to iron, while the other, which is the true corona line, is probably due to some as yet unknown substance as much rarer than hydrogen as that is lighter than anything else with which we are acquainted. The real nature of the corona, and the causes of its peculiar configurations and structure, remain a problem as yet unsolved; we have, apparently, somewhat analogous phenomena in our own terrestrial aurora borealis and in those presented by the tails of comets, but whether the resemblances are based on any substantial identities is yet to be determined.

In preparing this article continual reference has been made to Proctor's *The Sun Ruler of the Planetary System*, and to Secchi's *Le Soleil* and its German translation by Schellen, which contains in an appendix a very complete account of the bibliography of the subject. To these works the reader is referred for completer information, and to the papers by Faye, Secchi, Vicaire, and others which have appeared in recent numbers of the *Comptes Rendus* of the French Academy, as also those in the *Astronomische Nachrichten* by Spörer, Zöllner, and Wolf. C. A. Young.

Sun'apee, p.-v. and tp., Sullivan co., N. H. P. 808.

Sun'-Birds, the Promeropidæ, a family of small, brilliantly-colored, slender-billed birds, found in the Old World, and chiefly in hot countries. They represent the humming-birds of the New World, and some of them approach quite near the humming-birds in appearance and habits.

Sun'bury, county of New Brunswick, Canada, bisected by the navigable river St. John. Area, about 1000 sq. m. It is level, densely timbered, and in some parts very fertile. Cap. Oromocto. P. 6824.

Sunbury, tp., Livingston co., Ill. P. 891.

Sunbury, p.-v., Berkshire tp., Delaware co., O., on Cleveland Mount Vernon and Columbus R. R., has 1 weekly newspaper. P. 236.

Sunbury, v., Clay tp., Butler co., Pa. P. 216.

Sunbury, p.-b., cap. of Northumberland co., Pa., on Philadelphia and Erie, Northern Central, Shamokin Valley, Sunbury and Lewistown, and Danville Hazleton and Wilkesbarre R. Rs., 53 miles N. of Harrisburg, contains several churches, good schools, 1 bank, 1 daily and 3 weekly newspapers, 2 planing and saw mills, fine hotels, and the repair-shops of the Philadelphia and Erie R. R. P. 3131.

J. E. Eichholtz, Ed. "Democrat and Daily."

Sun'cook, p.-v., Pembroke tp., Merrimack co., N. H., at confluence of Suncook and Merrimack rivers, and at junction of Suncook Valley with Concord R. R. of New Hampshire.

Sun'da Islands is the common name of that chain of large islands belonging to the Malay Archipelago which, commencing with Sumatra and ending with Timor, separates the Java Sea from the Indian Ocean.

Sun'day [Sax. *Sunnan dæg*; Lat. *Dies solis*; in Sanskrit and other languages of India the name of the first day of the week has the same signification], the secular name of the first day of the week, which is held among Christians as a Sabbath or rest-day and in remembrance of Christ's resurrection. As soon as the Christian religion came to be recognized by the state, laws were enacted for the observance of the Sunday. Constantine (321) prohibited all business except agricultural labor, and all legal proceedings except the manumission of slaves. Subsequent emperors made similar enactments. Theodosius II. (425) forbade games and theatrical exhibitions on Sunday (*Cod. Theod.*, xv. tit. 7). The most strict of these laws is that of Leo and Anthemius (469, *Cod. Justin.*, iii. tit. 12). The laws of Theodoric the Great, several kings of France, and especially Charlemagne (813), prohibited servile work and secular business.

In England, Sunday laws were of very early origin. The common law distinguished Sunday from other days by allowing no judicial acts on that day, according to the maxim, *Dies dominicus non est juridicus.* The code of Ina, king of the West Saxons (about 693), punished servile work by fine. Alfred the Great (876) forbade work, traffic, and legal proceedings on Sunday. Similar laws were in force through all the Saxon period, and were often enacted in subsequent reigns. The statute 27 Hen. IV. c. 5 enacts that all fairs and markets on Sundays, except in harvest, shall cease on pain of forfeiture of goods. The statute 5 and 6 Edw. VI. c. 3 makes Sundays, with Christmas, Easter, etc., holy days, but permits work in harvest and in other cases of need. The statute 1 Eliz. c. 2 punishes by fine persons absenting themselves from church without excuse. In 1618, James I. issued his *Book of Sports*, in which he declares certain games, sports, etc. lawful on Sundays after divine service. Charles I. in 1638 reissued the *Book of Sports.* The most important of the English statutes is 29 Chas. II. c. 7, which prohibits all worldly labor or business (works of necessity and charity only excepted), the sale of goods, travelling for purposes of trade, and the serving or executing of any process or warrant, except in case of treason, felony, or breach of peace. The dressing of meat in families, and its sale in inns and eating-shops, and the crying of milk before nine and after four, are allowed. This statute, somewhat modified by subsequent laws, is the present Sunday law of England, and lies at the basis of the Sunday laws of this country.

In France, during the Revolution, when the Christian calendar was abolished and the decade substituted for the week, each tenth day was made a rest-day, and its observance was enforced by a law (17 Thermidor, An. VI.) which required the public offices, schools, workshops, stores, etc. to be closed, and prohibited sales except of eatables and medicines, and public labor except in the country during seed-time and harvest. On the restoration of the Gregorian calendar, Sunday was recognized in the *Code Napoléon* (Art. 25, 260). A law of 18 Nov., 1814, prohibited ordinary labor, traffic, etc., and, though declared by the courts in 1838 and 1845 to be still in force, it has been for many years a dead letter. In Switzerland, recent legislation has granted to railway employés and all government office-holders the concession of at least one Sunday in every three. In some of the cantons steps have been taken for

the further restriction of Sunday labor. The question is agitated in Belgium and Germany of better protection by law of Sunday-rest for operatives.

The early American colonists brought with them the observance of Sunday, both as a religious and as a civil institution, and both the religious and secular observance of the day was enforced by laws similar to the English statutes, though modified by the popular feelings and modes of life. The early laws of Massachusetts, Connecticut, Georgia, South Carolina, and Virginia compelled attendance at church, the Massachusetts law (1782) providing that such attendance was not required where there was no place of worship which the person could conscientiously attend. (The oft-quoted "Blue Laws" of Connecticut are a pure fiction, first published in London in 1781 by Samuel Peters in revenge for being driven from the colony on account of his obnoxious royalism.) After the establishment of the Federal government, as the separation between Church and State came to be more fully understood and carried out, the earlier Sunday laws were modified in conformity with this principle, and the legislatures and courts have been careful to distinguish between Sunday observance as a religious and as a civil institution, and to enforce only the latter. The existing Sunday laws rest chiefly upon the following grounds: The right of all classes, so far as practicable, to rest one day in seven; the right to undisturbed worship on the day set apart for this purpose by the great majority of the people; the decent respect which should be paid to the religious institutions of the people; the value to the state itself of the Sunday observance as a means of that popular intelligence and morality on which free institutions are conditioned. Sunday laws exist in every State of the Union, with the partial exception of Louisiana, which at the time of its admission was inhabited by persons of French descent, with laws and usages differing from those of the other States, where the Anglo-Saxon element predominated. The Federal Constitution provides that Sunday shall not be reckoned in the ten days within which the President may return any bill; the Federal courts and the offices of the departments are closed; the service of the post-offices is restricted; no session of Congress is held, and provision is made by act of Congress for the observance of Sunday in the army and navy. Beyond this, Sunday legislation does not come within the sphere of the Federal government. The statutes of the States differ somewhat in details and strictness. Sunday is everywhere held as a *dies non*. Public affairs are suspended; the legislatures do not sit; courts are not held, except that in some cities police courts are open for an hour or two; legal processes are not served. In most of the States common labor and traffic are prohibited; contracts made or for service on Sunday are invalid; public amusements are restricted or forbidden. In many of the States exception is made in favor of those who observe the seventh day of the week. In Louisiana the only Sunday law is that which makes it (with Christmas, New Year's Day, etc.) a public rest-day, and provides that citations shall not issue, nor proceedings be had, nor suits instituted on that day, and that it shall not be reckoned in computing interest and in protests, etc. The constitutionality of Sunday laws has been decided frequently by the highest courts of the several States.

(Robert Cox, *Literature of Sabb. Question* (Edinb., 1865); *Amer. Law Review*, vol. ii.; *Prot. Epis. Quar. Rev.*, vol. vii.; Mark Hopkins, *Sabb. and Free Institutions*, in Doc. 29 of N. Y. Sabb. Committee; Judge W. F. Allen, opinion in *Lindenmüller* vs. *The People*, 33 Barbour, 548. See LORD'S DAY, SABBATH.) W. W. ATTERBURY.

Sunday Letter. See EASTER, by PRES. F. A. P. BARNARD.

Sunday-Schools. The importance of this subject may be inferred from the fact that in 1874 there were said to be 2,900,000 pupils in Sunday-schools connected with Methodist, Baptist, Presbyterian, and Congregational churches in the U. S. Sixty years before, such an institution as a Sunday-school connected with a church was a thing almost unknown. The Sunday-school of the present day has several distinctive features: (1) It is held on the first day of the week, a day observed by Christians as holy time, a day on which there is a general suspension of secular labor, on which public schools everywhere are closed, and which affords peculiar facilities for instruction in religious truth. (2) It is a school for positively religious instruction. It is not its object to teach reading, writing, and arithmetic, or to furnish occupation for the idle and entertainment for the listless, or merely to secure a reformation of manners and morals. Its aim is higher and avowedly religious. (3) It is thoroughly a Bible school. The Holy Scriptures furnish the basis, and almost exclusively the textbook, of instruction. Ecclesiastical history, systems of theology, denominational controversies are subordinated to the study of the Bible. Even Church catechisms are not made prominent; indeed, to a great extent they are laid entirely aside, and the pupil's attention is directed to the meaning of the Scriptures, and to the duties which are to be inferred from them. (4) It is for children and youth universally, whether rich or poor, Christian or pagan, educated or illiterate. Its advantages are freely offered to all, without any charge, direct or indirect, for tuition or for incidental expenses. (5) The pupils are usually grouped together in small classes, comprising those of equal attainments, and each class is brought into very close relations, it may be for a number of consecutive years, with its teacher. (6) Instruction is given by unpaid lay teachers, who undertake their task as one of the attractive and appropriate forms of Christian work. (7) The instruction is supplementary to that given by the family, the state, and the ministry. While many pupils may be found whom the public schools do not reach or who are under no Christian influences at home, the great mass of Sunday-school children attend the common school throughout the week, belong to nominally Christian families, and come in some measure within the reach of pulpit instruction. The Sunday school has a field upon which the state cannot enter, gives instruction with a regularity and method which few households can secure, and gains a nearer access to young minds than preachers in miscellaneous assemblies expect to find. (8) The Sunday-school is to a very large extent independent of ecclesiastical control. The direction of its affairs is not usually given to the constituted authorities of the congregation. The ecclesiastical books and digests prescribe no rules for conducting it. It is rather an *imperium in imperio*, or at least a voluntary organization very informally constituted, quite flexible in its methods, having no pecuniary interests to create trouble, and managed very much as the superintendent and teachers prefer.

History.—To Robert Raikes of Gloucester, England, is to be ascribed the distinction of having originated a movement in the interests of philanthropy some results of which are now seen in the modern Sunday-school system. His plans, first made public in the *Gloucester Journal* (1783), of which he was editor, were afterward unfolded more at length and discussed in various numbers of the *Gentleman's Magazine*. Having had his attention called in 1781 or 1782 to the ignorance and poverty of certain children in the suburbs of his native city, he started among them, on his own responsibility, what in modern phrase would be called a missionary enterprise, hiring some women to teach them to read and to recite the Church catechism. Boys and girls were received from six to fourteen years of age. They were taught from ten to twelve o'clock on Sunday mornings, and again in the afternoons before and after church service. A clergyman, the Rev. Mr. Stock, consented to assist by going the rounds on Sunday afternoons to examine the progress made and enforce order and decorum. Aiming thus to benefit the very poor, and to teach children for whom no public instruction was provided, the founder regarded the Sunday-school as a means of "civilizing the common people of the kingdom." The success which attended these schools in Gloucester commended them to public favor. The queen admitted Mr. Raikes to an audience at Windsor, and talked with him for an hour about the results. In 1785 a society was formed for establishing Sunday-schools throughout the British dominions. Four years later, 300,000 scholars were enrolled as attendants. The teachers continued for some years to receive wages, the men being paid two shillings a day, and the women one shilling or one and sixpence, and each teacher having thirty or forty scholars. In the schools founded by the society reading was taught, but not writing or arithmetic. The schools, however, encountered occasional opposition—sometimes on the ground that they were not under the direction of clergymen, and sometimes from persons who discountenanced all education of the poor. In Scotland, on the other hand, it was argued that Sunday-schools of that sort were unnecessary, inasmuch as sufficient secular instruction was given in the parish schools, while religious training was provided for in other ways.

These movements in Great Britain attracted attention on this side of the Atlantic, and led to the organization in Jan., 1791, of the Philadelphia Society for the Support and Institution of First-Day or Sunday-Schools. Among the founders were Bishop White, Dr. Rush, and Mathew Carey, the first of whom was president. The object aimed at was to furnish education to youth who lacked advantages, and to promote a reformation of morals and manners. Paid teachers were employed, and they gave instruction in reading and writing. The society was afterward incorporated, and in 1800 had expended $4000 and given instruction to 21,027 pupils. At the present time it expends about $000 per annum on schools in the city. The extensive organi-

zation of Sunday-schools for *religious* instruction characterizes the second decade of the present century. In 1811 and 1812 the Rev. Robert May, an English missionary on his way to India, visited New York and Philadelphia and opened evening schools on the English plan. In 1814, Mrs. Isabella Graham of New York began a Sunday-morning school for ignorant adults. Many schools were founded in Connecticut in the year 1816. In October of that year one was commenced in Dr. Morse's parish in Charlestown, Mass., but not without some hesitation, lest the giving of secular instruction should be a profanation of the Lord's Day. In Massachusetts the law made ample provision for teaching children to read and write, and Sunday-schools were regarded as necessary only for such cities as New York and London, where ignorant parents neglected the religious education of their children and no adequate provision was made for secular tuition. In many cases the churches looked askance upon the Sunday-school, made no provision for its maintenance, and left the organization and management of it entirely to individuals. Consequently, its growth as a religious institution was attended with serious disadvantages, which were, however, counterbalanced by the organization of union societies for the founding and nurture of Sunday-schools. Thus, in 1816 were founded the New York Female Union Society for Sabbath-Schools and the New York Sunday-School Union; in 1817, the Philadelphia Sunday and Adult School Union: in 1824, the American Sunday-School Union; in 1825, the Massachusetts Sabbath-School Union; and in 1827 the Sunday-School Union of the Methodist Episcopal Church. In these societies Christian people of different communions cordially co-operated. Many schools founded in cities and in new settlements were entirely undenominational, and had no connection with any Church, while in other places the custom grew up to have a school organized for the children and youth of every distinct congregation. In 1830 the American Sunday-School Union announced its purpose to establish a Sunday-school through the Western States in every neighborhood that was without one, and three years afterward it enlarged its plan so as to include the Southern States. Schools thus founded became in multitudes of cases the *nuclei* for churches. Similar work of a missionary character has been extensively prosecuted by other societies under strictly denominational management; and so heartily have the people approved of the Sunday-school as a permanent institution that for thirty years or more it has been expected as a matter of course that the members of every local church would sustain such a department for the religious nurture of their children.

It would be a mistake, however, to infer from the recent date at which the modern Sunday-school system came into favor that the importance of the religious education of youth had not been appreciated previously by the Protestant churches. Two hundred years before the days of Raikes a rubric in the Book of Common Prayer directed the curate of every parish, half an hour before evensong on Sundays, to examine the children of his parish in the catechism, and enjoined on fathers and masters to send their children and servants to him for this purpose. The schools established by Luther in Germany were kept seven days in the week, thoroughly providing for the religious instruction of the pupils. John Knox introduced into Scotland a system of Sunday-schools. The early history of New England shows that a weekly exercise in the Westminster Assembly's Catechism was one of the ways by which the children of Christian families were indoctrinated in the truth, and this was supplemented by the instructions of the parish minister. John Wesley is said to have instituted Sunday-schools in Savannah in 1737. According to I. D. Rupp, Sunday-schools were established in Lancaster co., Pa., before the period of Raikes, and C. S. Rafinesque asserts that they have existed for centuries in Italy.

The establishment of Sunday-schools is but part of a modern movement in respect to general education. Robert Raikes was the contemporary of Rousseau, Basedow, and Pestalozzi. The *Emile* of the former maintained the doctrines that it is the function of the State, and not of the Church, to teach, and that teachers should be of the laity, and generally married. Basedow founded a model school at Dessau in 1774, reducing to practice the ideas of Rousseau, and Pestalozzi in 1775 gathered fifty pauper children into his own house, aiming to relieve their wretchedness and impart to them instruction. Thus early were influences at work to revolutionize the methods of secular education, and the fruit is seen not only in colleges and public schools, but also in the provision now made for the religious training of children in schools where the laity, and not the clergy, are the teachers, where Church catechisms and tenets are generally laid aside, and where the ecclesiastical organization attempts no control over the appointment of teachers, or even the selection of topics for study.

Sixty years have witnessed not only a large increase in numbers of schools and pupils, but also great changes in the accessories of Sunday-schools. It is sufficient to mention such apparatus as libraries, question-books, hymn- and tune-books, illustrated papers, blackboards, maps, and mottoes. Each school must have its circulating library of juvenile literature, its hymnal arranged with sprightly, fascinating music, its pictorial paper enlivened with anecdote and replete with instruction, and some form of text-book to outline the course of study and instruction. Furthermore, the Sunday-school has ceased to be an institution for the poor exclusively or for the young exclusively. Special inducements are indeed presented to the poor by providing them garments and by occasional gifts at Christmas, but social distinctions are done away, and all classes of the people are expected to be represented. Not seldom a whole congregation of adults becomes organized as a Sunday-school for Bible study, in which the eldest have their place no less than the children. Sunday-schools have had their effect even on church architecture, so that no house of worship now claims to be complete which does not provide special accommodations for teachers and scholars engaged in the study of the Bible. Different rooms are needed for the various departments, the arrangement of seats must bring the pupils near to their several teachers, and all must be so arranged as to make it easy for all to have in common some general exercises of devotion.

While, on the one hand, the union character of Sunday-schools is less marked than formerly, as each school is sheltered under a denominational roof, the system has such flexibility that those who are personally interested in it are often brought together in consultation without being fettered by sectarian rules. Hence we hear of county and State conventions for the discussion of matters of common concern. A system of uniform lessons for all the Sunday-schools of the country has of late years become very popular, and has been adopted by many schools in Great Britain and on the Continent, and it has been estimated that more than 5,000,000 people are now studying the same passage of Scripture every Lord's Day. It is impossible to recount the immense service which the Sunday-school has rendered as a means of Christian education or as a work of philanthropy among the poor and degraded. Multitudes of children from poor and ungodly homes have learned for the first time in Sunday-schools the gospel story, and have carried home with them new ideas which have ripened into new lives. Visits from their teachers on week-days have brought the extremes of society into personal contact, and opened doors of influence which otherwise had remained closed; and besides the remote effects which have to do with a future life, the time and money spent on Sunday-schools are more than compensated by their inculcation of virtue, their steady influence in the regeneration of society and the amelioration of its woes, and saving from vice and crime millions who have enjoyed their advantages.

Literature.—A full list of books referring to the history and theory of Sunday-schools would include not less than 200 volumes. Among them are such as these: (1) *History. The Gentleman's Magazine* (1785–1800); Belcher's *Life of Robert Raikes;* Powers's *Rise and Progress of S. S.*, containing *Life of Raikes and Fox* (1863); Bray's *History of S. S.* (1847); *History of Mass. S. S. Society* (1850); Ferris's *Semi-Centennial Discourse* (1866); Watson's *First Fifty Years of the S. S.* (London, ? 1863); *American Quarterly Register for 1829;* Baird's *Religion in America* (1844); Sprague's *Life of Dr. Morse* (1875); also the *Annual Reports* of American S. S. Union (1825 *seq.*), New York S. S. Union (1817 *seq.*), New York Female Union (1817 *seq.*), Massachusetts Sabbath S. Union (1826 *seq.*), Massachusetts S. S. Society, Connecticut S. S. Union (1825 *seq.*), Methodist S. S. Union (1841 *seq.*), Foreign S. S. Association. (2) *Theory and Practice.* Packard's *Teacher Taught* (1841) and *Teacher Teaching* (1865); Todd's *S. S. Teacher* (1837); Collins's *Teacher's Companion* (1842); Mrs. David's *The Sunday-School* (London, 1847); Inglis, *The Sabbath-School* (1850); Alexander's *American S. S. and its Adjuncts* (1856); Hart's *Thoughts on S. S.* (1864) and *S. S. Idea* (1870); Taylor's *Sunday-School Photographs* (1864); Tyng's *Forty Years in S. S.* (1866); Pardee's *S. S. Index* (1868); House's *S. S. Handbook* (1868); Eggleston's *Manual* (1869); Trumbull's *Children in the Temple* (1869); Vincent's *Church School and its Officers* (1872); Cachemaille, *Church S. S. Handbook* (London, 1872); *Evangelical Alliance Essays* (1874). (3) *Periodicals. American S. S. Magazine* (1823 *seq.*); *Church S. S. Magazine* (London, 1865 *seq.*); *S. S. Teacher* (Chicago, 1866 *seq.*); *S. S. Teacher* (London, 1868 *seq.*); *The Hive* (London, 1868 *seq.*); *S. S. Helper* (Chicago, 1870 *seq.*); *S. S. World*, *S. S. Times*, and many others.
E. W. Gilman.

Sun'derbunds, the name generally given to that part of the delta of the Ganges which extends between the

Hoogly and the Megna. It consists of a great number of smaller and larger islands, covered with dense forest vegetation, and infested by tigers and crocodiles of uncommon size and singular ferocity. As this tract of land is in the highest degree pestiferous, the government has taken measures in order to improve it, or at least make it innoxious, and in many places the forests have been cleared and the ground transformed into sugar and rice fields.

Sun'derland, town of England, county of Durham, on the Wear, near its mouth on the North Sea, forms, together with its suburbs—Wearmouth on the S. bank and Monk-Wearmouth and Southwick on the N. bank of the river—one parliamentary borough of 104,490 inhabitants. It has extensive docks and shipbuilding yards along its harbor; large manufactures of glass, earthenware, rope, sailcloth, anchors, and other ironware, and is, next to Newcastle, the greatest coal-shipping port in the world.

Sunderland, p.-v. and tp., Franklin co., Mass., on Connecticut River and on New London Northern R R., is noted for the beautiful mountain-scenery of "Sunderland Park" and for a cavern of considerable dimensions. P. 832.

Sunderland, p.-v. and tp., Bennington co., Vt., on Batten Hill River and on Harlem Extension R. R. P. 553.

Sunderland (La Roy), b. in Exeter, R. I., in 1804; entered the ministry of the Methodist Church in 1823; became prominent in the temperance and anti-slavery movements and in other reforms of the day, especially in those relating to physiology and psychology; was connected, as editor or contributor, with various journals and periodicals, and published many works, among which are—*A Question on Temperance* (1828), *Essay on Theological Education* (1834), *Testimony of God against Slavery* (1834), *Anti-Slavery Manual* (1837), *Christian Lore* (1837), *Mormonism Exposed* (1842), *Pathetism*, etc. (1843, 1847, 1850), *Book of Psychology* (1852), *Book of Human Nature* (1852), *The Trance, and how Introduced* (1860), and *Manual of Self-Healing by Nutrition, without Medicine* (1862).

Sunderland (Spencer, Earls of). Henry Spencer, the first earl, b. in 1620; succeeded upon the death of his father in 1633 to the title of Lord Wormleighton; joined Charles I. at the beginning of the civil war; fought at Edgehill; was created earl of Sunderland in June, 1643, and was killed at the battle of Newbury, Sept. 20, 1643. His wife was the sister of Algernon Sidney.—Robert Spencer, his son, the second earl, b. in Paris about 1641; lived on the Continent during the time of the Commonwealth; returned to England at the restoration of Charles II.; was sent on embassies to Madrid and Paris in 1671, and became a privy councillor in 1674 and secretary of state in 1678. He at first opposed and then supported the bill for the exclusion of the duke of York, afterward James II., and was removed from office by Charles in 1681, but was reinstated in 1682, and exercised a controlling influence in the government during the remainder of the reign, and was continued in office by James II., who succeeded to the throne in 1685. He turned Roman Catholic in 1687, but was detected in a secret intrigue with the prince of Orange; was dismissed in 1688, and took refuge in Holland: was specially excepted in the act of indemnity granted by the prince of Orange upon his accession as William III. Having become Protestant again, he returned to England in 1690; gained the favor of William, and in 1695 was made lord chamberlain and privy councillor, but retired from public life in 1697 with the reputation of having been the basest public man of his age. D. at his seat of Althorp Sept. 28, 1702. —Charles Spencer, his son, the third earl, b. in 1674; professed liberal principles, and was returned to Parliament for Tiverton in 1695. His first wife, a daughter of the duke of Newcastle, having died, he married in 1699 a daughter of the duke of Marlborough, thereby strengthening his alliance with the dominant Whig party. He succeeded to the earldom in 1702; in 1705 was sent on embassies to Vienna and Berlin; in 1706 took part in negotiations for the union between England and Scotland; in 1707 was appointed secretary of state by Queen Anne; was dismissed in 1710, declining a large pension offered him by the queen. Upon the accession of George I. in 1714, he was made lord lieutenant of Ireland, in 1715 lord privy seal, and in 1717 secretary of state again and president of the council, and in 1718 first lord of the treasury. He was apparently deeply involved in the "South Sea Bubble," but the case having been investigated by the House of Commons, he was acquitted by a vote of 233 to 172, but was driven from office by Walpole in 1720. D. Apr. 19, 1722. By his marriage with the daughter of John Churchill, the great duke of Marlborough, he became the progenitor of the present ducal house, their son being created the second duke, and assuming the family name of Spencer-Churchill. A. H. Guernsey.

Sundew. See Drosera, Insectivorous Plants, and Pitcher Plants.

Sun-Dial. See Dial.

Sun'field, p.-v. and tp., Eaton co., Mich. P. 1106.

Sun-Fish, a name given for various, but never very obvious, reasons (but chiefly, apparently, because the species bask in the sun or have brilliant colors) to different aquatic animals. (I.) In the U. S. and Canada it is most frequently applied to species of fresh-water fishes belonging to the family Centrarchidæ, and chiefly to the genera *Pomotis* and *Lepomis*. These are readily recognized by the extension of the opercula backward into more or less enlarged or elongated membranous, highly-colored, ear-like lobes, and the radial formula—viz. dorsal fin with ten spines and ten or eleven rays, and anal fin with three spines and nine or ten rays; the colors are always quite brilliant. *Pomotis* has the pharyngeal bones wide, and armed with pavement-like teeth, and *Lepomis* has narrower pharyngeal bones provided with acutely conic teeth. The species are quite numerous, there being about three species of *Pomotis* and nine or ten of *Lepomis*. The best known in the Northern States are the (1) *Pomotis aureus* (= *P. vulgaris*); (2) *Lepomis auritus* (= *Pomotis appendix* or *rubricauda* of many authors); and (3) *Lepomis incisor*. The *P. aureus* is the common "sun-fish" of New England and the Middle States, and is at once recognizable by the ear-flaps being black tipped with scarlet, and by the orange spots of the sides. (2) The *L. auritus* is equally readily distinguishable by the very long black but bluish-edged ear-flaps. (3) The *L. incisor* has squarish black ear-flaps. The first is the smallest, and the last two the largest, of the species mentioned. Wherever found, they are generally among the most common fishes, and afford much sport to at least boyish anglers. They are quite carnivorous and bold fishes, and take the hook baited with the common earth-worm with avidity. (II.) On the sea-coast, to some extent, but more especially in England, it is given to species of Orthagoriscidæ (which see). (III.) In some parts of England the name is also applied to the basking shark (*Cetorhinus* or *Selache maximus*). (IV.) It is also frequently applied by sailors to the species of acalephs or jelly-fishes floating on the surface of the ocean.
Theodore Gill.

Sunfish, tp., Pike co., O. P. 628.

Sun'flower, the *Helianthus annuus*, a coarse and tall annual plant of the order Compositæ. It is often seen in gardens, and is well known for its large and showy compound flowers. It is a native of America, probably of Northern Mexico, but its original home is uncertain. In Europe the plant is raised for its seeds, which afford a good drying oil, nearly equal to that of linseed. The leaves are fed to cattle, the seeds to poultry, and the flowers yield good honey. The planting of sunflowers is reputed to be a preventive of miasmatic fevers. The pith is sometimes used instead of the true moxa.

Sunflower, county of N. W. Mississippi, intersected by Sunflower River. The surface is level and swampy, but very fertile. Cattle and swine are numerous. Staples, cotton, Indian corn, and sweet potatoes. Cap. Johnsonville. In 1874 a portion of the county was set off to form Leflore county. Area, 720 sq. m. P. 5015.

Sungaria. See Soongaria.

Sunn Hemp, the fibre of *Crotalaria juncea*, a leguminous herb of Bengal, extensively cultivated in India both for its fibre and as a forage plant for cows. The sunn hemp is exported extensively. It is inferior to true hemp, but better than jute, and is used for cables and canvas.

Sunnas. See Sunnites.

Sun'nites, the principal of the two great divisions of Mohammedans, so called from their maintenance of the authority of the *Sunna* (Ar., "custom" or "legal usage"), a compilation of the sayings and teachings of Mohammed, his companions and immediate successors, which is rejected by the Shias (which see). They are therefore the orthodox believers, and comprise the Moslems of Arabia, Northern Africa, the Turkish empire generally, and most of those of Toorkistan. They are subdivided into four sects, the Hanefites, Malekites, Shafeites, and Hanbalites, named after their respective founders, of whom the two former flourished in the second, and the two latter in the third century after the Hegirah. The collection now known as the *Sunna* consists of many thousands of short "traditions," laws, apologues, and parables from many sources, few of which, however, are authentic.

Sun Prairie, p.-v. and tp., Dane co., Wis. P. of v. 626; of tp. 1610.

Sun'rise, tp., Chicago co., Minn. P. 240.

Suns'bury, tp., Monroe co., O. P. 1128.

Sun'stroke, Insolatio, or **Coup de Soleil,** prostration of the animal vitality from long exposure to the direct heat of the sun. The method of this nervous exhaustion may be by peripheral nerve irritation in the extensive tract of overheated, congested skin, but more often is due to the overheating of the blood in the peripheral capillaries, and the sedative influence exerted by it upon the nutrition of the central ganglia. Sunstroke has been regarded as a state of paralysis of the vaso-motor or ganglionic nervous system. In its first form or stage, that of congestion and excitement, the surface of the body is intensely red and hot—a condition often disconnected with any actual sunburn, but due to general capillary relaxation and congestion consequent upon the impairment of the nerve centres which control the elastic arterial walls. For the same reason, the various large glands and organs of the body—liver, spleen, kidneys, lungs—are engorged with blood, swollen, and very tender to touch. The brain is congested, stimulated to excessive and incoherent mental action. The temperature of the body may be 112° F. or more; the pulse full, hard, bounding; the heart's action tumultuous; the breathing is hurried, labored, and noisy; the conjunctiva reddened, pupil contracted: there may be headache, delirium, convulsions. In graver cases, either at the outset or later as a second stage, one of depression or shock following that of excitement, the various vital functions may be alarmingly depressed, indicating suspended nutrition and organic change of the irritated nerve-centres. The patient becomes unconscious; the pulse feeble, compressible, and irregular; breathing slow, irregular, stertorous; the surface may be cool and pale; convulsive action is absent, and the muscular system completely relaxed. Death may occur suddenly by syncope or paralysis of the heart, by pulmonary congestion, by exhaustion, or by convulsion. After death the blood does not coagulate, hence there is no marked *rigor mortis* or rigidity of the body. Physical fatigue, exhaustion, over-clothing, bad ventilation, deficient drinking-water, alcoholic excess, are predisposing causes of sunstroke. Disturbance of the natural moisture, evaporation and radiation from the skin, is regarded the immediate cause of the overheating of the blood; hence, a murky, damp heat is attended with more cases of sunstroke than when the atmosphere, though hot, is dry and clear. The treatment of sunstroke consists in promptly withdrawing caloric from the overheated body, or, when shock and coma are present, by diffusible stimulants and revulsive agents, maintaining strength and relieving cerebral congestion. The cold douche to the head, neck, and chest, evaporating lotions or ice-bag to the head and spine, the wet sheet swathing the entire body, and cold immersion are agencies to be employed with judgment to the overheated body with the best results. Bromides may be employed, but arterial sedatives, as digitalis or veratrum, are dangerous. Reversely, in coma and the sinking stage or form, sinapisms, blankets, and heat may be applied to the surface, rich liquid food, ammonia, and alcohol administered by mouth or rectum, blisters applied over the nape of the neck.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Sun-Worship is an essential part of the religious system of the PARSEES (which see). The ancient Peruvians, who worshipped every aspect of nature, paid the chief honors to the sun. The old Egyptians, the Greeks, the Italians, and the Celtic and Teutonic races, the East Indians, and some African pagans, were, as some heathen races still are, sun-worshippers. In fact, sun-worship is one of the most widely-diffused forms of nature-worship, the genial and fructifying warmth and brightness, the mysterious nature, and the constant course of the great luminary appealing powerfully to the religious feelings of the ruder peoples.

Supercar'go, a person who accompanies a cargo shipped to a foreign port, and is entrusted by the owners with its sale or exchange. The supercargo, as such, has no control over the management or navigation of the vessel, on board of which he is merely a passenger until the port is reached, although he may receive authority to direct the destination of the voyage. He is simply the agent of the owners of the cargo, and derives his sole authority from their instructions, although it is held that if by any unexpected emergency he is rendered unable to comply with the letter of his instructions, it is his duty to do the best he can for the interests of the owners.

Supereroga'tion [Lat. *supererogatio*, "more than is required"], **Works of,** in the Roman Catholic Church, good works performed by a Christian over and above his simple duty. These works constitute a fund of merit which is applied to the relief of souls in purgatory.

Superheated Steam. See STEAM, by PROF. W. P. TROWBRIDGE, A. M.

Supe'rior, tp., Osage co., Kan. P. 966.

Superior, tp., Washtenaw co., Mich. P. 1268.

Superior, tp., Williams co., O. P. 1627.

Superior, p.-v. and tp., cap. of Douglas co., Wis., at the head of Lake Superior, in lat. 46° 38′ N., lon. 91° 3′ W., contains a fine natural harbor, 3 churches, 3 excellent public-school buildings, handsome court-house and park, 1 newspaper, 1 lumber and 2 shingle mills, and 2 hotels. P. 1122. C. S. DOUGLAS, ED. "TIMES."

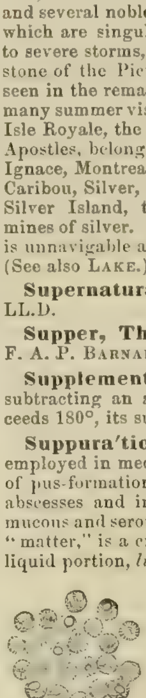
Superior, Lake, the largest fresh-water lake in the world, and indeed the largest of all lakes except the Caspian Sea, which is salt. It is roughly triangular in outline, and is bounded N. W. by Minnesota and the province of Ontario, N. E. by Ontario, and S. by Wisconsin and Michigan. Its area is over 31,400 sq. m.; elevation, 627 feet above the sea and 49 feet above Lake Huron. Its mean depth is about 1000 feet. The greatest length is 355 miles; breadth, 160 miles. The northern shores are high and broken, composed of Laurentian and Huronian rocks, and abounding in valuable silver-ores. The American side is generally lower and more sandy, and is especially rich in its abundant deposits of native copper, with which native silver is often associated, and in the not less valuable beds of red hematite iron ores, which are extensively wrought. Whitefish, sturgeon, and several noble species of lake-trout abound in its waters, which are singularly clear and cold. The lake is subject to severe storms, and the effect of the waves upon the sandstone of the Pictured Rocks and of Grand Island may be seen in the remarkably fantastic forms which attract hither many summer visitors. The islands are not very numerous. Isle Royale, the largest, also Grand Island and the Twelve Apostles, belong to the U. S.; and Pie, Michipicoten, St. Ignace, Montreal, Leach, the Slate Islands, Sandy Islands, Caribou, Silver, and many smaller islands are Canadian. Silver Island, though small, has extremely productive mines of silver. The lake never freezes over in winter, but is unnavigable at that season on account of the shore ice. (See also LAKE.)

Supernatural. See MIRACLES, by PRES. J. H. SEELYE, LL.D.

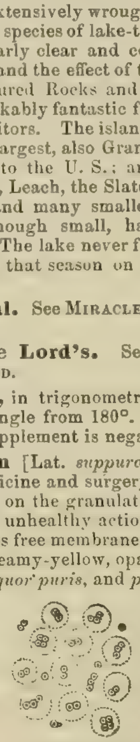
Supper, The Lord's. See EUCHARIST, by PRES. F. A. P. BARNARD.

Supplement, in trigonometry, the result obtained by subtracting an angle from 180°. If the given angle exceeds 180°, its supplement is negative.

Suppura'tion [Lat. *suppuratio*, "abscess"], a term employed in medicine and surgery to designate the process of pus-formation on the granulating surface of wounds in abscesses and in unhealthy action or inflammation of the mucous and serous free membranes. Pus, popularly termed "matter," is a creamy-yellow, opaque fluid, composed of a liquid portion, *liquor puris*, and *pus-cells* or *corpuscles*. As it is developed in abscess or granulating wounds, either from degeneration of existing tissues or from hasty, imperfect, or retrograde cell and tissue formation, its constituents are to be studied only as vitiated and changed forms of the cellular and liquid elements of the blood or of the elementary cells, as lymph, epithelial, and mucous cells, which have but recently developed from the blood.



Pus corpuscles, as seen in healthy pus.



The same, after the addition of acetic acid.

The creamy consistency and yellow color of pus varies with the abundance or scarcity of the pus-cells in the liquor puris or colorless pus-serum. These pus-cells, though somewhat larger than the white blood, lymph, and mucous corpuscles, are not easily distinguishable. They are lacking in power to organize and form cells and tissues, and are characterized by the presence of one or several nucleated masses, which are rendered visible by dilute acetic acid, which clears away the granular opacity of the albuminoid cell-contents. Pus-cells tend to speedy disintegration, their contents undergoing fatty degeneration, and their cell-walls rupturing, disseminating fatty and necrosed or dead granules throughout the *liquor puris*. Such pus is not creamy and yellow, but often thin, watery, dirty or brown in color, and has an offensive smell, and is termed ichorous pus; pus is often discolored by blood. The pus formed on free surfaces, as on the mucous lining of the nose or bronchial tubes, is largely a product of cast-off or rapidly-formed and degenerated epithelial cells. In other places, as abscesses, where congestion or inflammation exists, good authorities maintain that the white blood-corpuscles migrate through the coats of the capillaries, and, failing to organize, become pus-cells. This occurs either as the result of over-pressure, inflammations of dense structures notably terminating in suppuration, or

in consequence of impurity of the blood or lowered vitality of the nervous force. Suppuration when *circumscribed* constitutes abscess, which tends to discharge through the nearest surface, either of the exterior of the body or of some internal cavity. Diffuse suppuration occurs in erysipelas and in catarrhal inflammations, as of the air-passages, stomach, and intestines and bladder. The formation of pus is hastened by applications of heat and moisture—hot fomentations and poultices. Its formation is often announced by a slight chill, and accompanied by a febrile disturbance and pulsating, throbbing pain, either dull or intense, at the point of pus-formation. Diffuse or uncircumscribed suppuration of the solid tissues endangers life by absorption of purulent or ichorous septic matter; pus absorbed into the blood develops pyæmia or septicæmia, characterized by lowered vitality, hectic fever, sallow cachectic complexion, sweet breath, multiple abscesses in different parts of the body, exhaustion, and death.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Supra-renal Capsules. See KIDNEY, by E. DARWIN HUDSON, JR., M. D.

Surajah Dowlah. See CLIVE, and INDIA, ITS HISTORY, by R. C. CALDWELL.

Surat′, town of British India, presidency of Bombay, on the Taptee, in lat. 21° 12′ N., lon. 72° 47′ E. It is 6 miles in circumference, and surrounded with walls surmounted by towers. At the end of the eighteenth century it is said to have had 800,000 inhabitants, but now its manufactures have died out and its trade is lost. Many of the Portuguese, French, and Dutch establishments which flourished in the last century are deserted, and the place is most important now in a military point of view. P. 95,000.

Surety. See GUARANTY and SURETYSHIP.

Sure′tyship is a contract whereby one person, called the "surety," is bound to be answerable for the debt, default, or miscarriage of another, called the "principal," or whereby he engages that the principal shall do some act, or undertakes himself to do some act in case the principal fails to do the same. It necessarily implies two obligations to the same creditor—one, the direct original liability of the principal; the other, the collateral, auxiliary undertaking of the surety. This contract enters very widely into the transactions of business and the administration of both public and private affairs, and assumes a very great variety of forms. One of the most common instances is the mercantile guaranty. (See GUARANTY.) The bonds given by public or private officials for the faithful discharge of their duties, the various kinds of bail in civil or criminal proceedings, the undertakings on appeal to higher courts, and those required by statute in many dealings with the government, are also familiar examples of the contract. No particular form of words is necessary to create the obligation of suretyship, and whether or not it exists depends upon the actual relations and intentions of the parties. For example, if a promissory note is accommodation-paper, although it resembles in all respects an ordinary business note, yet either the maker or the endorser, as the case may be, will be a surety for the other. By the statute of frauds the contract must always be in writing, signed by the party to be charged thereby. (See FRAUDS, STATUTE OF, and GUARANTY.) The undertaking of the principal and of the surety may be contained in one single instrument; as, for example, a note or a bond jointly signed by several makers or obligors, whereof one may be the principal debtor and the others his sureties, or the undertaking of the surety may be in a separate instrument, as in the case of a guaranty. There must, however, always be an existing obligation of the principal, either commencing at the same time with that of the surety or entered into previously. Not only must the contract be in writing; it must always be supported by what the law regards as a valuable consideration; but it is not necessary that this consideration should be any benefit to the surety; it is sufficient if it is a legal detriment to the creditor. When the contract of the principal debtor is executed simultaneously with that of the surety, and is entered into upon the strength of the latter's liability, the one consideration is sufficient to support both obligations. But if the original is already executed, so as to be binding upon the principal debtor, the collateral responsibility of the surety must be sustained by a new and independent consideration. The original liability of the principal is always the limit of the surety's obligation, and cannot therefore be transcended. The surety cannot, except by his own consent, be held to any greater responsibility, either in respect to amount or time, than that originally assumed by himself and by his principal. His undertaking being for the benefit of another, and not of himself, is construed strictly, and is never extended by implication or by a loose interpretation. The nature of his liability of course depends upon the terms of his agreement. Sometimes the creditor may sue him either jointly with or separate from the principal, or may enforce his liability before proceeding against the principal; sometimes the creditor must first exhaust his legal remedies against the principal before any steps can be taken against the surety and in order to fix the latter's responsibility. The nature, object, and language of each particular contract determine into which of these two classes it falls. The surety is discharged by performance, by payment, by release, or by any other act which puts an end to the principal's obligation, and also by any material change in the legal relations between the creditor and the principal, even though the change is not actually injurious to him. He must judge for himself on what state of facts he is willing to be held responsible, and, having so determined, no one can shift his liability on to any other ground without his own consent; he can stand upon the terms of his contract. It is therefore the settled doctrine that his undertaking cannot be extended, enlarged, or changed either by operation of law or by any arrangements between the creditor and the principal debtor. The changes which will discharge the surety from all liability are of many kinds and forms. Among them are the substitution of a new contract between the creditor and the principal in place of the original one; alterations in the terms of such original agreement; a modification of the parties, and the like. If the creditor enters into an agreement with the principal, which is supported by a consideration and binding upon them, whereby the time of payment or other performance of the original undertaking is extended, the surety is discharged. Mere delay on the part of the creditor, or indulgence given by him to the principal, although in the mean time the latter should become insolvent, does not discharge the surety, for he may himself pay the debt at any time, and then enforce his own claim for remuneration against the principal debtor. If the surety should request the creditor to go on and enforce his demand against the principal, and after such request the creditor should neglect for an unreasonable time to do so, and the debtor should meanwhile become insolvent, there is a conflict of judicial opinion as to the effect produced thereby upon the surety's liability. Many of the decided cases, and perhaps a majority of them, hold that the surety is discharged; others maintain that he is not. The following are the most important incidents of this contract: If the surety himself pays the debt or any part thereof, or performs the obligation which he has undertaken, he is entitled as against his principal to be fully exonerated—that is, he is entitled to be wholly indemnified and relieved from all loss or damage sustained by means of his engagement. Whatever money he pays he can recover back from the principal in an action based upon the latter's equitable liability to refund and to make his surety completely whole. A most important auxiliary in enforcing this demand for compensation and exoneration is supplied by the equitable doctrine of subrogation. Upon the fulfilment of his own collateral undertaking the surety is subrogated to all the rights of the creditor against the principal debtor. In other words, he is substituted in the place of the creditor, and becomes clothed with the rights of that creditor, and can use all the means which the latter could have used against the principal. He may not only enforce the original contract, and the judgment thereon, if any, which the creditor has recovered, but he may demand, obtain, and avail himself of all the collateral securities which had been delivered to the creditor by his principal. (See SUBROGATION.) Finally, when there are two or more sureties, and one of them pays the debt, he is entitled to a contribution from his co-sureties, so that the shares of all shall be equalized, and he shall be refunded what he has paid in excess of his own equitable proportion. (See CONTRIBUTION.)

JOHN NORTON POMEROY.

Surface Geology. See GEOLOGY, CHEMICAL.

Surf′-Bird, a turn-stone (*Aphriza virgata*, family Charadriadæ), a small wading bird of the American Pacific coasts, about ten inches long, named from its habit of allowing the surf occasionally to dash over it as it seeks its prey on the rocky shores. Its flight is short and irregular.

Surf′-Duck, a sea coast duck of America, one of the group called scoters in Great Britain and coots in the U. S. It is the *Oidemia perspicillata*, and is quite black, except a little patch of white on the head, and another on the nape. Its flesh is not eatable.

Surgeon. See ACANTHURUS CHIRURGUS.

Surgery. See APPENDIX.

Su′ricate [Fr. *surikate*], sometimes called **Zenick** [*Ryzæna (suricata) capensis*], a carnivorous mammal of South Africa, about twelve inches long, with a tail of something more than half that length, and closely resembling the ichneumon; of a grayish brown color, tinged with yel-

low, and faint darker bands across the back. Its habits are nocturnal, dwelling in burrows, and it is often domesticated, when it is very useful as a destroyer of vermin.

Surinam, or **Dutch Guiana.** See GUIANA.

Surmullet. See MULLET and MULLIDÆ.

Surnames. See NAME, by C. G. LELAND, A. M.

Sur'plice [Lat. *super pellicium*, "over the pelisse"], a clerical garment worn in churches by priests and all clerics, and even by acolytes and choir-boys. It is considered to be a shortened stole.

Surprise Valley, tp., Siskiyou co., Cal. P. 649.

Surratt', tp., Prince George's co., Md. P. 775.

Sur'rey, inland county of England, bordering N. on the Thames, which separates it from Middlesex, comprises an area of 748 sq. m., with 1,090,270 inhabitants. It is intersected from E. to W. by a range of low hills, whose highest point, Botley Hill, rises 880 feet, and which slopes gently northward to the Thames, while to the S. the ground is more elevated and broken. In the northern part the soil is very fertile; in the southern it consists mostly of clay, chalk, and iron-sand, and in the whole western part the land is heath. Wheat, hops, and vegetables for the London market are raised; hogs and poultry are extensively reared. Near London manufacturing industry is carried on.

Surrey (HENRY HOWARD), EARL OF, b. in 1516, was the eldest son of Thomas Howard, duke of Norfolk; passed his youth at the court of Henry VIII., and was one of the most accomplished noblemen of the time, a brave soldier, and a fine poet. In 1544 he commanded the English forces in France; was made field-marshal, and subsequently governor of Boulogne. In Jan., 1546, he suffered a reverse, in consequence of which he was recalled and committed to the Tower, from which he was soon released, but in December was again arrested upon charge of treason for having quartered the royal arms upon his escutcheon. Upon his trial he proved conclusively that he had a right to bear these arms together with his own, but was notwithstanding condemned, and beheaded upon Tower Hill Jan. 21, 1547. His works consist of sonnets, amatory poems, elegies, paraphrases of the Bible, and translations of the second and fourth books of the *Æneid*. They present the earliest instances of the use of blank verse and the sonnet in English poetry, and have been several times republished, the latest edition being that of George F. Nott (1871).

Sur'rogate [Lat. *subrogare* or *surrogare*, to "substitute"]. Originally, this officer was a deputy of the bishop in the English diocesan courts, appointed by him to act in his stead as judge in the matters over which such courts had jurisdiction. Prior to the year 1857, when the court of probate and divorce was created, the diocesan courts of the bishops had jurisdiction not only in ecclesiastical causes, but also in certain civil affairs, particularly in the probate of wills and the granting of letters testamentary and of administration; and the court of the archbishop of Canterbury was the chief tribunal of England for these purposes. As the bishop himself could not always hear and decide causes, he was in the habit of appointing a deputy or substitute, called the "surrogate," to act as judge, especially in respect to civil matters. At an early day this delegate would be an ecclesiastic; at a later time he was a professional lawyer. This practice, which commenced without express authority of law, was afterward sanctioned by numerous statutes. The surrogate thus became the actual officer of the diocesan courts who exercised judicial functions in testamentary and administration cases, while in the archbishop's court a permanent judge was appointed, who was also the chief judge in admiralty and in matrimonial causes. This civil jurisdiction of the ecclesiastical tribunals was taken away in 1857. In the U. S. there is a separate court of each State having a general jurisdiction over the settlement of decedents' personal estates, and often a special jurisdiction over certain matters connected with their real estates. In New York these tribunals, of which one exists in each county, are called the surrogates' courts, and the judges thereof the surrogates. As a general rule, the county judge is *ex officio* the surrogate—that is, the same person holds the two offices. If the population of the county exceeds 40,000, a surrogate is chosen in addition to the county judge. He is elected by the electors of the county, and holds his office for six years. He has an official seal, and wills admitted to probate, letters testamentary and of administration are recorded in his office. He has exclusive jurisdiction over the probate of wills, the appointment and removal of executors and administrators, and original jurisdiction over the settlement of their accounts. He may also appoint and remove guardians, and settle their accounts, admeasure dower when the right thereto is not disputed, and order the sale of decedents' lands when the personal property is insufficient to pay the debts. An appeal lies from his decrees to the general term of the supreme court, and thence to the court of appeals. In some other States also the officer possessing the same general functions is termed the surrogate, but he is more frequently called the judge of probate. In one or two States, as in New Jersey, a subordinate official of the probate court is denominated the surrogate, but his powers are rather those of a clerk than of a judge.

JOHN NORTON POMEROY.

Surrounding Hill, tp., Woodruff co., Ark. P. 248.

Surrounding Hills, tp., Prairie co., Ark. P. 635.

Surry, county of N. W. North Carolina, drained by Yadkin, Fisher, and Ararat rivers. The surface is hilly, and in parts mountainous, Ararat or Pilot Knob Mountain in the S. E. being the most elevated point in this part of the Alleghany range. There are manufactures of cotton goods and chewing tobacco. Staples, Indian corn, tobacco, wool, butter, and honey. Cap. Dobson. Area, about 500 sq. m. P. 11,252.

Sur'ry, county of S. E. Virginia, lying between James and Blackwater rivers. The surface is somewhat hilly and the soil generally fertile. Staples, Indian corn, peas and beans, potatoes, wool, and sawed lumber. Cap. Surry Court-house. Area, 340 sq. m. P. 5585.

Surry, p.-v. and tp., Hancock co., Me. P. 1242.

Surry, p.-v. and tp., Cheshire co., N. H. P. 318.

Surry Court-house, p.-v. and tp., cap. of Surry co., Va.

Sur'tees (ROBERT), b. at Durham Apr. 1, 1799; took his degree of B. A. at Christ Church, Oxford, in 1800; studied law at the Middle Temple for two years, and upon the death of his father in 1802 settled upon his estate at Mainsforth, where he devoted himself to antiquarian pursuits and to the preparation of his *History and Antiquities of the County Palatine of Durham*, of which vol. i. appeared in 1816, vol. ii. in 1820, vol. iii. in 1823, and vol. iv., completed after his death by Rev. James Raine, with a *Memoir* by George Taylor, in 1840. The Surtees Society for the publishing of inedited MSS., founded in 1834, and named in honor of him, has issued more than fifty volumes, relating mainly to the districts included in the ancient kingdom of Northumbria. D. Feb. 11, 1834.

Survey'ing [Lat. *super*, "over," and *videre*, to "look"], a branch of applied mathematics whose object is to determine the relative positions of points on or near the surface of the earth. It may be divided into two great branches—*plane surveying* and *geodesic surveying*. In plane surveying the curvature of the earth is not taken into account, the general surface being regarded as a plane; in geodesic surveying, the curved form of the earth's surface is considered. The former is employed when only a small portion of the earth's surface is to be examined; the latter when a large extent of territory is involved.

Plane Surveying.—A plane survey may be undertaken for any one of a great number of objects. We have, accordingly, a great number of branches of the subject, of which the following are the most important: (1) *Land Surveying.* In this branch the object to be attained is the determination of the area and shape of a tract of land. (2) *Topographical Surveying.* The object of this branch is to determine not only the directions and lengths of the principal lines of tract to be surveyed, but also the undulations of the surface, the directions and locations of its water-courses, and all the accidents, whether natural or artificial, that distinguish it from the level plane. (3) *Hydrographical Surveying.* Here the object to be attained is the determination and location of the general outline of coasts; the shore-lines of harbors, bays, and inlets; the positions, depths, and character of channels; the situations of islands, shoals, and sunken rocks, and, in general, all the facts relating to lines of ocean navigation or that may be of interest to those engaged in commerce. (4) *Railroad Surveying.* In this branch the object is to ascertain the best line of communication, whether by railways, common roads, or canals, between two given points. It embraces the conditions incidental to facility of transit, cheapness of construction, and capacity for trade and travel, together with all considerations connected with the question of accommodation to intervening towns and villages. This branch of surveying includes all surveys for the location of aqueducts for supplying water to towns, cities, or manufacturing establishments. (5) *Mining Surveys.* Mining surveys may be undertaken either for the purpose of determining the location and position of the shafts, galleries, and underground excavations of a mine already in existence, or it may be required for determining the proper positions for the shafts and galleries of a mine yet to be opened. This branch involves, incidentally, a thorough knowledge of all the branches heretofore named,

and also a knowledge of the general principles of geology. (6) *General Reconnoissance.* A reconnoissance is a rough survey which may be undertaken for any one of a great variety of objects; it may be either civil or military. (See RECONNOISSANCE.) Besides the branches of plane surveying already enumerated, we may mention geological surveys, surveys for sanitary purposes, such as sewerage, ventilation, and the like, and surveys for works of military defence.

Geodesic Surveying.—A geodesic survey may be made for the purpose of determining the length of an arc of the earth's meridian, or for the more general object of ascertaining the grand outlines of an extended tract of country. To the former we may refer the survey commenced by France in the latter part of the last century for determining the length of a meridional arc through Paris reaching from the equator to the pole. This survey resulted in finding a value for this arc in terms of the *toise*, and the value found, divided by 10,000,000, was made the basis of the French system of measures and weights—a system known as the "metric system," and now adopted by many nations. To the latter we may refer the trigonometric surveys that have been carried on by almost all civilized nations of the earth for ascertaining the geographical features of their respective territories. As examples we may mention the trigonometric survey of Great Britain, known as the *Ordnance Survey*, the great survey of India, and the survey of our own country now in progress, and at present known as the *Coast Survey*. In all geodesic surveys the first operation consists in measuring, to the last limits of accuracy, one or more distances called *base-lines*. These base-lines, which are from 5 to 7 miles in length, are connected by the processes of triangulation with a multitude of points, so taken that the lines joining them shall constitute a network of triangles extending over the entire tract to be surveyed. These points serve as points of reference, to which other points are referred by the process of *secondary triangulation*. The latter points in turn serve as starting-points from which the more minute filling up of the survey is completed. The positions of the principal or primary points of the system are not only determined with respect to the extremities of the base-lines, but their absolute positions are fixed by the astronomical methods for determining latitude and longitude. In addition, the lines radiating from the principal triangulation-points are fixed with respect to the meridian by means of angles called azimuths. When the geodesic survey is carried on for geographical purposes, it is usually connected with the accompanying hydrographic work, the points of the former serving as the basal points of the latter. (For full particulars see GEODESY and HYPSOMETRY.)

In all kinds of surveys, whether plane or geodesic, two classes of operations are required: *first*, the measurement of certain lines and angles, which can only be done in the field: and, *secondly*, the reductions and computations, which can best be conducted in the office. The former class of operations, which consist chiefly in the measurement of lines and angles, constitute what is called the *field-work* of the survey; the latter class of operations, which embrace not only the computations, but also the entire work of delineation known as plotting and charting, constitute what is known as *office work*. In plane surveying the instruments employed are the chain or tape, the compass, and the theodolite, with their necessary accompaniments. In geodesic surveying the same instruments are used, together with the plane-table and all necessary astronomical instruments, such as the portable transit, the altitude and azimuth instrument, Talcott's zenith sector, and the like. (See COAST SURVEY, GEODESY, and HYDROGRAPHY.)

Survey of the Public Lands.—The public lands consist of those vast tracts of territory that belonged to the U. S. after the Revolution, together with all that was afterward ceded by individual States soon after the formation of the Constitution, with the additions that have since been made by treaty with Indians or by conquest. In 1802, Col. Mansfield, then surveyor of the North western Territory, inaugurated a plan for surveying and recording such portions as were offered for sale; which plan, with slight alteration, has continued in use to the present time. The general features of the plan then adopted, and still in use, are as follows: The entire public domain is first divided into parts called *land districts*, each of which is put in charge of an officer called a *surveyor-general*, who controls all the surveys in his particular district. In each district a meridian line is run, extending through the entire district, and from some point of this meridian an E. and W. line is run, which also extends through the district. These lines are determined astronomically, and when located serve as axes to which the subdivisions of the district are referred. Parallel to the axes, and on each side of them, other lines are run 6 miles apart, dividing the whole territory into squares, each containing 36 square miles. These squares are called *townships*. To take into account the obliquity of the meridians, suitable offsets are made in accordance with an established system. The townships lying between two consecutive meridians 6 miles apart constitute a *range*, and the ranges are numbered from the principal meridians, both E. and W. In each range the townships are numbered both N. and S. from the principal E. and W. line. Thus, if a township lies 12 miles E. of the principal meridian and 18 miles N. of the principal E. and W. line, it is called township 3 N., range 2 E. Each township is divided by meridians and E. and W. lines into squares having a mile on each side. These are called *sections*, and each contains 640 acres, more or less. The sections of a township are numbered from the N. E. corner, running along the northern tier of sections to No. 6, thence backward to section No. 12, which lies exactly S. of No. 1, and so on alternately, running from right to left and from left to right, to the south-easterly corner, which is No. 36. The four middle townships are numbered respectively 15, 16, 21, 22. In some of the Western States township No. 16 is set apart for school purposes, and is therefore called the *school township*.

If the land is very valuable, the sections are divided into half sections by meridians, and sometimes into quarter sections by lines running E. and W., and then again are divided into eighths by meridians. To designate one of these subdivisions, we say, for example, that it is the W. half of the S. W. quarter of section No. 16, township No. 7 N., range 3 W.; and if necessary we add the designation of the land district. (For a more detailed account of the method of surveying the public lands see Gillespie's *Surveying*, pp. 363–378.) W. G. PECK.

Survey, Trigonometrical. See GEODESY, by J. E. HILGARD, and SURVEYING, by PROF. W. G. PECK, LL.D.

Surville', de (CLOTILDE), b. about 1405, of the noble family Vallon-Chalis; married, in 1421, Berenger de Surville (who fell at the siege of Orleans in 1428), and d. over ninety years old. Her poems were not published until 1803—*Poésies de Clotilde*, edited by Ch. de Vanderbourg—and on their first publication their authenticity was much contested. It is now generally agreed upon, however, that these poems really are by her, but have been interpolated and retouched by one of her descendants, the marquis de Surville, who was put to death in 1798.

Surviv'orship. When two or more persons are jointly interested in certain legal relations, and one of them dies, the others are termed "survivors;" and not only the mere act of being thus left, but more especially the sum of legal rights and duties belonging to them by virtue of being thus left alive, is termed "survivorship." The peculiar and essential feature of survivorship consists in the fact that, so far as the joint relation extends, the legal rights and obligations of the deceased pass to his survivors, and not to his heirs or administrators; or, to speak more accurately, these rights and duties *remain* in the survivors, having been entirely extinguished in respect to the deceased. As illustrations: If two persons are joint owners of land, and one dies, the other continues to be the sole and absolute owner, the heirs of the deceased inheriting nothing; and if two persons, A and B, are joint debtors, and A dies, at the common law B remains the sole debtor, the estate of A not being liable in any manner or to any extent. This ancient doctrine has been somewhat modified; for, although the estate of the deceased debtor A is still, in England and in most of the American States, not liable *at law*, it may be sued *in equity* if the creditor cannot enforce his claim in a legal action against the survivor B. The doctrine of survivorship exists in the following legal relations: (1) joint owners of land, (2) trustees, (3) joint debtors, (4) joint creditors, and (5) partners. Its peculiar operation in the cases of joint owners of land and of joint debtors has already been described. If one of several trustees dies, the survivors, down to the last one, are clothed with all the powers and responsibilities of the original number. This particular rule has been changed by statute in certain States, as, for example, in New York, and on the death of one or more trustees others may be appointed by the court to act in their stead with the survivors. When one of two or more joint creditors dies, the survivor or survivors have the right and power to enforce the demand, the legal interest belonging to them alone, but they are accountable to the estate of the deceased for his share. The case of partners includes both that of joint creditors and of joint debtors. Upon the death of a member of the firm, the survivor is the legal owner of all rights and claims due to the partnership, and is the legal debtor for all liabilities owing by it. He alone can recover by suit or otherwise what belongs to the firm, and he alone can settle its debts or be sued at law by its creditors. He

must account to the administrator of the deceased, however, for the latter's share in the concern; and such administrators may, under the circumstances before mentioned, be sued in equity. Some of the foregoing rules, especially those in respect to suits against surviving partners and other joint debtors, have been changed by statute in certain States, the creditor being permitted to prosecute the survivor and the estate of the deceased at once, either jointly or separately, as he chooses.

JOHN NORTON POMEROY.

Sus [the Latin name of the hog], the principal genus of the Suidæ, a family of mammals of the order Ungulata, sub-order Artiodactyla, and section Omnivora or Non-ruminantia, typified by the common hog. In contrast with the other families of the section, it offers the following characters: The form in all is essentially like that of the domesticated hog, but mostly less gross; the feet are unguligrade (*i. e.* with the hoofs only touching the ground), and the external toes and hooflets are reduced in size and do not assist in progression, the median (third and fourth of normal series) only being of functional use in walking; the snout is disciform, and provided with a cartilaginous ring, and in the disk the nostrils are open and forward; the mammæ are in considerable number (4–10), ventral as well as inguinal; the back has no dorsal scent-gland; the tail is short or rudimentary; the tegumentary appendages are developed as stiff bristles; the skull has the palato-maxillary axis little deflected, and nearly parallel with the occipito-sphenoidal axis; the orbits are directed outward and forward; the occipital bones have long deflected styliform paroccipital processes in front of the occipital condyles, and emit transverse internal ridges in which are the condyloid foramina; the basiphenoid is normal, and has no pouch-like cavities; the squamosals have the articular processes projecting directly outward from their bases (and thus aloof from the auditory bullæ), and the zygomatic processes overlie the malar bones; the articular surfaces for the lower jaw are transversely concave, antero-posteriorly convex, and limited by no post-glenoid processes; the pterygoid bones are twisted and reflected outward, the crest continued upward and backward into the temporal region; the malar bones are elongated, and have long inferior processes; the lower jaw has no preangular expansion, and its condyles are triangular; the teeth are generally in full number—*i. e.* M $\frac{3}{3}$, P. M. $\frac{4}{4}$ ($\frac{3}{3}$), C. $\frac{1}{1}$, I. $\frac{3}{3}$ ($\frac{2}{3}$) $\times$ 2 = 44; the molars have corrugated cusps, presenting, when worn, deeply-sinuated insular areas; the canines of the upper jaw, in the males, are more or less twisted outward and upward, and parallel with the lower. The feet in their anatomy offer characters shared with the wart-hogs and peccaries, and differentiating from the hippopotamids: the last phalanges are elongated and trihedral; the manus (or front foot) has an unciform little or no broader than deep, and the second phalanx not wedged between the trapezoid and magnum; the pes (or hind foot) has a cuboid deeper than broad, and emarginated behind, and separate from the navicular. Such are the chief distinctive characters common to all the Suidæ, and distinguishing them in combination from the other kindred forms of the order. The living representatives of the family are aboriginally peculiar to the Old World, although in the Tertiary epoch species appeared to have existed in America. Exclusive of the domesticated forms, seventeen species have been recognized by the latest systematic inquirer into the subject, J. E. Gray. Eleven of these belong to the genus *Sus*, and are all peculiar to Asia, except *S. scrofa* (the wild-boar of Europe) and *S. sennaarensis* of Northern Africa; two represent in India the genus *Porcula*; three in Africa, the genus *Potamochærus*; and a single species in India and the Archipelago exemplifies the very strongly-marked genus *Babirussa*. The domesticated swine are subject to great variation, and Gray has even differentiated them into two peculiar genera—*Scrofa* for most of the breeds, and *Centuriosus* for a peculiar race of Japan and China, distinguished by the strongly-defined concentric wrinkles of the face. (See further BABYROUSSA, BOSCH VARK, HOG.) THEO. GILL.

Su'sa [the *Shushan* of the Scriptures, the Greek τὰ Σοῦσα, "the city of lilies"], an ancient city of Persia, the capital of the province of Susiana, and one of the residences of the Persian monarchs. Even in ancient time there was some doubt with respect to its precise site, some placing it on the Choaspes, others on the Eulæus. In modern time both Shuster and Sus have been designated as occupying the site of the ancient city, until the accurate researches and the excavations by W. F. Williams and Loftus have decided the question in favor of Sus. The city was at the time of Alexander the Great one of the largest and most magnificent cities of the world, celebrated for its delicious climate, containing a gorgeous palace and temple, and used as the treasury of the realm. The booty which Alexander took here was immense, and enabled him to pay a sum to each of his soldiers and a largess to the generals.

Susan'nah, History of, a short apocryphal book, considered by the Roman Catholic Church to be canonical, and regarded as the thirteenth chapter of Daniel. In the common English Bible it is, however, made a distinct book. It relates the story, the temptation, and virtue of Susannah, a beautiful Jewish matron, the punishment assigned her by her enemies, her final rescue from death, and the overthrow, by the judgment of young Daniel, of the wicked men who designed her ruin. Whether the incidents recorded are historical or fictitious is a disputed point. The story was probably written in Greek. Its authorship is not known.

Su'sanville, p.-v. and tp., cap. of Lassen co., Cal., has 2 weekly newspapers. P. 638.

Su'so (HEINRICH), b. at Ueberlingen, in the present grand duchy of Baden, Mar. 21, 1300; entered a Dominican monastery in Constance in 1313; studied theology at Cologne under Eckart; led for several years a life of seclusion and the severest asceticism; became then an itinerant preacher, and wrote several religious works of a mystical character, which made a deep impression, and of which the most remarkable, *Von der ewigen Weisheit* (*Horologium Sapientiæ Æternæ*), has been translated into all European languages. D. at Ulm Jan. 25, 1365. His collected works were translated into new High German by Diepenbrock (Regensburg, 1829), but his writings have not so much interest as those of the other German mystics—Eckart, Tauler, etc.

Suspen'sion, in music, the prolongation of one or more notes of a chord so as to extend over and occupy part of the time of the next succeeding chord. A suspension is, as it were, a temporary overlapping of one chord by some of the members of another chord preceding it, or the delay of a dissonance in reaching the chord into which it is to be resolved. (For illustrations of the nature and various kinds of suspensions see latter part of MUSIC.)

Suspension, p.-v. and tp., Bullock co., Ala. P. 880.

Suspension Bridge. See BRIDGE, by GEN. J. G. BARNARD, A. M., LL.D.

Suspension Bridge, p.-v., Niagara co., N. Y., on Niagara River, 1½ miles below the Falls, so named from the great railway suspension bridge. (See BRIDGE.) It is 800 feet long, 24 feet wide, with the rail-track 18 feet above the carriage-way. It is one of the most brilliant triumphs of modern engineering, and one of the few structures that not only harmonizes with the grand scenery of the vicinity, but even augments its impressiveness. Begun in 1852, the first locomotive crossed in Mar., 1855. It is used by New York Central and Erie Railways, connecting them with Great Western and Canada Southern Railways on the Canada side. The village has 1 weekly newspaper, 1 grist-mill, and 3 churches. The U. S. government has a large, well-built stone edifice, used for custom-house and post-office. P. 2276. GEORGE W. HOLLEY.

Susquehan'na, county of N. E. Pennsylvania, bordering on New York, watered by affluents of Susquehanna River and traversed by several railroads. The surface is hilly throughout, but well adapted for grazing and heavily timbered with pine, and there is a large trade in lumber. There are manufactories of agricultural implements, carriages, furniture, iron castings, woollen goods, saw-mills, flour-mills, and tanneries. Staples, oats, Indian corn, buckwheat, wheat, potatoes, wool, and dairy products. Cap. Montrose. Area, about 800 sq. m. P. 37,523.

Susquehanna, tp., Cambria co., Pa. P. 1106.

Susquehanna, tp., Dauphin co., Pa. P. 2264.

Susquehanna, tp., Juniata co., Pa. P. 890.

Susquehanna, tp., Lycoming co., Pa. P. 346.

Susquehanna Dépôt, p.-b., Oakland tp., Susquehanna co., Pa., on Susquehanna River and on Erie R. R., at N. terminus of Jefferson branch, has locomotive repair-shops, manufactures, and 2 weekly newspapers. P. 2729.

Susquehanna River is formed by the union of its E. and W. branches at Northumberland, Pa. The E. branch, the larger, rises in Otsego Lake, Otsego co., N. Y., at an elevation of 1300 feet. Its course is S. and then S. W. to the Pennsylvania line, which it crosses twice, afterward flowing S. E., and thence S. W. to the junction. The W. branch rises in Cambria co., Pa. It has a very tortuous and generally eastward course through a region abounding in timber and coal, but less celebrated for its fertility and beauty than the valley of the E. branch, a portion of which, called the Wyoming Valley, is world-renowned for the historic events of which it has been the scene, as well as for the mineral wealth which it contains. The main Susquehanna flows first in a S. and then in a S. E. course through

a wide, open, exceedingly fertile, and very picturesque country of Devonian slates and limestones. It reaches the head of Chesapeake Bay at Port Deposit, Md. It is a wide and stately stream, but is shallow, and is nowhere navigable to any extent, save in the spring, when the freshets bring down great rafts of logs and lumber and some loaded boats. The length of the main stream is 150 miles, of the W. branch 200 miles, of the E. (or N.) branch 250 miles. The branches afford great water-power. The main stream and both branches have been canalized, but the railroads have to a great extent rendered the canals useless.

Sus'sex, county of England, S. of Surrey and bordering on the English Channel, comprises an area of 1466 sq. m., with 417,407 inhabitants. It is intersected from E. to W. by a range of low hills, called the South Downs, consisting of chalk covered with fine turf and affording excellent pasturage, where the celebrated breed of sheep called the Southdowns is reared. To the N. of the range is an extensive forest-region, famous for its timber from time immemorial; to the S. the ground is wholly under tillage, and large crops of wheat, barley, beans, turnips, and hops are raised, and hogs, fowl, and rabbits are reared.

Sussex, county of S. Delaware, bordering on Maryland, drained by affluents of Nanticoke and Pocomoke rivers and traversed by Philadelphia Wilmington and Baltimore and Junction and Breakwater R. Rs. The surface is level and the soil fertile. Staples, Indian corn, wheat, tobacco, sweet potatoes, lumber, wool, and dairy products. Cap. Georgetown. Area, about 1000 sq. m. P. 31,696.

Sussex, county of N. New Jersey, bordering on New York and Pennsylvania, drained by affluents of Delaware River and traversed by Sussex R. R. The Blue Mountains cross the W. part, and the Hamburg and Wayawanda Mountains the E. part, the entire surface being hilly, with a fertile soil. There are several small lakes, of which Hopatcong in the S. E. part supplies the summit-level of the Morris Canal. Franklinite iron ore, zinc, and slate occur. There are flouring-mills, saw-mills, ironworks, and distilleries. Staples, Indian corn, oats, wheat, rye, buckwheat, hay, potatoes, wool, and dairy products. Cap. Newton. Area, about 600 sq. m. P. 23,168.

Sussex, county of S. E. Virginia, drained by Blackwater and Nottoway rivers and traversed by the Atlantic Mississippi and Ohio and Richmond Potomac and Fredericksburg R. Rs. The surface is hilly and the soil fertile. Staples, Indian corn, oats, tobacco, and wool. Cap. Sussex Court-house. Area, about 400 sq. m. P. 7885.

Sussex (Earls and Dukes of). This title has been borne by persons of different families: Thomas Ratcliffe, earl of Sussex, b. in 1526; was sent in 1553 as English ambassador to the emperor Charles V. to negotiate the marriage between Queen Mary and Philip of Spain, son of the emperor; on his return was made knight of the Garter and lord deputy of Ireland, and in 1569 president of the North, in which capacity he put down the insurrection against Elizabeth headed by the dukes of Northumberland and Westmoreland, and during the reign of James I. was made lord chamberlain. D. without issue July 9, 1583.—Augustus Frederick, duke of Sussex, sixth son of George III., b. at Buckingham Palace Jan. 27, 1773; was sent to Göttingen to complete his education; went to Italy, and there, being still a minor, contracted a marriage with Lady Augusta Murray, daughter of the earl of Dunmore. A marriage between a prince of the blood-royal and a subject without the royal assent was prohibited by law, and the court of prerogatives pronounced this marriage to be null and void; but the prince and the lady lived together as man and wife until her death in 1830. Their eldest son, known as Sir Augustus d'Este, claimed to be of legitimate birth, but this claim was never allowed. Their daughter, known as Mademoiselle Augusta d'Este, married Sir Thomas Wilde, an eminent lawyer, who in 1850 was raised to the peerage as Baron Truro. The marriage of Prince Augustus Frederick was highly offensive to his father, and he was always in disgrace at court, and it was not till 1801, when he was twenty-eight years old, that he was created duke of Sussex, with an allowance of £12,000 a year, which was afterward increased to £18,000. He took no part in public affairs, but, although of very moderate abilities and attainments, collected an extensive library, which was especially rich in editions of the Bible in various languages, and was fond of presiding at public dinners. D. Apr. 21, 1843, leaving directions in his will that his body should be buried in the cemetery at Kensal Green, and not at Windsor. The title is now dormant.

Sussex Court-house, p.-v. and tp., cap. of Sussex co., Va. P. 1778.

Sut'cliffe (Matthew), LL.D., b. in Devonshire about 1550; entered Trinity College, Cambridge, as a civilian, but took holy orders, and became archdeacon of Taunton in 1586, dean of Exeter in 1588, and prebend of Wells in 1592. He founded a college at Chelsea, of which he was the first provost, the fellows of which were to devote themselves to writing the annals of their times and to combating popery and Pelagianism; but the institution fell into decay, became an asylum for invalid soldiers, and finally a part of Chelsea Hospital. He wrote many polemical works, among which are *Treatise on Ecclesiastical Discipline* (1590), *Disputatio de Presbyterio* (1591), *De Catholica et Orthodoxa Christi Ecclesia* (1592), *De Pontificis injusta Dominatione in Ecclesia* (1599), *De Purgatorio* (1599), *De Vera Christi Ecclesia* (1600), *De Missa* (1603), *De Indulgentiis et Jubileo* (1606). D. in 1629.

Suth'erland, county of Northern Scotland, bordering on the Atlantic and on the North Sea, comprises an area of 1754 sq. m., with 23,686 inhabitants. The surface is elevated, mountainous, and rugged, interspersed with large tracts of moorland or covered with extensive forests, where herds of red-deer roam wild. Agriculture is in a very improved state, but, on account of the physical character of the country, confined to a few places. Rearing of cattle and sheep and fishing of salmon and herring are the principal occupations.

Sutherland (Alexander John), M. D., b. about 1810; was educated at Christ Church, Oxford: published *Clinical Lectures on Insanity* and the *Pathology of Insanity*, and was one of the authors of the report on the *Treatment of Insanity* (1845). D. in 1867.

Sutherland (Dukes of). George Granville Leveson-Gower, the first duke, b. Jan. 9, 1758, was the son of the marquis of Stafford; entered the House of Commons while young; was ambassador to France 1790-92, and was raised to the peerage in 1799 as Baron Gower. His uncle, the duke of Bridgewater, dying in 1803, he inherited his immense property, which, with the estates which he already held, made him the most wealthy nobleman of England. He was created duke of Sutherland in 1833, and was a munificent patron of the fine arts. D. July 19, 1833. The Bridgewater estates were entailed upon his second son, Francis (who was afterward created earl of Ellesmere, thus founding a new house), while the remainder of the property devolved upon the eldest son, George Granville Sutherland-Leveson-Gower, the second duke (b. in 1786; d. Feb. 28, 1861), who is chiefly noted as the husband of Harriet Elizabeth Georgiana, daughter of the earl of Carlisle, famous for her beauty and accomplishments, and for her patronage of anti-slavery and other philanthropical movements (b. May 21, 1806; d. Oct. 27, 1868). The present and third duke is George Granville William Sutherland-Leveson-Gower, b. Dec. 19, 1828; was member of the House of Commons for Sutherlandshire 1852-61, succeeding to the dukedom Feb. 21, 1861. He is one of the wealthiest of British peers, having large estates in England and Scotland, and for residences Stafford House, London; Dunrobin Castle and Loch Inver House, Sutherlandshire; Trentham Hall, Staffordshire; Lilleshall House, Shropshire, and Tarbat House, Ross-shire.—His eldest son, by courtesy marquess of Stafford (b. July 20, 1851), a lieutenant in the life-guards, has since 1874 represented Sutherlandshire in the House of Commons.

Sutherland (John), M. D., b. early in the present century; studied at the University of Edinburgh, where he took his degree as M. D. in 1831; subsequently held several minor appointments; represented the British government at the international quarantine conference held in Paris in 1851, and in 1856 was sent as royal commissioner of sanitary arrangements to the army of the Crimea. He was afterward made medical superintendent and inspector-general of the board of health, a member of the royal commission to inquire into the condition and health of the Indian army, and a commissioner for the improvement of barracks and hospitals.

Sut'lej, the easternmost of the "five rivers" of the Punjaub, rises in Thibet in lat. 31° 5′ N., lon. 81° 6′ E., at an elevation of 20,000 feet above the sea, breaks through the Himalaya as a furious torrent at an elevation of 8194 feet, flows in a south-western direction, and joins the Indus in lat. 29° N. as a calm, majestic stream, 700 yards broad, 30 feet deep, and navigable at all seasons.

Su'tra [Sansk., a "thread"], in Sanskrit literature, the technical name of the numerous series of religious aphorisms and rules which constitute an important part of Hindoo literature, including all the ritual, grammatical, metrical, and philosophical works. They consist of brief sentences to be committed to memory, and were usually written separately on dried palm-leaves tied together by a string, whence the name.

Suttee' [Sansk., *Sati*, "a virtuous wife"], a term incorrectly applied by English writers to denote the practice

formerly common in India of a widow burning herself on a funeral pile along with the body of her husband. The practice was unknown to the primitive Aryans, and is not alluded to in the Vedas, except in a single passage of the *Yajur-veda* of disputed authenticity, and is not sanctioned by the laws of Menu, but rests upon the authority of the later Sastras and Puranas. Between 1815 and 1826 there were above 7000 cases of suttee in Bengal alone. A prohibitory law was enacted in 1829, and rigidly enforced in Bengal by Lord William Bentinck, and was extended to the allied native states in 1847, since which time the practice has virtually ceased.

Sut′ter, county of Central California, lying between Sacramento and Feather rivers. It is mostly level bottom-land, with the exception of the Sutter Buttes, an isolated group in the N. part. Timber is very scarce. Staples, wheat, barley, hay, wine, and wool. Cap. Yuba City. Area 576 sq. m. P. 5030.

Sutter, tp., Amador co., Cal., on Sutter Creek. P. 1966.

Sutter, tp., Sacramento co., Cal. P. 1078.

Sutter, v. and tp., Sutter co., Cal., on California Pacific R. R. P. 1075.

Sutter (John Augustus), b. at Kandern, Baden, Feb. 15, 1803; graduated as a Swiss military officer at Berne, and in 1834 emigrated to America; established himself as a trader at Santa Fé, New Mexico; in 1838 crossed to the Pacific coast, sailed for the Sandwich Islands, thence back to Alaska, and while voyaging down the coast was stranded in what is now known as the Bay of San Francisco, July, 1839. He made his way into the interior, received a Mexican grant of land, and in 1841 built a fort and founded a settlement which he called New Helvetia, on the site of the present city of Sacramento. The Mexican government made him governor of the northern district of California, and when the Americans came into possession of the region he was appointed alcalde and Indian agent. He was in Feb., 1848, engaged in enlarging the race of his saw-mill, when gold was discovered in the excavation. This discovery soon proved his financial ruin; his laborers deserted him; his lands were overrun by gold-diggers, and he failed to secure any recognition of his claims beyond an annual allowance of $3000 from the State. In 1873 he left California and took up his residence at Litiz, Lancaster co., Pa.

Sutter Creek, p.-v., Sutter tp., Amador co., Cal.

Sut′ton, p.-v. and tp., Worcester co., Mass., on Blackstone River and Canal and on Providence and Worcester R. R., has 3 churches, 2 cotton-mills, 8 saw-mills. P. 2699.

Sutton, p.-v., cap. of Clay co., Neb., on Burlington and Missouri R. R. in Nebraska, 60 miles W. of Lincoln, has 3 churches, an excellent school, a handsome park, 2 hotels, a large flouring-mill, and 1 newspaper. P. about 500. Wellman Bros., Props. "Times."

Sutton, p.-v. and tp., Merrimack co., N. H. P. 1155.

Sutton, tp., Meigs co., O., on Ohio River. P. 4369.

Sutton, p.-v. and tp., Caledonia co., Vt. P. 920.

Sutton (Amos), b. at Sevenoaks, Kent, in 1798; in 1824 was ordained as a missionary to India, and stationed at Orissa, where, with the exception of a single visit to England and America, the remainder of his life was passed. He compiled an Oriya dictionary, grammar, and lesson-book, translated the Bible and other books into that language, in which he also put forth several tracts. In English he published a *Hymnbook for the Mission Congregations*, a *Guide to the Saviour*, *Family Chaplain* (1831), and *Orissa and its Evangelization* (1850). D. at Cuttuck, India, Aug. 17, 1854.

Sutton (Charles Manners), b. in 1780, was the eldest son of the archbishop of Canterbury (also Charles Manners Sutton, b. 1755; bishop of Norwich 1792; archbishop of Canterbury 1805; author of several sermons and papers on natural history; d. 1828); was educated at Eton and Cambridge; called to the bar in 1805; returned to Parliament for Knaresborough in 1807, representing that borough until 1832, when he was elected for the University of Cambridge. He was chosen Speaker of the House of Commons in 1817, and was re-elected to successive Parliaments until 1835, when he was defeated by Mr. Abercrombie by a majority of 10. He was shortly afterward made a peer under the titles of Viscount Canterbury and Baron Bottsford, but is better known by his original name. D. July 21, 1845.

Sutton (J. H. T. Manners). See Canterbury, Viscounts.

Sutton (Thomas), b. at Knaith, Lincolnshire, in 1532; was educated at Eton and Cambridge, afterward studying law at Lincoln's Inn; became secretary to the earl of Warwick, and in the rebellion of the dukes of Northumberland and Westmoreland was made master of ordnance at Berwick, and in reward for his services was created for life master-general of ordnance in the North, commanding a battery at the siege of Edinburgh in 1573. While thus employed he purchased from the bishop of Durham two manors in which extensive coal-mines were discovered, which soon produced for him an immense fortune, which he expended in a magnificent manner. But upon the death of his wife, in 1602, he resolved to devote his great wealth to charitable uses, and purchased the dissolved monastery of Chartreux, which had been bestowed upon the duke of Suffolk, where he founded the hospital and school of Charter-house. (See Charter-house.) He died before the edifice was fully completed, and his remains, which were at first interred elsewhere, were removed to a vault prepared for them in the chapel of the Charter-house. D. Dec. 12, 1611.

Sutton's, tp., Williamsburg co., S. C. P. 466.

Su′ture [Lat. *sutura*, "seam"], in anatomy, is the line of union of two bones between which there is no motion. Where motion is intended, the union is a joint or diarthrosis. The most general term for the immovable joint is synarthrosis; this includes the suture (*sutura*); the schindylesis, in which a thin lamina of bone is received between two laminæ of another bone; and the gomphosis, in which a long process is inserted into a socket. The fixed joints called sutures (*suturæ*) are of two primary kinds, called *sutura vera* and *sutura notha*. Sutura vera, the true suture, presents three species—*sutura dentata*, where the bones are joined by tooth-like processes; *sutura serrata*, where the bones have serrate edges; and *sutura limbosa*, where they overlap like selvages of cloth, but with notched processes. Of sutura notha, the bastard suture, there are two kinds—*sutura squamosa*, scaly suture, where two beveled margins overlap each other; and *harmonia*, where two rough surfaces are simply applied to each other.

Suwal′ki, town of Russian Poland, government of Augustovo, has many educational institutions. P. 16,896.

Suwan′nee, county of N. Florida, drained by Suwannee River and traversed by Jackson Pensacola and Mobile R. R. The surface is undulating, with several small lakes and swamps. Staples, Indian corn, oats, sweet potatoes, peas, and beans, with a little cotton and sugar. Cap. Live Oak. Area, 790 sq. m. P. 3556.

Su′warow, or **Su′voroff** (Alexei Vasilievitch), Count Rimnikski, Prince Italiski, b. in Finland Nov. 24, 1729; entered early the Russian army, and was made a colonel after the battle of Kunersdorf, Aug. 12, 1759, and a general in 1783, after the campaign against the Tartars on the Kuban. As commander-in-chief in the Turkish war of 1787 he defeated the Turks at Kinburn Oct. 1, 1787, at Fokshany Aug. 1, 1789, on the banks of the Rimnik Sept. 22, 1789, and took Ismail with great slaughter Dec. 22, 1790. In 1794 he commanded in Poland, and took Pragawitz Sept. 24, 1794, after which Catharine II. made him field-marshal. But his most brilliant exploit was his Italian campaign in 1799. He had fallen into disgrace under Paul I., and had even been deprived of his rank, but on the demand of the emperor of Austria he was, nevertheless, made commander-in-chief of the Russian army which was sent to Italy to co-operate with the Austrians against France. He defeated the French at Trebia July 17–19, 1799, and at Novi Aug. 15, 1799, and then crossed the Alps to join the Austrians under Korsakoff and Hotz. But both the Austrian generals had been defeated, and Suwarow was compelled to retreat. Shortly after the Russian-Austrian alliance was dissolved, and the Russian army withdrawn from the theatre of war. Died a few days after his return to St. Petersburg, May 17, 1800. His *Autobiography*, written in French, was edited by Glinka in 2 vols. (Moscow, 1819).

Svend′borg, town of Denmark, on the island of Funen, has a good harbor, considerable shipbuilding, and an active export-trade. P. 6700.

Swa′bia, or **Suabia** [Ger. *Schwaben*], was formerly the name of a territory of South-western Germany, corresponding to the present Würtemberg and Baden, and bounded S. and W. by the Rhine, which separated it from Switzerland and France, and N. and E. by the Palatinate, Franconia, and Bavaria. Its original name was *Alemannia*, but when, in 496, the Alemanni were conquered by Clovis, the country received the name of Swabia after the Suevi, who inhabited large parts of it. In 1080 the emperor Henry IV. made it a duchy, and bestowed it as an hereditary fief on Frederick of Hohenstaufen. Under this family the country, which is one of the most beautiful and fertile in Germany, prospered and became the seat of a flourishing civilization. But when the family became extinct with Conradin, who, as the head of the Ghibelline party, was executed at Naples in 1268, Swabia was broken up into many small dominions and free cities, which acknowledged no other authority than the emperor himself, and

out of the different coalitions and unions and leagues which these petty states formed in order to defend themselves, and which several times played a conspicuous part in German history, came, at last, the two duchies of Würtemberg and Baden. From 1563 to 1806, Swabia was one of the ten circles into which the German empire was divided.

Swain, county of S. W. North Carolina, formed since the census of 1870 from Jackson county, and separated from Tennessee by the Great Smoky Mountains. The surface is well adapted for stock-raising. Cap. Charleston.

Swain (CHARLES), b. in Manchester, England, in 1803; was employed in the business of his uncle, a dyer, until thirty years old, when he became an engraver, having in the mean time contributed verse and prose to various periodicals, in time becoming known as "the Manchester poet," and in 1857 receiving a pension of £50 from the civil list. He published many volumes of poems, among which are—*Metrical Essays* (1827), *Beauties of the Mind*, etc. (1831), *Dryburgh Abbey* (1832), *Cabinet of Poetry and Romance* (1844), *Rhymes for Childhood* (1846), *Dramatic Chapters*, etc. (1848), *English Melodies* (1849), *Letters of Laura d'Auverne*, etc. (1853), *Art and Fashion* (1863), *Songs and Ballads* (1867), and a *Memoir of Henry Leverseye* (1835). A collection of his poems was published in Boston in 1872. D. at Manchester Sept. 22, 1874.

Swain (DAVID LOWRY), LL.D., b. near Asheville, N. C., Jan. 4, 1801; graduated at the University of North Carolina; was admitted to the bar in 1823; elected to the State legislature 1824; appointed judge of the supreme court 1831; was governor of the State 1832–35, and from 1835 to his death president of the University of North Carolina. He wrote many valuable historical papers, and published *History of the British Invasion of North Carolina in 1776* (1853). D. at Chapel Hill, N. C., Aug. 28, 1868.

Swains'borough, p.-v. and tp., cap. of Emanuel co., Ga. P. 108.

Swain'son (WILLIAM), b. in Liverpool Oct. 8, 1789; served in the commissary department of the British army 1807–15, devoting himself especially to the study of natural history; accompanied the German naturalist Koster in his travels in South America 1815, after which he settled in London, and began in 1820 the issue of his works on natural history. In 1841 he emigrated to New Zealand, where he was attorney-general, and subsequently published several works on the natural history and social and political condition of that colony and Tasmania. Among his works, many of which have become standard and have passed through several editions, are—*Zoological Illustrations* (1st series, with 318 colored plates, 1820–23; 2d series, with 136 plates, 1829–33); *Exotic Conchology* (1821–22; new ed. 1841); *The Naturalist's Guide for Collecting and Preserving all Subjects of Natural History and Botany, particularly Shells*, 1840; 11 vols. on zoology, etc., in Lardner's *Cabinet Cyclopædia* (1834–40), including Classification, Quadrupeds, Birds, Fishes and Reptiles, Habits and Instincts, Malacology, Taxidermy, and Biography of Zoologists; *Birds of Western Africa*, and *Fly-Catchers* (in Jardine's *Naturalist's Library*, 1837–38); *Ornithological Drawings*, of birds from Brazil and Mexico (1834–41); *Observations on the Climate of New Zealand* (1840); *New Zealand*, being the subject of a lecture on the colonization of that island (1859); and *New Zealand and the War* (1862). He also made a government survey and report of the forests and trees of Tasmania; furnished papers to scientific periodicals and the journals of learned societies; prepared the article on the geographical distribution of man and animals in Murray's *Encyclopædia of Geography*; assisted Sir John Richardson in the account of North American birds contained in his *Fauna Boreali-Americana* (1831); and with Mr. Shuckard prepared the *History and Natural Arrangement of Insects* (1840). He appears to have been living as late as 1876.

Swal'low [Ang.-Sax. *swalewe*], the English name given (sometimes with and sometimes without specific qualifications) to the birds belonging to the family Hirundinidæ, and which are distinguished by their wide deep gape, allusion to which is evidently conveyed in the name. They all have the form familiar in the common swallows of the U. S.; the neck is rather short; the head full; the bill short, but comparatively broad and depressed, triangular, the sides rapidly converging, and the whole slightly decurved toward the tip; the gape is very deep, and continued backward nearly as far as, or quite under, the eyes; there are no distinct rictal bristles; nostrils sub-lateral; the wings are very long and pointed, and have only nine primaries, of which the second is generally longest, but the first is nearly or quite equal to it; the tail is forked or emarginated, and normally consists of twelve feathers; the

legs are weak and small, the tarsi being not longer than the middle toe; the tarsi have each two lateral undivided plates, meeting behind in a sharp ridge; the toes are not versatile, long and slender, three anterior and one posterior, and with the normal number of joints; the claws curved and acute, but slender. Such are the principal external characters of the family. Some anatomical features are noteworthy, inasmuch as they demonstrate the close relationship of the family with the ordinary singing birds (such as the sparrows, thrushes, etc.), and the great differences from the swifts, which resemble them so much as formerly to have been generally united with them. Thus, as in the Coracomorphæ or Passeres generally, "the sternum has a forked manubrium," and "its posterior edge has a single notch on each side;" "the clavicles have expanded T-shaped scapular ends, and send back a vertical process from their inferior junction;" and the muscles of the larynx are modified after the type common to the Oscines or singing birds. The species are quite numerous, and representatives are found in almost every land and every zone save the extreme polar regions. By G. R. Gray (*Hand-List of Birds*, vol. i. pp. 68–75) 111 species are recognized. The several genera have been differentiated by one writer (R. B. Sharpe in *Proc. Zool. Soc. London*, 1870, p. 288) into two groups, called by him sub-families—viz. (1) Hirundininæ, in which the outer edge of the wing is smooth-feathered, containing almost all of the species; and (2) Psalidoprocninæ, in which it is serrated or armed with stiff recurved hooks, represented by the African genus *Psalidoprocne* and the American *Stelgidopteryx*. The species are among the most active and graceful of birds, and their circling and sweeping flight is well known to observers. They feed almost exclusively on insects, which they take on the wing. Their mode of nesting is various. The female lays in most cases five or six eggs. The most common American species are *Progne subis*, the purple martin; *Petrochelidon lunifrons*, the cliff or eave swallow; *Hirundo horreorum*, the barn swallow; and *Cotyle riparia*, the bank swallow or sand martin. The chimney swallow is a swift or cypselid. (See SWIFT; also MARTIN.) THEODORE GILL.

Swal'lowing, or **Deglutition,** is the physiological act by which food (in man and most vertebrates, after more or less trituration by the teeth) is carried from the mouth to the stomach by means of the pharynx and œsophagus. The process of swallowing is, in the higher animals, an exceedingly complicated one. It is initiated by voluntary muscles, which pass the food or drink from the mouth into the pharynx. Here the process becomes essentially an involuntary one. The mechanism of the pharyngeal part of the act of swallowing is not perfectly understood, or, at least, physiologists are not quite agreed as to the functions of the epiglottis and the neighboring structures which serve to prevent the passage of the food and drink into the larynx. (For a discussion of the whole question see Flint's *Physiology*, part ii. pp. 181–207.)

Swam'merdam (JAN), b. at Amsterdam Feb. 12, 1637; studied medicine, especially anatomy, at Leyden and Paris;

settled in Amsterdam, and acquired a great reputation both as a physician and as an entomologist, but was induced by the Bourignon revival to turn away from science, and sold his collections, and even his manuscripts. D. at Amsterdam Feb. 15, 1680. His entomological works, *General History of Insects*, *Natural History of Bees*, and *History of the Ephemeras*, were translated into English by T. Floyd in 1758.

Swamp'scott, p.-v. and tp., Essex co., Mass., on Massachusetts Bay and on Eastern R. R., is a fashionable watering place and has several elegant hotels. P. 1846.

Swan [Ang.-Sax.], a name applied to those swimming birds of the family Anatidæ which have a bill nearly equally broad throughout and as long as the head; the cere soft and extending to the eye; the front toes with a large web; the hind toe without a lobe; the tail short and rounded; the second and third wing quills the longest. They are the largest species of the family, and among the largest of birds. Some put all the swans into one genus, *Cygnus*; others admit four genera, *Cygnus*, *Olor*, *Chenopis*, and *Coscoraba*. *Chenopis* includes the black swan of Australia, *C. atrata*. There are considerable anatomical differences among the swans. The North American swans, *Cygnus americanus* (whistling swan) and *C. buccinator* (trumpeter swan), are fine birds, both white. The tame swans are of two European species—*C. olor* (red-billed swan) and *C. immutabilis* (Polish swan). The European wild swans are *C. ferus* and *C. minor*. South America has two—*C. nigricollis* and *C. coscoraba*. In all, about ten species are known. Swans live to a great age. They are mostly beautifully white, and their down is prized for trimming ladies' garments. The flesh is not very good except when the birds are young.

Swan, tp., Warren co., Ill. P. 1007.

Swan, p.-v. and tp., Noble co., Ind., on Grand Rapids and Indiana R. R. P. 1295.

Swan, tp., Marion co., Ia. P. 1001.

Swan, tp., Vinton co., O. P. 1062.

Swan (James), b. in Fifeshire, Scotland, in 1754; came to America at an early age; was clerk in a mercantile establishment in Boston; published a *Dissuasion to Great Britain and the Colonies from the Slave-Trade to Africa* (1772); espoused the patriot cause; was one of the "Boston tea party;" aide-de-camp to Warren at Bunker's Hill, where he was wounded; became captain of artillery, secretary to the Massachusetts board of war, member of the legislature in 1778, and afterward adjutant-general of the State. He went to Paris in 1787, deeply involved in debt; wrote *Causes qui sont opposées au Progrès du Commerce entre la France et les États-Unis de l'Amérique* (1790), which gained considerable reputation for him. He acquired a large fortune, returned to America in 1795, and became famous for his munificence. In 1798 he returned to Europe, and was engaged in important commercial and financial enterprises until 1815, when, upon the suit of a German with whom he had transactions, he was arrested and thrown into the prison of Ste. Pélagie in Paris, where he remained fifteen years, living in sumptuous style and maintaining an unceasing litigation in the French courts. Besides the works already mentioned, he published—*On the Fisheries* (1784), *Fisheries of Massachusetts* (1786), *National Arithmetick* (1786), and an *Address on Agriculture, Manufactures, and Commerce* (1817). D. in Paris Mar. 18, 1831.

Swan (T. L.), U. S. N., b. Aug. 23, 1841, in Maryland; graduated at the Naval Academy in 1860; became a lieutenant in 1862, a commander in 1874; served in the Brooklyn at the battle of Mobile Bay, Aug. 5, 1864, and was thus mentioned in the official report of his commanding officer, Capt. James Alden: "Lieut. Thomas L. Swan, the ordnance officer, had everything ready, and the working of his department was admirable; he was principally occupied during the action with the bow-chasers."

Foxhall A. Parker.

Swan (William Draper), b. at Dorchester, Mass., Nov. 17, 1809; was for many years principal of the Mayhew Grammar School, Boston; afterward became a publisher, and in 1862 was elected to the State senate; prepared a series of ten popular spelling and reading books for schools, and in connection with his brother, Robert Swan and Daniel Leech, a series of three volumes of arithmetic; also published *The Critic criticised and Worcester vindicated* (1860). D. at Dorchester Nov. 2, 1864.

Swan City, tp., Saline co., Neb. P. 418.

Swan Creek, tp., Saginaw co., Mich. P. 427.

Swan Creek, tp., Fulton co., O. P. 1100.

Swan Lake, p.-v. and tp., cap. of Turner co., Dak.

Swan Lake, tp., Meeker co., Minn. P. 539.

Swann, tp., Taney co., Mo. P. 1787.

Swann (Thomas), b. at Alexandria, Va.; was educated at Columbian College and the University of Virginia; studied law at Washington, and was appointed secretary to the Neapolitan commission; settled at Baltimore in 1834; became a director of the Baltimore and Ohio R. R. in 1836, and its president 1847–53, and was also president of the North-western Virginia R. R.; in 1856, and again in 1858, was elected mayor of Baltimore. He emancipated his slaves previous to the opening of the civil war, and was an earnest Union man throughout that contest. In 1864 he was elected governor of Maryland, and in 1866 Senator in Congress, but declined to leave the executive chair. In 1868 he was chosen a Representative in Congress, and subsequently at each term, becoming in 1875 chairman of the committee on foreign affairs.

Swannano'a, p.-v. and tp., Buncombe co., N. C. P. 1526.

Swan Quarter, p.-v. and tp., cap. of Hyde co., N. C. P. 1115.

Swans'borough, p.-v. and tp., Onslow co., N. C. P. of v. 141; of tp. 1475.

Swan'sea, town of England, county of Glamorgan, South Wales, at the mouth of the Tawe, where a good harbor, lined with convenient quays and docks, has been built. When, in 1830, the rich coal-fields in the vicinity and the peculiar adaptability of the coals for smelting purposes were thoroughly explored and understood, the town became the centre of the English copper production, and developed very rapidly. Copper ore is brought hither not only from Great Britain and Ireland, but also from Cuba and Australia, and 185,000 tons of copper are annually produced. Very important too are its breweries, tanneries, and manufactures of iron, pottery, and porcelain, and of a peculiar kind of patent fuel, a mixture of culm and tar compressed into the shape of bricks. P. 51,720.

Swan's Isle, p.-v. and tp., Hancock co., Me. P. 451.

Swan'ton, tp., Lucas co., O. P. 447.

Swanton, p.-v. and tp., Franklin co., Vt., on Missisquoi River, near Lake Champlain, and on Vermont Central R. R., has several manufactories, an academy, and 1 weekly newspaper. P. 2866.

Swan'ville, p.-v. and tp., Waldo co., Me. P. 770.

Swan'zey, or **Swan'sea,** p.-v. and tp., Bristol co., Mass., on Mount Hope Bay and on Providence Warren and Bristol R. R., has 5 churches, and is noted in New England history for the massacre of several men by Indians June 24, 1675, which gave rise to "King Philip's war." P. 1294.

Swanzey, p.-v. and tp., Cheshire co., N. H., on Ashuelot River, has cotton and woollen factories. P. 1626.

Swarth'more, p.-v., Delaware co., Pa.

Swartz (Olaus), b. at Norrköping, Sweden, in 1760; studied natural science, especially botany, at the University of Upsal; travelled extensively in Finland, Lapland, the West Indies, etc., and was appointed professor of natural history in the Medico-Chirurgical Institute of Stockholm, where he d. in 1818. The most remarkable of his writings are *Flora Indiæ Occidentalis* (3 vols., 1806), *Synopsis Filicum* (1806), besides a number of minor essays in the *Transactions* of the Linnæan Society in London.

Swata'ra, tp., Lebanon co., Pa., on Swatara Creek, includes the v. of Swatara Gap, on Lebanon and Pine Grove branch of Philadelphia and Reading R. R. P. 2015.

Swa'tow, or **Chow-Chow,** town of China, province of Quang-Tong, on the China Sea, has a good harbor, which was opened to foreign commerce by the treaty of Tien-Tsin. Its trade has rapidly increased since that time. Sugar, rice, paper, and tobacco are exported; opium, cotton and woollen goods, and metallic wares are imported.

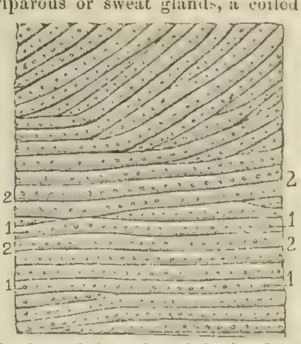
Swayne, tp., Mississippi co., Ark. P. 93.

Swayne (John Wager), son of Noah H., b. at Columbus, O., in 1835; graduated at Yale College in 1856; studied law and practised at Columbus; major of Ohio regiment 1862; became colonel; served through the Atlanta campaign, losing a leg at Salkahatchie; brevetted brigadier and major general 1865, and was afterward assistant commissioner of refugees, etc., and retired from the army July, 1870.

Swayne (Noah Haynes), LL.D., b. in Culpeper co., Va., Dec. 27, 1804; was clerk in an apothecary's shop in Alexandria; studied law; was admitted to the bar in 1824, and commenced practice at Coshocton, O.; in 1829 was elected to the State legislature; was U. S. district attorney 1830–39; was chosen judge of the court of common pleas in 1834, but declined the office; was again elected to the legislature in 1836, and was prominent in organizing asylums and institutions for the deaf and dumb, the blind, and the insane; in 1861 was appointed a justice of the U. S. Supreme Court.

Swe'aborg, or **Sveaborg,** a fortress of Russia, on the northern coast of the Gulf of Finland, occupying seven small islands which outlie the town and harbor of Helsingfors, and are connected by boat bridges. The place was originally fortified by Sweden. When (1809) Finland became a province of Russia, the latter made it a military and naval dépôt. The isle of Vargoe is the central or principal fortress; the isle of Great Oester-Svartoe the principal naval dépôt and dockyard. The place was bombarded by the allied fleets in 1855. (See BOMBARDMENT.) J. G. BARNARD.

Sweat, or **Perspiration,** the exudation, through the pores of the skin, of water, with numerous excretory elements in solution. The amount of water exhaled from the skin either in the form of the insensible perspiration, which maintains its softness and moisture, or in perceptible sweat, is but little less than the volume of the urine or the equivalent in water of the moisture exhaled from the lungs in breathing. It varies with the seasons and climate, sweat being most profuse in summer and the warmer regions. The action of the skin is complementary to that of the kidneys, chilling of the integument producing renal hyperaemia. The amount of solid excretory matter and carbonic acid gas eliminated by the skin is small, but cannot be suppressed without danger to life. Experiments of closing the pores by a coating of varnish or tin-foil, both in man and lower animals, have induced alarming depression and death. Reversely, the artificial stimulation of the perspiration is a valuable channel for eliminating morbific matter in impaired health or disease. Bathing, friction, and clean clothing, by favoring activity of the sweat-glands and open pores, are means of preserving health. The sweat is secreted by the sudoriparous or sweat glands, a coiled tubular mass beneath the skin, with an excretory tubule terminating on the surface. (See HISTOLOGY, "sweat-glands.") The tube is about $\frac{1}{370}$th of an inch in diameter, the coils or glands vary from $\frac{1}{125}$th to $\frac{1}{25}$th or $\frac{1}{12}$th of an inch in diameter. The number of sweat-openings varies on different surfaces; thus, as enumerated by Krause, to the square inch the palm of the hand (see figure) has 2736, the back of the hand 1490, sole of the foot 2685, top of the foot 924, forehead 1258, cheek 548. The number of sweat-glands in the body is estimated at 381,248, and the aggregate length of tubules as $2\frac{1}{3}$ miles.



Surface of the palm of the hand; a portion of the skin about one-half an inch square, magnified four diameters (*Sappey*): 1, 1, 1, 1, openings of the sweat-ducts; 2, 2, 2, 2, grooves between the papillæ of the skin.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Sweat'ing Sickness, one of the several prevalent and fatal epidemics occurring during the fifteenth, sixteenth, and early part of the seventeenth centuries. It was also known as "pestilent sweat" and as the "English ephemera," as the English people both at home and abroad were chiefly attacked. In Germany, Holland, Sweden, and Denmark it prevailed more mildly. It first appeared in England in 1485. It was of brief period both in individual cases and in duration of single epidemics. Fully half of the population in infected towns were taken down with the disease, the mortality great, but where death did not result all danger was past in twenty-four hours, and epidemics rarely lasted a month. Of the five great English epidemics of the sweating sickness, the remaining four were in 1506, 1517, 1528, 1551. The attack consisted of a febrile and sweating period. It commenced with pains in the back, shoulders, and limbs, flushes of heat, oppression at the liver and stomach, pain in the head, delirium, palpitation, followed by heaviness and desire to sleep, which in fatal cases tended to become profound coma or stupor. Profuse sweating now set in, in favorable cases leading to speedy convalescence. The patient was liable to one or many relapses. The disease spared the aged and young, attacking chiefly middle aged, plethoric men of all classes and rank. Both in England and on the Continent the greater prevalence of this disease among Englishmen was attributed to their peculiarly gluttonous, excessive diet. By Hecker, Guy, and others the several epidemics of this disease are ascribed to preceding periods of atmospheric and telluric insalubrity, the influence of gathered armies, and to the absence of house and street drainage in the larger cities and towns. Its period of incubation, rapid progress, and speedy convalescence disconnect it from epidemics of the typhus class. Hecker has termed it "a rheumatic fever in the most exquisite form that has ever yet been seen in the world." It has also been regarded a form of influenza or catarrhal fever. Guy considers it undoubtedly of malarial nature, an ague with short febrile and sweating stages, often malignant and fatal in the first or congestive period, and in convalescence leaving, as in all malarial periodic disorders, a temporary lassitude and frequent recurrences. The treatment most successful in these epidemics was absolute rest for twenty four hours, and blanketing, warm air, and warm drinks to hasten profuse sweating.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Swed'berg (JESPER), b. at Fahlun, Sweden, Aug. 28, 1653; studied theology at the University of Upsal, and was appointed pastor at Vingaker in 1690, professor of theology at Upsal in 1692, and in 1702 bishop of Skara in West Gothland. D. July 26, 1735. He was the author of the first Swedish grammar, and published in 1694 a hymnbook which was suppressed as pietistic. His father's name was Isaksson; the name Swedberg he assumed from an estate; he was the father of EMANUEL SWEDENBORG (which see).

Swede Grove, p.-v. and tp., Meeker co., Minn., on St. Paul and Pacific R. R. P. 446.

Swe'den (KINGDOM OF) occupies the larger part of the Scandinavian peninsula, extending between lat. 55° 20′ 18″ and 69° 3′ 21″ N., and comprising an area of 444,814 quadrate kilomètres, of which 407,446.51 is land and 37,367.49 water; 49 per cent. of the whole area is productive soil, besides the pastures, 42.6 is forest, 6.4 under cultivation; or, expressed in hectares, 17,568,000 is forest, 2,547,700 is arable land, 1,986,100 is natural meadow, 26,400 is garden, etc. Agriculture forms the principal occupation, and employs about 3,000,000 people—that is, three-fourths of the whole population; there are 253,650 land-owners. Formerly, a most peculiar kind of husbandry prevailed: the forest was felled and burnt, and in the ashes the grain was sown. But that has now nearly ceased. In the northern districts, however, the fields are sown every year till they are completely exhausted; they then lie fallow for a series of years, and are used as pasture-ground. A perfect system of rotation is employed only on the larger estates in the middle and southern provinces. Rye thrives everywhere, wheat only in the southern parts; barley is the most common cereal. Oats, peas, and beans can be raised only as high as lat. 64° N., but potatoes everywhere. The annual production of grain is estimated at 31,000,000 hectolitres, of potatoes at 18,500,000; which is more than the country needs, although grain forms the most important item of exportation. The cattle-breeding is still capable of great development. There are many cattle, but not improved. In 1872 there were 446,309 horses, 2,103,319 horned cattle, 1,659,644 sheep. The horned cattle and the horses are small but vigorous; the sheep yield only coarse wool. In 1870 there were 124,326 goats. The number of reindeer is estimated at 100,000. The profit of cattle-breeding (horses not reckoned) was estimated in 1870 at 115,000,000 francs. The forests form a considerable part of the national wealth, and their management is of the highest importance. Wood is not only used as fuel, but, outside of the two larger cities, Stockholm and Göteborg, most houses are built entirely of this material, and it forms a valuable export. About 20 per cent. of the forests belongs to the state or public property. They consist chiefly of fir and spruce, mixed with birch, alder, and ash; S. of the Dal-Elf the oak appears, and in the southernmost provinces the beech. About 890,000,000 cubic feet of firewood, 110,000,000 cubic feet of timber, and 150,000,000 cubic feet of lumber for exportation—in all, 1,150,000,000 cubic feet or 30,000,000 cubic mètres of wood—are annually felled. Mining and smelting are of great importance. Sweden is rich in ores, especially in iron ores. They occur chiefly within a belt extending from E. to W., from Uppland and the southern parts of Gesbrikland, through Westmanland, Nerike, and the southern parts of Dalarne, to the eastern part of Wermland, and it is simply due to the difficulty in procuring the necessary fuel that the iron production is not still more important. Sweden possesses coal only in the province of Skåne, and had to import 26,906,103 cubic feet of coal and coke in 1872. The forests in the neighborhood of the mines are nearly exhausted. The iron ore produced in 1871 amounted to 662,539,460 kilogrammes; 4939 persons were employed in raising it. In the same year 298,760,740 kilogrammes of pig iron, 187,692,650 kilogrammes of bar iron, and 8,033,930 kilogrammes of Bessemer steel were produced; 3812 persons were employed at the blast furnaces, 6073 at the rolling-mills, 5101 at the foundries and manufactories. Large quantities of iron and steel are exported,

especially to England. Next to iron, copper is the most important: 1,420,800 kilogrammes were produced in 1871, and 96,580 kilogrammes of sulphate of copper. Only small quantities of gold are produced: of silver 975 kilogrammes in 1871, of lead 89,050 kilogrammes, of zinc 32,171,990 kilogrammes. Salt, manganese, sulphur, graphite, and feldspar occur, though only in small quantities. Of peculiar importance is the country's richness in peat. According to recent estimates, about 12,000 quadrate kilomètres are covered with peat to a depth of from 2 to 10 mètres, which substance is used of late more and more for smelting and other purposes. Hunting was regulated by a law of Oct. 21, 1864, and definite shooting-seasons determined for the elk, stag, deer, wild reindeer, beaver, hare, woodcock, moorhen, heathcock, grouse, swan, duck, eider goose, snipe, etc. The bear, wolf, lynx, glutton, fox, and birds of prey are always chased, and a prize is paid for every specimen of the four first species killed: 99 bears, 47 wolves, 107 lynx, 139 gluttons were annually killed between 1866 and 1870. The fisheries yield a considerable profit, especially the herring fisheries along the Baltic coast (about 3,000,000 crowns a year) and the salmon fisheries in the rivers. The chemico-technical industry, though still very young, is highly developed in several directions. Thus the Swedish matches, for instance, are celebrated all over the world. The largest factory, employing about 1500 persons, is located in Jönköping, but there are about 30 more. The exportation of this one article amounted in 1872 to more than 6,000,000 kilogrammes. Manufactures of acids and salts are established at Stockholm, Göteborg, and Fahlun; of manures at Stockholm and Göteborg; of fats and soaps, mineral and wood oils, of dyestuffs, etc., at several places. Sugar-refining is an important branch of industry; of whisky about 38,000,000 litres are annually produced; 99 tobacco manufactories were in operation in 1871, and produced about 4,000,000 kilogrammes of goods, valued at about 7,000,000 crowns. The manufactures of woollens at Norrköping, Stockholm, Halmstad, Malmö, Landscrona, and other places consume annually 1,750,000 kilogrammes of foreign wool, without satisfying the demands of the country; woollen fabrics valued at about 15,000,000 crowns are annually imported. The cotton industry has been very fluctuating since the American war; it reached its maximum in 1871, with a production of about 12,000,000 kilogrammes, but in 1872 only about 6,500,000 kilogrammes were produced. The linen manufactures are chiefly dependent on home industry, though there are large weaving-factories at Almedal and Göteborg. The silk industry stands at the same point of development as centuries ago, and is unimportant; the value of the annual production amounts to 1,500,000 crowns. The leather industry is small; 4,500,000 kilogrammes of hides and skins were imported in 1871. The manufacture of metallic wares is not so important as it ought to be with such excellent iron and steel; the centre of this branch of industry is the town of Eskilstuna in Södermanland. The standard of gold and silver is regulated by the government; imported articles of these metals are examined, and if they do not come up to the standard of the country, they cannot be sold. The industry in wood is considerable, though chiefly home industry; there exist only a few factories for cabinet-work—3 in Stockholm, 1 at Sandarna. The potteries and the stone and glass factories produce fine articles. The building material is mostly granite; the porphyry articles from Elfdal in Dalarne are celebrated; the glass manufactories at Kosta and Limmared are important; earthenware is made at Rörstrand, Gustafsberg, and Höganäs. The hardware manufactures are small, but the paper manufacture has recently increased, and several fine inventions have been made in the manufacture of paper from wood. In 1871 the number of persons engaged in trade comprised 26,281 males and 13,256 females, to which must be added 883 master mechanics. There were 1955 manufacturers, employing 40,420 operatives. The commerce is steadily increasing. In 1861 there were 10,199 dealers and 5755 clerks; in 1871 there were 13,431 dealers and 8750 clerks. Foreign commerce is also increasing. The principal articles of exportation are the products of agriculture, the forests, the mines, and the fisheries. The principal articles of importation are colonial goods, spinning materials, textile fabrics, hides, leather, guano, coal, salt, and railway materials. The following table shows the development of the commerce of the country:

	Value of imports.		Value of exports.	
1850,	36,354,000	crowns	38,625,000	crowns.
1860,	82,469,000	"	86,496,000	"
1865,	105,863,000	"	108,086,000	"
1870,	141,686,000	"	172,502,000	"
1871,	169,179,000	"	161,623,000	"
1872,	216,366,000	"	199,815,000	"
1873,	271,440,000	"	221,904,000	"

In the last year the traffic with foreign countries was as follows, counted in thousands of crowns:

	Importations from.	Exportations to.
Denmark	37,240	21,874
Norway	13,549	7,424
Finland	5,554	3,614
Russia	13,436	3,497
Germany	62,057	18,249
Great Britain	95,015	120,915
Holland and Belgium	15,834	12,619
France	9,367	19,189
Spain and Portugal	2,850	2,888
Mediterranean countries	1,225	2,304
United States	7,960	6,951
Canada	—	171
West Indies	1,314	31
Brazil	3,419	674
Rio de la Plata	2,154	100
Cape	260	266
Australia	205	1,138

Nearly all the foreign commerce is carried on by sea, and for the greater part by foreign vessels; Swedish vessels carried 43 per cent. of the imports and 30 per cent. of the exports. In 1873 the statistics of navigation showed—entrances, 7422 vessels, of 306,739 lasts burden, of which 4367, of 149,349 lasts, were Swedish, and 3055, of 157,390 lasts, foreign; clearances, 14,913 vessels, of 713,819 lasts burden, of which 7991 vessels, of 248,466 lasts, were Swedish, 6922 vessels, of 465,353 lasts, were foreign. At the end of 1873 the merchant fleet comprised 4078 vessels, of 142,144 lasts burden, of which 3490 were sailing vessels of 125,542 lasts burden, and 588 steamers of 16,602 lasts burden and 20,675 horse-power; 1781 sailing vessels, of 25,350 lasts burden, and 432 steamers, of 4754 lasts burden and 10,542 horse-power, were engaged in the home trade. The number of sailors was 24,732. By the law of Nov. 10, 1865, measures and weights were determined as follows: the unit of length is the *fot* (foot); 10 *fot* = 1 stång, 10 stång = 1 *ref*, 1 *fot* = 10 tum (inches), 1 tum = 10 lines. The dry measures are: 1 cubic foot = 10 *cans*, 1 *can* = 100 cubic inches. The weights are: 1 *nyläst* = 100 cwts., 1 cwt. = 100 pounds, 1 pound = 100 *ort*, 1 *ort* = 100 grains. The mile = 36,000 feet; and the acre = 56,000 quadrate feet. By the law of Feb. 3, 1855, the *riksdaler*, a silver coin, was made the basis of the coinage. Of 2 pounds of coinage silver, consisting of 12 parts of silver and 4 parts of copper, 100 *riksdaler* were made: 1 *riksdaler* = 100 *öre*. A gold coin, the *karolin*, equal to 10 francs, was also made. By the convention of Dec. 18, 1872, between Sweden, Norway, and Denmark, the *krona* (crown), a gold coin equal in worth to the old *riksdaler*, was made the basis of the coinage. The coin gold contains 90 parts of gold and 10 parts of copper. The notes of the state bank pass as legal payment. The state bank was founded in 1668 in Stockholm, and has branch offices in Göteborg, Malmö, Wisby, and Luleå. On Dec. 31, 1874, the population numbered 4,341,559. In 1872 there were 29,470 marriages, 131,128 births, 72,947 deaths, 4145 still-born. The average annual emigration between 1860 and 1870 amounted to 12,245; the emigration was 29,003 in 1870, 17,450 in 1871, 15,915 in 1872, 13,580 in 1873. In 1870 there were 4,162,087 Evangelical Lutherans, 3809 Baptists, Mormons, and Methodists, 190 Reformed, 573 Roman Catholics, 30 Greek Catholics, and 1836 Jews. The most important towns are Stockholm (150,446), Göteborg (63,748), Malmö (30,676), Norrköping (26,365), Gefle (16,787), Carlskrona (16,643), Jönköping (12,548), Upsala (12,367), and Lund (11,680). Politically, the country is divided into 25 *län*—Stockholm City, Stockholm-län, Upsala, Södermanland, Östergötland, Jönköping, Kronoberg, Kalmar, Gotland, Blekinge, Kristianstad, Malmöhus, Halland, Göteborg and Bohus, Elfsborg, Skaraborg, Wermland, Örebro, Westmanland, Kopparberg, Gefleborg, Westernorrland, Jemtland, Westerbotten, Norrbotten. But the geographical division of the country into three parts is also still in use—Swealand, the central part; Götaland, the southern part; and Norrland, the northern. Lapland, the northernmost part of the country, belongs to Norrland. Norrland and Lapland comprise an area of 246,053 quadrate kilomètres—that is, more than one-half of Sweden—but it has only 530,000 inhabitants—2.1 to 1 quadrate kilomètre. Götaland is the most densely-peopled part of the country, having 28 inhabitants to 1 quadrate kilomètre; Swealand has 16. The established Church is the Lutheran. The ecclesiastical division comprises 12 episcopal sees—namely, Upsala, Strengnäs, Linköping, Wexiö, Kalmar, Wisby, Lund, Göteborg, Skara, Karlstad, Westerås, and Hernösand. The government is a constitutional monarchy. The fundamental laws are—the constitution of June 6, 1809, the succession act of Sept. 26, 1810, the law on the freedom of the press, July 16, 1812, and the act of the constitution of the representative assembly, June 22, 1866. An act of July 31 and Aug. 6, 1814, regulates the relations to Norway. All government business is laid before the king in the state council, and there despatched. The state council consists

of 10 members, among which are the chiefs of the seven departments of justice, foreign affairs, war, navy, interior, finances, and worship and education. The popular representation, called the *riksdag*, consists of two houses. To be a member of the second house an income of 800 crowns and an age of twenty-five years are demanded; of the first, an income of 4000 crowns and an age of thirty-five years. The consent of both houses is necessary to issue a law, to fix the budget, to levy taxes and duties, etc. In questions relating to the ecclesiastical constitution the consent of the church assembly (*kyrkomöte*), convened every five years, is necessary. Every third year the chiefs of the nobility assemble in a congress of nobles to discuss their own affairs, but the nobility has no prerogatives. The interior self-government, which is very old, received its present form by the law of Mar. 21, 1862. Each of the 90 towns, and in the country each parish—of which there are about 2500—forms a community. The *läns* form communities of a higher order, in which self-government is carried on by assemblies of deputies. The Swedish law is not based on the Roman law, but developed independently, according to the wants of the people. It dates from 1734, but has received many extensions since that time, one of the most important of which is the criminal code of Feb. 16, 1864. Juries are employed only in press cases. The budget of 1876 shows —ordinary receipts, 25,917,000 crowns, among which 14,600,000 from the railways; extraordinary receipts, 41,590,000, among which 20,000,000 from the custom-houses, 13,130,000 from taxes on whisky, etc.; collateral receipts, 28,169,013; total receipts, 95,676,013. Expenses —ordinary, 55,185,400, among which 1,266,000 to the royal family, 11,772,300 to the army, 13,091,000 to the interior, 4,617,600 to the navy, 11,357,700 to the finances; extraordinary, 27,329,200, among which 9,850,842 to the army and navy, 12,000,000 to the railways; collateral expenses, 13,161,413; total expenses, 95,676,013. At the end of 1874 the debt amounted to 130,477,920, of which 37,813,900 was home debt, and 92,664,020 foreign debt. The army consists of five classes of soldiers: (1) *värfvade*, volunteers who are engaged for six years; (2) *indelta*, troops in cantonment, who receive a certain payment in money or naturalia, possess house and ground, and annually serve for several weeks; they are bound to serve as long as capable; (3) *beväring* or *landvärn*, troops levied by conscription, among which every Swede is bound to serve from his twentieth to his twenty-fifth year; (4) the militia of Gotland, which is not bound to serve outside of the island; (5) the volunteer tirailleurs, established in 1861. The infantry of the permanent army comprises 2 regiments of body-guards, 2 regiments of body-grenadiers, 17 regiments of infantry, 1 regiment of chasseurs, 1 grenadier battalion, 1 grenadier corps, and 3 chasseur corps. In peace each regiment has two battalions of four companies—in war, three. The cavalry consists of 47 squadrons—namely, 1 regiment of body-guards, 3 regiments of hussars, 1 corps of hussars, 1 regiment of dragoons, 1 corps of mounted chasseurs. The artillery consists of 30 batteries, among which 22 are field artillery, 6 are mounted, and 2 batteries are on foot. The engineers consist of 1 battalion of pontoniers, 1 company of military telegraphers, and 1 battalion of sappers. In 1873 the army numbered 35,646 men of the line, 86,101 in the reserve, and 29,026 in the militia; in all, 150,773 men. In 1873 the navy consisted of 1 ship of the line, of 350 horse-power, 66 guns, and 735 men; 1 frigate, of 400 horse-power, 16 guns, and 316 men; 3 corvettes of 1100 horse-power, 22 guns, and 565 men; 4 monitors, of 610 horse-power, 8 guns, and 330 men; 10 small monitors, of 403 horse-power, 10 guns, and 411 men; 112 gunboats, 1 transport vessel, 2 avisoes; in all, 4183 horse-power, 139 guns, and 3078 men, besides 10 sailing-vessels, with 110 guns and 1625 men; and 87 rowing vessels, with 113 guns. Of railways, there were in Sept., 1875, in operation, 1509 kilomètres belonging to the state, and 2091 kilomètres in private possession; and under construction, 600 kilomètres belonging to the state, and 2000 to private associations. In 1873 there were 611 post stations, and 15,011,874 letters were despatched, of which 1,112,689 were to foreign countries. Receipts from the post, 3,170,561 crowns; expenses, 2,869,986. In 1874 the telegraph comprised 7818 kilomètres of lines, of which 194.1 kilomètres were submarine, with 18,633 kilomètres of wires and 159 stations; 986,397 telegrams were despatched; receipts, 1,229,678 crowns. The popular education is obligatory and good. At the end of 1871 there were 7528 institutions for popular instruction, and 9 seminaries for the education of teachers; 77 higher schools, 21 academies, 2 universities—in Upsala and Lund.

History.—The introduction of Christianity and the consolidation of a national empire were accomplished during the reign of Eric IX. (d. 1160), who subsequently was worshipped as the patron of the country. The contest between the two royal families—that of Sverker and that of Eric—which began in 1061, continued, however, up to 1250. During these controversies, replete with open battles and secret murders, there arose a number of powerful families which, in connection with the higher clergy, suppressed the people and opposed the royal power. The most powerful of these families was that of the Folkunger, from which issued many jarls, and finally also a new dynasty (1266-1365). By the battle of Enköping (1365) Albert of Mecklenburg obtained the crown, but was defeated at Falköping (1389) by the Danes, and Margrethe, daughter of the Danish king Waldemar, and widow of the Norwegian king Haco, now became queen of Sweden. Her grand-nephew, Eric of Pomerania, was chosen heir apparent at Kalmar (July 20, 1397), and at the same time a union was concluded between Sweden, Norway, and Denmark. But Eric's government was so bad that the Swedes separated and determined nevermore to obey a foreign king. Nevertheless, in Oct., 1440, Christopher of Bavaria ascended the Swedish throne. In 1448 the Swede, Charles Knutson, succeeded him as king, but was expelled by the treacherous archbishop Oxenstiern, who crowned Christian I. of Oldenburg king of Denmark and Norway June 19, 1457. Knutson, however, returned by the aid of the Swedish peasants, and reigned till May 15, 1470. Under his successor, Sten Sture, the peasants again defeated the Danes at Brunkeberg (Oct. 11, 1471), and Sten Sture reigned till Dec. 13, 1503, though under perpetual warfare. During the anarchical state which followed his death, Christian II. of Denmark seized the crown, but made himself hateful by his cruelty (the Stockholm massacre, Nov. 8, 1520), and by the valor of the peasants of Dalarne, Gustavus Wasa succeeded in expelling him, and ascended the throne in 1523. He broke the power of the Roman Catholic clergy, but under his successors, Eric XIV. and John III. (1560-92), they recovered their influence, and the country was agitated by religious disturbances. Sigismund (1592-1600), a Roman Catholic, was overthrown by his uncle, Charles IX. (1600-11), a zealous Protestant; and his son, Gustavus Adolphus (1611-32), became a celebrated king and general, the champion of Protestantism, and the dangerous enemy of Austria during the Thirty Years' war. Nevertheless, under his reign the nobility were powerful and the people were poor. The power of the nobility still more increased under the government of Queen Christina and the chancellor Oxenstiern. Sweden obtained by the Peace of Brömsebro (1645) the island of Gotland and other important territories from Denmark, and by the Westphalian peace (in 1648) Pomerania, Rügen, Wismar, Bremen, and Verden. Her political influence was considerable. Charles X. Gustavus (1654-60), a cousin of Christina, count palatine of Zweibrücken, involved the country in wars with Denmark, Poland, and Russia, but gained by the Peace of Roeskilde (1658) Skåne and the whole southern part of the present Sweden from Denmark. Charles XI. (1660-97) regulated the relations of Sweden to Poland, Brandenburg, and Austria by the Peace of Oliva (May 6, 1660), to Denmark by the Peace of Copenhagen (June 26, 1660), and to Russia in 1661, and left the country in a good state to his son, Charles XII. Sweden had at that time reached the culminating point of its power. It comprised, besides its present territories, Finland, Esthonia, Livonia, Carelia, Ingria, Pomerania, Rügen, Bremen, Verden, and the city of Wismar. But Charles XII. ruined it for a whole century by his senseless wars. He maintained its political power, but became, nevertheless, the first cause of its subsequent decline. Even the great northern war, in which he gained such fine laurels, hurt the prosperity of the country. By consenting to the establishment of a constitutional government, Ulrica Eleonora, the sister of Charles XII., and married to Friedrich of Hesse, was chosen regent in preference to the nearest heir, Duke Charles Friedrich of Holstein. On Feb. 21, 1719, she made oath on the constitution, according to which a state council of twenty-four persons was to take part with the king in the government. Meanwhile, the war went on, but unfortunately; by the Peace of Stockholm (Jan. 20, 1720) Sweden ceded Bremen and Verden to Hanover, and Stettin and part of Pomerania to Prussia; and by the Peace of Nystad (Sept. 10, 1721) ceded Esthonia, Carelia, and Livonia to Russia. Two parties arose in the state councils—the *Hats* and the *Caps*—and from 1720 to 1772 their rivalries greatly disturbed the country. The Hats were the friends of the king, the Caps contended for freedom and progress. In 1741 the Hats prevailed with the king, and the war with Russia was renewed, but it was unlucky, and by the Peace of Åbo (in [illegible]) Sweden lost a part of Finland. On Mar. 25, 1751, Adolphus Friedrich of the house of Holstein-Gottorp ascended the throne, but the state council had at this time assumed the whole power of governing. The king was almost without influence, and when in 1756 the state council arraigned and decapitated several of the king's friends, he was [illegible]

save them. In the Seven Years' war Sweden joined France, but with small effect. Gustavus III., who ascended the throne in 1771, broke the power of the nobility, but was assassinated Mar. 29, 1792, and succeeded by his son, Gustavus IV. Adolphus. Under his government Sweden interfered in a most awkward manner in the affairs of Europe. First, it fell out with England, lost the island of St. Bartholomew, and saw an English fleet victorious in the Baltic; then it successively came into conflict with France and Russia, and lost Pomerania and Finland; finally, the army rebelled and deposed the king Mar. 29, 1808. The duke of Sodermanland succeeded, and reigned from June 6, 1809, as Charles XIII., but as he had no children, the French marshal Bernadotte was chosen crown prince, and he soon became the real ruler of the country. He refused to join Napoleon in his war against England, concluded an alliance with Russia, and led the Swedish army in 1813 and 1814, in reward for which he obtained Norway from Denmark by the Peace of Kiel (Jan. 14, 1814). After the death of Charles XIII. (Feb. 5, 1818), Bernadotte ascended the throne as Charles XIV. John. His measures for the material development of the country were successful, but in other respects his government was destitute of any definite character—a perpetual yielding to the nobility. He d. Mar. 8, 1844, and was succeeded by his son, Oscar I., who promised a reform of the constitution in a liberal direction, but did not carry it out, and who in 1854 showed a desire of joining France and England against Russia in order to reconquer Finland, but remained neutral. During the reign of his son, Charles XV., who succeeded him July 8, 1859, the constitutional reform was accomplished, June 22, 1866. He d. Sept. 18, 1872, and was succeeded by his brother, Oscar II. AUGUST NIEMANN.

Sweden (LANGUAGE AND LITERATURE OF). See SWEDISH LANGUAGE AND LITERATURE.

Sweden, p.-v. and tp., Oxford co., Me. P. 549.

Sweden, tp., Monroe co., N. Y. P. 4558.

Sweden, p.-v. and tp., Potter co., Pa. P. 357.

Swe'denborg (EMANUEL), b. in Stockholm, Sweden, Jan. 29, 1688. His father, Jesper Swedberg, was bishop of Skara in West Gothland, and was charged with the care of the Swedish churches in England and in the North American colonies. His family was ennobled by Queen Ulrica in 1719, and took the name of Swedenborg. He thereafter took his seat with the equestrian order of nobles. His education was the best which could be given him. After leaving the University of Upsala, he travelled widely through Europe. In the course of his life he visited Italy, France, and Germany, and spent much time in Holland and in England, publishing most of his books in those countries. He applied himself with great industry to mathematics and mechanics, and later to the natural sciences, and especially to physiology. In 1716 he was made assessor of the board of mines by Charles XII. He assisted the king at the siege of Frederickshall in 1718 by transporting some vessels over fourteen miles of land by machines of his own invention. Between 1718 and 1733 he published many small mathematical and philosophical works; among them were treatises on chemistry, in which he attempted to apply geometry to the phenomena of chemistry and physics; on the elemental nature of fire; on a new method of finding longitudes by lunar observations; on a method of constructing docks and dikes; and on a mode of ascertaining the powers of vessels by the application of mechanical principles. At Leipsic, in 1722, he published *Miscellaneous Observations* on various scientific questions; among them were proofs that some of the Swedish mountains, and much of what is now dry land, were once under the sea, and that the whole earth was at one time probably covered with water; that the transmutation of metals, then sought by many, was impossible; that there is no central fire in the earth. In the same year he published a treatise on the Swedish currency. For the next ten years he published nothing, being occupied with the duties of his office. In 1734 he published, at the expense of the duke of Brunswick, his *Philosophical and Mineralogical Works,* in 3 vols. folio, of which the first volume is his *Principia, or the First Principles of Natural Things, being new Attempts toward a Philosophical Explanation of the Elementary World.* This very remarkable work is a complete cosmogony, and it would be impossible to give here even a general account of it; but some of his views may be stated. He held that matter is resolvable in the last analysis, not into definite atoms or molecules occupying space, but into points of dynamic force. This view Faraday held, and some of his remarks imply that he considered it demonstrable. The same view is expressed at the close of De la Rive's great work on electricity as the only one which accounts for electrical phenomena. Swedenborg in his *Principia* sets forth distinctly the nebular hypothesis. Laplace, who is regarded as its originator, says Buffon first suggested it to him, and a copy of Swedenborg's *Principia* is now in London which was owned by Buffon, and has his autograph on the title-page. Swedenborg asserts that nature is everywhere the same, in great as well as in little, mere size making no difference. Hence he maintained a peculiar doctrine of vortices, looking on each molecule, which is derived from the primal point, and each sun and earth formed of molecules, as all having the gyrating force of the primal point, which he defines as "pure and total motion," and as the origin of all things in nature. These vortices were entirely different from those of Descartes and Leibnitz, which Newton's theory of gravitation superseded. He held also that heat, light, and electricity were but modifications of one element, one ether, and that magnetism is in all matter, latent or active, and is one of the means and forces by which matter exists. This view also is very similar to that which Faraday held. But it is difficult to present his views on these subjects intelligibly in few words. In 1734 he published in Leipsic a small work on *The Infinite, and the Prime Cause of Creation, and the Mechanism of the Operation of the Soul and the Body.* In 1740 he published *The Economy of the Animal Kingdom;* in 1744 and 1745, *The Animal Kingdom* and *The Worship and Love of God.* At that time his reputation as a man of science and a philosopher was firmly established. He was a member of many learned societies, and had been invited in the most flattering terms to become a professor of pure mathematics in the University of Upsala. From that time to the present eminent scientists who have studied his works have borne testimony to his wide and exact learning and profound thought, and acknowledged that important discoveries in science were anticipated by him.

He had always been a thoroughly religious man, but for a few years before 1745 his diaries and notebooks (which have been published to the extent of 12 or more 8vo vols.) show that he was changing the direction of his studies from the physical and natural to the psychical and spiritual. In that year, he tells us, he "was called to a new and holy office by the Lord himself, who manifested himself to him in person, and opened his sight to a view of the spiritual world, and granted him the privilege of conversing with spirits and angels." In 1747 he resigned his office of assessor, which he had held for thirty years, requesting that half of his salary might be continued to him. The king accepted his resignation, and granted him a pension for life equal to his full salary. He wrote to a friend: "My sole view in this resignation was, that I might devote myself to that new function to which the Lord had called me. On resigning my office a higher degree of rank was offered me, but this I declined, lest it should be the occasion of inspiring me with pride." From 1749 to 1756 he published the *Arcana Cœlestia* in 8 4to vols.; in 1758, *An Account of the Last Judgment and the Destruction of Babylon; On the White Horse mentioned in the Revelation; Heaven and Hell; On the Planets in our Solar System and in the Starry Heavens,* and *On the New Jerusalem and its Heavenly Doctrines;* in 1763, *The Doctrine of the New Jerusalem concerning our Lord,* same *Concerning the Sacred Scriptures,* same *Concerning Faith,* same *Concerning Life,* a *Continuation concerning the Last Judgment and the Destruction of Babylon,* and *Angelic Wisdom concerning the Divine Love and Wisdom;* in 1764, *Angelic Wisdom concerning the Divine Providence;* in 1766, *The Apocalypse Revealed:* he had written a much larger work, *The Apocalypse Explained* as far as the 10th verse of the 19th chapter, which he did not publish, nor, as far as is known, finish—it has been published since his death; in 1768, *The Delights of Wisdom concerning Conjugial Love;* in 1769, *A Brief Exposition of the Doctrine of the New Church,* and a small work entitled *The Intercourse between the Soul and the Body,* which is called in the English translation *A Treatise on Influx.* In 1771 he published his last work, *The True Christian Religion, containing the Universal Theology of the New Church.* He also left voluminous manuscripts, of which Dr. J. F. S. Tafel, professor and librarian in the University of Tübingen, published many. After the publication of the *True Christian Religion* he went to London, and while there, on Christmas Eve in 1771, he was struck with hemiplegia. After a few weeks he recovered his speech, and his faculties were clear to the last. His strength gradually declined, and he died, without pain or struggle, Mar. 20, 1772.

He has never been charged with imposture. In his system religion and philosophy are one, and in neither of them can there be found anything to suggest the idea of unsoundness of mind. His scientific and philosophical works, published before what his disciples call his illumination, are characterized by exact statement and sustained and coherent argument. The same qualities are to be found

in his theological writings so far as they relate to principles or doctrines. For thirty years he held an important public office, and how well he discharged its duties may be inferred from the favor of his king when he resigned it. As one of the nobles of Sweden he took an active part in their deliberations. Count Höpken, in 1761 and for many years prime minister of Sweden, said, in an address delivered after his death, "The most valuable and well-written memorials on finance were presented to the diet of 1761 by Swedenborg." This was after he had published for years, and while he was continuing to publish, his relations of things seen and heard in the spiritual world, and was widely known in Sweden as professing to have his spiritual senses open. What must have been the strong sense and sound judgment which could thus commend themselves to men of business and overcome the prejudice against him as a visionary! He had the friendship and confidence of the sovereigns of Sweden to his death. His rules of life exhibit the man. They were: "I. Often to read and meditate on the word of God; II. To submit everything to the will of Divine Providence; III. To observe in everything a propriety of demeanor, and to keep the conscience clear; IV. To discharge with fidelity the functions of my employment and the duties of my office, and to render myself in all things useful to society." They who think he was insane must rest that opinion on the fact that for more than twenty-five years, with brief intermissions, he claimed that he was in the spiritual world whenever he wished to be there, and published what would fill volumes of things there seen and heard. He held that we live while in this world because we have a spiritual body, which fills and animates our material body; that this spiritual body is formed of spiritual substance, and at death (which usually occurs about the third day after apparent death) leaves the material body and rises into a world of spiritual substance; that spiritual substance stands to the spiritual organs of sense and the mind therein as material substance stands to the material senses, and is related to and affects them in a similar way; that this material substance, while the spiritual body is within it, is an instrument by which the spiritual senses perceive material things, and a barrier between them and spiritual things; and that when it pleases Providence this barrier ceases, wholly or partially, to obstruct the perception by the spiritual senses of spiritual things. Then the spiritual senses are "open."

It may be added that Swedenborg exhibited in many instances a knowledge of facts which, as it seemed, implied an opening of his spiritual senses. Kant, the German philosopher, examined into and related some of them. In 1759, Swedenborg was in Gottenburg, and on the 19th of July dined at the house of William Castel with a large party. About six o'clock he appeared much disturbed, and stated that a dangerous fire had broken out in Stockholm at the Sudermalm, and was spreading rapidly. He then described the progress of the fire, and at eight o'clock declared that it was extinguished. This was reported to the governor, who sent for Swedenborg and received from him a description of the fire. On the 21st a messenger arrived from Stockholm (which is 300 miles from Gottenburg), announcing the fire and describing it precisely as Swedenborg had done. Another case is this: Marteville, ambassador from Holland to Sweden, died, and his widow married again; a claim was brought against his estate for 28,000 guilders, which she knew her husband had paid, but the receipt could not be found. A story arose that Swedenborg had helped her to it. Her second husband, being applied to, made the following statement: She had requested Swedenborg to learn from her husband where the receipt was. He replied he would do so if he could; a week afterward Marteville came to her in a dream and described to her a secret drawer in his cabinet where she would find the receipt, and also a valuable jewel which had been lost. She arose at once, found the drawer, and in it the receipt and the jewel. Early the next forenoon Swedenborg called and stated that he had seen Marteville the preceding night, who told him he should go and impart to his wife a matter of much moment to her. The queen of Sweden, seeing Swedenborg at court, made some inquiry of him respecting her brother, the prince of Prussia, who had recently died. He replied that he had not seen him. A week afterward he came again to court, went at once to the queen, and in a low tone made a communication to her. She was much moved, and said to those about her, "Only God and my brother can know what he has just told me." Of these incidents Kant simply says the evidence is unanswerable, but does not himself testify to them or to his belief of them. His religious views Kant entirely rejected. Of his philosophy he makes this singular statement: "The system of Swedenborg is unfortunately very similar to my own philosophy. It is not impossible that my rational views may be considered absurd by reason of that affinity. As to the offensive comparison, I declare we must either suppose greater intelligence and truth at the basis of Swedenborg's writings than first impressions would give, or that it is a mere accident when he coincides with my system—a *lusus naturæ*. Such a wonderful agreement exists between his doctrines and the deepest results of reason that there is no other alternative whereby the correspondence can be explained." Many other circumstances similar to the foregoing narratives might be mentioned. But Swedenborg never regarded them as proofs of his mission, or as of importance in any way, holding that the doctrines of the New Church (for a brief statement of which see article on the NEW JERUSALEM CHURCH) could be received only in freedom, and by those to whose desire for goodness they commend themselves, and whose reason they satisfy.

THEOPHILUS PARSONS.

Swedenborgians. See NEW JERUSALEM CHURCH, by T. PARSONS, LL.D.; and SWEDENBORG.

Swedes'borough, p.-v., Woolwich tp., Gloucester co., N. J., on Raccoon Creek, at S. terminus of Philadelphia and Swedesborough branch of West Jersey R. R., has 1 newspaper and several manufactories, and is situated in the midst of a fine fruit growing region.

Swedes'burg, v., Upper Merion tp., Montgomery co., Pa., on Schuylkill River. P. 386.

Swedish Language and Literature. The Swedish language is a modern development of that Teutonic language which in ancient times was spoken uniformly throughout the whole of Scandinavia, Denmark, Norway, and Sweden under the name of *Norræna* or *Dönsk Tunga*, and which, in the ninth century, was brought to Iceland by the Norwegian colonization of that island, where it still lives in its original form under the name of the Icelandic language. It is impossible to tell exactly at what time this primitive language began to separate into the different branches, Danish and Sweden. The Runic inscriptions, in which Sweden is very rich, and which are found from the southern frontier of Denmark to the northern part of Sweden, show that the separation had not taken place in the eleventh century. Nevertheless, in the sixteenth century, at the time of the Reformation, Swedish had become an individual language, as different from its mother-tongue, the Icelandic, as from its sister-tongue, the Danish; and from that time it went on developing on its own principle, but influenced first by the German, and then by the French language, until in the eighteenth century it became finally settled in its present form, a little earlier than the Danish. Of the Scandinavian languages, the Swedish is, without any qualification, the most beautiful. Its materials are purer than those of the Danish, richer than those of the Norwegian, and in its grammatical forms it is more varied and less weakened than the Danish, more easy and less encumbered than the Norwegian. Its speech is sonorous and melodious, like that of the southern languages, remarkable for its clear, beautiful vowels, and marred with no harsh consonants. But the style in which it is written is inferior. Only on two fields, the humorous song and the historical narrative, has the Swedish style attained any high degree of excellence, and succeeded in establishing this degree of excellence as the general standard. On other fields exaggeration and vagueness are not uncommon.

A series of detached literary monuments from the fourteenth and fifteenth centuries, a more collected effort in the sixteenth, brought about by the Reformation, and a rather fantastical attempt in the seventeenth, inspired by Queen Christina, form the introduction to the history of the Swedish literature, which begins in the eighteenth with Olaf Dalin. The oldest literary monuments are provincial laws of the thirteenth: *Kämparisor* and some religious writings, the revelations of St. Brigitta of Wadstena (1302-72), of the fourteenth; *Riddarrisor* and rhymed chronicles of the fifteenth century, of which the *Kämparisor* and *Riddarrisor* are the most remarkable. They are popular songs, the first of a more heroic, the second of a more chivalric character, and they exhibit the closest resemblance to the Danish *Kjæmperiser*, both in the subjects they treat and in their general treatment, tone, and language. But they have had a very different fate. In Denmark all singing ceased from the middle of the seventeenth century, and when once more a song was heard in that country, in the last decade of the eighteenth century, it was a product of literature and an affair of society; it flourished a short time, and then it died out almost entirely. In Sweden the popular song continued flowing in one uninterrupted stream from pagan times to our days. The skald, the knight, the peasant, the soldier, the priest, the student, followed one after the other, and the songs rang in every corner of the country. The popular song is the golden leaf in Swedish literature. A Swedish song

means the same as a Dutch picture or a Greek statue, the best the nation has produced. In 1476 a university was founded at Upsal; in 1483 a printing-office was established at Stockholm; and thus Sweden was possessed of the two most effective literary instruments which modern times have invented. Nevertheless, the literature which the Reformation called forth in Sweden was not great. Olaus Petri (1497–1552) translated the New Testament, composed a comedy of the book of Tobit, and wrote a Swedish chronicle. Laurentius Petri (1499–1573) translated the Old Testament and published a collection of sermons and hymns. But although these two men, who stood at the head of the whole movement, were not exclusively theologians, the literature which resulted from the spiritual fermentation of the time was mostly confined to theology. Under Gustavus Adolphus (1611–32) several libraries were captured in Germany and carried to Sweden, and his daughter, Queen Christina (1632–54) invited many of the most celebrated literary men of Europe to her court—Descartes, Salmasius, Vossius, Huet, Heinsius, Puffendorf, and others. Thus, broader views were originated and new starting-points formed, but the whole had an artificial and fantastical character. The two most conspicuous men of this time were Olaf Rudbeck (1630–1702) and Georg Stjernhjelm (1598–1672). Rudbeck was one of the most extraordinary men of his time. He studied medicine and discovered the lymphatic vessels; he lectured on botany at Upsal and founded the botanical garden; he became professor in anatomy and was deeply versed in the science of mechanics. But he became most famous as an antiquarian. His work, *Atlantica sive Manheim*, is one of the most learned and ingenious books ever written, though the sum-total of the whole argumentation is that Adam and Eve were Swedes, and Paradise located at Upsal. Stjernhjelm is less fantastic, because he was less gifted, but he is more artificial, for he was only an imitator. On account of his *Hercules*, a didactic epic, written in hexameters, he is generally called the father of Swedish poetry, but that is only a title.

In the beginning of the eighteenth century Swedish literature rid itself of the aspect of insulated efforts and incidental talents, and assumed the character of conscious education and representative taste. This period, which extends into the next century, to 1809, went through three different phases of rising (Dalin), culminating (Gustavus III.), and falling into decay (the Academy), but it may be generally characterized as the reign of French taste. Great activity was shown both in science and in literature proper. It was the time of Linnæus (1707–78) and Swedenborg (1688–1772). Christopher Polhammer (1661–1751) constructed the Trollhætta Canal and the dock at Carlscrona. Johan Ihre (1707–80) wrote his Swedish dictionary and a grammar of the Latin language, which was extensively used also outside of Sweden. Olaf Rudbeck the younger (1670–1740) was a good ornithologist, and C. V. Scheele (1742–86) a great chemist. But it was from the poet Olaf Dalin (1708–63) that the period received its true character. He was not a man of genius and great creative power, but he had versatile talents, taste, education, and knowledge. He could not awaken new life, but he could form a standard, and for nearly a century his countrymen followed the direction he had given them. He studied first medicine, and then law, but turned later to history, and his *Svea Rikes Historia* (4 vols., 1747–62) exercised a great influence, not on account of its new and elevated views—for as a critical and philosophical work it is rather deficient—but on account of its noble narrative and elegant style. Still greater was the effect of his *Den Svenska Argus*, a literary periodical, an imitation of Addison's *Spectator*, which he published in 1733 and 1734. It made him the centre of the Swedish civilization, and the influence of his talent and taste was still more strengthened by his relations to the court; he was the tutor of the young crown prince and a favorite of the queen, Luise Ulrike, a sister of Frederick II. of Prussia. Of his poetical works, *Den Svenska Friheten*, an allegorical epic, and *Brynhilda*, a tragedy, are cold and trivial to our taste, but in their own time they were models, and looked like inspirations; and his satires and minor poems are often witty and ingenious, always lively and elegant. Of a very different character were the poems of Mrs. H. C. Nordenflycht (1718–63), but it was only a difference of talent, not of taste. The literary circle of which she formed the centre, and which later developed into a literary society, "Utile Dulci," was nothing but a propaganda for French taste. The most prominent members of this circle were G. P. Creutz (1729–85), the author of *Atis och Camilla*, an idyl, which charmed all people, and G. F. Gyllenborg (1731–1808), who wrote *Tåget öfver Belt*, an epic. During the reign of Gustavus III. (1771–92) the period reached its culmination. Gustavus was a highly-gifted man, eloquent, ambitious, and with a lively sense for poetry and art. His craving for magnificent action, and more especially for the admiration which generally accompanies great deeds, found only a scanty gratification in real life, but with so much the greater intensiveness it turned to the ideal. The king became a poet himself, and he and his court stood actually at the head of Swedish literature. Like his uncle, Frederick II., he was deeply imbued with French ideas and French taste, but he was more successful in making his court the seat of the Muses and Graces, for he was less narrow. I. H. Kellgren (1751–95), C. G. Leopold (1756–1829), and J. G. Oxenstiern (1750–1818), the three greatest celebrities of the period, and intimate friends of the king, were not imported from France, like Voltaire and Maupertuis; nor were they mere imitators. The French period in Sweden was always thoroughly patriotic; the subjects were taken from Swedish life and history. And it was national, at least so far as it generally took its pictures from Swedish landscapes. A certain independence it also showed by preferring the English edition of the French taste to the original. Pope and Addison were followed more closely than Boileau and Voltaire. And it admitted within its pale Bellmann (1740–95), the very opposite to the classical ideal, a romanticist before romanticism was discovered. He dashed down on paper, with a few broken lines, some grotesque figures in some still more grotesque situations, such as he had seen in his nightly carousals in the suburbs of Stockholm, and with a few dots here and there he indicated the Swedish landscape which formed the background of the scene. But couched as these strophes are in a most original music, which he composed himself, the whole forms a picture of a delicacy, depth, and power of impression which are rarely equalled. There is ten times more elegance in the representation Bellmann gives of a drunken corporal than in that Voltaire gives of a princess; and his countrymen felt it immediately, and accepted him. But on literature at large Bellmann had no influence.

A transition from the classical to the romantic ideal, from the French to the German influence, was formed critically by C. A. Ehrensvärd (1745–1800) and C. H. Hoijer (1767–1812), and poetically by F. M. Franzén (1772–1847) and J. O. Wallin (1779–1839). Ehrensvärd's *De fria Konsternas Filosofi* ("The Philosophy of the Fine Arts") was very slow in gaining acknowledgment, but Hoijer's lectures on philosophy at the University of Lund were heard with enthusiasm. Of the works of Franzén and Wallin, it is their hymns which connect them with the new time that suddenly burst upon Sweden after the political revolution of 1809. Great scientists arose—in chemistry, Johan Jakob Berzelius; in botany, Elias Fries and K. A. Agardh; in history, Fryxell and Geijer; in medicine, Retzius; in philosophy, Boström; in theology, Reuterdahl and Thomander; and it is worth noticing that the Latin language was now abolished in scientific communications and supplanted by the Swedish. In literature proper the new time announced itself under two forms, the romantic and the national, of which the former was most conspicuous in the contest with the old, while the latter became the true representative of Swedish taste and Swedish civilization. The romantic school, called the "Phosphorists," from *Fosforus*, the name of its journal, was headed by P. D. A. Atterbom (1790–1855) and L. Hammarsköld (1785–1827), the first as poet, the latter as critic. Atterbom was a rich genius, deep though somewhat mystical, and generally true in spite of the exuberance of his imagination. But his turn of mind was more reflective than plastic. His lyrical poems, many of which are very long, have already lost some of their impressiveness. But his book on the history of the Swedish literature, *Svenska Siare och Skalder* (6 vols., 1841–55), is a work of the very first rank. Also Hammarsköld's *Svenska Vitterhedens Historia* ("The History of Swedish Literature") is an interesting and valuable book, though somewhat partial and confused. Influenced by the romantic school, although not belonging to it, stood E. J. Stagnelius (1793–1823), perhaps the greatest poetical genius the Swedish people have produced, perhaps only considered so on account of the peculiarity of his mind, which he lived long enough to show, but not long enough fully to expose. The national school, called also the Gothic, and represented by the journal *Idunna*, was headed by Tegnér and Geijer, on whom special articles will be found in this book, as well as on the later representative, Runeberg. The Goths emancipated themselves very soon from the character of being a school, of which character they had borne very strong marks at their first appearance, especially in the writings of P. H. Ling (1766–1839). Men like Tegnér and Geijer form no schools; they make a national literature, and they found in the next generation many and various talents which followed out in every direction the principles given. Clemens Petersen.

Swedo'na, p.-v., Richland Grove tp., Mercer co., Ill. P. 359.

Sweet Bay. See BAY.

Sweetbrier. See EGLANTINE and ROSE.

Sweet-bread. See PANCREAS.

Sweet Chalyb'eate, p.-v., Alleghany co., Va., so named from its mineral springs, a place of summer resort.

Sweet Flag. See ACORUS CALAMUS.

Sweet Gale. See GALE.

Sweet Gum. See GUM TREE.

Sweet Home, tp., Clarke co., Mo. P. 1000.

Sweet Land, tp., Muscatine co., Ia. P. 1510.

Sweet Pota'to, the *Batatas edulis*, a convolvulaceous twining plant, a native of Southern Asia, whose rich sweet tuberous roots are employed as food. The sweet potato is extensively cultivated as an article of food in the U. S. It is grown as far N. as New Jersey, and does well in S. Michigan. It is the potato of the older English writers.

Sweets'burg, p.-v., Dunham tp., Missisquoi co., Quebec, Canada, on South-eastern Counties Junction Railway, 41 miles W. by N. of Stanstead. P. about 300.

Sweet'ser (CHARLES HUMPHREYS), b. at Athol, Mass., Aug. 25, 1841; graduated at Amherst College in 1862; founded the *Round Table*, a literary journal, in New York; was connected with other newspapers, and in 1867 was one of the originators of the *Evening Mail*; he, however, discontinued his connection with this, and in 1869 commenced the *City*, which ill-health compelled him to discontinue. He published *Songs of Amherst College* (1860), *History of Amherst College* (1860), and *Tourist's and Invalid's Guide to the North-west* (1867). D. at Pilatka, Fla., Jan. 1, 1871.

Sweet Sop, the soft, sweet, and aromatic fruit of *Anona squamosa* (order Anonaceæ), a small shrub, a native of tropical America, now common in most hot countries. It is extensively used as an article of food. Its seeds have an acrid, perhaps a poisonous quality, shared by the leaves, which have also a disagreeable smell.

Sweet Springs, p.-v. and tp., Monroe co., West Va. P. 1354.

Sweet'water, county of Central Wyoming, extending from Montana on the N. to Colorado and Utah on the S., crossed by the Wind River and Rocky mountains, watered by Big Horn, Green, and Sweetwater rivers, and traversed in the S. part by Union Pacific R. R. Some gold and iron have been found. Cap. Green River City. Area, about 35,000 sq. m. P. 1916.

Sweet Water, p.-v. and tp., Menard co., Ill. P. 230.

Sweet Water, p.-v., Monroe co., Tenn., on East Tennessee Virginia and Georgia R. R., 42 miles W. of Knoxville, in the heart of Sweetwater Valley, has several churches, 2 schools, 1 foundry, 1 newspaper, and 3 machine-shops. It is the business-centre of Monroe co. P. about 1200.

C. B. WOODWARD, ED. "ENTERPRISE."

Swetchine' (ANNE SOPHIE), b. at Moscow in 1782; was educated at the court of Catharine II.; married in 1799 Gen. Swetchine, and kept one of the most celebrated salons in St. Petersburg. In 1815 she turned to Roman Catholicism. She then removed to Paris, where she d. Sept. 10, 1857. After her death De Falloux published *Mme. Swetchine, sa Vie et ses Œuvres* (2 vols., 1859). The *Life and Letters of Madame Swetchine* and *The Writings of Madame Swetchine* were translated into English by Harriet W. Preston (1867 and 1869).

Swett (JOHN APPLETON), M. D., b. in Boston Dec., 1808; graduated at Harvard College in 1828 and at the Harvard Medical School in 1831; studied in Paris, especially in the hospitals; returned to America, and became connected with the New York Dispensary, where he delivered a series of lectures which were regularly reported and published in the New York *Lancet*. In 1842 he was elected one of the physicians to the New York Hospital, and in 1853 was appointed professor of the theory and practice of medicine in the University of New York. D. Sept. 17, 1854. He left a considerable legacy for the benefit of the orphans and widows of medical men; and published a *Treatise on Diseases of the Chest*, being a course of lectures delivered by him in the New York Hospital (1852).

Swett (SAMUEL), b. at Newburyport, Mass., June 9, 1782; graduated at Harvard College in 1800; studied law, and entered upon practice, but subsequently became a merchant; was a representative in the legislature of Massachusetts, and during the war of 1812 served on the northern frontier, on the staff of Gen. Izzard, with the rank of major. He published—*Abstract of Baron de Rogniat's Considerations on the Art of War* (1817), *History of the Battle of Bunker's Hill* (1826), *Sketches of a Few Distinguished Men of Newbury and Newburyport* (1846), *Who was the Commander at Bunker's Hill?* (1850), *Defence of Col. Timothy Pickering against Bancroft's History* (1859), *Original Planning and Construction of Bunker's Hill Monument* (1859), and fugitive poems. D. at Boston Oct. 28, 1866.

Sweyn, or **Sven,** king of Denmark and father of Canute the Great; invaded England, conducted several successful campaigns, and proclaimed himself king, but died (1014) before he had firmly established his power, leaving Canute as his successor.—Another SWEYN, son of Godwin, earl of Kent, a powerful Anglo-Saxon noble, and connected by marriage with Sewyn of Denmark, ravaged Wales in 1046; abducted an abbess; fled to Bruges, thereby forfeiting his estates; served in the English fleet against the count of Flanders; was restored to his estates; murdered his kinsman, Bjorn, and in expiation went on a pilgrimage to Jerusalem. Died on his way home, about 1050.

Swietenia. See MAHOGANY.

Swie'ten, van (GERARD), b. at Leyden May 7, 1700; studied medicine, pharmacy, and chemistry at Louvain and in his native city under Boerhaave, and was appointed professor of medicine, but was subsequently compelled to resign his office because he was a Roman Catholic. He went to Vienna, where he was appointed physician to the empress Maria Theresa, president of the faculty of medicine, and director of the imperial library. D. at Schönbrunn June 18, 1772. He wrote *Commentarii in H. Boerhaavii Aphorismos de cognoscendis et curandis Morbis* (5 vols., Leyden, 1741–72).

Swift, the name given to certain swift animals. I. It is most familiar in connection with birds of the family Cypselidæ, evidently bestowed on account of their swiftness of flight, and has been extended as a popular scientific term to all the members of the family. These have the same general form as the swallows, and, as is exemplified in the familiar "chimney swallow" (a true swift) of the U. S., the neck is short; the head depressed; the bill is very small and short, much depressed, and transversely triangular, being broad at the base, and with the sides converging rapidly toward the tip; the gape is very deep, and extends backward beneath the eyes; there are no well-defined rictal bristles; nostrils superior and close together; the wings are very long and pointed, incurved and pointed, and have ten primaries, of which the first and second are longest; the tail is diversiform, but always composed of ten feathers; the legs are very short and weak (much more so than in the swallows), the tarsi being much shorter than the middle toe; they are destitute of distinct scutellæ; the toes are of normal structure, each three-jointed (the modifications serving to differentiate the species into sub-families), but the hinder is always more or less versatile; the claws are well developed, curved, and acute. Co-ordinate with these superficial characters are some important osteological and myological ones. The sternum is almost if not quite destitute of a manubrial process, and its posterior border is entire, being sometimes convex and rarely concave; the scapular ends of the clavicles are not T-shaped; and the muscles of the lower larynx have not more than one pair of intrinsic muscles. The humerus is very short and the manus very long, in this respect agreeing with the corresponding parts of the goatsuckers, the near relatives of the swifts, and much exceeding the tendency in the same direction exemplified in the swallows. The species are less numerous than the swallows, Gray recognizing only 69. Remarkable differences in the structure of the feet differentiate the species into two sub-families—viz. (1) Cypselinæ, in which the three anterior digits have each three phalanges; and (2) Chæturinæ, in which the digits have, respectively, the outer five, the middle four, and the inner three phalanges, as in birds generally. Their distribution nearly coincides with that of the swallows, almost every country having its species. They also agree in most respects as to habits with the swallows, but their voice differs, and instead of being a kind of cheerful twitter, as in the swallows, is a feeble scream. The North American species are (1) *Panyptila melanoleuca*, white-throated swift; (2) *Nephœcetes niger*, black swift; and (3) *Chætura pelagica*, chimney swallow. The first two are Cypselinæ, the last Chæturinæ. To this family belong the birds (*Collocalia*) which make the celebrated edible nests so esteemed in China. II. In some parts of the U. S., especially of the Southern States, swift is also the name given to certain lizards of the family Iguanidæ, and especially to the *Sceloporus undulatus*, a species which runs with great celerity.

THEODORE GILL.

Swift, county of W. Minnesota, formed since the census of 1870, drained by Minnesota, Chippewa, and Pomme de Terre rivers, and traversed by St. Paul and Pacific R. R. The surface is rolling, with several small lakes, and the soil good. Cap. Benson. Area, about 750 sq. m.

Swift (JONATHAN), D. D., b. in Dublin Nov. 30, 1667. His father died seven months before the birth of his famous son, leaving his widow and an infant daughter in extreme

penury. His uncle Godwin made some provision for the family, and, when Jonathan was fifteen, had him entered at Trinity College, Dublin, where in 1685 he received his degree of B. A. by special favor. He seems to have remained at college until 1688, his uncle Godwin having in the mean time died insolvent, his maintenance and education being now assumed by his uncle William, of whom Swift always spoke with gratitude and affection. Subsequently, Swift joined his mother in England, where she was living on the bounty of relatives, one of them the wife of Sir William Temple. Sir William received him into his household at Moor Park in Surrey, making use of his services as an amanuensis, and apparently giving him the means of entering himself at Oxford for a short time, where he obtained his degree as M. A. in 1692. While residing at Moor Park he read much, but greatly impaired his constitution by what he ambiguously styles "a surfeit of stone-fruit." Whatever this surfeit may have been, among its consequences were frequent attacks of vertigo, prostration, and those forebodings of ultimate insanity which shadowed his whole life, and caused him to observe his birthday as a day of mourning. His position at Moor Park was an unpleasant one, and he went over to Ireland, and not without difficulty succeeded in 1695 in gaining admittance to holy orders and the prebend of Kilroot, worth £100 a year. Temple soon missed his services, and invited him to resume them: Swift was weary of living in a remote Irish town, and accepted the invitation. It was during this second residence at Moor Park that the intimacy grew up between Swift and Esther Johnson, known best as the "Stella" of Swift's life. She was a pretty, black-eyed girl of about thirteen, who with her mother occupied an anomalous position in the household: nominally, she was an attendant of Lady Giffard, Temple's sister, but was always called "Miss Hetty," and was generally, but without sufficient grounds, supposed to be a natural daughter of Sir William. Swift, who was more than twice her age, took a sort of charge of her education, and as she grew up she became devotedly, and beyond all doubt innocently, attached to him. Swift's position was greatly improved: he saw Temple's visitors, of whom King William III. was not seldom one, who promised that the young secretary should some day have an English prebend. Temple died in 1699, leaving a legacy of £1000 to "Miss Hetty" and a sum of money to Swift, with the charge of editing his posthumous works—a task which he performed, dedicating the volume to the king, and confidently expecting some substantial acknowledgment. But none came, and Swift accepted an offer of Lord Berkeley, who had been appointed one of the lords justices of Ireland, to accompany him as chaplain and private secretary. But his lordship was told that the post of secretary was unfitted for a clergyman, and Swift was persuaded to surrender it upon promise of receiving the first good church benefice which should fall vacant. This proved to be the vicarages of Laracor and Rathbeggan and the prebend of Dunlavin, all worth about £350 a year. He took possession of Laracor in 1700, and Stella, accompanied by an elderly female friend, came over to Ireland, took lodgings in a neighboring village, but made her residence at the rectory whenever Swift went to London, which he did every year. Swift while at Moor Park had written considerable, the famous *Tale of a Tub* probably being written at this time, but had as yet published nothing. In 1701, on his first visit to London, he made his earliest essay as a political writer in a pamphlet purporting to be a *Discourse on the Contests between the Nobles and the Commons of Athens and Rome*, but which was really a defence of the Whig leaders. This was received with great favor, and brought him into immediate connection with the political and literary chiefs of the party; but no preferment was offered him which he thought worth his acceptance, and in 1708 he went directly over to the Tories, who now came into power. He had set his heart upon an English bishopric, which was precisely what they dared not give, for his *Tale of a Tub* had been published, and the archbishop of York had persuaded Queen Anne that the author of that witty but indecent burlesque was unfit to wear the lawn sleeves; the most they could venture was to promote Dr. Sterne, the dean of St. Patrick's, to the bishopric of Dromore, and give the deanery thus vacated to Swift, who in 1713 went back to Ireland. Some four years previously he had become acquainted with Hester Vanhomrigh, whom he celebrates as "Vanessa," the daughter of a widow who would have upon the death of her mother a fortune of about £4000. She was less than twenty, he more than forty years old: she fell violently in love with him, and urged him to marry her; this he evaded, rather than positively declined, but their intimacy, an entirely innocent one, continued, and at length, her mother having died, she followed him to Ireland, much against his wish, and, ignorant of the claims of Stella, continued her eager suit to him. She finally learned of his relations with her rival, and in 1723 wrote to her demanding to know in what position she stood to Swift. Stella sent this letter to him; he rode straight to the residence of Vanessa, flung the letter before her without saying a word, and left her. Her heart was broken, and she died within a short time. The year which witnessed the death of Vanessa was a notable one in the life of Swift. There was a scarcity of small coin in Ireland, and a patent was granted to one William Wood for coining brass farthings and halfpence to the amount of £108,000; and this scandalous privilege had been granted at the instance of the duchess of Kendall, one of the king's mistresses, who was to share the profits. The people were indignant; the Irish Parliament vainly remonstrated, until one day a letter appeared in a Dublin newspaper bitterly denouncing this debased coinage, and signed "M. B., Drapier," followed in quick succession by several others. The *Drapier Letters* struck the right chord and gave form to the popular feeling. No one would take the obnoxious halfpence. The government offered a large reward for the discovery of the author of the letters, and urged a prosecution of the printer, but in spite of the rage of the judge the grand jury refused to find a bill against him. When at length it was found that Swift was the author, he became the popular idol, and when the English ministry proposed to arrest him, they were assured that a force of 10,000 men would be required to do this. The *Travels of Lemuel Gulliver* were published anonymously in 1726, in which and the following year Swift visited London, and renewed his intimacy with Bolingbroke, Pope, Gay, Arbuthnot, and others of his old friends; but after the death of Stella, in 1728, he never left Ireland. For several years he kept on writing with all his old vigor and bitterness upon matters connected with Ireland, and composed many verses and epigrams. In 1736 the attacks of vertigo had so seriously shaken him, physically and mentally, that he could no longer continue his literary labors; by 1740 his memory had almost entirely failed, and he became subject to bursts of passion which resulted in furious lunacy, which lasted for two years, when he sank into a state of complete idiocy, continuing three years, until his death. He had some time before made his will, by which he bequeathed the bulk of his property, amounting to about £10,000, to found a hospital for the insane. D. Oct. 19, 1745. The character of Swift was by no means a lovely one, but was far less unlovely than represented by Macaulay and Thackeray. As a humorist Swift occupies the first rank; as a poet, a very low one. The *Tale of a Tub* is his wittiest production. The first two parts of *Gulliver's Travels*, containing the voyages to Liliput and to Brobdingnag, are inimitable as satires upon the times in which he lived. The other two parts, fortunately less read, containing the visits to Laputa and the country of the Houyhnhnms and the Yahoos, are in the main disgusting—the production, let us hope, of a man verging upon insanity. The works of Swift have appeared in numerous forms. (For a list of them see *Allibone*.) The best edition is that edited by Sir Walter Scott (19 vols., 1814). His biography has been written by Dr. Johnson in his *Lives of the Poets*, and by Scott, forming a volume of his edition of Swift's works, which must still be considered the standard biography; for that begun by John Forster, who had collected much new material, was cut short by his death soon after the publication in 1875 of the first of the three proposed volumes. A. H. GUERNSEY.

Swift (JOSEPH GARDNER), LL.D., b. in Nantucket, Mass., Dec. 31, 1783, son of Dr. Foster Swift, U. S. army, and descendant of Thomas Swift and Hopestill Foster, the first settlers of Dorchester, Mass.; in 1800, Joseph was appointed a cadet at the U. S. Military Academy, from which institution he was the first graduate, Oct. 12, 1802, when promoted second lieutenant in the corps of engineers, rising through successive grades to be chief engineer, with rank of colonel, July 31, 1812, during which period he was mainly engaged in the construction of fortifications on the Atlantic coast. In the war of 1812 he first served in the Carolinas on the staff of Maj.-Gen. Pinckney; in 1813, as chief engineer of the army, was engaged in Gen. Wilkinson's campaign on the St. Lawrence, participating in the battle of Chrystler's Field, and subsequently (1813-14) superintended the defence of New York, including Brooklyn and the heights of Harlem; for these services was brevetted brigadier-general Feb., 1814; after the war assumed the direct supervision of the Military Academy, of which he was (*ex-officio*) the superintendent, and was its inspector for a short period previous to Nov. 12, 1818, when he resigned in consequence of the appointment of the French officer Gen. Bernard to the rank of brigadier-general and "assistant engineer" of the U. S. (See BERNARD (SIMON).) Upon his resignation he was appointed surveyor of the port of

New York, which position he held until 1827. In 1829, Pres. Jackson appointed him to superintend the harbor improvements on our great lakes, on which duty he continued until 1845, meanwhile (1830-31) constructing the railroad from New Orleans to Lake Pontchartrain, said to be the first road laid in America with T-rails. (See RAILROADS.) The successful completion of this work through a cypress swamp heretofore considered impassable added much to Gen. Swift's reputation; was chief engineer of the New York and Harlem R. R. 1833; on peace mission to the British provinces 1841. D. at Geneva, N. Y., July 23, 1865. G. C. SIMMONS.

Swift (WILLIAM H.), b. at Taunton, Mass., Nov. 6, 1800; was a cadet at the U. S. Military Academy from 1813 to 1818, when ordered (as a cadet) to join Major Long's Rocky Mountain expedition, with which he served until 1821, having meanwhile (1819) received his commission as second lieutenant of artillery; from 1821 to 1832 served on topographical duty in making surveys of military defences of the Atlantic coast; of the Chesapeake and Ohio Canal; of the Florida Canal, and rivers and harbors of the Gulf of Mexico; in constructing a map of the post-offices and post roads of the U. S.; and in 1828 29 made a survey of the Ithaca and Oswego and Catskill and Ithaca R. Rs., N. Y., and 1831-32 of the Boston and Providence, Norwich and Worcester, and Providence and Stonington R. Rs.; in 1832 was appointed brevet captain and assistant topographical engineer, and for ten years was employed as assistant on the geodetic survey of the Atlantic coast, being in charge of river and harbor improvements from Maine to Connecticut 1837-42; from 1836 to 1840 was also resident and constructing engineer of the Massachusetts Western R. R., from Worcester to the western boundary of Massachusetts; was assistant to the chief of topographical engineers 1843-49, during which period he made (in connection with Ex-Gov. John Davis of Massachusetts) an examination of the ILLINOIS AND MICHIGAN CANAL (which see), and report thereon, resulting in a loan by means of which the canal was completed; from 1847 to 1849 was engaged in constructing the iron-pile lighthouse at Minot's Ledge, Massachusetts Bay, which was destroyed by the great gale in Apr., 1851. (See LIGHTHOUSE CONSTRUCTION.) In 1849 he resigned from the army, and was president of the Philadelphia Wilmington and Baltimore R. R. 1849-51, and of the Massachusetts Western (Worcester, Mass., to Albany, N. Y.) 1851-54; since 1845 has been president of the board of trustees of the Illinois and Michigan Canal, and continued as such until 1871; chairman of trustees of the land mortgage of the Hannibal and St. Joseph R. R. Co. since 1856. G. C. SIMMONS.

Swift (ZEPHANIAH), LL.D., b. at Wareham, Mass., in Feb., 1759; graduated at Yale College in 1778; studied law, and practised at Windham, Conn.; was Representative in Congress 1793-96, and in 1800 secretary to Mr. Ellsworth, minister to France; was appointed judge of the supreme court of Connecticut in 1801, and was chief-justice 1806-19; was several times elected to the State legislature, a delegate to the Hartford Convention, and a member of the committee to revise the laws of the State; published an oration on *Domestic Slavery* (1791), *System of the Laws of Connecticut* (1795-96), *Digest of the Law of Evidence*, etc. (1810), *Digest of the Laws of Connecticut* (1822-23; new ed., revised by Henry Dutton and N. A. Cowdrey, 1849 53). D. at Warren, O., Sept. 27, 1823.—His daughter, MARY A., published about 1833 *First Lessons on Natural Philosophy*, which was a popular textbook for many years, and was translated in 1846 into the Karen language, and in 1848 into Burmese.

Swift Creek, tp., Edgecombe co., N. C. P. 2383.

Swift Creek, tp., Pitt co., N. C. P. 1800.

Swift Creek, tp., Wake co., N. C. P. 1145.

Swim'ming. The specific gravity of the human body being slightly greater than that of water, swimming with man is an artificial operation, but one easily learned, with or without an instructor. There is no better method than that suggested by Dr. Franklin: Let the learner wade out to where the water is breast-deep, turn toward the shore, and throw a white pebble or any other object easily discernible into the water a short distance before him, and plunge after it: the resistance which the water makes to his struggles to reach it will buoy him up, and the moment he has acquired sufficient confidence and command of his limbs to strike out regularly, he has learned to swim. Teachers usually support the breast of the pupil with their hand, and then cause him to strike out properly with his hands and feet; then suddenly withdraw the hand, leaving him to himself. Corks and floats of any kind are a hindrance rather than an aid in learning to swim. When one has learned to keep himself afloat, the next thing is to learn how to propel himself. The body being as nearly as may be in a horizontal position, draw the arms and legs slowly toward the body, and then extend them with a quick and strong impulse. The hands should be kept flat, the fingers closed; in beginning the stroke, the farther forward the arms are thrown the better; the legs should at the beginning be well apart, and in the act of kicking they will be brought together. One will naturally learn first to swim on the belly, striking with all four limbs at once, but the practised swimmer will soon adopt the side stroke. Throwing himself, say, on his left side, he puts forward the left arm so as to form a kind of cutwater, while with the right arm, directed downward and backward, and with both legs, he makes a strong stroke: thus three limbs are always moving at once in the same direction. This method, however, requires much more muscular exertion than that of belly swimming, and can be kept up only a short time without change. Swimming on the back is very easy, and may be kept up for a long time: one can indeed swim in this position without making any use of the arms, which may be folded over the breast, though they will usually be kept close by the side of the body, and a very gentle movement of them is sufficient to keep the face well out of the water: or one may float upon the water merely by this slight movement of the arms. The specific gravity of salt water being greater than that of fresh, it is much easier to swim in it. Indeed, if the saturation is very great, as in the Dead Sea and the Great Salt Lake, the specific gravity is greater than that of the human body, and a man cannot sink in it. Expert swimmers attain a very considerable speed. A British soldier swam 2½ miles in 45 minutes in the Red Sea; a professional swimmer near London swam a mile in 26 minutes; at Chester, Pa., in a swimming-match, J. B. Johnson made 10½ miles in 3h. 10m.; and not long since two young girls swam from London Bridge to Greenwich pier, a distance stated to be nearly 5 miles, the one in 1h. 7m. 45s., the other in 1h. 8m., which is the most rapid swimming on record, although exceeded in other respects by Capt. Webb, who in 1875 swam from Blackwall pier to Gravesend, 20 miles, in 4h. 42m. 44s. Webb also in the same year performed the astonishing feat of swimming from Dover to Calais, in a zigzag course about 50 miles, in a little less than 22h., his body being lubricated with porpoise oil, and he being accompanied by a boat from which he was occasionally furnished with a little refreshment, of which he partook while treading water. These are, however, professional feats which the ordinary swimmer cannot expect to accomplish. (See also DROWNING and RESUSCITATION.) A. H. GUERNSEY.

Swim'ming Pens, tp., Sumter co., S. C. P. 1631.

Swin'burne (ALGERNON CHARLES), b. near London Apr. 5, 1837; received his education partly at Eton, partly in France, and in 1857 entered Baliol College, Oxford, where he remained only a short time, and subsequently made a visit to Italy. He has published *Rosamond* and *The Queen Mother*, two dramas (1861); *Atalanta in Calydon*, a tragedy constructed after the Greek model, in which he first manifested his peculiar powers (1864); *Chastelard, a Tragedy* (1865); *Poems and Ballads*, which were so severely criticised for their erotic character that the English publisher endeavored to suppress them, and which were put forth in New York under the title *Laus Veneris* (1866); *William Blake, a Critical Essay* (1868); in conjunction with W. M. Rossetti, *Notes on the Royal Academy Exhibition* (1868); *A Song of Italy* (1867); *Siena, a Poem* (1868); *Ode on the Proclamation of the French Republic* (1870); *Bothwell, a Tragedy* (1870); *Songs before Sunrise* (1871); *Essays and Studies* (1875); *Erechtheus*, another successful drama on the Greek model (1875); and several minor poems, essays, and critiques.

Swine. See SUS, and also BABYROUSSA, HOG, and BOSCH VARK.

Swinemün'de, town of Prussia, province of Pomerania, on the island of Usedom, and forms the port of Stettin. It is fortified, has a good harbor, carries on a considerable trade, and is noted as a bathing place. P. 6970.

Swin'ton (WILLIAM), A. M., b. in Edinburgh Apr. 23, 1833; came to the U. S. in 1843; studied at Amherst College; in 1853 taught in a female seminary at Goldsborough, N. C., and subsequently in a private school in New York; during a considerable part of the civil war was the correspondent, mainly with the Army of the Potomac, of the *New York Times*; in 1866 received the degree of A. M. from Amherst College, and was subsequently appointed professor of belles-lettres in the University of California. He has contributed to *Putnam's Monthly* and the *Atlantic Magazine*, and has published *Rambles among Words* (1859), *The Times Review of McClellan* (1864), *Campaigns of the Army of the Potomac* (1864), *The Twelve Decisive Battles of the War* (1870), *History of the New York Seventh Regiment during the Rebellion* (1870), and *Word Analysis* (1872).

Swir, a river of Russia, government of Olonetz, issues from the south western extremity of Lake Onega, and enters, after a course of 130 miles, the eastern part of Lake Ladoga. It is navigable throughout its whole course, and forms part of the great water-road which connects the Neva with the Volga, and thereby the Baltic with the Caspian.

Swiss Guards. Bodies of mercenary Swiss troops have since the fifteenth century been employed in many European countries as body-guards and for duty about courts. The Parisian *Gardes Suisses* were organized in 1616. They were very faithful to the interests of the Bourbons. In 1789 they were roughly handled by a mob, and Aug. 10, 1792, almost every man was killed in the heroic defence of the Tuileries. They numbered about 2000 men. Their heroism is commemorated by Thorwaldsen's *Lion of Lucerne*, erected in 1821 near Lucerne. Louis XVIII. reorganized the Swiss Guard in 1815. In the revolution of 1830 they were defeated and dispersed. At the Vatican the pope's body-guard is composed of Swiss mercenaries.

Swiss'helm (JANE G. C.), b. at Wilkinsburg, Pa., in 1816; was editor of the Pittsburg *Saturday Visitor* from Jan., 1845, to Sept., 1856, and of the St. Cloud (Minn.) *Visitor* from Jan. to July, 1858, after which she took charge of the St. Cloud *Democrat*. She was a frequent contributor to Neal's *Gazette*, the *Dollar Newspaper*, *Commercial Journal*, New York *Tribune*, etc., and published in 1853 *Letters to Country Girls*.

Switz'er (STEPHEN), settled as a gardener in Hampshire, England, where he d. in 1745; published *Country Gentleman's Companion*, *Account of Grass-Seed*, *Practical Fruit Gardener*, *Kitchen Vegetables*, *Introduction to Hydrostatics and Hydraulics*, etc.

Switz'erland, Confederation of [Ger. *Schweiz*; Fr. *Suisse*; It. *Svizzera*]. This little state occupies, in the heart of Europe, the culminating region of the continent, from which the land slopes in every direction toward the surrounding seas. Like a natural fortress it rises in the midst of large states without yielding its independence to any of its powerful neighbors. From France, on the W., it is separated by the Jura Mountains. On the N. the Rhine and Lake Constance mark its boundary toward Germany; on the E., the deep valley of the Rhine and the snowy ranges of the Rhaetian Alps border it along the Austrian dominions; on the S., the main chain of the Central Alps forms a natural barrier toward Italy. Its territory is comprised between 45° 48' and 47° 48' N. lat. and 5° 58' and 10° 30' E. lon. from Greenwich. Its extreme length from E. to W. is 208 miles; its greatest width from Tessin on the S. to Schaffhausen on the N., 138 miles. Its surface, according to the federal survey, is 15,992 English sq. m., or not much more than one-thirteenth of the area of France.

Physical Structure.—The general figure of Switzerland is an oblong square with irregular outlines, extending from the S. W. to the N. E., the long sides being formed by the Alps and Jura, the small ones marked by the two large lakes of Geneva and Constance. There are, therefore, three physical regions, each with a special character—the narrow belt of the Jura, the broad belt of the Alps, and the plain or hilly plateau between the two.

A. THE ALPINE REGION, though the poorest in resources for man, is by far the most characteristic of Switzerland, and is also the most extensive, covering little less than two thirds of its area. It is not composed of a single chain, but is a broad and high mountainous zone, scooped out into innumerable sharp ridges and valleys, mostly deep and narrow, comprising the greater part of the Central Alps, with the loftiest peaks and largest snow and ice fields of the whole Alpine system. Its limit toward the central plain is approximately marked by a line drawn from Lausanne, on Lake Geneva, to Arbon, on the shores of Lake Constance; on the S. it runs along the snowy peaks of the central chain, except in Ticino; its width, on the Swiss territory, is over 60 miles. A single glance at a good physical map enables one to distinguish in this apparently confused mass of mountains two main chains, running toward the E. N. E., separated by a long, almost continuous furrow, in which flow, in opposite directions, the two largest streams of Switzerland, the Rhone and the Rhine. These two chains nearly unite their bases in the group of the Gothard, which forms a high swell from which the waters flow in every direction.

The Southern or Main Chain, which divides the Italian waters from the northern, is composed of four groups: (1) The high but short and narrow chain of the Mont Blanc, which, by a political trick at the close of the Franco-Italian war, was given to France, against nature and international treaties. It stretches from S. W. to N. E. between the valley of Chamouni and Val d'Entrèves; its highest peak, Mont Blanc proper, 15,781 feet, is also the culminating point of the continent of Europe. The sharp picturesque peaks, or needles, formed by the gradual decay of the vertical strata of crystalline rocks; the rounded form of the central dioritic dome; the mighty glaciers flowing all around from its crests and filling its deep gorges, among which is the world-renowned Mer de Glace, the scene of the researches of Forbes and Tyndall; the blue Glacier des Bossons and the vast Glacier de la Brenva, both descending from the central pinnacle, the first in the Vale of Chamouni, the other on the Italian slope, toward the Allée Blanche,—all these phenomena, so often described, need only to be alluded to here. (2) The group of the Pennine Alps, running nearly due E. from the col of the Great St. Bernard to the Col du Simplon, between the valleys of the Rhone and Val d'Aosta. Its culminating points are the Grand Combin, 14,170 feet, on the W.; the bold pyramid of Mont Cervin, or Matterhorn, 14,712 feet, in the centre; the broad cluster of the Monte Rosa, 15,217 feet, on the E. This is the most massive of the Alpine groups. It sends out long and heavy spurs, some of which rival in height and bulk the main chain, such as the chain of the Mischabelhörner, between the valleys of Saas and St. Nicholas, rising in the Dom to 14,948 feet; and near by the snowy range of the Dent Blanche, 14,321, with the Weisshorn, 14,803 feet. This grand Alpine scenery has of late been made accessible, and the tourist, placing himself in its very centre, on the Gorner Grat, has in view around him the imposing peaks of Monte Rosa, the giant form of Mont Cervin, and a score of other snow-capped heights, measuring from 13,000 to 15,000 feet, with as many glaciers descending along their slopes to the valleys below. Farther E. the Fletschhorn, 13,182 feet in height, along the Simplon road, marks the limit of the Pennine Alps. (3) The group of the Gothard, along the upper waters of the Rhone and Rhine, extends between the Simplon and Lukmanier passes, and includes the Alps of Ticino. Though its main chain is crowned with snow, the high peaks disappear, and seldom exceed 10,000 feet, while their bases and the bottom of the valleys rise higher. The watershed is transferred more to the N., between the two small longitudinal valleys of Urseren, 4738 feet, and Airolo, 3868. (4) The group of the Grisons, or Rhætic Alps, from the Lukmanier pass to the eastern boundary of Switzerland, is the most extensive, but most irregular and complicated. It begins with high snow-peaks near the sources of the Rhine, among which the Rheinwaldhorn rises to 11,148 feet; but the salient feature is given by two snowy chains enclosing the valley of the upper Inn, or Engadine, placed farther S., almost on a line with the Pennine Alps, and following the normal trend of the Alps. The northern or Albula range separates the waters of the Rhine from those of the Inn and Danube; on the southern side the wild Alps of the Bernina, 13,294 feet, at the head-waters of the Inn and the Adda, divide the basin of the Danube from that of the Po.

The Northern Chain, though occupying the second rank, has perhaps a more controlling influence on the topography of the better part of Switzerland than the central chain. It follows closely the long valleys of the Rhone and Rhine, and terminates where these two streams cut transversely the Alpine chains. Its short slope is turned toward them, and its long slopes toward the northern plain. Deep transverse valleys divide it into three groups, closely corresponding to those of the central chain: Between the Rhone and Aar, the Bernese Alps, opposite the Pennine, or Alps of Valais; between the Aar and Reuss, the Alps of Uri and Unterwald, adjoining the Gothard group; between the Reuss and Rhine, the Glarides or Alps of Glarus, opposite the Alps of Grisons. (1) The Bernese Alps are the largest, and by far the most remarkable, of these groups. Beginning with the Dent de Morcles, 9639 feet, near the Rhone, they increase in elevation toward the E., through the Diablerets, 10,666 feet, and the Wildhorn, 10,722 feet, to the magnificent mountain-knot of the Bernese Oberland, whose highest peaks, the Finster-Aarhorn, 14,026 feet, the Aletschhorn, 13,803 feet, and the Jungfrau, 13,672, are but a trifle lower than Mont Blanc and Monte Rosa. Here lie the lofty snow-fields which feed the glacier of the Aar, the spot of Agassiz's classical investigations; that of Aletsch, the longest of the Alps; those of Grindelwald, which extend farther than any into the lower cultivated regions. While by the grandeur of its outlines and extent of its glaciers the Bernese Oberland fully equals its rivals, it surpasses them in the beauty of its cascades, the charm of its lakes, and the loveliness of its valleys. (2) In the middle group, which appears like a continuation of the Bernese Oberland, the Alps of Uri rise in the Schneestock to 11,920 feet, in those of Unterwald the Titlis reaches 10,627 feet, while Pilatus, 7003 feet, and the Rigi, 5877, with their comfortable hotels, are placed on the border of the plain, like observatories in front of this vast curtain of snowy heights. (3) In the group of the

Glarides the chain of the Tödi, 11,887 feet, is the controlling feature, and more to the N., just above the village of Glarus, the Glärnisch, 9539 feet, reaches the snow limit. To the N. E., between the lakes of Wallenstadt and Constance and the valley of the Rhine, an isolated group, with the chain of the Churfirsten, 7565 feet, and the Sentis, 8215, fills the greater portion of the cantons of St. Gall and Appenzell.

It is interesting to see how much these natural divisions have influenced the formation of the political communities. Each forms the centre, or the whole, of one or more of the twelve Alpine cantons, as any map will show. Valais, Ticino, Grisons, on the S. of the central valley, and on the N. Freiburg and Berne on one side, the four primitive cantons in the centre, Glarus, St. Gall, and Appenzell on the other.

A striking feature of the Alps is the great depth of their indentations, which increases both the facility of communication and the chance for cultivation. The bottom of the valleys, like those of Chamouni, Zermatt, Grindelwald, is from 10,000 to 11,000 feet below the neighboring peaks. Deep notches, or *cols*, cut down to one half the height of these snowy chains, and corresponding to the heads of transverse valleys, afford a comparatively easy passage from one side to the other, and render possible the construction of highroads between the opposite slopes. A carriage-road crosses the main chain by the Simplon, 6595 feet, leading from the Rhone valley to Lago Maggiore and Milan—a masterpiece of engineering, constructed by the order of Napoleon I. It was the first of the kind, and is still the only one in the western section. The St. Gothard road, 6595 feet, between the Reuss and Ticino, is scarcely less remarkable, and the only one crossing both chains in the central knot from Lake Lucerne to Lago Maggiore. In Western Grisons is the San Bernardino road, 6768 feet, from the Hinter Rhein valley through Val Misocco to Lago Maggiore, and more to the E. is the Splügen, 6946 feet, from the same valley to Lago di Como, both roads leading through the fearful gorges of the Via Mala. Eastern Grisons has the Julier Pass, 7503 feet, and the Albula, 7589 feet, from the Rhine to the Upper Engadine; the Maloggia, 5942 feet, leading from the head of the Inn valley to the Splügen road and Lago di Como; and the Bernina Pass, 7644, from the Engadine to the Valtellina, or valley of the Adda. In addition to these ten passes, fine military roads have lately been built, connecting the Rhone and Rhine through the Furca Pass, 7992 feet, the valley of Urseren and the pass of Oberalp, 6732 feet, opening thus an uninterrupted carriage-travel through the heart of the Alps from one end of Switzerland to the other. Nor did the enterprise of the Swiss stop here. A proposed railroad through the Simplon having failed, another more central, forming the most direct communication between Germany and Italy, has been traced through the St. Gothard. (See St. Gothard, Tunnel of.) It enters the mountain at Göschenen, in the Reuss valley, at 3650 feet above the sea, and emerges at Airolo, 3868 feet, on the Italian side, thus passing 2800 feet below the top of the present road. The tunnel is to be 9 miles long, the longest as yet attempted. The boring advances at the rate of 15 to 20 feet a day, and is expected to be finished within a few years. Besides these great highways there are a number of bridle-paths, much frequented during the good season, among which may be named the Great St. Bernard, 8110 feet, with its famous hospice and benevolent monks, across the Pennine Alps, from Martigny to Aosta; the Lukmanier, 6292 feet, E. of St. Gothard, from the sources of the Rhine to the Ticino; the Sanetsch, 7369 feet, from the upper Sarine; over the Bernese Alps to the Valais; the picturesque Gemmi, 7556 feet, from Lake Thun; and the Grimsel, 7103 feet, from the Aar to the sources of the Rhone.

The predominance of transverse valleys over those which run parallel with the Alpine ranges is a marked feature of the Swiss Alps. To these valleys, which, cutting through all secondary chains, open the shortest way to the heart of the snowy regions, the Alps owe most of the beauties which attract so many visitors. Rapid slopes, foaming torrents, wild gorges connecting occasional open green, flat bottoms, perhaps basins of former lakes, following one above the other as resting-places for the turbulent waters in their wild course; high and steep walls, enlivened by waterfalls; lakes with the view of distant snowy peaks in the background, these are scenes found in all, but greatly varied in each. The valley of the Aar, with its celebrated cascades; of the Reuss, with the wild scenery of the Devil's Bridge; of the Rhine, with the stupendous gorges of the Via Mala,—are types which once seen are not likely to be forgotten.

The *geology* of the Swiss Alps is a complicated problem not yet fully solved. As a general fact, we may accept the results of the latest investigations of Prof. B. Studer, and distinguish a central zone composed of several distinct masses of crystalline rocks, granite gneiss, and crystalline slates, flanked on each side by wide chains of Secondary rocks and slates, and bordered on the outside by Tertiary conglomerates and sandstones. The strata of the crystalline rocks are more or less vertical, often assuming a fan-like expansion, while those of the middle chains, on both sides, are raised against and around them, folded and contorted, the outside Tertiaries even turned over, all bearing evidence of a strong lateral pressure by which they seem to have been upheaved. Of the six crystalline centres that Studer counts from Mont Blanc to the Rhætic Alps, the most remarkable is that of the Bernese Oberland, which extends as far as the Glarides. In crossing the Alps we pass successively from the younger to the older formations, until we reach the central zone, beyond which we find again the same formations in reversed order. Rich as the Alps are in beautiful and rare minerals, they are poor in useful ones, and mining has never been anywhere extensively carried on.

B. The Jurassic Belt—*the second physical region*—which comprises only a portion of that mountain system, is, in structure and outline, a complete contrast to the Alpine region. Long, uniform, parallel chains, without the marked indentations and projecting peaks so characteristic of the Alps, intercept open, trough-like valleys, with gentle acclivities. The general system deviates slightly to the N. from the direction of the Alps, but the single chains tend to keep in parallelism with them. This structure of the Jura is explained by assuming that it was originally a simple plateau, whose southern edge has been folded into long ridges by successive upheavals of the Alps, toward which its greatest heights and steepest slopes are turned, while the altitudes diminish in proportion to their distance from them. The highest point, Le Crêt de la Neige, which is in the French Jura, opposite Geneva, has an elevation of 5653 feet; La Dôle, the first on Swiss territory, 5505 feet; the Chasseron, in the canton of Neufchâtel, 5286 feet; the Hasenmatt, in Soleure, 4751 feet; the Lägeren, in Zurich, 2828 feet. The interior valleys communicate among themselves and with the plain by deep gorges, called *cluses*, furnishing an escape for the waters. Some are of large size, as the Val de Ruz, Val de Travers, in Neufchâtel, 2500 feet high, and Val Delémont, in the Bernese Jura, 1400 feet. Their moderate elevation permits of agriculture, while the higher and colder valleys, like those of La Chaux de Fonds and Locle, over 3000 feet, only admit of grazing. All the Jura mountains are made up of a series of Mesozoic limestones, whose geological name, Jurassic formation, is taken from them. Along their base only, and in the bottom of the interior basins, layers of the lower Cretaceous rocks are found covered over by more recent Tertiary deposits. On the slope looking toward the Alps are spread, up to an elevation of 2300 feet, a vast number of erratic boulders of Alpine origin, among which the granites of Mont Blanc and the rocks of the Pennine Alps are the most abundant, some of them reaching a size of 20 by 10 feet. Large rock-surfaces, admirably polished and striated, indicate the work of the ancient glaciers which once covered the plain of Switzerland and transported to the Jura these debris of of the Alps.

C. The Plain of Switzerland is the third physical region. It is so called by contrast to the mountain land, but is in reality a hilly plateau of an average elevation of 1400 feet, with a few alluvial plains. It has a gentle inclination from the Alps to the Jura, and another, still less marked, from the S. W. to the N. E. along the base of the Jura. On both extremities, however, the lakes of Geneva, 1230 feet, and Constance, 1306 feet, mark two depressions below the general level, which receive the waters of the Rhone and the Rhine. The basin of the Lake of Geneva is separated from the general plain by the gentle heights of the Jorat, 2500 feet; that of Lake Constance by the hilly region of Thurgovia. This vast region was in geological times covered with waters which have left deep deposits of a soft greenish gray sandstone, called *molasse*, full of fossils, mostly of marine origin, and used extensively for building purposes. These strata, which belong to the middle Tertiary age, have been laid bare by the last upheaval of the Alps, and raised in their neighborhood to hills of 2[illegible] and 3000 feet elevation.

The river system of Switzerland shows a remarkable symmetry of arrangement, which is but the consequence of the regularity of the physical structure above described. From the central swell of the St. Gothard and its [illegible] the Rhine and the Rhone flow in opposite directions between the two main chains. At about the same distance from their source each quits the valley to cross the northern chain at right angles, the Rhine to enter Lake Constance; the Rhone, the Lake of Geneva. Leaving Lake Constance, the Rhine runs to the W., forming just below Schaffhausen

the celebrated Rheintall, the Niagara of Europe. Further it gathers in its course most of the waters of Switzerland, and turning suddenly to the N. at Bâle, carries them to the North Sea and the Atlantic. Issuing pure and clear from Lake Geneva, the Rhone, after receiving its main tributary, the Arve, from Mont Blanc, crosses the chain of the Jura at the Perte du Rhône, where it disappears for a short distance in a deep fissure, and descends by rapid strides to the Mediterranean. From the same Gothard region flow four other rivers—the Aar and Reuss to the N., the Ticino and Tosa to the S.—which, placed two by two opposite each other, complete the symmetrical arrangement of this remarkable hydrographic centre. On the northern slope the Aar drains the Bernese Oberland, the Reuss the Alps of the four primitive cantons; on the southern, the Tosa and the Ticino drain the Gothard Alps. All these streams, like the Rhine and Rhone, before entering the plain, pour their turbid waters into deep lakes, from which they flow out pure and transparent. The Aar fills the Lake of Brienz, 1857 feet in altitude, and the Lake of Thun, 1850 feet; the Reuss, the quadruple lake of Lucerne, 1434 feet; the Ticino and Tosa, the long and deep trough of Lago Maggiore, 646 feet. The two extreme divisions of the northern chain have also each their river. The Linth gathers the waters of the Glarides and of Lake Wallenstadt, 1394 feet, and forms the Lake of Zurich, 1342 feet, from which it issues at Zurich under the name of Limmat. The Sarine leads the waters of the Bernese Alps through Freiburg into the Aar. The Emme, the Suhr, the Glatt, and the Thur, all of third rank, rise in the border Alps. All these streams follow the general slope of the plain toward the Jura; but the most important is the Aar. Reaching the base of the Jura near the Lake of Bienne, it turns at right angles, and, continuing its course along that chain, receives all the waters of the central plain, including those of the lakes of Neufchâtel, 1427 feet, Morat and Bienne, 1424 feet, and, uniting with the Reuss and Limmat, carries them by a single channel to the Rhine through the last spurs of the Jura.

The second great hydrographical centre is found in the Alps of Grisons, in the Upper Engadine, where the waters of the Rhaetic Alps flow through the Inn and the Danube into the Black Sea; through the affluents of the Hinter Rhein to the Atlantic; through the Maira, Lago di Como, 699 feet, and the Po, to the Adriatic. Thus, little Switzerland, thanks to its commanding position in the midst of the continent, sends to all the seas surrounding Western Europe the waters flowing from its everlasting stores of ice and snow.

Climate.—In a country where the differences of altitude are so considerable the temperature and moisture of different places vary greatly, according to their elevation and physical situation. We can here give only a few general features more especially applicable to the central plain, which, containing the greater part of the cultivated land, is the most important. For the mountainous parts the difference in the character of vegetation and culture will express more clearly than an array of figures the differences of climate due to altitude. Under the general influences which make Europe the warmest of the temperate continents, the climate of Switzerland is milder than that of any mountain-country in the same latitude, while the quantity of rain is rather above the average. This is shown by the following table, which gives the average temperature of the year and the warmest and coldest months, together with the average amount of rain in inches, at the following cities of the plain:

Places.	Latitude.	Altitude	Temperature. January.	July.	Year.	Amount of rain in inches.
Geneva...	46.12	1250	31.5	65.4	48.5	32
Neufchâtel....	47.0	1600	32.3	66.5	49.0	33
Berne	46.51	1770	26.9	62.6	46.0	46
Zurich..........	47.23	1350	29.2	65.7	48.[illegible]	33
Bâle	47.34	900	33.0	66.4	49.1	25

This shows that Geneva, though 1300 feet above sea-level, and nearly 4° of latitude farther N., has an annual temperature equal to that of Boston, with cooler summers and milder winters. The extremes of temperature seldom exceed 90° or fall below 10°. The spring is early and pleasant; the first flowers appear in March, and May is the month of roses. The summer has frequent rains; September is clear and mild, but in October the weather begins to be raw; November and December, however, are often quiet and warm in the heights, while the plain, and especially the lake region, is covered with a thick layer of fog, which, seen from the Jura, appears like a vast sea of clouds studded with islands and bordered by the glistening chain of the Alps. The quantity of rain in the plain is rather greater than in the neighboring portions of France and Germany—33 inches against 25—and increases near the mountains. It is 46 inches in Berne, and on the southern slope of the Alps, which is struck by the warm S. wind, it sometimes reaches even a considerably higher figure. The prevailing winds are, as in all Europe, the alternate normal equatorial and polar currents—the first, from the S. W., warm and rainy; the other, called the *Bise*, from the N. E., cold and dry. A peculiar wind called the *Foen*, felt especially in the eastern part of Switzerland, and more frequently during the winter, is noted for its great heat and dryness, flowing from the S. across the Alps, and descending with great fury along the northern valleys. Its origin is disputed, some taking it for the sirocco of the Mediterranean, others believing it to be a part of the returning trades. Under its influence the snows of the mountains melt with such rapidity as to cause the most destructive inundations.

The various *zones of vegetation* which can be distinguished, from the lowest valleys to the limit of permanent snow, are—(1) *The lower region*, comprising all the central plain and its lower hills, and extending from 700 to 2000 feet above sea-level. It is the zone of deciduous trees, the chestnut, walnut, oak, and beech, and of the vine. Here the cultivation embraces all the European grains, including even maize to a certain extent. Extensive vineyards along the borders of the lakes of Geneva and Neufchâtel produce wines of considerable reputation. The wines of Eastern Switzerland are less esteemed. All the fruits of temperate latitudes grow abundantly, and acquire in the Jura a rare degree of excellence. In the southern valleys the fig and the olive flourish; chestnut forests are abundant, and vineyards rise from 500 to 700 feet higher than on the northern slopes. To this zone belongs the central plain, which is the great agricultural region, the richest and most cultivated, as well as the most populous, of Switzerland. Here also we find all the great cities, which are either situated at the outlet of the Alpine valleys and lakes, as Geneva, Berne, Lucerne, and Zurich, or along the base of the Jura, as Neufchâtel, Soleure, and Aarau. (2) *The second region* is that of the lower mountains, from 2000 to 4000 feet. In the lower half the hardier deciduous trees, such as the beech, ash, and maple, are still abundant, and the cereals and hardy fruits, apples, pears, and plums, are cultivated. In the upper half, comprising the higher valleys of the Jura and the lower Alps, spruce forests, extensive pastures, and a scanty cultivation of oats and barley are characteristic. (3) *The sub-Alpine region*, or zone of conifers, extends from 4000 to 5500 feet on the N., and from 4000 to 6000 feet on the S. It comprises the middle Alps, and its upper limit is also that of the growth of trees. The forests are composed of spruce, larch, and in its highest parts the alpine form of the *Pinus cembra* is characteristic. Here agriculture ceases, but the rich grassy pastures of the Alps begin, on account of which this region is often called "the Cattle Alps," or similar names. In it are also found, mostly in Grisons, the highest permanent villages. Silvaplana, at the sources of the Inn, lies at 5958 feet; Bivio, in Val Oberhalbstein, at 5827; Cresta, in Val Avers, at 6365 feet above the sea. (4) *The Alpine region*, from the limit of trees, 6000 feet, to the limit of permanent snow, 9000 feet, begins by a zone of shrubs, reaching to 7000 feet, among which the lovely Alpine roses (*Rhododendron ferrugineum* and *hirsutum*), the creeping azaleas, junipers, willows, and alders are the most conspicuous. The rich pastures of the preceding region are replaced by a short, thick, aromatic turf, growing in isolated patches on the surface of the rocky soil, and studded with the short-stemmed and brilliant flowers which make the charm of the tiny Alpine flora. But soon these humble shrubs also disappear, and leave the entire field to those puny representatives of the vegetable world which grow among every heap of débris, in every nook and crevice of rock where a scanty soil can lodge, or spread on every tuft of verdure their bright, well-nigh stemless, corollas. The deep-blue gentianas, the sky-colored myosotis, the light-pink *Silene acaulis*, the delicate purple *Soldanella alpina*, and over 200 other species, grow to the very edge of perpetual snow, and even far above, to 10,000 and 11,000 feet, on the bare rocks too precipitous to retain snow on their slopes. The nimble chamois, the steinbock, or rock-sheep, now nearly extinct, the lämmergeyer, or large eagle, the formidable enemy of the lamb, the sleepy marmot, are the representative animals of the Alpine region. (5) *The region of perpetual snow* in the Alps is broader and more extensive than in any other mountain-system of Europe. Its lower limit is found in the Bernese Alps at 8800 feet of altitude; in the Grisons, at 9200 to 9400 feet; on the southern slope it rises to 9000 and 9800 feet. There is, therefore, even in midsummer, an uninterrupted zone of snow from 6000 to 7000 feet high, such as is offered by no other mountain-chain, neither on the continent of Europe nor on that of North


MAP OF
SWITZERLAND
Drawn, and Engraved on Copper-Plate
EXPRESSLY
FOR
JOHNSON'S UNIVERSAL CYCLOPÆDIA
Scale of Miles
Mülhausen
Mülheim
Schopfheim
Lörrach
Altkirch
BALE or BASEL
Rheinfelden
Liestal
Waldenburg
Delle
Porentrui
Mt Terrible
St Hippolyte
Besançon
River Doubs
Chaux de Fonds
Locle
NEUFCHATEL
Chasseral
Landeron
Bienne
Nidau
Aarberg
Burgdorf
BERNE
Laupen
Murten
Avenches
Payerne
FREIBURG
Schwarzenburg
Yverdon
Moudon
Echallens
Orbe
Mt Chasseron
5286
Pontarlier
Mt Jorab
LAUSANNE
Morges
Aubonne
La Dôle
5505
Nyon
LAKE OF GENEVA
Vevay
Villeneuve
Coppet
GENEVA
Cret de la neige
5653
Aigle
Bex
Diablerets
10666
SION
Martigny
St Maurice
Dent du Midi
Dent de Morcles
9639
Thun
Spiez
Stockhorn
Frutigen
Interlaken
Jungfrau
Aletschhorn
13803
Gemmi Pass
7556
Wildhorn
10722
Mt Stroubel
Leuk
Visp
Brieg
Col du Simplon
Weisshorn
14803
Dent Blanche
14321
Zermatt
Matterhorn
14712
MONTE ROSA
15217
Grand Combin
14170
Gr. St. Bernard
8110
Le Géant
13800 ft.
MONT BLANC
15781 FT.
Chamouni
Annecy
Lake Annecy
F R A N C E
V A U D
F R E I B U R G
V A L A I S
P I E D M O N
Aarau
Aarburg
Zofingen
Langenthal
Sursee
Willisau
Mt Napf
SOLEURE or SOLOTHURN
Longitude East 85 from


East
from
Greenwich
9
10
WURTEMBURG
BAVARIA
TYROL
THURGAU
ZURICH
APPENZELL
SCHWYTZ
GLARUS
GRISONS
LOMBARDY
VALTELINA
Waldsee
Leutkirch
Riv. Iller
Ravensburg
Oberhofen
Kempten
Isny
Tettnang
Friedrichshafen
Lindau
Immenstadt
Sonthofen
Bregenz
Uebertingen
Radolfszell
CONSTANCE
LAKE OF CONSTANCE
Weinfelden
Romanshorn
Bischofszell
Arbon
Rorschach
FRAUENFELD
Riv. Thur
R. Rhine
Kaiserstuhl
Bulach
Andelfingen
Winterthur
Wyl
Flawyl
ST GALL
Trogen
Herisau
Altstetten
Grüningen
ZURICH
Rapperschwyl
Bremgarten
Feldkirch
Bludenz
Sentis
8216
Wesen
Wallenstadt
VADUZ
Sargans
Flums
Mels
Churfirsten
ZUG
Einsiedeln
Arth
SCHWYTZ
GLARUS
Näfels
Meyenfeld
R. Landquart
Zizers
Brunnen
STANZ
Kerns
Tells Platte
ALTORF or ALTDORF
CHUR
Davos
Vorder Rhine
Ilanz
Tödi
Dissentis
Platta
Andermatt
Oberalp Pass 6732
Tusis
Albula
Albula Pass
7589
Riv. Inn
Lukmanier Pass 6292
Rheinwaldhorn
11148
Splugen Pass
S.Bernardino Pass
Septimer P.
7582
Maloja
Julier Pass
Silvaplana
Bernina Pass
BERNINA ALPS
Piz Bernina 13294
Faido
Malvaglia
Chiavenna
Mt della Disgrazia
Sondrio
R. Adda
Morbegno
BELLINZONA
Locarno
Ascona
Mt Camoghe
Lugano
LUGANO
Capo di Lago
Varese
Como
Lecco
Lake of Como
Lake d'Orta
Orta
Washington
86
87
47
46

America, occupying a large portion of the Swiss territory. From the lower limit of these vast snow-fields long streams of ice, which are but a mode of melting of the snow, the glaciers, pass through the several zones of vegetation just described, and reach in the glaciers of Grindelwald within 3000 feet of the level of the sea. In a single day's walk the traveller may thus pass from the cold but brilliant abode of everlasting winter, through all the intermediate steps, marking as many different climates, to the evergreen region of an almost perpetual summer, and admire under the shade of the olive and the fig tree the Alpine rose which he plucked the same morning at the foot of the snow-fields. These are the contrasts which lend so much charm to the Alpine scenery and make it without rival. A. Guyot.

Switzerland, History of. The most ancient records of the inhabitants of Switzerland are found in the pre-historic implements and traces of ancient lake dwellings in most lakes of that country. The constructions of the lake-dwellers seem to indicate that their builders were of Asiatic origin. But who were those who erected them? Did they belong to one and the same people? How, when, and by whom were they exterminated? These are questions which may remain unsettled for ever. Like structures have been found in other places N. and S. of Switzerland, but nowhere in so great a number. It is remarkable that no human débris was discovered among the thousands of specimens of workmanship left by that ancient people. The Helveti were thus not the first inhabitants of Switzerland, but they are the first whose name has been transmitted to us by history. Situated as they were between the Romans and the Germanic tribes of the North, which were incessantly endeavoring to open their way toward better climates, the Helveti had to suffer from both these neighbors, and their mountains and valleys had to witness many a battle. The Helveti made several attempts to leave such an unsafe country and to establish themselves to the westward, but they continually found either the Gauls or the Roman armies to stop them. They always fought with great valor, and even once compelled the Romans themselves to pass under the yoke. But what could a small tribe do alone against a powerful enemy always able to send new armies into the field? The Helveti, notwithstanding their valor and partial successes, were on all occasions compelled to fall back to their mountains. They once had the temerity to attack Cæsar's army in a place near the Rhone, at the outlet of this river from the Lake Lemannus. Here, again, they were overpowered by the legions of the mighty Romans, their military tactics, and their superior discipline. The remainder of the tribe of the defeated Helveti were forced to retreat, and to repair again to their valleys. After this they received the name of "confederates" from the Romans, who assured them of their protection. The duty of the Helveti was now to form a bulwark on behalf of Rome against the Germans, and their country became a Roman province. The E. was occupied by the Rhæti, the S. by the Pennini, the centre by the Helveti proper, and their next neighbors W. were the Sequani, belonging to the Gauls.

The time came, however, when the Romans had to withdraw their forces and make room for other invaders, the Ostrogoths, the Alemans, the Burgundians, and the Franks, who occupied Switzerland up to 879, the date of the foundation of the first kingdom of Burgundy. The last of the Burgundian kings parted with his sovereignty in favor of the emperor Conrad II. in the year 1016, so that the greater part of what is now Switzerland was placed under the immediate rule of the emperors. At the beginning of the twelfth century the emperor granted to the dukes of Zähringen, as vassals, besides many other lands, the greater part of Western Switzerland and the Lesser Burgundy. At the death of the last Zähringen (1218) Switzerland was again put under the paramount authority of the emperor, who, however, conferred several parts thereof on other vassals, whom the Swiss were not always ready to acknowledge as their lords. The Swiss were willing to submit themselves to the emperors as their paramount lords, but bore uneasily the rule of the imperial vassals. The latter were sometimes at war with each other. The leagues of these nobles induced the Swiss communities to form like associations: the three forest cantons, Uri, Schwytz, and Unterwalden, formed such a league in 1291, which was indeed the nucleus of the twenty-two cantons of the present confederation.

The house of Hapsburg, which had been instituted by the duke of Zähringen protector of the "Lands"—for such the forest cantons were called—attempted to increase their rights and domains; the Lands opposed, and tried in their turn to free themselves from the dominion of the house of Hapsburg. The Swiss were successful, but did not conquer their liberty without many an encounter or battle. The league of the Swiss of 1291 was renewed in 1315, after the famous battle of Morgarten, gained by them over the Austrians, and which has been called the Thermopylæ of Switzerland. In the western part of that country the house of Savoy had an authority almost as considerable as that of Hapsburg in the centre and the E.; but in the first part of the fourteenth century the influence of both these houses began to decline. In 1386 the Swiss again routed the Austrians at Sempach. The period from 1412 to 1431 witnessed the annihilation of the Austrian power and the undermining of the house of Savoy, which was to lose all its domains in Switzerland at the time of or after the Reformation. In the fifteenth century the Swiss, still victorious, had again to fight several battles with foreign armies—the Armagnacs, under Louis XI., at St. Jacob, near Bâle, in 1444, and the veteran troops of Charles the Bold of Burgundy, at Grandson and Morat, in 1476.

Another period of the history of Switzerland extends to 1648. It witnessed, first, the extinction of the last vestige of the house of Savoy and the establishment of the principles of the Reformation. This was a period of intestine wars with the aristocratic element, which, combining with the ecclesiastical lords, invoked in their behalf the privileges they had obtained, many of them as far back as the twelfth century. Treating the country people, the peasants, as subjects, the latter were generally reduced to silence during these wars, and it required on the part of the latter renewed efforts during several centuries before they were put on the footing of a perfect equality guarantied by constitutions. Throughout the same period religious wars took place between the Roman Catholics and the Reformers—wars in which the former were sustained by France. These wars were not terminated before the beginning of the eighteenth century. The followers of both faiths are now living on an equal footing, and have their respective rights secured; which does not, however, prevent majorities from sometimes laying a heavy hand on minorities. After each of the religious wars treaties of peace were made, but peace did not return. The Thirty Years' war nearly put an end to the Swiss confederation. Happily for her, the Treaty of Westphalia (1648) declared Switzerland independent of the German empire.

Up to the time of the death of Louis XIV. the greatest disorder existed in Switzerland, and this disturbed condition of things continued until the outbreak of the French revolution, the principles of which gained ground easily in Switzerland. The number of malcontents increased, and the Swiss were to be seen in opposing armies. The mighty canton of Berne, the largest of the states, fought valiantly to the last against the new ideas and the foreign republican armies, but without success, for she was overpowered. Thus, Switzerland fell into the hands of foreigners, sustaining within an anti national party. She was to be converted into a republic, "one and indivisible," according to the views of the French Directory. This lasted four long years. To that form of government succeeded a sort of league based upon federal principles. Under this constitution Switzerland recovered an appearance of peace, but the mediator of that "mediation act" (Feb. 13, 1803) was a mighty neighbor and a despotic ruler. The mediation lasted ten years, and came to an end at the fall of the French empire. Then Switzerland threw herself into the arms of the Holy Alliance. The European reaction against France took place, and Switzerland had to participate in it; her soil was invaded by the allies, as it had been so often and so long by the French armies. By the Congress of Vienna (1815) her independence was again acknowledged and guarantied. The spirit of self preservation and sense of dignity developed themselves in Switzerland, and new efforts were made to give the country a stronger and more independent basis. Switzerland was led to it by new internal disturbances and external occurrences—notably, the revolutions in France in 1830 and 1848. Constitutions were framed, one after the other, more on the basis of political theories than on the practical development of history. The last constitution voted by the people bears the date of May 29, 1874.

If Switzerland has been for a very long time suffering from want of a sufficiently central power, it is obvious that the tendency of our age is to increase that centralization to the detriment of the sovereignty of the cantons. Here is the danger for that country, as well as for other federal states. In 1802 a delegation was sent to Paris to ask the First Consul's opinion as to the form which should be given to a new constitution which Switzerland had in view. His answer was, "Nature made you to be a federative state: no reasonable man attempts to conquer nature." A true word, indeed, but how many times did he observe his precept? George A. Matile.

Switzerland, Statistics of. Switzerland consists, according to the census of 1870, of the following cantons:

Cantons.	Area in sq. m.	Population.	Roman Catholics.	Protestants.
Aargau	542	108,873	89,180	107,703
Appenzell, Outer Rhodes	160	48,726	2,358	46,175
Appenzell, Inner Rhodes	62	11,913	11,720	188
Bâle city	14	47,760	12,301	34,455
Bâle, country	162	54,127	10,245	43,523
Berne	2,660	506,551	66,015	436,304
Freiburg	643	110,832	93,951	16,819
Geneva	109	93,239	47,868	43,639
Glarus	267	35,150	6,888	28,238
Grisons	2,774	91,782	39,843	51,887
Lucerne	579	132,338	128,338	3,823
Neufchâtel	312	97,284	11,500	84,334
St. Gall	780	191,015	116,060	74,573
Schaffhausen	116	37,721	3,051	34,466
Schwytz	350	47,705	47,047	647
Soleure	303	74,713	62,078	12,448
Thurgau	382	93,300	23,454	69,231
Ticino	1,095	119,619	119,350	194
Unterwalden, Upper	183	14,415	14,055	358
Unterwalden, Lower	112	11,701	11,632	66
Uri	415	16,107	16,018	80
Valais	2,026	96,887	95,953	900
Vaud	1,244	231,700	17,592	211,686
Zug	92	20,993	20,082	878
Zurich	665	284,786	17,942	263,730
Total	15,988	2,669,247	1,084,525	1,566,345

During the same year the movement of the population comprised 18,610 marriages, 83,300 births, 72,838 deaths; during 1871, 19,514 marriages, 81,629 births, 77,998 deaths. The emigration to America averaged from 1868 to 1872, 4465 a year; in 1873 it amounted to 4957, in 1874 to 2672. The cantons, however, of Uri, Freiburg, Solothurn, Vaud, and Geneva are not included here, as they give no record of emigration. In 1870, 94.3 per cent. of the population, or 2,517,599, were natives; 5.7 per cent., or 150,907, were foreigners. The foreigners comprised 62,228 Frenchmen, 57,245 Germans, 18,073 Italians, 5872 Austrians, 360 Hungarians, 2297 Englishmen, 1599 Russians, 1404 Americans, 492 Belgians, 349 Spaniards, 260 Hollanders, 93 Danes, 123 Swedes and Norwegians, 389 from other countries, and 123 of unknown birth. German was spoken in 384,538 households, French in 133,575, Italian in 30,079, Romansh in 8778.

The constitution of Aug. 7, 1815, was superseded by a new one Sept. 12, 1848, of which a revision was adopted May 29, 1874. According to this revised constitution, the legislative power of the government of the federal republic is vested in the federal assembly, consisting of the national council and the council of states. The national council is formed of delegates elected by the people at large, one for each 20,000 souls; so that, according to the census of 1870, the assembly consisted of 135 members. Every voter, not a clergyman, is eligible. The council of states consists of 44 members, each canton sending 2. Besides its legislative power, the federal assembly has the right to make treaties and alliances with foreign powers, declare war and conclude peace, take measures for neutrality or intervention, sanction the constitutions of the cantons, etc.; but all federal laws and all general measures in which the whole confederacy is concerned, and which are not of a pressing nature, are subject to a popular vote on the demand of 30,000 voters or 8 cantons. The executive power belongs to the federal council, whose seven members are chosen by the federal assembly for three years from among the whole mass of Swiss citizens eligible to the national council. More than one member, however, cannot be chosen from the same canton, and no member can hold any other office either in the confederacy or in any single canton, nor can he carry on any business. The president of the federal council, who is also the president of the confederacy, is chosen by and among the members of the council for one year, and he cannot be reëlected until after the intervention of one year. The federal court consists of 9 members and 9 substitutes chosen by the federal assembly for six years. Under its jurisdiction belong all cases between the confederacy and the cantons, between canton and canton, between the confederacy or the cantons on the one side and a corporation or private individual on the other, etc. The cantons have each its own constitution, and form 25 republics, with 25 different constitutions, Bâle, Unterwalden, and Appenzell being each divided into two. These constitutions range from purely democratic to perfectly representative systems, but each constitution must be sanctioned by the federal assembly before it can come into force. Ecclesiastical authorities are, in the Reformed Church, the synods, assemblies of the whole clergy; and at their side stands in each canton, as the highest administrative authority, an ecclesiastical council—in Geneva a consistorium. The Roman Catholic Church has 5 bishoprics: Bâle (residence, Solothurn), Chur, Lausanne-Geneva (residence, Freiburg), St. Gall, and Sion.

On the occupations of the inhabitants the mountainous character of the country exercises great influence. 31 per cent. of the soil is unproductive, 69 productive: 19 are covered with forest, from 35 to 38 are meadows and pastures. Only the cantons of Bâle (country), Lucerne, Schaffhausen, Solothurn, Thurgau, and Zug produce more grain than they use; those of Aargau, Berne, Freiburg, Vaud, and Valais produce just enough for home demand; but the other cantons must import grain. The total production of grain averages annually 5,000,000 hectolitres; that of potatoes, 9,000,000. The production of fodder is very considerable, and is estimated at an annual average of 45,000,000 cwts. The cultivation of vines, fruit trees, and garden-plants is flourishing. The cattle-breeding is celebrated. On Apr. 21, 1866, the country possessed 993,291 cattle, mostly of excellent breeds, 100,324 horses, 375,482 sheep. An important source of wealth is the exportation of wood. The products of the chase are of small importance, but fishing is carried on with great success. Mining yields no great profit; the country is poor in metals. About 600,000 cwts. of salt are annually raised, and much building-stone is quarried. Mineral springs are numerous. The manufacturing industry is very considerable, especially of cotton, which employs about 70,000 hands and has its centre at Zurich—silk, straw goods, leather, paper, wooden-ware, machinery, watches, jewelry, etc. Watches are made especially at Geneva and Neufchâtel—more than 1,000,000 a year. The manufacture of embroidery flourishes, especially in St. Gall and Appenzell; that of silk ribbon in Bâle, Aargau, Berne, and Thurgau. The commerce is also important; its transactions amount to about 1,300,000,000 francs a year. The principal articles of export are cotton and silk goods, watches, and cheese; those of importation, raw cotton and silk, iron, grain, and colonial products. There exist no official records of the commercial transactions, but the value of exports is estimated at about 500,000,000 francs; that of imports at about the same; and that of the transit traffic, which is very important on account of the central position of the country between Germany, Italy, and France, at about 300,000,000 francs. In Oct., 1875, there were 2000 kilomètres of railway in operation; all the lines are private. In 1874 the post-office comprised 742 bureaus, 1916 stations, and 30 agencies in foreign countries, and carried 63,252,884 letters—namely, 48,519,764 domestic and 14,733,120 international—besides 39,623,445 domestic papers and 2,027,899 from Germany and Austria. Receipts, 14,465,622 francs; expenses, 13,932,545 francs. At the end of 1874 the telegraph had 815 public and 84 railway stations. At the end of 1873 it comprised 5843 kilomètres of lines, 14,169 kilomètres of wires, and 715 stations. In 1874 it carried 2,652,104 despatches—namely, 1,846,898 domestic, 562,205 international, and 216,001 transit—besides 58,895 government despatches. Receipts, 1,855,813 francs; expenses, 1,855,731 francs. Public education is under the control of the separate cantons, and occupies, generally, a high standard; also in the Roman Catholic cantons, where the separation of school and Church has been carried out with good effect. The country has 3 universities—Bâle, Zurich, and Berne—and 3 academies—Geneva and Lausanne for theology, jurisprudence, and literature, and Freiburg for jurisprudence and natural science. According to the budget for 1875, the receipts of the confederacy amounted to 39,033,209 francs, the expenses to 39,766,000 francs. At the close of 1873 the public debt amounted to $5,650,000, and the value of the federal property to $5,691,000. The army consists of (1) the regular army, formed of men between 20 and 32 years; and (2) the Landwehr, comprising all men between 33 and 44 years. The staff consists of 3 colonels, 16 lieutenant-colonels and majors, and 35 captains; in all, there are 784 officers in the regular army, and as many in the Landwehr. The regular army numbers 106,102, the Landwehr 97,036. But this army does not exist as a standing army; it is formed only when the federal assembly finds it necessary for order and safety.

August Niemann.

Switzerland, county of S. E. Indiana, separated from Kentucky by Ohio River. It has an undulating surface and fertile soil. There are flour-mills, saw-mills, and manufactures of woollen goods, carriages, and cooperage. Staples, Indian corn, wheat, hay, potatoes, sorghum-molasses, wool, and dairy products. Cap. Vevay. Area, 220 sq. m. P. in 1870, 12,134.

Switzerland, tp., Monroe co., O. P. 1342.

Sword, a curved or straight weapon, usually with one or two cutting edges and a sharp point, but also made (scimitar, etc.) without a sharp point or (rapier) without a cutting edge. Swords of pre-historic and even much later times were often of bronze, but for many ages steel has been the material exclusively employed, except that occasionally some other material has been used for swords designed for state occasions and pageants. Damascus, To-

ledo, Pistoja. Bilbao, and Milan are among the cities of the Old World which have been famous for the excellence of their swords. Among the forms of the sword are the sabre, scimitar, rapier, broadsword, small-sword, etc.

Sword′-Fish, a common name for fishes of the family Xiphiidæ, remarkable for having the upper jaw prolonged forward in the shape of a bony sword. The common sword-fish (*Xiphias gladius*) ranges from our Atlantic coast eastward to the Mediterranean. It is often from ten to sixteen feet long, has very fine scales, no ventral fins, a long broken dorsal fin, and a large and deeply-forked caudal. It is a very rapid swimmer, and is reputed to assail the largest whales with its sword. It sometimes strikes ships with such force as to penetrate several thicknesses of plank, and the sword is often broken off and left *in situ*. It is generally esteemed as food, and taken by the harpoon, thus affording an exciting and dangerous sport, but is too scarce to be of commercial value.

Swords, tp., Cherokee co., Ala. P. 379.

Swoszowice, small town of Western Galicia, circle of Wadowice, is famous for its sulphur-mines, which produce annually more than 7000 cwts. of pure sulphur.

Swy′naerde, town of Belgium, province of East Flanders, has celebrated manufactures of laces and tiles. P. about 2000.

Sya′grius, the last Roman ruler in Gaul, was a son of Egidius. After the death of Majorianus (in 461), Egidius, governor of Gaul, refused to acknowledge his successor, Severus, made himself independent, and even subjugated some of the neighboring Frankish tribes. His son, Syagrius, who inherited the country, was less successful in his dealings with the Franks, and it finally came to a decisive battle between him and Clodwig, the chief of the Franks, at Soissons in 486. Syagrius was defeated, and fled to the Visigothic king, Alaric II., who surrendered him to Clodwig, by whose command he was put to death.

Syb′aris, city of Magna Græcia, in Lucania, was founded by Achæans and Trœzenians about 720 B. C., 3 miles from the Tarentine Gulf, between the rivers Crathis and Sybaris, the modern Crati and Coscile. It rose rapidly to a great prosperity, founded other colonies—Posidonia, Laüs, and Scidrus—covered a space of 6 miles in circumference, and was notorious for the luxury and effeminacy of its inhabitants. In 510 B. C. Telys, a demagogue, succeeded in overthrowing the oligarchic constitution of the city, and 500 of the wealthiest citizens emigrated to Crotona. Telys demanded their surrender, and as this was refused, he declared war against Crotona. But the Crotoniats routed and massacred the Sybarite army, and destroyed the city utterly by changing the course of the river Crathis and flooding the site of Sybaris with its waters. The city never recovered, but in 443 B. C. Thurii was founded in its neighborhood.

Sy′bel, von (Heinrich), b. at Düsseldorf Dec. 2, 1817; studied history under Ranke at Berlin, and was appointed professor at Marburg in 1845, at Münich in 1856, at Bonn in 1861, and director of the archives at Berlin in 1875. His first work was the *Geschichte des ersten Kreuzzugs* (1841), but his principal work is the *Geschichte der Revolutionszeit* (3 vols., 1853–57, afterward continued; translated into English by Perry, London, 1868). He also wrote *Entstehung des deutschen Königthums* (1845), *Die Erhebung Europas gegen Napoleon I.* (1860), besides a great number of minor essays, partly historical, partly political, such as the *Klerikale Politik im neunzehnten Jahrhundert* (translated into English by J. S. Henderson, London, 1871).

Sycami′na, city of Palestine, situated near the present Haifa, between Acre and Cæsareia Palæstinæ, at the northern basis of Mount Carmel. It was here that Ptolemy Lathyrus, son of Cleopatra, landed the army of 30,000 men which he had brought from Cyprus to besiege Ptolemais; and in 1831, Ibrahim Pasha also selected the place to land his troops.

Syc′amine [Gr. συκάμινος], an ancient name for the mulberry, both black and white, also for the true sycamore.

Syc′amore [Gr. συκόμορος, from σῦκον, a "fig," and μόρον, a "mulberry;" Heb. *shik′mah*], a tree and its fruit, the *Sycomorus antiquorum*, a near relative of the fig. It is a widespreading, shady tree, much planted in the Levant for its shade. Its light, fragile wood is reputed to be indestructible. Its fruit is inferior in quality to that of the fig, but is abundant and palatable. In some parts of the U. S. the buttonwood or plane tree is improperly called sycamore, and in England that name is applied to a kind of maple (*Acer pseudoplatanus*).

Sycamore, p.-v. and tp., cap. of De Kalb co., Ill., on Sycamore and Cortland R. R., has 8 churches, good schools, 1 semi-weekly and 5 weekly newspapers, 3 banks, a large harvesting-machine and other manufacturing interests. Principal business, farming and dairying. P. of v. 1967; of tp. 2852. H. L. Boies, Ed. "True Republican."

Sycamore, tp., Montgomery co., Kan. P. 547.

Sycamore, tp., Hamilton co., O. P. 5460.

Sycamore, p.-v. and tp., Wyandot co., O., on Miami Canal. P. 850.

Sycamore, tp., Barnwell co., S. C. P. 1359.

Syc′ophant [from σῦκον, a "fig," and φαίνειν, φαντεῖν, to "disclose," to "inform"], originally an informer on fig-exporters, and was formed at a time when it was strongly forbidden to export figs from Attica. In this, its original meaning, however, it does not occur in the Greek literature. By the older writers it means an informer in general, a slanderer, a backbiter, but subsequently it came to designate a mean flatterer, a wretch who tries to get a good meal, present, etc., by catering to people's vanity, and in this meaning it has been adopted in most modern languages.

Syd′enham (Charles Edward **Poulett Thomson**), Baron, b. at Waverley Abbey, Surrey, England, Sept. 13, 1799, son of a wealthy merchant trading to Russia; became clerk, and subsequently partner, in the St. Petersburg house; was afterward a partner in the London firm; met with some losses by investing in Mexican mines 1825; became intimate with Bentham and his circle of political economists, whom he represented in Parliament from 1826; vice-president of the board of trade and treasurer of the navy Nov., 1830; president of the board of trade June, 1834; obtained a seat in the cabinet 1835; appointed governor-general of Canada Aug., 1839; created Baron Sydenham Aug., 1840, and after a brief administration, in which he effected the union of Upper and Lower Canada, he d. at Kingston, Canada, Sept. 19, 1841, from the results of a fall from his horse. His *Memoirs* were published in 1843 by his elder brother, George Poulett Scrope, M. P.

Sydenham (Floyer), b. in 1710; was educated at Wadham College, Oxford, where he took his degree of M. A. in 1734; became eminent as a Platonic scholar, translating into English several of the *Dialogues* of Plato, and publishing a *Dissertation on the Doctrine of Heraclitus, so far as it is mentioned or alluded to in Plato* (1775), and the *Onomasticum Theologicum, an Essay on the Divine Names according to the Platonic Philosophy* (1784). He fell into great pecuniary distress, was arrested on a trifling debt due to his victualler, and thrown into prison, where he d. Apr. 1, 1787. The sympathy excited by his fate gave rise to the establishment of the Literary Fund.

Sydenham (Thomas), b. at Winford Eagle, Dorsetshire, in 1624; was educated at Oxford, and in 1648 became a fellow of All Souls' College; studied medicine at the college of Montpellier, France; took his degree of M. D. at Cambridge, and established himself about 1660 as a physician in London, where he soon attained the foremost place. He abandoned the mere routine system of practice then prevalent, basing his own upon the theory that there is in nature a recuperative power which it is the province of the physician to aid, not to oppose. He was especially acute in observing and describing the symptoms of diseases, and carefully studied the relations between epidemics and the conditions of the atmosphere. Among the services which he rendered to medical practice was the treatment of intermittent fever by cinchona and the administration of cooling remedies in smallpox. His works, which are not numerous, comprising in all only a single volume, were written in Latin, but have been frequently translated. In 1843 was founded the Sydenham Society, for the purpose of printing important medical works in English and other languages. Its first issue was the complete works of Sydenham, in Latin (1846), and translated into English by Dr. Greenhill, with a memoir by Dr. Latham (1848). D. in London Dec. 29, 1689.

Syd′ney, the capital of the English colony of New South Wales, Australia, is on the southern shore of Port Jackson, which, whether for beauty of scenery or adaptability as a port, is unrivalled by any other harbor in the world. Although Sydney has now a formidable rival in the metropolis of Victoria, the natural advantages she possesses place her in the position of the first city of Australia, justly entitling her to the appellation of the "Queen of the Pacific." The city occupies the centre of a great Carboniferous basin. A great portion of it is built upon sandstone rock of the finest and most compact kind. The aspect of Sydney, when seen from the harbor, is splendid. Along the rocky, deeply-indented coast line, behind the forest of tall masts, stretch the long rows of stone houses, broken now and then by larger edifices, churches and manufacturing establishments, with their tall chimneys. On a hill to the left stands a castle, the palace of the governor, built in Gothic style, and a little below, on a steep promontory, is situated Fort Macquarie, which, however,

seems built more for the luxury of saluting English men-of-war than for the purpose of a serious encounter. The city is somewhat straggling and irregular in form, and occupies a site of various elevation. The observatory, on the hill to the N. W. of the town, is in lat. 33° 51′ 4″ S. and lon. 151° [illegible] E. The greatest length of the city is 3⅜ miles, the greatest breadth nearly 3 miles. The most prominent streets are George, Pitt, Bridge, York, Bent, and Macquarie streets. The most remarkable buildings are—the university, a structure of immense dimensions and very rich decoration, the museum of natural history, the market hall, the post office, and a number of schools and churches, large and small, in good taste and in bad. Twenty-three suburbs or townships surround the city; they are all incorporated boroughs; the most important are Glebe, Paddington, Waverley, Southhead, Newtown, St. Leonard, etc. Business is most lively along the Darling harbor, occupied by the numerous coasting vessels, while the large, sea-going vessels anchor at Sydney Cove, beside Fort Macquarie. The city is lighted by gas, and provided with water from the Lachlan and Botany swamps; it is rich in public promenades and charitable institutions. For parliamentary purposes the city is divided into two electorates, each of which returns four members to Parliament. The general government of the city is in the hands of a municipal council consisting of 16 aldermen. Sydney is the entrepôt for the products of the colony, and carries on itself an important manufacturing industry in iron, machinery, linen, cloth, soap, and tobacco. Its commerce is very great. In 1874 the colony was visited by 4385 vessels of 1,990,894 tons burden. The value of its imports amounted to £11,293,739, that of its exports to £12,345,603. By far the largest part of this traffic goes through Sydney. New South Wales was originally intended for a convict colony, and on Jan. 28, 1788, 1000 convicts and soldiers were first settled here; now it is a rich and important colony, and its capital has developed with extraordinary rapidity. Capt. Phillip, chief of the fleet which carried the convicts, selected the place and founded the city; in 1800 it numbered about 26,000 inhabitants. Between 1861 and 1871 the population increased 32 per cent. Of the 134,756 inhabitants the city comprised in 1871, 75,945—namely, 38,142 males and 37,803 females; and the suburbs 58,810—namely, 28,555 males and 30,255 females. Deportation ceased entirely in 1850. AUGUST NIEMANN.

Sydney, a seaport, cap. of Cape Breton co., N. S., on Cape Breton Island, on the S. W. arm of Sydney harbor. It was once the capital of the island. It is connected by rail with Bridgeport and other coal-mining centres. Coal, butter, and cattle are the principal exports. It has 6 churches, 2 weekly newspapers, and a fine court-house. Sydney mines are 18 miles distant. (See NORTH SYDNEY.) Sydney light is in lat. 46° 18′ N., lon. 60° 9′ W. Steamers ply regularly to Halifax (284 miles distant) and several other ports. The harbor is excellent. P. 2900.

Sydney (ALGERNON and PHILIP). See SIDNEY.

Syene. See ASSWAN.

Syenite. See GRANITE.

Sykes (GEORGE), b. at Dover, Del., Oct. 9, 1822; graduated at the U. S. Military Academy in 1842, when appointed a brevet second lieutenant in the 3d Infantry, his first service being against the Seminoles in Florida. In the war with Mexico he served with credit from Vera Cruz to the Mexican capital, gaining the brevet of captain for gallantry at Cerro Gordo. From 1848 to 1861 he was almost constantly with his regiment on the frontier, serving on numerous expeditions and being engaged in frequent actions with hostile Indians. In 1855 he attained a captaincy, and in the early part of 1861 was serving with his company in Texas. Hastening North, he was in May appointed major of the newly-authorized 14th Infantry, and in July commanded the battalion of regular troops in the battle of Bull Run. Commissioned a brigadier-general of volunteers in September, he commanded the regular infantry in the defences of Washington during the winter of 1861–62, and in the Virginia Peninsular campaign of 1862 the division of regulars (Porter's corps) which so stubbornly maintained its position on the right at the battle of Gaines's Mill. In the succeeding campaigns he continued in command of this division at the second battle of Bull Run, Antietam, Fredericksburg, and Chancellorsville, and on the appointment of Gen. Meade to the command of the Army of the Potomac (June, 1863) Sykes succeeded to that of the 5th corps, which a week later was engaged at Gettysburg, and at the head of which he continued during the ensuing operations of the Army of the Potomac until Apr., 1864, when ordered to duty in the department of Kansas. For gallantry at Gaines's Mill he was brevetted colonel, brigadier-general for Gettysburg, and major-general for gallant services during the rebellion. Mustered out of the volunteer service in Jan., 1866, he returned to duty with the 5th Infantry, of which he had been appointed lieutenant-colonel in Oct., 1863. In Jan., 1868, he became colonel of the 20th Infantry. D. at Fort Brown, Texas, Feb. 9, 1880.

Sykes (OLIVE **Logan**), daughter of Cornelius A. Logan, b. in New York in 1841; made her début on the stage in Philadelphia 1854; went to England 1857; pursued a course of study at a female college; became a contributor to English and French papers; published two novelettes (1860); reappeared on the stage at Wallack's, New York, in 1864, in *Eveleen*, a play written by herself; had considerable success on the stage, but retired in 1868, since which time she has devoted herself principally to lecturing on woman's rights and on other social topics, magazine-writing, and newspaper correspondence, and has published two or three volumes of essays and lectures. From 1857 to 1865 she was the wife of Edmund A. Delille, and is now (1876) the wife of Wirt Sykes, U. S. consul at Cardiff, Wales, whence she corresponds with several American periodicals, retaining as her literary signature her maiden name.

Sykes (WILLIAM HENRY), F. R. S., b. in Yorkshire, England, in 1790; joined the Bombay army 1804; served under Lord Lake at Bhurtpoor; commanded a regiment at Kirkee and Poona in the Deccan campaign 1817–20; qualified as interpreter of the Hindustani and Marathi languages; became statistical reporter to the Bombay government; retired with the rank of lieutenant-colonel 1831; became a commissioner of lunacy for London 1840; was subsequently a director in the East India Company, and its chairman 1856–57; was elected lord rector of the University of Aberdeen 1854; was at one time chairman of the Society of Arts; was chosen president of the Royal Asiatic Society 1858, and of the Statistical Society of London 1863; entered Parliament for Aberdeen as a Liberal 1857; was a severe critic of the British military policy in India and China after 1860; published many papers in scientific periodicals on the natural history, geology, meteorology, and statistics of India, and was author of *Notes on the Religious, Moral, and Political Condition of Ancient India*, *The Origin and Progress of the Taeping Rebellion in China* (1863), and other publications on military science and on vital statistics. D. June 16, 1872.

Sykes'ville, p.-v., Freedom tp., Carroll co., Md., on Baltimore and Ohio R. R.

Sylamore, tp., Izard co., Ark. P. 400.

Sylla. See SULLA.

Syl'labus [Lat.: literally, an index of words or heads of a book, a table of contents; also a collection or résumé] is a document issued by Pope Pius IX. Dec. 8, 1864, which condemns eighty current doctrines of the age as heresies, referring for particulars to the various earlier official documents of the same pope. Its full title is: *A Syllabus, containing the Principal Errors of our Times, which are noted in the Consistorial Allocutions, in the Encyclicals, and in other Apostolical Letters of our Most Holy Lord, Pope Pius IX.* As the pope has since been declared infallible (by the Vatican Council in 1870), this digest of errors must be regarded as infallible, for it is certainly an official utterance addressed to the whole Catholic world, and sent to the bishops with a papal encyclical. The document is purely negative, but indirectly it teaches and enjoins the very opposite of what it condemns as error. It is divided into ten sections. The first condemns pantheism, naturalism, and absolute rationalism; the second, moderate rationalism; the third, indifferentism and latitudinarianism; the fourth, socialism, communism, secret societies, Bible societies, and other "pests of this description;" the fifth, errors concerning the Church and her rights; the sixth, errors concerning civil society; the seventh, errors of natural and Christian ethics; the eighth, errors concerning Christian marriage; the ninth, errors concerning the temporal power of the pope; the tenth, errors of modern liberalism. Among the errors condemned are the principles of civil and religious liberty, and the separation of Church and State. The Syllabus indirectly asserts the infallibility of the pope, the exclusive right of Romanism to recognition by the civil government, the unlawfulness of all non-Catholic religions, the complete independence of the papal hierarchy, the power of the Roman Church to coerce and enforce, and its supreme control over public education, science, and literature. It reasserts all the extravagant claims of the mediæval papacy, and is a declaration of war against modern civilization and progress. It is irreconcilable with an independent state. It has provoked the new conflict between the papal and the civil power in Prussia, Austria, Brazil. The Syllabus is printed in the *Acta et Decreta Concil. Vatic.* (Friburg, 1871), and in Schaff's edition of Gladstone's pamphlet on the *Vatican Decrees* (New York, 1875, p. 109). See Schaff, *History of Creeds*, vol. i. p. 128; Pronier, *La Liberté re-*

ligieuse et le Syllabus (Genev., 1870); Gladstone, *Vatican Decrees*, the replies of Cardinal Manning and Dr. Newman to Gladstone (1875), and Gladstone's second pamphlet, *Vaticanism* (1875), in triumphant self-vindication. Newman's defence of the Syllabus is ingenious but feeble, and virtually denies its dogmatic force, saying (p. 108), "We can no more accept it as *de fide*, as a dogmatic document, than any other index or table of contents." PHILIP SCHAFF.

Syllacages, tp., Talladega co., Ala. P. 1034.

Syllogism. See LOGIC, by PROF. W. D. WILSON, LL.D., L. H. D.

Syl'van, tp., Osceola co., Mich. P. 43.

Sylvan, p.-v. and tp., Washtenaw co., Mich. P. 1931.

Sylvan, p.-v. and tp., Richland co., Wis. P. 888.

Sylvan Grove, tp., Dale co., Ala. P. 524.

Sylva'nia, p.-v., cap. of Screven co., Ga.

Sylvania, p.-v. and tp., Lucas co., O., on Lake Shore and Michigan Southern R. R. P. 1400.

Sylvania, p.-v., Columbia tp., Bradford co., Pa. P. 212.

Sylvania, tp., Potter co., Pa. P. 267.

Sylvant, tp., Richland co., Wis. P. 888.

Sylves'ter, p.-v. and tp., Green co., Wis. P. 1034.

Sylvester, the name of two popes and an antipope. What is told of SYLVESTER I. (314–335), that he converted and baptized the emperor Constantine, and received Rome and its temporalities as a donation, is only fable.—SYLVESTER II., whose true name was GERBERT, was born in Auvergne; studied in Spain under Bishop Hatto of Barcelona, and with the Arabs at Seville and Cordova; travelled in Italy; acquired a great reputation for learning, and was appointed by Otto II. teacher to his son, Otto III. While director of the school of Rheims, to which he attracted many students, he was elected archbishop of that diocese in 991 by a synod which deposed Archbishop Arnulf, but he was not confirmed by the pope, and had to give up his see to Arnulf. He then left Rheims, and repaired to Otto III., by whose aid he became archbishop of Ravenna in 998, and in the following year pope. His knowledge of mathematics, astronomy, and physics led people to consider him a magician.

Sylvester (JOSHUA), b. in England in 1563; became eminent as a linguist; was a member of the Company of Merchant Adventurers at Stade, Holland. D. at Middleburg, Holland, Sept. 28, 1618. Author of numerous poems and tracts, but best known as the translator into English of Du Bartas's *Divine Weekes and Workes* (1621).

Syl'vius (JACOBUS), (JACQUES DUBOIS), b. at Louville, near Amiens, France, in 1478; studied medicine at the University of Paris, where he was appointed professor in 1550, and d. Jan. 13, 1555. He was the first to practise injection of the blood-vessels during their dissection; a fissure of the cerebrum is called the fissure of Sylvius. His *Opera Medica* were collected by René Moreau, and appeared at Geneva in 1630.

Symbols. See SIGN.

Symbols, Chemical. See CHEMISTRY, by PROF. G. F. BARKER, M. D.

Symbols, in zoology. See ZOOLOGY.

Syme (JAMES), M. D., b. in Edinburgh, Scotland, in 1799; graduated in surgery 1821; was lecturer and professor of surgery at Edinburgh many years, and originated many improvements, including the resection of diseased joints in place of amputation, the process known as "Syme's operation" for amputation of the foot at the ankle-joint, and the removal of large tumors of the lower jaw by excision of the entire bone. D. at Edinburgh June 26, 1870. Author of *The Excision of Diseased Joints* (1831) and *Principles of Surgery* (1832), both reprinted at Philadelphia (1866). A *Memorial of the Life of James Syme, M. D.*, was prepared by Dr. Robert Patterson (Edinburgh, 1871).

Sym'machus, b. at Sinagia, in Sardinia, about 440; was elected pope Nov. 22, 498, after the death of Anastasius II., but his election was contested, and Laurentius was elected antipope. Symmachus was supported by Theodoric, king of Italy, and Laurentius by the Byzantine emperor. The contest lasted for several years, but was finally decided in favor of Symmachus. But of more interest are the enactments of the various synods held during his reign, and which contributed much to the development of the papal power. In 502 a synod of Rome decreed that no layman should interfere in the affairs of the see of St. Peter without incurring the severest penalties; and in 503, when the pope was accused of peculation and adultery, another synod of Rome declared that the occupant of the see of St. Peter could be judged by none but God. Symmachus d. July 19, 514, and was declared a saint; his feast is celebrated on the day of his death.

Symmachus (QUINTUS AURELIUS), b. and educated in Gaul, but acquired great fame as an orator, and held some of the highest civil offices in Rome in the latter part of the fourth century A. D. Of his works, the *Epistolarum Libri X.* have come down to us, and are of considerable historical interest; editions by Juretus (1580), Scioppius (1608), and Pareus (1651). Fragments of his speeches were discovered by Cardinal Mai, and published in *Scriptorum Veterum nova Collectio* (1815) and in Meyer, *Orat. Rom. Fragm.*, p. 627–636. He was one of the last champions of paganism, but a noble and pure character.

Symmes, tp., Edgar co., Ill. P. 1185.

Symmes, p.-v. and tp., Hamilton co., O. P. 1377.

Symmes, tp., Lawrence co., O. P. 995.

Symmes (JOHN CLEVES), b. on Long Island, N. Y., July 21, 1742, was a member of the Continental Congress 1785–86; judge and chief-justice of the supreme court of New Jersey; was appointed judge of the North-west Territory 1788, and was the founder of the settlements in the Miami Valley. D. at Cincinnati Feb. 26, 1814.

Symmes (JOHN CLEVES), nephew of the preceding, b. in New Jersey about 1780; entered the army as an ensign 1802; was a captain in the war of 1812, serving on the Niagara frontier; settled at Newport, Ky., and made himself notable throughout the West by propounding a theory that the earth is hollow, open at the poles, and habitable within, containing several other concentric hollow spheres. He published several arguments and delivered many lectures (from about 1818) in support of his theory, and petitioned Congress to fit out an expedition to test it. D. in poverty at Hamilton, O., May 19, 1829. A son of his has recently (1876) revived the theory.

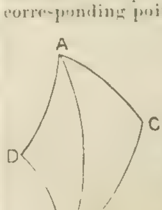
Symmes (THOMAS), b. at Bradford, Mass., Feb. 1, 1678; graduated at Harvard 1698; was minister at Boxford, Mass., 1702–08, and at Bradford from 1808 to his death, Oct. 6, 1725. Author of *Historical Memoirs of the Late Fight at Piggwackett, with a Sermon, occasioned by the Fall of the Brave Capt. John Lovewell* (1725; republished, with notes by Dr. Nathaniel Benton, 1861), and the *Sermon* was republished by Frederick Ridder in his *Expeditions of Capt. Lovewell* (1865).

Symmes's Corners, p.-v., Fairfield tp., Butler co., O. P. 127.

Sym'metry [Gr. συμμετρία], a mathematical term implying regularity in the arrangement of the parts of a mathematical figure. Two points are said to be symmetrically disposed with respect to a straight line when they are on opposite sides of the line and equally distant from it—that is, when they are so situated that a line joining them is bisected by the given line. A curve is symmetrical with respect to a line when its points, taken in pairs, are symmetrically disposed with respect to that line—that is, for each point on one side of the line there is a corresponding point on the other side, equally distant from it. In this case the given line is called an *axis of symmetry*. Thus, in the ellipse, for every point on one side of the transverse axis there is on the other side a second point such that the chord joining them is bisected by that axis. The transverse axis of the ellipse is therefore an axis of symmetry.

There is a species of symmetry called *oblique symmetry*, differing from that just explained in the fact that the chords joining the corresponding points are oblique to the line that bisects them. Thus, in the ellipse any diameter bisects all chords parallel to its conjugate. The ellipse is therefore said to be obliquely symmetrical with respect to any one of its diameters.

The idea of symmetry may be extended to surfaces, lines of symmetry being replaced by planes of symmetry. A surface is said to be symmetrical with respect to a plane when for each point on one side of the plane there is a corresponding point on the other side, such that the line joining them is bisected by the plane. If the chords are perpendicular to the plane, the symmetry is said to be *right*; otherwise it is said to be *oblique*. A plane of symmetry is often called a *diametral* plane, and is then defined to be a plane which bisects a system of parallel chords of the surface.



Symmetrical triangles on the surface of a sphere are spherical triangles whose sides are equal each to each, but not similarly situated. Thus, if the triangles A C E and A D C have the side A E common, the side A C equal to A D, the side C E equal to D E, the angles at A and E being equal, as well as the

angle at C and D, the triangles are symmetrical. Although they are equal in all their parts, they cannot be superposed so as to coincide.

In analysis an expression is said to be symmetrical with respect to two letters when the letters may change places without changing the form of the expression. Thus, the expression $x^2 + y^2 = R^2$ is symmetrical with respect to x and y. W. G. Peck.

Sy'monds (John Addington), M. D., b. at Oxford, England, Apr. 10, 1807; educated at the University of Edinburgh, where he graduated in medicine 1828; became physician to the general hospital at Bristol about 1832; lecturer at the Bristol Medical School 1834; Gulstonian lecturer 1858; president of the British Medical Association at Bristol 1863, and took a prominent part in the social science congress of 1869. D. at Clifton Feb. 25, 1871. Author of *Sleep and Dreams* (1851), *The Principles of Beauty* (1857), of various poems, addresses, and essays, and of a posthumous volume of *Miscellanies* (1871) containing some fine descriptions of Italy and some intelligent art-criticism.

Sy'mons (Jelinger Cookson), b. in England in 1809; graduated at Corpus Christi College, Oxford, 1831; was called to the bar 1843; edited the *Law Magazine* several years, and became government inspector of schools 1847. D. at Great Malvern Apr. 7, 1860. He edited J. W. Smith's valuable *Lectures on the Law of Contracts* (1847), wrote several professional treatises, and was author, among other works, of *Railway Liabilities* (1846), *Tactics for the Times* (1849), *School Economy* (1852), *Lunar Motion* (1856), in which he denied the rotation of the moon upon her axis, and *William Burke the Author of Junius, an Essay on his Era* (1859).

Sympathetic Inks. See Ink, by Prof. B. Silliman, M. D.

Sympathetic Nervous System. See Ganglionic Nervous System, by E. C. Seguin, M. D., and Histology, by Col. J. J. Woodward, M. D.

Sym'phony, or **Sinfonia** [Gr. σύν and φωνή], in music, is an elaborate composition designed for performance by a full orchestra, and consisting of several distinct movements (usually four in number), each of which has its own individual character, as the *allegro, andante, adagio, minuet, scherzo,* etc., while the whole unite in forming one symmetrical and complete work of art. There appears to have been no important difference between the symphony and the overture until about the end of the last century. William Staunton.

Symphytum. See Comfrey.

Sympiesometer [from συμπιέζω, "compress," and μέτρον, "measure"], an instrument for indicating the amount and variations of atmospheric pressure, consists of a vertical glass tube, terminated above by an oblong bulb, and bent upwards at its lower extremity, where it expands into a cistern open at the top. The bulb and upper part of the tube contain hydrogen gas, the cistern and lower part of the tube colored oil of almond. As the pressure of the atmosphere varies, the enclosed hydrogen gas expands or contracts by proportional, but large, quantities, and the liquid consequently rises or falls in the tube through large spaces; the scale attached is corrected also for temperature, and its indications correspond to those of a mercurial barometer.

Symp'toms [from the Gr. συμπίπτω, to "concur," to "fall together"], in medical diagnosis and prognosis, are the phenomena by which the physician judges of the nature and probable course of the disease he deals with. Symptoms are *objective*—that is, perceptible to the physician's senses—or *subjective*, perceptible only to the patient's senses, such as pain, deafness, etc. Each may be valuable, but the former are as a rule much more to be depended upon. These are by some writers called *physical signs*, as distinguished from *vital symptoms*, but these are sometimes objective, and practically all are classed as symptoms. Few symptoms are absolutely *pathognomonic*, or infallible signs of some one disease; but in general the import of symptoms can be learned only by the use of careful observation and patient and logical thought, guided by experience.

Syn'agogue, the place of worship of the Jews [from Gr. συναγωγή, class. Gr. "collection," "gathering:" LXX. "assembly," "meeting:" New Testament and ecclesiastical writers בית הכנכת, "house of assembly:" Προσευχή = בית תפלה. For distinction between συναγωγή and ἐκκλησία see Trench, *Synonyms of the N. T.*, § 1]. Early tradition, both Jewish and Christian, refers the origin of synagogue-worship to the patriarchal or Mosaic age. Of the private and social religious life in Israel previous to the Exile almost nothing is known, and it seems clear that it had no centre away from the temple and feasts at Jerusalem. The prophets exercised great influence among the people, and gathered them together for instruction (2 Kings iv. 23), but these meetings were irregular, infrequent, and never became general among the people (2 Chron. xvii. 9). It was undoubtedly during the Captivity, when the people, afar from temple and native land, assembled privately on their sabbaths and feast-days for reading the Law and devotion, that the system had its origin; but not until after the Greek conquests, and the consequent dispersion of the Jews throughout Western Asia and Europe, was it fully developed as one of the characteristic features of Judaism. Wherever the Jews went they carried their religion and laws with them, and in every settlement of ten בטלנים (*i. e.* men at leisure to attend service and hold the communal offices) they built a synagogue, supplying, as a centre of their social religious life, the place of the temple. In Palestine the development was more gradual, but at the time of Christ synagogues are found in every town and village throughout the country, and he makes use of them for much of his teaching. Since the destruction of the temple, the synagogues, which have been the only place of worship of the Jews, have exercised an immense influence on the Jewish religious and national character; to such an extent have they cultivated the idea of local worship that the temple is almost eliminated from their religion.

As the founders of the early Church were brought up under synagogue influence, the intimate connection of the forms of worship, officers, and order of the Christian Church with that of the synagogue is most natural. (Comp. זקנים — πρεσβύτεροι = "elders;" גבאי צדקה = διάκονοι = "almoners," "deacons;" שליח צבור = ἄγγελος ἐκκλησιας = "minister," "teacher;" חזן — ὑπηρέτης = "sexton.")

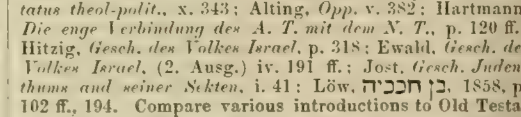
Literature.—(See Winer and Herzog (Leyrer), under "Synagogue;" Smith (Plumptre), Kitto (Ginsburg), "Synagogue;" Vitringa, *De Synagoga Vetere* and *Archisynagogus*; Zunz, *Gottesdienstliche Vorträge der Juden, Der Ritus des synagogischen Gottesdienstes geschichtlich entwickelt*; Allen, *Modern Judaism*; Bernard, *Synagogue and Church*; Jerusalem, Megillah, iii.; Maimonides, "יד חזקה: Engelmann, הגיון לב.) (Compare also various histories of Israel—Herzfeld, Jost, Grätz, Ewald, etc.)

The Great Synagogue (כנסת הגדול).—A body of 120 men (אנשי כנסת הגדול), who, according to Jewish tradition (*Baba bathr.*, fol. xiv. 2, xv. 1; Megilloth, 17 b. 18 c.; *Pirke Aboth.*, i. 1), were constituted by Nehemiah (x. 1–10), after the return from the Exile, for the reorganization of religious worship and civil order. To them is attributed the formation of the canon of the Prophets (נביאים), etc. Many (Simon, Spinoza, Alting, Rau, Aurivillius, De Wette; see below) regard, without sufficient ground, the whole account as an invention of the later Rabbinical schools. Most probably Ezra and Nehemiah gathered around them a council (Neh. viii. 13) for aid and advice in re-establishing the Jewish Church and State, and this body perpetuated itself until it developed into the Sanhedrim.

Literature.—See above under Sanhedrim. See also Rau, *De Synagoga Magna*, Aurivillius (ed. J. D. Michaelis), *De Synagoga vulgo dicta Magna*; Grätz, in Frankel's *Monatsschrift*, vi. 31 ff., 61 ff.; Spinoza, *Tractatus theol-polit.*, x. 343; Alting, *Opp.* v. 382; Hartmann, *Die enge Verbindung des A. T. mit dem N. T.*, p. 120 ff.; Hitzig, *Gesch. des Volkes Israel*, p. 318; Ewald, *Gesch. des Volkes Israel*, (2. Ausg.) iv. 191 ff.; Jost, *Gesch. Judenthums and seiner Sekten*, i. 41; Löw, בן חכביה, 1858, p. 102 ff., 194. Compare various introductions to Old Testament: Simon, *Histoire Crit. du Vieux Testament*, lib. i. cap. viii.; Bleek, *Einleitung*, p. 690; Keil, *Einleitung*, p. 499; also De Wette, Horne, Stähelin, etc.; Bertheau (*Comm. zu Esra*, p. 101). Thomas C. Murray.

Synaptase. See Emulsin.

Syncopa'tion [Gr. συγκοπή], in music, a certain arrangement of notes which often produces a sudden check of the rhythmical movement, thus disturbing the regular accent, and rendering emphatic that part of a bar or measure which would otherwise be unaccented. See *a, b,* and *c* in the example following:



Syncopation of a simpler kind occurs when the last note of any bar and the first note of the bar succeeding are tied together by a "bind," and thus form in reality only one note. Formerly, instead of writing two notes separately with a bind, it was usual to write only one (equal to the

sum of both), and place it directly across the bar-stroke. Syncopations are also called "driving notes." W. STAUNTON.

Syn'cretism [Gr. συγκρητισμός] is said to have originated in ancient times as the designation of a custom characteristic of the inhabitants of Crete, who forgot or overlooked all their internal dissensions as soon as a controversy occurred with any foreign country. In the sixteenth century the word was used to denote those attempts which were made by Pico de Mirandola, Bessarion, and others to reconcile the philosophy of Aristotle with that of Plato. But a still more extensive use for the name was found in the seventeenth century, it being applied to the views of George Callixtus and his followers, who hoped to heal the schism of the Christian Church by acknowledging the traditions of the first Christian centuries beside the Bible, and declaring the *Symbolum Apostolicum*, the common basis of the various Christian denominations, as sufficient for the definition of true Christianity.

Syn'dicate. This word first came into general use in connection with the funding of our national debt by a combination of native and foreign bankers. Originally, it meant a council of judges, but the associated action of great capitalists having a specific object in view required a new word, or a new meaning to an old one; hence "syndicate." D. G. CROLY.

Syn'ergism [Gr. σύν, "with," and ἔργειν, to "work"] denotes those views of the work of regeneration according to which the human volition is not absolutely passive, and the divine grace not the only activity. In the time of the Reformation these views were represented by Melanchthon, and in the latter part of the sixteenth century vehement controversies arose between the synergists, Pfeffinger, Strigel, etc., and the orthodox, Flacius, Arnsdorf, etc. The question was finally settled by the *Formula Concordiæ* in favor of the orthodox.

Syne'sius, b. about 375 in Cyrene, the civil metropolis of the Libyan Pentapolis; studied philosophy in Alexandria under Hypatia, of whom he became an enthusiastic disciple; was sent at the head of a provincial embassy to the emperor Arcadius at Constantinople in 397, and stayed there for three years, which time he describes as exceedingly painful; visited Athens in 402, but found himself greatly disappointed, and spent most of his time in rural retirement near the frontier of Cyrenaica, occupied with the study of philosophy and literary pursuits. In 410 he was elected bishop of Ptolemais, the ecclesiastical metropolis of the province, but his relation to Christianity previous to his election is rather obscure, and it cannot be made out with certainty whether he was baptized or not. He accepted the election with great reluctance. Many of the Christian doctrines he could not reconcile with the ideas of the Neo-Platonic philosophy which formed his innermost conviction; he felt averse to the large secular business connected with the episcopate; he was married, and he was absolutely unwilling to renounce wedlock. Nor did he feel happy in his new office, which, however, he filled with conscientiousness and energy. The date of his death is not known, but about 430. Of his works are extant several essays, among which *De Insomniis*, a wild Neo-Platonic speculation; several orations, among which that held before Arcadius; a number of hymns, often translated into modern European languages; and letters of great and varied interest. Collected edition, with Latin translation, by Petavius (Paris, 1612; 2d ed. 1640); critical editions by Krabinger of separate works. (See H. N. Clausen, *De Synesio*, Copenhagen, 1831, and C. Thilo, *Commentarii in Synesii Hymnos*, Halle, 1842–43.)

Syngenesia. See COMPOSITÆ.

Syngnath'idæ [Gr. σύν, "together," and γνάθος, "jaw"], a family of marine acanthopterygian fishes distinguished by a highly-elongated form, with little flesh, the body almost covered with partially-ossified plates, the head and snout long and tubular, and the males having pouches in which the eggs of the female are hatched. The type of the family is the pipe-fish (*Syngnathus*), a genus of the order LOPHOBRANCHII (which see), containing more than twenty species, which are sometimes grouped as the sub family Syngnathinæ, which is characterized by the egg-pouch being always on the tail, which is open through its whole length. They attain a length of two or three feet, live upon small marine animals and the eggs of other fishes, and have great affection for their young, which after being hatched often return to the egg-pouch of the male parent for protection. Not all the pipe fishes belong to this family, that name being often given also to the fishes forming the family Fistularidæ, also called pipe-mouths and flute-mouths.

Synodites. See CENOBITES.

Synod of Dort. See DORT, SYNOD OF.

Syn'onym [Gr. συνώνυμον], a term applied to one of a group of two or more words of the same language, all of which have the same meaning. Practically, however, there are few strict synonyms, the words that pass for such being expressions of ideas nearly but not perfectly identical. There are consequently few instances where one word can be made to do the work of another without some qualification or circumlocution. The English language is peculiarly rich in what are called synonyms, and they confer upon it the power of expressing nice shades of thought in condensed and forcible terms. Some of the Oriental tongues, however, far excel ours in the number of synonyms, but in many cases these are figurative, highly poetical, and entirely conventional uses of terms by no means in themselves synonymous. This style of utterance is with us tolerated only in poetry.

Syno'vial Mem'brane [Gr. σύν, "with" or "resembling," and ᾠόν, "egg"], a membrane in the animal in structure resembling serous membrane, but having a secretion unlike the thin watery product of the latter, and termed synovia or synovial fluid, denoting that it is thick, viscid, and glairy like the white of an egg. There are three classes of synovial membranes in the human body: (1) The articular, or those lining the lateral and antero-posterior walls of the closed cavities of the joints, and secreting a fluid to lubricate the opposed cartilaginous surfaces of the articulating bones. (2) Vaginal or sheath-like synovial membranes, which surround the tendons when passing through osseo-fibrous canals or grooves in the surfaces of bones, as is the case in the hand and foot. (3) Bursæ (Gr. βύρσα, "a bag"), little synovial sacs or cushions interposed between parts moving one upon the other with friction, as where a tendon glides over or presses directly upon a bony prominence. The synovial fluid consists of nearly 95 per cent. of water, rendered viscid by mucus, epithelial cells, fat, albumen, and salts. The synovial membranes are frequently the seat of disease. Acute synovitis, acute inflammation, may attack any joint as the result of violent injury, exposure to cold, rheumatic taint, or less often from vitiated blood in the course of fevers and other diseases. The symptoms are local swelling, extreme tenderness upon touch or pressure, pain when moved, and often persistent agonizing pain caused by the distension of the sensitive inflamed cavity by a hypersecretion of fluid. Penetrating wounds of the large synovial cavities, whether gunshot, incised, or occurring in connection with fractures, are serious, often necessitating the loss of a limb. Chronic synovitis is often a product of tubercular or scrofulous hereditary taint, with injury or over use as incipient or exciting cause. The destructive process often involves the ends of the bones and the ligaments, which are softened and disintegrated. Abscess, partial dislocations, and ankylosis, or stiff joint, are the chief misfortunes which result. The synovial bursæ often become swollen and prominent by hypersecretion, and also by injury and inflammation. Such is the ganglion or "weeping sinew" of the back of the wrist. It resembles a cystic tumor; its contents must be evacuated and the membranous sac irritated or lacerated to obliterate it by adhesive inflammation. The occurrence of distended bursæ, and difficulty of cure in many cases, are due to their connection with the cavity of an adjacent joint.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Syntax. See GRAMMAR.

Synthesis. See ANALYSIS.

Synthet'ic Divi'sion, in arithmetic, which corresponds with Horner's method for the synthetic division of algebraic quantities, is an ingenious method invented by George Suffield of performing the division of numbers in such a manner that the portion of the quotient already found shall be utilized to facilitate the finding of the remaining portion; it is especially valuable for abbreviating calculations which by the ordinary processes of division are long and tedious. To popularize the method it will be first explained for those who understand the first four rules of arithmetic only: We know that if we multiply the divisor and the quotient into each other, the product will be equal to the dividend, and in certain cases we shall be able to observe the quotient itself occupying a place among the partial products obtained in the process of multiplication: thus, 305963 ÷ 401 = 763, and multiplying the quotient by the divisor, we have —

$$\begin{array}{r} 763 \\ 401 \\ 763^{*} \\ 305200 \\ 305963 \end{array}$$

where the partial product, marked *, is the quotient itself, and the other partial product is 100 times greater than the

quotient: so that if we can find a means of taking away 400 times the quotient from the product, we shall leave the true quotient. But as we do not know the true quotient, we cannot at once determine what figures will represent 400 times the true quotient; yet, as a sufficient portion of the larger partial product is unaffected by the partial product obtained by the multiplication by the unit figure to enable us to find the first figure of the true quotient, we can readily find the product of the true quotient $\times$ 400. Taking the dividend, 305963, we first divide the 30 by 4, which gives us 7, with a remainder (at present we only want the 7), and we know this 7 must be that resulting from the multiplication of the figure in the hundreds' place of the true quotient by the figure in the units' place of the divisor: if, therefore, we subtract this 7 from the figure in the hundreds' place of the dividend, we shall obtain the fourth figure of the larger partial product; 7 from 9 leaves 2, and as the fifth and sixth figures must be ciphers, 305200 must be equal to the true quotient multiplied by 400; and since, by subtraction,

$$\begin{array}{r} 305963 \\ \underline{305200} \\ \ldots 763 \end{array}$$

it follows that 763 is the quotient resulting from the division of 305963 by 401. This is synthetic division *subtractive*, and in practice is formed thus:

$$\begin{array}{r} 4)\underline{305.963} \\ \ldots 763 \end{array}$$

The mental process is this: We say 4 in 30 = 7, and 2 over; write 7 under 9; 4 in 25 = 6, and 1 over; write 6 under 6; 4 in (19 – 7) 12 = 3, and no remainder; 4 in 6 – 6 = 0; 4 in 3 – 3 = 0; therefore, 763 is the exact quotient arising from the division of 305963 by 401. To facilitate synthetic division in arithmetic it is desirable to have the divisor near 10 or some multiple of 10; yet the divisor must not be 10 nor any multiple nor aliquot part of 10. Suitable divisors are obtained by multiplying or by dividing both dividend and divisor by such a number as will make the divisor some multiple of 10 or near it. Supposing, to take a simple example, 2680235791 is to be divided by 857, we multiply both dividend and divisor by 7, and quickly obtain the true quotient by short synthetic division *additive*, thus:

$$\begin{array}{r} 6)\underline{18761}650.537 \\ \ldots.3127463.000 \end{array}$$

In this instance the mental process is: 6 in 18 = 3, write 3 under 1; 6 in 7 = 1, and 1 over; 6 in 16 = 2, and 4 over; 6 in (41 + 3) 44 = 7, and 2 over: 6 in (26 + 1) 27 = 4, and 3 over; 6 in (35 + 2) 37 = 6, and 1 over; 6 in (10 + 7) 17 = 3, minus 1: 6 in (5 + 4 – 10, for the 1 must of course be carried as 10, because we are using it with figures one place lower in the scale of local value), minus 1 = 0 – 1; 6 in (3 + 6 – 10) – 1 = 0 – 1; 6 in (7 + 3 – 10) 0 = 0; therefore, 3127463 is the quotient, and there is no remainder. Hence the *Rule:* First multiply or divide the divisor by a number that will bring it very close to a multiple of 10 (401 is already a suitable divisor, and 857 $\times$ 7 = 5999); next add or subtract that figure which will make the partially-converted divisor (401 or 5999) a power of 10 (400 or 6000); and, having multiplied or divided the dividend by the figure used to manipulate the divisor, point off in the converted dividend as many decimal places, commencing at the units' place, as there are ciphers in the converted divisor (400 or 6000). Place the first figure of the quotient as many places from the beginning of the converted dividend as would be required for the first division by the synthetic divisor with the ciphers annexed (we must have 3059 to divide by 400, and 18761 to divide by 6000; we therefore place the first figure of the quotient under the 9, or four places, and under the 1, or five places, from the beginning respectively). Divide as in the ordinary process, but add in the quotient figure standing in vertical line with the figure of the dividend which is being manipulated. The integer portion of the quotient will be complete when the decimal point in the dividend is reached.

By using the processes of ordinary division in combination with synthetic division, the number of divisors reducible to synthetic divisors applicable to the short-division process may be almost indefinitely increased; thus, supposing we have to divide by 117, the first synthetic divisor directly obtainable would be 117 $\times$ 7 = 819 = synthetic divisor 82; but 39 $\times$ 3 = 117 = 3 $\times$ synthetic divisor 4; we may therefore divide synthetically by 4, and in the ordinary way by 3, commencing with either process. Of divisors of this class more will be learned hereafter.

The general principle of the process may now be readily considered by adopting Mr. Suffield's arrangement of commencing with the period of circulating decimals. When q is a prime, the "cycle of q" (that is, the period or periods of the decimals equal to all the vulgar fractions, in their lowest terms, whose denominator is q) has $q-1$ places of figures: but when q is *not* prime, some of the $(q-1)$ fractions will not be in their lowest terms, and will therefore have periods belonging to another cycle, and there will be altogether as many places of figures in the "cycle of q" as there are numbers less than q and prime to q; that is to say, $q \,.\, \frac{a-1}{a} \,.\, \frac{b-1}{b} \,.\, \frac{c-1}{c}$, etc. places. In the case of terminating decimals, $q = 2^m \,.\, 5^n$, and the above formula gives $2^m \,.\, 5^n \,.\, \frac{2-1}{2} \,.\, \frac{5-1}{5}$ as the number *not* of decimal places, but of the different decimals which can be formed from all fractions in their lowest terms with a denominator q. All the periods of the same "cycle" are of equal length, and when q is prime, the number of figures in any period is $(q-1)$ or an aliquot part thereof. But when q is not prime, but $= a, b, c$, etc. (these being prime factors of q, and all unequal), then if α, β, γ, etc. represent the number of figures in each of the periods of the "cycles" of a, b, c, etc., respectively, the number of figures in any period of the "cycle of q" is equal to the least common multiple of α, β, γ, etc. If in reducing $\frac{p}{q}$ to a decimal a remainder occurs equal to the sum or difference of two previous remainders, r and r', or an exact part, as $\frac{1}{m\text{th}}$, of a previous remainder, the rest of the period may easily be found by adding or subtracting the terms already found for $\frac{r}{q}$ or $\frac{r'}{q}$, or by dividing those for $\frac{r}{q}$ by m, always taking care to bring down the newly-obtained decimals to the right hand of the decimals by the addition, subtraction, or division of which they are produced. If in reducing $\frac{p}{q}$ to a decimal, a remainder occurs $= q - p$, the last half of the period is obtained by subtracting each of the figures of the first half from 9. If the cycle have only one period, the digits of the first and last half of the period will be "complementary" to each other; otherwise each period of the "cycle" will either consist of two complementary halves, or the "cycle" will consist of complementary pairs of periods; therefore, the complementary digits 0 and 9, 1 and 8, etc., must exist in every cycle in *pairs*. If q be a prime, the decimals of all the fractions $\frac{1}{q}$, $\frac{2}{q}$, or $\frac{q-1}{q}$ are contained in its cycle, and form an arithmetical progression; and if the whole "cycle" be known, the decimal answering to any of the above fractions can be determined by inspection. The importance of knowing this when a long series of closely-similar calculations has to be made will be apparent; but under ordinary circumstances the results can be more quickly obtained by calculation than by inspection. The period of the reciprocal of a number may be obtained backward by multiplication.

The principles explained above are developed in Mr. Suffield's rule for synthetic division: "*To find* Q, *the quotient of* A $\div$ B.—Let a_{n-1}, a_{n-2}, etc. a_1, a_0 be the digits in the n last places of B. Then if $9 - a_{n-1}$, $9 - a_{n-2}$, $9 - a_{n-3}$, etc., $9 - a_1$, $10 - a_0$, be added respectively to these digits, it will convert B into a number with a significant part (which call the synthetic divisor), followed by n ciphers. Point off n places of decimals from the units' place of A, and divide it by the synthetic divisor so as to find q, the first figure of Q; then above or below each of the n places of the dividend, which would in common division have to be brought down to find the next n figures of the quotient, write respectively $(9 - a_{n-1})q$, $(9 - a_{n-2})q$, etc. etc., $(9 - a_1)q$, $(10 - a_0)q$, leaving room at the right hand of each multiple for the same multiple of all the other figures of the quotient when found. Now suppose all the figures of the quotient *known*, and thus treated, the result would be (including the dividend) $n+1$ horizontal rows of figures, and their sum (adding the figures as they stand, and putting the decimal point of their sum under the decimal point of the dividend), divided by synthetic divisor, would give the same quotient Q, and remainder, as A $\div$ B. But Q is not known until the division is completed; therefore to form the true dividend which, divided by the synthetic divisor, gives Q, we must find one figure of Q at a time, and operate on it when found according to the rule, thus forming the true dividend as we proceed with the division." To prove the rule, let B =

$$\text{Syn. div.} \times 10^n - \big\{(9 - a_{n-1}).10^{n-1} + (9 - a_{n-2}).10^{n-2} +, \text{etc.}, + (9 - a_1).10 + (10 - a_0)\big\};$$

$\therefore -Bq = -q$ syn. div. $\times 10^n + q(9 - a_{n-1}).10^{n-1} + q(9 - a_{n-2}).10^{n-2} +$, etc., $+ q(10 - a_0)$.

If the n last digits of the divisor be each 9, the general rule will be much simplified. There will only be two rows of figures to add together—the dividend and the quotient, whose first figure will be placed above or below the nth figure of the dividend to the right of the units' place of the first remainder, and in determining the period of the circulator the quotient will be the sole dividend. If there be $(m + 1)$ rows, including the dividend, to add together, we can never in performing the addition have more than m to carry; therefore, if a certain figure of the quotient would give a remainder < synthetic divisor —m, it is the right figure to take; otherwise, it is a doubtful case, and we must give this figure the *largest* value it will admit of, supposing it introduced into the multiple quotients, and taking into account the figure which on that supposition might have to be added to the remainder. The "doubtful case" will occur most frequently for *small* values of synthetic divisor. When the synthetic divisor is large, the same process is applied with *long* instead of short division.

In his pamphlet Mr. Suffield has given a large number of examples to elucidate the system. (See *Synthetic Division in Arithmetic, with some Introductory Remarks on the Period of Circulating Decimals*, by George Suffield, M. A., Clare College, Cambridge (Cambridge and London, 1863).) EDWARD DAVID HEARN.

Syphax. See MASINISSA.

Sy'pher (JOSIAH R.), b. at Liverpool, Pa., in 1832; graduated at Union College in 1858; studied law, and was admitted to the bar in 1862; contributed to various journals and periodicals, and in 1865 became one of the editorial staff of the New York *Tribune*, of which journal he established the Philadelphia branch office in 1867. He has published *History of the Pennsylvania Reserve Corps* (1865), *School History of Pennsylvania* (1868), and, in conjunction with E. A. Apgar, *School History of New Jersey* (1870).

Syph'ilis, a specific chronic contagious disease peculiar to the human organism, and more or less remotely associated with the venereal act. It is always acquired through contact with a human being, one suffering from syphilis, or from contact with some material which has been in contact with the vitiated secretion of a syphilitic. The term *syphilis* is an arbitrary one, and dates back to Frascatorius, A. D. 1521 (Baumler: *Ziemssen's Encyclopedia*, vol. iii. p. 4), who relates, in a poem concerning the disease, that "a herdsman of King Alkithous, Syphilus by name, was afflicted with it by Apollo in punishment for paying divine homage to the king instead of to the god." Syphilis has been recognized and described, under various names, in the earliest written history of every quarter of the globe. The Chinese account of it dates back to the writings of Hoan-Ti, 2637 years before the Christian era. (*La Médecine chez les Chinois*, Paris, 1863, translated by Capt. Dabry, and referred to by M. Lancereaux in his treatise on *Syphilis*, Paris, 1866.) In India its record appears in the Ayur vedas of Susrutas, a treatise on Indian medicine written A. D. 400. (Berkeley Hill on *Syphilis*, London, 1868, p. 3.) Celsus, Hippocrates, and others describe the disease as existing among the ancient Greeks and Romans. (*Ibid.*, p. 4.) The Abbé Brasseur de Bourbourg (*Histoire des Nations civilisées du Mexique et de l'Amérique centrale durant les Siècles antérieurs à Christophe Colomb*, Paris, 1857, p. 181) writes that "numerous documents in the languages of the tribes of the valley of Anahuac, etc. have proved to him conclusively the existence of syphilis in America prior to its discovery by Christopher Columbus." (Lancereaux, vol. i. part 10, p. 7.) Mr. Berkeley Hill, in his excellent treatise on syphilis, cites Duremberg, who "quotes from a manuscript of the ninth century (now in the Imperial Library at Paris) which contains a very complete enumeration of ulcers, fissures, condylomata, etc.; these affections, it further says, may also spread to or affect the genitals." (*Ibid.*, p. 8.) Lanfranco of Milan (A. D. 1295) even separates ulcers of venereal origin into three varieties. Bernard Gordon, who taught at Montpellier in the latter end of the thirteenth century, mentions a case of eruption which was communicated through venereal contact. The existence of syphilis can thus be shown in very remote periods in the history of mankind, but it is only from the year 1494 that well-authenticated records of its European recognition are handed down to us. In that year a notorious outbreak of this disease occurred in the army of Charles VIII. of France (who was at that time besieging Naples). It was characterized by ulcers upon the genitals, pains in the bones, and eruptions of the skin, and was known as the *morbus Gallicus*, or the French disease. It prevailed to a fearful extent, not only among the soldiery, but among the people of the country: even the dignitaries of Church and State, monks, nuns, etc., did not escape, and a terror of it was spread throughout the land. The cause was attributed to various occult influences, chiefly atmospheric, and to the evil influence of certain unfavorable planetary combinations. It was found to be contagious, and supposed to be communicated by the breath. The celebrated Cardinal Wolsey was publicly accused of communicating this disease to King Henry VIII. by whispering in his ear. After a time, however, it was recognized as the result of venereal contact, and was then claimed by some to have been introduced by the sailors of Columbus, who had returned about this time from the discovery of America; nevertheless, this was not generally accepted.

The literature of that time ascribed the locality of origin to various regions, and designated it as "mal Anglais," "morbus Gallicus," "maladie de Naples," "pox," "la grosse vérole," "lues venerea," etc. It was then recognized as distinct from the contagious genital ulcer, the action of which was simply local, and which had long been known, and also from gonorrhœa, and was appreciated as a constitutional disease, capable of hereditary transmission. Within a comparatively short period, however, the distinctions between syphilis, the local ulcer (or chancroid), and gonorrhœa, were lost sight of, and all were accepted as of common origin, differing only in development, from some constitutional idiosyncrasy or predisposition, until the latter part of the eighteenth century, when Benjamin Bell of London claimed a distinct origin for gonorrhœa, and M. Philip Ricord of Paris in 1831 proved the fact by a long series of ingenious and conclusive experiments. M. Bassereau, a pupil of M. Ricord, in 1852 demonstrated a distinct and characteristic difference between the local contagious ulcer (the *chancroid*) and the lesion (*chancre*) which was followed by constitutional syphilis, and proved by a large number of observations that the local contagious ulcer (the chancroid) was not followed by, nor was it capable of producing, any constitutional disease, while the true syphilitic sore (chancre) was *always* followed by the constitutional manifestations of syphilis. Subsequently to the enunciation of this important fact by M. Bassereau, M. Clerc, a contemporaneous observer, while admitting the facts advanced by M. Bassereau, claimed to have proved a unity of origin for the chancre and the chancroid, and stated his conviction that the chancroid was the product of the inoculation of the secretion of a syphilitic sore (chancre) upon a person who was or had been the subject of syphilitic disease.

The medical profession at the present day is still divided in regard to the position of M. Bassereau and M. Clerc. Those believing with the former the distinct nature and origin of chancre (syphilis) and chancroid (the local ulcer) are known as *dualists*; those accepting the view of M. Clerc are known as *unicists*. Dr. Bumstead of New York was the first to separate, in a systematic treatise *On Venereal Diseases* (New York, 1861), the two forms of venereal lesion, and treat of them as separate and distinct diseases.

The question involved in this controversy—one of great importance—has failed to find an adequate solution, for the reason, chiefly, that clinical observations, which have been relied upon almost wholly for the solution of this matter, are made under peculiar embarrassments, moral, mental, physical, and circumstantial, so that the same apparent conditions falling under the notice of one observer, often present phases and peculiarities in the practice of another, that warrant entirely different conclusions; and hence, notwithstanding that the disease (syphilis) has been studied by numerous earnest and competent observers for a very long period, wide and honest differences of opinion exist in the matter of unicity and duality. These can never be completely settled until some other and more philosophic mode of arriving at conclusions can be adopted than that afforded by clinical observation alone. To this end the science of venereal diseases demands attention, more especially as the great advances in general physiology and pathology within the past few years have rendered it possible to understand many morbid conditions and processes which no amount of ability, earnestness, or opportunity could have deduced from clinical research.

The nature of syphilis, and the manner in which the human system is infected by it, are yet equally undetermined. Opinions in regard to these points have been almost as numerous as the writers on the subject since its [illegible] European advent in 1492. Mr. Acton, a valued [illegible] authority, writes (*On the Urinary and* [illegible], London, 1860, pp. 279–347), "We must, however, [illegible] admit that in the present state of science it is impossible to determine where or under what circumstances the [illegible] or its effects first appeared. . . . My own opinion is that syphilis originally arose from some [illegible] the economy from animal or decomposing matter, and that, thus produced, it has been transmitted from one [illegible] to another." Of syphilitic [illegible] observation teaches us only the *fact* [illegible]

remains undiscovered. We have no means of detecting the poison in the solids or in the liquids of the syphilitic sore. The blood taken from veins in the neighborhood contains no new or altered element that can be detected by chemical investigation; the only apparent difference is a greater proportion of albumen and a diminution in the number of the red globules. Still, the system is contaminated, and our form of expression is, that a poison has been conveyed into the constitution, but the real explanation of the matter we do not know." Dr. Lionel S. Beale of London, whose name is associated with most laborious and scientific investigations in regard to the origin and nature of contagious diseases, announced in 1863 (*Disease-Germs, their Real Nature*, London, 1870, p. 61) his discovery of living animal disease-germs in fresh vaccine lymph, with the declaration that its active properties were due solely to these germs. They were described as consisting of minute particles of bioplasm or germinal matter, readily seen under a microscopic power of from 1000 to 2000 diameters; and, says Beale, "I think they consist of a peculiar kind of living germinal matter, the smallest particle of which under favoring conditions will grow and multiply, giving rise to millions of living particles like itself, . . . and which, like itself, may retain life after the death of the organism in which it was produced; living matter which has descended from the living matter of health, but which has acquired the property of retaining its life under new conditions; living matter destroyed with difficulty, and possessing such wonderful energy that it will grow and multiply when removed from the seat of its development and transferred to another situation, provided only that it is supplied with suitable nutrient pabulum." Like disease-germs were shown to exist in other diseases, and a similar source of origin was claimed by Beale in 1866 for syphilitic disease.

Thus far, however, our knowledge of the active principle of syphilis is chiefly, if not wholly, of a negative character. It is entirely free from any irritating property when separated from purulent combination; the transparent secretion of an unirritated syphilitic lesion shows, under the microscope, only the débris of epithelial cells, small round cells, and free granular matter; when inoculated upon the surface of a healthy person, it shows no sign of virulence, and healing of the wound takes place as promptly as when no such inoculation has been made. Subsequent to this healing, a period of complete rest ensues—the so-called *period of incubation*—varying from twenty-four hours to seventy days in well-authenticated cases, when a thickening or induration of the integument at the point of inoculation is noticeable. The epidermis becomes thin and friable, and a moist secreting surface soon presents. This secretion, under the microscope, shows no signs of ulcerative action; only the normal constituents of cell-proliferation are seen. The process thus far has been one of growth, resulting in the indurated papule. This, excised and examined under the microscope, shows only normal cell-elements — white blood-corpuscles—packed so closely that the induration is reasonably accounted for, and this embarrassing the circulation, so that the friability and final exfoliation of the overlying epidermis is readily explained. As this cell-proliferation or accumulation goes on, the nutrition of the more deeply-implicated tissue is cut off, a necrobiosis (death from altered life — *Virchow*) follows, which results in an open lesion or loss of tissue; and this, with its indurated base, is known as the *chancre* or initial lesion of syphilis. Up to this time the disease appears to have been purely local, but on examination the lymphatic glands in immediate connection with the part will be found enlarged and hardened, and if examined under the microscope will be found closely packed with the same sort of cells which were seen in the section of the indurated papule. Various influences (such as the simultaneous inoculation of the syphilitic principle with vicious purulent or other secretions, or from local irritation) may change the character and course of the *chancre*, but otherwise there will be no evidence of diseased action except that resulting from the aggregation of cell-material, and this apparently confined to the line of lymphatic vessels. Up to this time the disease is known as *primary syphilis*. Another period of apparent rest now occurs, the so-called *secondary incubation* of syphilis. During this period also there is no consciousness, on the part of the subject of the trouble, of any general discomfort, the disease is still confined to the point of inoculation and the group of lymphatic glands in immediate connection; this period continues from four to six weeks, or even longer, when groups of lymphatic glands remote from the point of inoculation—in the neck, in the axilla, and in the arms—will be found enlarged and hardened. The whole trouble, apparently, is still confined to the lymphatic system, until a rash, rose-colored and somewhat like measles, breaks out on the cutaneous surface. This is apparently the result of a sudden impression upon the sympathetic nervous system, consequent upon the entrance of the vitiated proliferating elements into the general circulation. Up to this time, their advent into the general blood-current has been delayed in the lymphatic system through obstructions afforded by gland-structures between the point of inoculation and the thoracic duct. This rash, which is known as syphilitic roseola, and marks the invasion of the second or constitutional stage of syphilis, is dependent, like all other varieties of roseola, upon a paresis of the vaso-motor nerves of the skin, and is of variable continuance, sometimes passing off in a few hours, again remaining, gradually exchanging the rosy hue for a copper color. This deeper color is due to the exudation of the coloring-matter of the blood (through prolonged stasis in the relaxed capillaries), and may continue for many weeks.

At about this period, probably through the extensive engagement, and consequent interference with the normal functions of the lymphatic system, the subject of syphilis experiences headaches, chiefly at night, pains in the bones, with increase of temperature, and a general malaise which is known as the *syphilitic fever*. There is also at this period a marked increase of the white corpuscular element in the blood, which is now found (like the secretion of the chancre and the cell-accumulations in the glands) to be capable of communicating syphilis by inoculation. This stage, which is also termed the *active* period of syphilis, is still further characterized by a tendency to engorgement and inflammation of parts closely allied to the lymphatic system, as the tonsils (which not unfrequently go on to active ulceration, with considerable loss of tissue), and to parts rich in lymphatic vessels, as the pharynx and velum pendulum palati. The syphilitic principle, which has thus far been traced, along with the excessive proliferation of the germinal or white-blood cells, from the point of inoculation, throughout the lymphatic system and into the blood-current, will, curiously, be found continuing its line of development independently of the general organism, except so far as is recognized in the localized accumulation of those cells which have hitherto characterized its progress. The lymphatic system, as far as known, is an under-drainage system,* one office of which seems to be to return to the general circulation the nutritive material carried out by the blood-vascular system in excess of the demand. Now, at the nearest point of contact of these systems of vessels (the lymphatic and arterial) we should expect to find collections of surplus material, which, having escaped from the arteries, were unable from any cause to effect an entrance into the under-drainage vessels, the lymphatics. The arrangement of these vessels in the skin, as described by Teichman (*Rindfleisch*, p. 277), is as follows: "The blood-vessels lie around the circumference of the papillæ (winding up, cork-screw fashion, around the papilla until they reach its apex), while the lymphatic vessels lie exactly in the centre of the papillæ, and no lymphatic vessels are found in the sebaceous follicles, the sweat-glands, or the hair-bulbs. Consequently, it is in this juxtaposition of the blood-capillaries surrounding the papillæ and the lymphatic capillaries, passing up through their centres, that we should expect to find materials escaped from the blood-capillaries detained in their transit into the lymphatic capillaries. Now, it is a well-recognized clinical fact that at the period of syphilis when evidences of general constitutional disturbance begin to be manifest—that is, from six weeks to six months after the enlargement of glands contiguous to the initial lesion—and simultaneously with or soon after the appearance of the roseola, we have a distinct papular eruption as a characteristic feature of syphilis. The papules, which may vary in size from a pin-head to a split pea, or even larger, and may occupy the breast, back, arms, face, or all these localities, and to a certain extent symmetrically on either side of the body, are *confined to the papillæ cutis*. Section of one of these papules, examined under the microscope, shows the same crowding of white-blood cells (germinal elements) which was found to characterize the induration of the initial lesion and the enlarged and indurated lymphatic glands. Inoculation of healthy persons with the materials forming the papule is known to result in the communication of syphilis. This *papular* or *secondary eruption* of syphilis, as it is sometimes called, may be interspersed with pustules, or may become pustular as a result of a low state of the system, or from some peculiar dyscrasia of the individual affected. Papules occurring upon the mucous membranes are known as *mucous patches*. Their surface soon becomes eroded and covered, especially at the borders, with a whitish fibrinous exudation, which is esteemed a characteristic of this lesion. Mucous patches always occur upon mucous membranes richly endowed with lymphatic vessels, as upon the soft palate, the tonsils, the gums, the inner surfaces of the

* Von Recklinghausen Stricker (Syd. ed., vol. i., p. 297).

cheeks, the tongue, the walls of the pharynx, etc. Papules occurring on integument at points of unusually abundant lymphatic distribution, as about the vulva, the anus, or the scrotum, about nails of fingers, toes, etc., often assume the characteristics of the mucous patch, and are termed *mucous tubercles*. The secretions of both mucous patches and mucous tubercles are highly inoculable, and constitute, from this fact, one of the most important features in the disease. The inoculation of a healthy person with syphilis frequently occurs through contact with the secretion of a mucous patch situated in the mouth, and results through contact, as in kissing, the only required condition being a crack or an erosion or simple eruption (cold sore). Numerous examples are recorded where the disease has been acquired through contact with a spoon or a pencil or a pipe, or even of a stick of candy, which has been contaminated with the secretion of a mucous patch. Fortunately, the syphilitic principle requires for its introduction into a healthy organism a pre-existing lesion of the skin or mucous membrane. A specific exudative inflammation of the *eye* (syphilitic iritis) is not an infrequent occurrence in early constitutional syphilis. Dr. Bumstead says: "We have no certain means of distinguishing *syphilitic iritis* from that dependent upon injury, rheumatism, or other causes. At an early stage of the disease the pupil assumes a dull appearance, owing to commencing changes in the interior capsule of the lens; it may also be somewhat irregular. This irregularity of outline, due to adhesion between its margins and the capsule of the lens, or to exudation into its substance, becomes more marked as the disease progresses, and is especially evident if the pupil be dilated by belladonna or atropine, when its margin is found scalloped. In some cases the adhesions become continuous around the whole circumference, and the capsule of the lens is covered with a layer of lymph which completely blocks up the pupil."*

The structures of the eye, especially the more delicate, as the iris, the retina, the conjunctiva, etc., have hitherto been considered entirely deficient in a lymphatic circulation. Schwalbe has nevertheless fully demonstrated its presence in all these structures, and has shown an especially generous distribution to the iris, and in excess of the neighboring tissues. With the presence of a vitiated germinal element free in the general circulation, with its known power to cause obstruction to the lymph-circulation, and a consequent hyperplasia, we find, as a natural sequence, exactly what we should expect *a priori*—viz. that in the advance and course of syphilis the delicate structures of the eye often suffer through the same causes that result in hyperplasias in other parts richly endowed with lymphatic vessels.

Pains in the bones are often associated with the active or secondary period of syphilis. Sometimes they are of a wandering character, and again are localized, usually at some point in the long bones of the arm or leg. Occasionally, a circumscribed spot of periostitis occurs, leaving a slight bony elevation termed a node. Affections of the hair and nails occasionally present themselves in early constitutional syphilis. The hair loses its lustre and falls, sometimes partially and in spots; at others not only does entire baldness result, but a loss also of the beard, eyebrows, and eyelashes. The nails may become dry, lustreless, and brittle, while sometimes papules occur about the borders which arrest growth and cause considerable irritation.

Recent observations have shown the presence of an extensive distribution of lymphatic vessels in every structure and tissue of the human organism. Even in the fibrous and cartilaginous tissues these vessels have been absolutely demonstrated. (*Lymphatics of Cartilage and Fasciæ*, Ludwig and Schweigger Seidel, Leipsic, 1872.) Wherever blood-vessels are present, an accompanying system of lymph-vessels is also found, thus going far to confirm a recent view of one of the offices of the lymphatic system as a necessary adjunct to the blood-vascular system in gathering in and returning to the general circulation the excess of germinal material exuded for purposes of nutrition. With this view of the uses of the lymphatic system, it is a comparatively easy matter to account satisfactorily for many diseased conditions heretofore considered anomalous, and to appreciate the causes of the multiform lesions of syphilis which have hitherto puzzled acute clinical observers, and conveyed the impression that this disease is developed by no fixed laws, but results from a general and, almost necessarily, permanent vitiation of the entire affected organism.

The active stage of syphilis is of varying duration, covering a period of rarely less than one or more than two years. During this time the secretions of all lesions and the blood are inoculable. Its course, as formerly described, is marked by a gradual invasion of the organism, and always in the line of lymphatic distribution. Many cases, however, are so mild that nothing more than slight glandular enlargements can be recognized, and again so severe that every possible manifestation is in progress at one and the same period. The causes of variation appear to depend upon different degrees of activity in the material inoculated, and in the condition and antecedents of the subject. Syphilis may be transmitted to offspring through the influence of a syphilitic parent, but only during the active period of the disease. Abortions, still births, and imperfectly-developed children may result from uterine and ovarian changes dependent upon antecedent syphilis, for a long period subsequent to the termination of active syphilis. It is a rule, however, to which there are few, if any, exceptions, that syphilis is transmitted by hereditary taint only while the lymphatic glandular enlargements remain. The complete disengagement of the lymphatic glandular system, with or without treatment, is the assurance of immunity from the danger of hereditary transmission.

Properly speaking, syphilis terminates with the secondary stage, and in the great majority of cases, as a result of treatment or by natural evolution, the subject of it remains in every respect well. In this regard it resembles a gonorrhœa which has pursued a favorable course, but in a certain number of cases a damage has occurred which is followed by consequences (such as stricture of the urethra) widely differing from the original disease. So in syphilis, the SEQUELÆ which result, and are generally described as the *tertiary* or *third period* of syphilis, may be assumed to be the effects of injury occurring during the active stage of syphilis. They lack in the first instance the element of contagion; in the second, the manifestations are unsymmetrical; in the third, they supervene after an interval of perfect health at periods varying from a few months to forty or more years from the active manifestations of the disease. They are characterized by the infiltration or deposit of lymphatic elements in the skin, in the muscles, in the bones, in the viscera. Such collections are termed syphiloma, or more generally gummata. The most exhaustive examinations discover in them only the débris of lymphatic or cicatricial elements. The results produced are only such as might reasonably be predicated upon a mechanical interference with the lymphatic circulation. Germinal material, imprisoned by interrupted natural channels, exhibiting in certain localities a low formative power, sufficient to produce constriction of vessels and tissues, but incapable of entering into the composition of any useful tissue; present, therefore, only as an obstruction, as a foreign body, or as cicatricial tissue, which may result finally in the compression and strangulation of important vessels and organs.

In the skin the earlier and more common sequel of syphilis appears as an eruption of a tubercular character, from the size of a grape-seed to the circumference of a dime, occurring singly or in groups, the latter variety being as a rule discrete; the former of a dark red color, often scarcely ulcerative, but still leaving permanent cicatrices. The larger variety usually, when in groups, assumes a crescentic form, and is characterized by a free serous exudation, which dries and accumulates in thick brown scabs, underneath which a painless ulceration, usually superficial, goes on. This is termed syphilitic impetigo. Solitary lesions may occur which pursue a similar course, involving larger surfaces, often one and even two inches in diameter, with deeper and more abrupt loss of tissue, and are known as syphilitic rupia. Or, usually, at a later period, the obstructive element may be so superficial that a dry scaly eruption called syphilitic lepra or psoriasis may occur. Again, profound obstructions of the integument occur, which may result in large and deep ulcerations extending through the entire thickness of the integument, involving the subcellular tissue and pursuing sometimes a tortuous course, when they are termed *serpiginous* ulcerations of syphilis. On the other hand, accumulations of the gummous material may be localized under the integument, and attain a considerable size, painless and sluggish, and when out of the line of pressure or external irritation may exist for a long time without serious inconvenience. These are known as *gummy tumors*. This same material may also accumulate in the testicle, so that it shall acquire the size of a large orange, or it may aggregate in the kidney (in both of which organs large lymph sacs are shown by His and Langer to exist). More rarely, the liver may be the subject of the deposit, when it often results in cicatricial contractions of its vessels and substance. The lungs, the brain, the heart, may each and all be involved in difficulty from the aggregation in their parenchyma of the gummous element. In the fibrous covering of the bones it may be imprisoned, causing periostitis, and consequent growth of new and imperfect bony mate-

* *Venereal Diseases* (3d ed., p. 660).

rial, called *syphilitic nodes*, or within the osseous substance, causing necrosis or death of the bone. And yet in all these varied and grievous accidents no constituent of the disturbing cause can be discovered to have any specific property, none which may not be reasonably attributed to a purely mechanical obstruction of the vessels of the lymphatic system. In the absence of any other alleged cause, this constriction may be assumed as the result of the contraction of fibrous material laid down in the early active stages of syphilis.

III. TREATMENT OF SYPHILIS from the earliest times has been a subject of controversy, but in every age of which we have record mercury, in some form, has been the sheet-anchor, ultimately relied upon for the amelioration and cure of the active forms of the disease. Originally administered as an *antidote* to syphilis as early as the fourteenth century, it was often pushed to such extremes that the effects of the drug were recognized as more damaging than the results of the disease, and from century to century it was by turns in favor and disfavor, until a knowledge based on more intelligent clinical observations showed that its beneficial effects were more surely and safely produced by a gentle and prolonged mercurial influence. The iodide of potassium, first introduced by Wallace of Dublin in 1832, has also, since that time, been held in high esteem for its influence in combating syphilitic disease, especially in its later forms. And while various plans of treatment have at times found favor, such as decoctions of guiacum-wood, sarsaparilla-bark, and numerous herbs, treatment by baths and various modes of sweating, diuresis, and purgation, and syphilization; mercury and the iodide of potassium have held the field, up to the present day, as the safest and most efficient means of treating syphilitic disease in all its forms. It is a curious and instructive fact that all modes of treatment which have ever found even a transient favor in the management of syphilis have been practically based upon a similar theory—namely, *a stimulation of the metamorphosis of tissue*; and that, although the power of acting as an antidote to the so-called syphilitic virus has been claimed for some, and more especially for mercury and the iodide of potassium, yet these very remedies are universally recognized as the most potent agents for bringing about tissue-metamorphosis known to science.

The behavior of syphilitic disease under a treatment which is simply calculated to hasten the metamorphosis of normal tissue would lead to the inference that the excessive accumulations of cell-growth which are shown to be characteristic of every stage of its development play an important part in the causation of the different manifestations of syphilis, and induce us to pause before claiming an especial virus as essential to the explanation of the different morbid conditions which characterize its advent and progress. The contagious element, which alone suggests the presence of a virus, would appear to act only in stimulating the normal cell-proliferation to a degree in excess of the ability of the natural processes to assimilate and utilize. This cell-excitation would seem capable of being communicated from one cell to another, and the rapid fission would of necessity result in a decreased ability to develop into permanent structures. Thus, we have the exact material which is known to make up the indurations and useless cell-accumulations which are associated with syphilis in all its forms and stages. This view of syphilis would explain the benefit known to result from the use of remedial measures capable of hastening the metamorphosis of tissue. Looking, then, upon imperfect cell-proliferation and accumulation as the *materies morbi* of syphilis, its removal by means which are most efficient, and yet least liable to affect the normal constituents of the organism, will constitute the legitimate aim of medicine. Large doses of mercury, in health, act in producing a rapid fatty degeneration of normal tissues. One of the prominent constituents of the secretions caused by a full mercurialization is a fatty detritus resulting from rapid tissue-metamorphosis. Small doses of mercury, sufficient only to accelerate in a slight degree the normal tissue-changes, may be administered for a very long period, not only without damage, but often with the effect of promoting healthful action. Now, if, as premised, the *materies morbi* of syphilis is an imperfect cell-proliferation, having less vitality, less organizing power, than normal cells, holding its forms by a feebler tenure than healthy tissue, then we might expect exactly what we do find as a result of clinical experience and observation—viz. that small doses of mercury, long continued, are efficient in removing—nay, in curing—syphilis without marked damage to the general organism. Such a degree of mercurialization as is sufficient to effect the destruction and elimination of the syphilitic elements, and yet not sufficient to disturb to any important degree any of the normal tissues or processes, constitutes the highest ideal of mercurial influence in the treatment of syphilis. The iodide of potassium is recognized as a potent agent in stimulating the lymphatic, vascular, and glandular systems, and in otherwise aiding in the normal processes of tissue metamorphosis. With less power to effect the disintegration of healthy and diseased structures than mercury, it is found less potent in the treatment of the active manifestations of syphilis; but from its known ability to unite with and render active the mercurial medicines, conjointly or previously administered, it constitutes a philosophical and invaluable adjunct in the treatment of syphilis, especially in its later forms, which have been described under *Sequelæ*, or *third period*. F. N. OTIS.

Syphiliza'tion, a term applied to the treatment of syphilis by the repeated inoculation of the purulent secretion of venereal sores, originated by M. Auzias of Turin in 1844. In his attempts to communicate syphilis to the lower animals, M. Auzias found that the pustules resulting from repeated inoculations of venereal sores gradually decreased in size and virulence, until, after a time, no effect was produced either by inoculation of the pus derived from previous inoculation, or even by that obtained from fresh sources. This modified action he attributed to the saturation of the system by the syphilitic virus; which point once reached, he claimed that no reaction occurred from the further introduction of the syphilitic virus, and hence an immunity from all harm from subsequent syphilitic exposures was attained. This point of saturation or tolerance, having in the same way been established in man, it was assumed, would afford a lasting security against the acquirement of syphilis. M. Auzias also claimed for this plan of treatment, which he termed *syphilization*, a promptly *curative* influence in all forms of syphilis, and communicated his views to the French Academy in 1851. They were at once combated by M. Ricord and his school. They received support from MM. Malgaigne, Gosselin, Diday, and others, but gained no permanent standing in France. In Italy numerous experiments were made by M. Sperino, but were finally discontinued on account of the public feeling against them. The most earnest advocate and exponent of syphilization was Prof. Boeck of Sweden, who claimed to have treated more than 1000 cases of syphilis by so-called syphilization between the years 1852 and 1865 in one of the public hospitals of Christiania, Sweden. The purulent secretion of both syphilitic lesions (infecting chancres) and the chancroid (the local non-infectious venereal sore) were used indifferently by him in making the inoculations. Prof. Boeck found it necessary, however, to irritate the syphilitic sore (the chancre) until it secreted a purulent fluid before a successful inoculation could be produced. Inoculations were made with the point of a lancet, first on the sides of the chest by three punctures, which in successful cases produced small pustules in about forty-eight hours. In the same manner inoculations were repeated from these pustules on the third day after their appearance. This process was continued on alternate sides of the chest (progressing from above downward) until the resulting sores (which, as a rule, became smaller on each succeeding inoculation) ceased to produce any purulent matter. Pus from a fresh source was then introduced, and the inoculations continued as before until the inoculating property was in like manner exhausted; and again a third and a fourth supply, until no reaction followed the introduction of pus from any source. A similar procedure was then instituted upon the arms, and finally upon the thighs; and when no inoculations could be made to succeed on any part of the body, the patient was said to be *syphilized*, and to enjoy a perfect immunity from the influence of syphilis. Under this process of *syphilization* it was claimed that persons afflicted with any form of syphilitic lesion rapidly improved to a final and complete recovery. The number of inoculations in each case varied from 100 to several hundred, and the time required to complete the syphilization was from three months to a year or more. It was claimed that the ulcers resulting from properly-performed inoculations rarely became of sufficient size to give much trouble. Prof. Boeck visited England in 1865, and by invitation of the surgeons of the Lock Hospital of London treated twenty-seven syphilitic patients in that institution by the process of syphilization. The results of this experiment were summed up in the report of a committee appointed for the purpose. In this report, while acknowledging the disappearance of syphilitic symptoms and lesions under repeated inoculations, the committee expressed the opinion that "syphilization is not a treatment which can be recommended for adoption; and that even if it could be admitted to possess all the advantages claimed for it by its advocates, these advantages would not compensate for its tediousness, its painfulness, and the lifelong marking it entails upon the patient." Prof. Boeck visited the U. S. in 1869, and treated seven patients by syphiliza-

tion in the Charity Hospital of New York City in the service of Prof. F. J. Bumstead. In the latest edition of his work on venereal diseases, issued in 1870, Prof. Bumstead, after a very friendly personal tribute to Prof. Boeck, and a fair summing up of the annoyances, difficulties, and dangers of the treatment of syphilis by syphilization, finally closes by saying: "I feel obliged to subscribe to the opinion of the London committee (Messrs. Lane and Gascoyen), that 'syphilization is not a treatment which can be recommended for adoption.'"

The claim of the advocates of syphilization, that the system of the patient is saturated or surcharged with the syphilitic virus by the repeated inoculations of pus from syphilitic or chancroidal sores, has been shown to be fallacious by demonstration of the fact that the purulence associated with a true syphilitic lesion is accidental, and quite independent of the syphilitic virus, and that the pus of the true chancroid never contains the syphilitic principle. Pus from the chancroid was chiefly and preferably used in the so-called syphilizing process, as it was always promptly auto-inoculable, while the secretion from the true chancre, the initial lesion of syphilis, furnished inoculable pus only after the application of some local irritant. That the pus so produced does not necessarily contain the virus of syphilis is shown by the known fact that inoculation of syphilitic blood, or non-purulent secretion of a syphilitic subject, often conveys syphilis to a healthy person independently of any suppurative action. Hence, the pus used in the inoculations for syphilization, not of necessity containing the syphilitic virus, could not surcharge the system with syphilis. Danielssen of Christiania inoculated a leper, who had never had syphilis, 400 times with the purulent fluid used by Boeck for syphilization, without other effect than the production of local sores; after which an inoculation of this patient with the secretion of an unirritated infecting chancre resulted in the prompt communication of constitutional syphilis. Lindmann (quoted by Van Buren and Keyes *On Syphilis*, p. 514) inoculated himself a number of times with chancroidal pus, always with success, but with no syphilis; finally, inoculating himself with the secretion of a well-determined lesion of syphilis, this was followed, after forty-five days, by an eruption of constitutional syphilis. Warnery of Lausanne (*ibid.*, p. 516) inoculated himself plentifully with pus from chancroids, which produced only local ulcers. Finally, employing the syphilitic virus once, an indurated chancre appeared after twenty-three days' incubation. This was followed in due course by constitutional syphilis. It was thus clearly shown that the system was not saturated with syphilis by the repeated inoculations of the syphilization process, nor in the least degree protected by it from the acquirement of syphilis; and yet a certain curative influence was acknowledged by all to result from the treatment of syphilis by this method. This was attributed by the opponents of syphilization solely to the counter-irritation and the depurative action caused by the suppurative process. With the view of proving the truth of this position, Drs. Lindmann, Hjort, Faye, and Danielssen treated a large number of cases of syphilis by inoculation with tartarized antimony, and with the result of obtaining not only a tolerance, or so-called saturation, after repeated inoculations, but nearly, if not quite, an equal measure of success in mitigating or curing syphilis by this plan, which was facetiously entitled *tartarization*. The theory that counter-irritation and depuration were the sole curative agents in the treatment of syphilis by syphilization, so called, first advanced by Prof. Faye of Christiania, Sweden, is now generally received, and since the death of Prof. Boeck in 1875 the treatment of syphilis by syphilization may be said to have fallen into merited disuse. F. N. OTIS.

Syphon. See SIPHON.

Sy'ra [anc. *Syros*], island of Greece, in the Ægean Sea, with an area of 55 sq. m., with 35,000 inhabitants. It is high and mountainous, the highest peak rising about 1000 feet above the level of the sea, but it is rocky and rather bare. It produces wheat, wine, figs, fruits, etc., but not in sufficient quantity to supply the demands of the inhabitants. Before 1821 it was an insignificant place, and had hardly 1000 inhabitants, but as it kept neutral in the great struggle between Greece and Turkey, it became a place of refuge to many Greek fugitives from the other islands, and the enterprising spirit and commercial skill they brought with them made the island prosperous in a short time.

Syra, or Hermopolis, capital of the island of Syra, is well built and has a safe, spacious, and convenient harbor. Its trade is very important. It owns about one third of the whole Greek merchant fleet, and nearly one half of all the imports to Greece goes through this harbor. Besides its trade, its shipbuilding is important. P. 20,996.

Syr'acuse [It. *Siracusa*], city of Sicily, chief town of the province of the same name, on the E. coast of the island, in lat. 37° 0′ N., lon. 15° 20′ E. The modern town occupies the rocky islet Ortygia (1 mile in length, ½ mile in breadth), which serves as an irresistible breakwater to protect the large harbor on the W., and across the mouth of which it lies. This harbor was formerly one of the finest in the world, and is even now the best, perhaps, in Sicily. Ortygia, though at some periods united to the main island by a viaduct or causeway, is now connected with it only by bridges. The small harbor, Porto Marmoreo, lies N. of Ortygia. The present town is fortified by walls and a citadel of the Byzantine period, as well as by works of the time of Charles V. and of Charles III. of Naples, so that it is, in fact, one of the strongest places in the kingdom of Italy. There is, however, little commerce here (the whole number of vessels entering the two harbors annually not exceeding 1200), and the industry is, if possible, even less, so that the general aspect of the town, in spite of the extraordinary beauty of its situation, is depressing in the extreme. Its chief interest consists in the still existing monuments of its former greatness, to understand which a brief sketch of its earlier history and topography will be necessary. According to Thucydides, Ortygia was colonized by the Corinthians 758 B. C., though the Phœnicians had probably made an earlier settlement here. Possessing every advantage of position and climate, with an adjacent country of marvellous fertility, the young colony grew with great rapidity, threw itself over upon the main island, and soon began to plant new settlements in various parts of Trinacria. When, after long and cruel wars, the Romans obtained possession of the rest of Sicily, Syracuse, together with some important places in its neighborhood, was left to Hieron II. (275 B. C.), who had become an ally of Rome. Under this king the city rose to its highest point of magnificence, and is said to have contained an immense population within its walls, then, according to some authorities, 22 miles in circumference; according to others, 14 miles. The grandeur of the edifices and the artistic wealth and refinement of Syracuse were altogether worthy its colossal size. But in the course of the Second Punic war, Hieronymus, the successor of Hieron, broke off the alliance with Rome and joined the Carthaginians—a step which proved the ruin of his kingdom. After a long and desperate resistance, in which the celebrated Archimedes exerted all the powers of his wonderful mechanical genius in the defence of his country, Syracuse fell into the hands of the Romans under Marcellus (212 B. C.), by whom it was barbarously sacked and an immense booty carried off to Rome. Even the great Archimedes himself was put to death—accidentally it is said, in the general slaughter. Cicero tells us that he himself recognized the tomb of Archimedes by the cylinder and sphere engraved upon it. From this time Syracuse, as well as the rest of Sicily, was but a subjugated Roman province, unscrupulously oppressed and plundered by that power for its own aggrandizement. The town at the time of its capture consisted of *four* distinct quarters—or *five*, if Epipolæ be included, as it no doubt was by those ancient writers who describe it as a *pentapolis*. Epipolæ, however, seems to have served rather as a citadel and fortress to defend the town on the N. W., and was probably never thickly inhabited. The four quarters proper were (1) Ortygia, or the islet; (2) Achradina, occupying the eastern coast of the main island, N. of Ortygia; (3) Tycha, W. of Achradina; (4) Neapolis, S. of Tycha. The most important remains of ancient Syracuse are found on the main island, though some objects of interest are still to be seen in the modern town. The Duomo occupies the site of an ancient temple, according to tradition the temple of Minerva mentioned by Cicero with such admiration, but some recent investigators hold it to have been dedicated to Diana, from its vicinity to the celebrated Fountain of Arethusa, which is very near this church. A large number of fine columns from the old temple have been made use of in the architecture of this church, but no trace is left of the doors of gold and ivory and other splendid adornments which made the pagan edifice the admiration of the world. Among the ruins of what is usually called the temple of Diana (Vico di San Paolo) the remains of a very remarkable Greek temple have lately been discovered. The museum, near the Duomo, contains ancient inscriptions, papyri, vases, statues more or less mutilated, etc., but its great treasure is the marble Venus (found 1804), considered by many as second only to the celebrated Venus of Milo. Unfortunately, this exquisite figure wants the head. Only a few among the many objects, more or less ruinous, of antiquarian interest to be seen on the main island can be enumerated here, and the reader is referred for further details to the authorities at the end of this article—the gigantic walls of Dionysius (400 B. C.), which unite at Fort Euryalus; the vast latomiæ, or quarries, which served both for prisons and as places for sepul

ture, and in which 7000 Athenian prisoners are said to have died of starvation 414–412 B. C.; the famous Ear of Dionysius; the Ara of Hieron (650 feet long, 75 feet broad), on which 450 oxen were sacrificed yearly; the amphitheatre, the theatre, the nymphæum, the aqueducts, the Street of Tombs, the splendid temples of Bacchus and of Proserpine, built by Gelon 480 B. C., from the spoils of Carthage, etc., etc. Of the ancient church of Santa Lucia, patroness of Syracuse, the W. portal only remains. The same is true of S. Giovanni, in the crypt of which St. Paul is believed to have preached. The catacombs below and near this church are very much like some recently-discovered Phœnician tombs. The Fountain of Cyane (Pisma) is reached by crossing the great harbor and ascending the Anapus, which is half choked with water-plants and overshadowed by the papyrus, the tufted, plumy crowns of which are sometimes lifted by the slender triangular stalks 15 feet or more above the water. These reeds are the support of luxuriant creeping plants, which shelter countless aquatic birds. The great temple of the Olympian Jove (sixth century B. C.) stood on a hill above the right bank of the Anapus, near the ancient bridge, but only two shafts of columns are now standing. It was from a statue in this temple that Dionysius the Elder took off the golden mantle placed upon it by Gelon, declaring that it was "too cold for winter and too heavy for summer." The site of the monuments of Gelon and Demarete is also near this temple. The sea-coast caves on the E. side of Achradina are scarcely inferior in beauty of color to the celebrated Blue Grotto at Capri. (See Serradifalco, *Antichità di Sicilia*; Gregorovius, *Wanderjahre in Italien, Siciliana* (1872); Smith, *Dictionary of Greek and Roman Geography*, article "Syracusæ," and authorities there cited.) CAROLINE C. MARSH.

Syracuse, p.-v., Turkey Creek tp., Kosciusko co., Ind., on Turkey Lake, has 1 weekly newspaper. P. 227.

Syracuse, p.-v., Morgan co., Mo.

Syracuse, p.-v. and tp., Otoe co., Neb., on Midland Pacific R. R. P. 640.

Syracuse, city, cap. of Onondaga co., N. Y., on the line of Erie Canal and New York Central and Hudson River R. R., 150 miles W. of Albany. It was settled about 1796, passing under different names until 1824, when it was called Syracuse. It was incorporated as a village in 1825, and as a city in 1847. It is noted especially for its extensive saltworks, which in years past have been a source of great wealth to those engaged in the manufacture of this staple article. The quantity manufactured has reached, in the most productive years, the annual amount of 9,000,000 bushels, but the ordinary average yield is from 7,000,000 to 8,000,000 bushels. The manufacturing establishments of Syracuse are numerous, and furnish employment to a large number of workmen. Among these establishments are 2 rolling-mills, numerous furnaces, glassworks, steelworks, agricultural machine works, and many others. The wholesale trade of the city is very large, aggregating many millions of dollars annually. There are large wholesale houses in dry goods, groceries, clothing, drugs and medicines, leather, boots and shoes, malt liquors, tobacco and cigars, etc. Syracuse has 10 banks, 2 savings banks, and several private bankers. The deposits in the savings banks amount to over $7,000,000. Each of these institutions has recently erected a large and elegant banking edifice in the central part of the city. The public and charitable institutions include the New York State asylum for idiots, the Home association for elderly females, the Onondaga county orphan asylum, the asylum of St. Vincent de Paul, the House of the Good Shepherd, and St. Joseph's Hospital. The Onondaga county penitentiary is a large establishment, and furnishes accommodations for criminals of surrounding counties. A large State armory, erected for military purposes, is also located here. Syracuse is a central point for numerous railroads. In addition to New York Central, there are Delaware Lackawana and Western R. R., Syracuse Northern, Syracuse and Chenango R. R., and Syracuse and South western R. R. There are also 5 street railways running to the suburbs of the city. There are 3 daily newspapers, 9 weekly papers, and several monthlies. The educational advantages of Syracuse are of a superior character. The public-school system is complete in all its appointments, and in the most prosperous condition. The plan for popular education embraces a high school and about 20 graded schools, all under the charge of a board of education elected by the people. The Syracuse University is located here, and comprises a college of liberal arts, a college of medicine, and a college of fine arts, all well supplied with competent professors. There are 3 public libraries—the Central Library, located in the high school building, and containing 14,000 volumes; the library of the court of appeals, in the court house, containing 8000 to 9000 volumes, generally of a legal character; and a small library in the rooms of the Young Men's Christian Association, designed especially for the use of that organization. The church organizations of the city are numerous, representing 12 or 14 different denominations, and numbering not less than 44 congregations. Many of them have large and commodious houses of worship. There is a large number of societies of a miscellaneous character, embracing social, military, temperance, benevolent, literary, musical, and secret organizations. The fire department is an efficient organization, having 5 steamers and a fire-alarm telegraph. There are 7 cemeteries, of which Oakwood and St. Agnes are large and laid out with great taste and beauty. The growth of the city has been rapid, the population increasing from 28,000 in 1860 to 43,051 in 1870, and 54,000 in 1876, and some of its citizens now living have seen the settlement of Bogardus Corners, with two log houses in 1796, change into the busy, thriving, and populous city of Syracuse in 1876.

J. G. K. TRUAIR, ED. "SYRACUSE JOURNAL."

Syracuse, p.-v. and tp., Meigs co., O., on Ohio River. P. 1273.

Syren. See *Sirene*, in ACOUSTICS.

Syria [Turk. *Suristan;* Arabic, *Esh-Sham*], at present forming, together with Palestine, a division of Asiatic Turkey, extends between lat. 31° and 37° 20′ N. along the Mediterranean from the Gulf of Iskanderoon to the Isthmus of Suez, and is bounded N. by Asia Minor, from which it is separated by the Taurus Mountains; E. by Mesopotamia, from which it is separated by the Euphrates and the Syrian desert; S. by Arabia. Its area is estimated at 60,000 sq. m., but its eastern and southern frontier, along the Syrian and Arabian deserts, is indefinite. Of its population no official statistics exist, but it is estimated at from one to two millions. The configuration of the country is quite remarkable. Connected to the N. with the Taurus Mountains, but losing themselves to the S. in the plateaus of the Arabian desert, two systems of mountain-ranges run parallel through the middle of the country, enclosing a valley of varying breadth and depth. The western system consists of the Lebanon, which rises in Jebel Timarum to a height of 10,533 feet, and ends abruptly on the banks of the Litany; the Samaria hills and the highlands of Judæa, which connect with the Sinaitic group. Toward the Mediterranean these mountains fall rapidly and in terraces, often sending spurs far into the sea, but generally leaving at their feet a belt of low, level, or undulating coast-land, from 10 to 15 miles broad. The ranges of the eastern system are generally lower, though the Anti-Lebanon in Mount Hermon reaches a height of about 10,000 feet, less sharply defined and more broken up in separate groups, the mountains of Moab, of Seir, etc. To the E. they roll off gradually into the plateaus of the Syrian desert. The depression between these two systems of mountain-ranges comprises the beautiful and fertile valley of Cœle-Syria (*El-Bukaa*), between Lebanon and Anti-Lebanon, from 10 to 20 miles broad, and elevated 2300 feet above the level of the sea. To the S., at the point where the Litany breaks through the western wall to the Mediterranean, the valley of Cœle-Syria connects by a narrow, rapidly-descending gorge, 15 miles long, with the valley of the Jordan (*El-Ghur*), which at the Lake of Merom (*El-Huleh*) is on a level with the Mediterranean, but at the Lake of Tiberias 650 feet, and at the Dead Sea about 1300 feet, below it. Here, as well as in several other places, the country bears a strongly-marked volcanic aspect, and earthquakes are frequent, and sometimes very destructive; Safed was fearfully devastated in 1837, Antioch in 1872, etc. The principal rivers are the Jordan, the Aasy, and the Litany. The Jordan rises in Mount Hermon as a wild mountain-torrent; forms the Lake of Merom, which is a swamp rather than a lake, covered with water-plants and overgrown with rushes, but teeming with fish; traverses the Lake of Tiberias, also called the Lake of Gennesaret or the Galilean Sea, a beautiful sheet of water encircled by high cliffs of chalk and basalt; and enters, finally, the Dead Sea, whose sluggish waters, which have no outlet, are so heavily laden with salt that salt thrown into them will not dissolve, and so strongly impregnated with sulphur and bitumen that no fish can live in them. Large lumps of bitumen and salt float on its waves, and innumerable pits of bitumen, extensive layers of stinking sulphur, and numerous hot mineral springs, whose waters ulcerate the skin, line its plantless, desert-like shores. The Aasy (that is, "the indomitable," the ancient *Orontes*) rises in the Anti-Lebanon and turns directly N., whence it is called by the Arabs *Nahr al Maklub*, "the perverse river," as all the other rivers of that region, the Jordan, Litany, Euphrates, etc., flow S. Afterward it turns to the W., and through a deep gorge between the Lebanon proper and the hills which connect it with the Taurus Mountains it reaches the Cilician Gulf

as a broad but calm and shallow stream. In the time of the Crusades it could be navigated by large vessels as far as Antioch; now its waters can hardly bear a boat. Besides the Litany (or Leontes), which rises on Mount Hermon and enters the Mediterranean a little above Tyre, there are about forty streams descending from the Lebanon to the sea, but most of them run dry in summer, and none are navigable.

Wherever the supply of water is sufficient, the soil, generally of a sandy and light character, proves to be very productive; all the choicest plants of the tropical and temperate zones grow luxuriantly. Nevertheless, in extensive districts and at certain seasons the country has a barren and desolate aspect. The climate, although different according to location, is dry and hot. Summer rains are rare, and in the coast-region and El-Ghur the summer heat is very oppressive; at Aleppo the thermometer often rises above 100°. The true cause, however, of the desolation of the country is not its difficult climate, but the circumstance that through centuries of bad fortune it has become almost depopulated and its few inhabitants degenerate. The implements and methods of cultivation are rude; the terracing of the slopes and the works of irrigation have been destroyed or have fallen into decay; the magnificent forests have well-nigh disappeared. In many places, however, the mountain-slopes are still covered with fine cedar, pine, and fir; terebinth and laurel groves occur in the valleys, and dwarf oaks, remarkable for the excellent gall-nuts they yield, grow on the table-lands. Wheat, barley, and beans are the common cereals, but also rice, dhurra, peas, and lentils are raised. Cotton and hemp, madder and indigo, tobacco and capsicum, melons and cucumbers, artichokes and potatoes, are extensively cultivated; and with comparatively little attention plantations of fig, olive, and mulberry trees succeed well, also orchards of peach, pomegranate, orange, lemon, apricot, and almond trees, and vineyards producing a delicious grape. Mules, asses, camels, horses of an excellent breed, horned cattle of an inferior race, broad-tailed, fine-woolled sheep, goats with pendent ears and silky hair, are the common domestic animals. Jackals, hyænas, and antelopes are found in the desert regions, the Syrian bear, wild-boars, and deer in the forests, wolves and wild buffaloes on the table land. Silk-worms are extensively reared. Of minerals, some coal is found in the southern regions, abundant salt, sulphur, and bitumen in El-Ghur, iron in the Lebanon, but mining is not carried on with any degree of energy. Manufacturing industry is mostly confined to coarse articles for home use, though some fine silks, stuffs of gold and silver thread, carpets, and arms, are produced. The population is a very much mixed race. Shemitic blood, however, is the prevailing element; the Osmanlee Turks, of the Turanian race, are the rulers. Arab is the language commonly spoken and written. The old Syriac or Aramaic has nearly died out. In the cities on the coast Greek is everywhere understood. The religion of the country comprises a great number of Mohammedan, Christian, and Jewish sects, some of a very peculiar character, such as the MARONITES, DRUSES, NUSAIRIEH, ASSASSINS (which see), but all of a very passionate temper. Outbursts of religious fanaticism are quite common. In 1860 the Mohammedans fell upon the Christians at Damascus, and at the same time the Druses fought with the Maronites. The bloodshed was finally stopped by the interference of England and France.

The oldest inhabitants of Syria were all of Shemitic descent, though belonging to various branches of the family and living in separate social organizations. When the Jews immigrated into Canaan, they found the promised land densely peopled, and covered with cities ruled by kings. But the Canaanites, like the Jews themselves, were Shemites, and so were the Phœnicians, who inhabited the coast-regions, where they had built Sidon and Tyre, whence they founded Carthage and established commercial stations all around the Mediterranean. So were also the Aramæans, who occupied Damascus and extended eastward toward the Euphrates. This territory, Syria proper, became subject to the Hebrew monarchy in the time of David; but after Solomon's death, Rezin made himself independent in Damascus, and while the Jewish empire was divided into two kingdoms, the Aramæan kings of Damascus conquered and incorporated the whole northern and central part of the country. In 740 B. C. the Assyrian king, Tiglath Pileser, conquered Damascus, and in 720 the kingdom of Israel. In 587 the kingdom of Judah was conquered by Nebuchadnezzar, king of Babylon, and Syria, with Palestine, was now successively handed over from the Assyrians to the Babylonians, from the Babylonians to the Medes, and from the Medes to the Persians, and many non-Shemitic elements were introduced into the population. After the battle of the Issos (333 B. C.) Alexander the Great conquered the country, and with him came the Greeks. After his death, they formed here a flourishing empire under the Seleucidæ, who reigned from 312 to 64 B. C. Seleucus I. (312–281) founded Antioch and made it his capital; it grew rapidly, and was for several centuries the largest and most brilliant city of the Orient. Beautifully situated at the foot of the Libanon, it received the surname of *Epidaphnes* from the neighboring grove of Daphne with its magnificent temple of Apollo. By the Orontes it had easy access to the Mediterranean, and by the Cilician passes it was connected with the principal caravan-routes to the East. An extensive and flourishing commerce sprang up, and on the basis of this traffic and the wealth it accumulated there arose here, as in Alexandria, a most peculiar form of civilization, a blending of Greek and Asiatic elements, which has left long and large traces of itself in the history of the human race. After the victories over Antigonus at Ipsus in 301, and over Lysimachus at Cyropedion in 282, the empire of Seleucus actually comprised the whole empire of Alexander with the exception of Egypt. But his son, Antiochus I. Soter (281–260), lost Pergamum, and failed in his attempts against the Gauls who invaded Asia Minor; and Antiochus II. Theos (260–247) lost Parthia and Bactria. Antiochus the Great (223–187) conquered Palestine, which by the division of Alexander's empire had fallen to the Ptolemies of Egypt; but under Antiochus Epiphanes (174–164) the Jews revolted, and after a contest of twenty-five years they made themselves independent. Under Antiochus XIII. (69–64) Pompey conquered the country and made it a Roman province, governed by a proconsul. After the conquest of Jerusalem (70 A. D.), Palestine was added to this province, and the whole placed under a *præfectus prætorio*. By the division of the Roman empire Syria fell to the eastern or Byzantine part, and the various phases of a decaying civilization which were developed in Constantinople repeated themselves at Antioch. In 632 the country was conquered by the Saracens, and from this time Syria and Palestine, the birthplace of Christianity, became and continued to be a Mohammedan country. In 654, Damascus was made the capital of Syria, in 661 of the whole Mohammedan empire; Antioch fell into decay. Damascus was an old and celebrated city. It stood in the centre of a large and exceedingly fertile plain, was strongly fortified, and many branches of industry were here carried to perfection. But it was principally a manufacturing place, not well fitted to be the capital of a great empire. The Abbassides removed their residence to Bagdad, and Syria sank into a mere province. In the eleventh century the Seljook Turks conquered the country, and an entirely new element of race was introduced, as different from the original Shemitic as from the subsequent Aryan. The establishment of the Latin kingdom by the Crusaders in 1099 was of short duration and of little advantage. They held Jerusalem till 1187, Acre till 1291, but they proved more rapacious and more cruel than the Turks; and it was nothing more than justice when the greatest and best among the crusaders bowed to Sultan Saladin as their superior—yea, as their model. When in 1291 the Mameluke rulers of Egypt finally drove the Christian knights out of the country, its cities were in ruins, its fields devastated, and its population degraded. Still worse things were in waiting—the invasions of Tamerlane and his successors, which actually transformed large regions into deserts and the inhabitants into savages. In 1517, Sultan Selim I. conquered the country, and since that time it has formed part of the Turkish empire, with the exception of the short period from 1832 to 1841, when Ibrahim Pasha governed it under the authority of his father, Mehemet Ali. But the Turkish government, though it has given the country peace, has by no means been able to develop its natural resources and revive its old prosperity.

CLEMENS PETERSEN.

Syr'iac [see SYRIA and ARAMÆA], a dialect of Aramæan or Low Shemitic, known to us only through a Christian literature so often called *Christian Aramæan*, also incorrectly called *West Aramæan*, as distinguished from Chaldee, East Aramæan. It first comes to our notice in the second century A. D., though there can be no doubt of its existence long before as a vernacular. It was spoken in various dialects throughout Syria, but the form in which it is preserved to us in literature is probably the cultivated dialect of Edessa. From the third to the eighth century it was the common language of Western Asia, but after the Mohammedan conquest (636) it began rapidly to decay, and has been replaced by the Arabic. During the tenth and eleventh centuries Syriac was given up in the cities, and by the end of the thirteenth it had disappeared from the villages and country; since then it has been practically a dead language, used only as the "ecclesiastical language" in the Syrian church, and spoken in a very corrupt idiom in some few mountain districts of the Lebanon and on Lake Urumiyah. As containing the most extensive literature of any Aramæan dialect, a knowledge of it

is necessary in the study of the Shemitic languages: it is, besides, of great importance for exegetical and historical theology, not only in its Bible versions (see below), but also in its extensive theological literature, which has preserved to us many of the most valuable works of the Greek and Latin Fathers. The alphabet consists of 22 letters, all consonants, and read from right to left, as follows:

SYRIAC.*		NAMES.	POWER.		HEBREW.
ܐ	ܒܐ	Olaph.	Light breathing.		א
ܒ	ܒܒܒ	Beth.	B,	b.	ב
ܓ	ܓܓܓ	Gomal.	G,	g.	ג
ܕ	ܒܕ	Dolath.	D,	d.	ד
ܗ	ܒܗ	He.	H,	h.	ה
ܘ	ܒܘ	Wau.	W,	w.	ו
ܙ	ܒܙ	Zain.	Z,	z.	ז
ܚ	ܚܚܚ	Cheth.	Ch,	ch.	ח
ܛ	ܛܛܛ	Teth.	T,	t.	ט
ܝ	ܝܝܝ	Yud.	Y,	y.	י
ܟ	ܒܟܟ	Koph.	K,	k.	כ
ܠ	ܠܠܠ	Lomad.	L,	l.	ל
ܡ	ܡܡܡ	Mim.	M,	m.	מ
ܢ	ܢܢ	Nun.	N,	n.	נ
ܣ	ܣܣܣ	Semkath.	S,	s.	ס
ܥ	ܥܥ	'E.	‛,	‛.	ע
ܦ	ܦܦܦ	Pe.	P,	p.	פ
ܨ	ܒܨ	Tsode.	Ts,	ts.	צ
ܩ	ܩܩܩ	Qoph.	Q,	q.	ק
ܪ	ܒܪ	Rish.	R,	r.	ר
ܫ	ܫܫܫ	Shin.	Sh,	sh.	ש
ܬ	ܒܬ	Tau.	T or th.		ת

The above character, called *P'sîtô* ("the simple," *i. e.* character), now generally in use, is a later caligraphic modification of an older character called *'Est'rangélo*, in common use before A. D. 800, and still used by Nestorians and in title pages of books. (Comp. Cufic and ordinary Arabic characters.) There are five vowels, denoted by diacritical points or Greek vowels, Α Ε Η Ο Υ, inverted, as follows:

ܰ or ÷ = ă

ܶ or .. = ĕ

ܺ or ܺ = ī

ܳ or ܳ = ō or ŏ

ܘ or ܘ = ū

In grammar it shares the common Aramaean peculiarities. In lexicon it is less copious than the other Shemitic dialects. It contains a great number of Persian, Greek, Latin, Arabic, Tartar, and even some French and English words, traces of the various races who in turn have ruled the country. The vocabulary is peculiarly rich in abstract and philosophical terms.

* The first column represents the initial letters; the second, the manner of joining the initial, medial, and final letters, as in Beth, Gomal, etc., or the junction of a letter with a preceding one only, as in Olaph, Dolath, etc.

TEXTBOOKS.—Thoroughly scientific textbooks are as yet wanting: for full list see Hoffman, *Gram. Syr.*, §§ 4 and 5.

(*a*) *Lexicons.*—Abul' Hassan, *Isa bar Bahlul* (963), the best native lexicon and basis of all modern lexicography, in MS. in Bodleian; Schaaf (C.), *Lexicon Syriacum Concordantiale* (Leyden, 1708), best for the New Testament and valuable as concordance: Castell (Edmund), in his *Lexicon Heptaglotton, Hebraicum, Syriacum*, etc. (London, 1669); the Syriac part, revised by John Dav. Michaelis, was reissued as *Edm. Castelli Lexicon Syriacum* (Göttingen, 1788). This remains still the only available lexicon, though entirely inadequate to the demands of the present. Bernstein (G. H.) collected a great mass of material for a lexicon, but only issued one part, *Lexicon Linguæ Syriacæ*, fasc. i. (Berlin, 1857). Smith (R. Payne), *Thesaurus Syriacus*, now publishing in Oxford, contains valuable material collected from papers of Bernstein, Quatremère, Lorsbach, etc., but the arrangement leaves much to be desired.

(*b*) *Grammars.*—Chris. Ben. Michaelis, *Syriasmus* (Halle, 1741), first Syriac grammar written on scientific principles, and still of great use. Hoffman (A.G.), *Gram. Syriaca* (Halle, 1827), the most exhaustive, but not always reliable; revised and enlarged (but not improved) by A. Merx, *Gram. Syr. quam post opus Hoffman refecit A. Merx*, 2 parts, all that have appeared (Halle, 1867–70); an abridged translation is Cowper's (B. H.) *Syriac Grammar.* Uhlemann (Fr.), *Grammatik der syrischen Sprache, etc.* (2d ed., Berlin, 1858), most serviceable, but by no means scientific; translated by Hutchinson (E.), (2d ed., New York, 1875); *New Syriac*, Stoddart; Nöldeke, *Grammatik der neusyrischen Sprache* (Leipsic, 1868).

(*c*) *Chrestomathies.*—Kirsch (G. W.), *Chrestom. Syr.*, revised by Bernstein (Leipsic, 1832), the lexicon extremely valuable; Rödiger, *Chrestomathia Syriaca* (2d ed. 1868).

LITERATURE.—Syriac literature reflects the situation of the country, which was continually subject to foreign dominion and devastated by hostile inroads; it has no freedom of range or originality in character. It is very largely made up of translations, and is almost exclusively religious.

FIRST PERIOD.—Up to the Mohammedan conquest, A. D. 636. Syriac a spoken language, and the Syrian universities of Edessa and Nisibis centres of learning for the entire Orient.

Bible Versions.—A. The Peshito (*i.e.* "The Simple") edition, the oldest Syriac literature that has come down to us. It exerted an immense influence in moulding the language, as well as all the subsequent literature, and has remained the accepted version among all parties of the Syrian Church. (*a*) *Version of New Testament.*—Earliest and most important translation of New Testament, invaluable for its critical study; made at Edessa in the second century. Editions: Widmannstadt and Moses of Marden (2 vols., 1555), *editio princeps*, best, but very rare. Serviceable is Henderson's edition of Gutbier's text, published by Baxter. *Literature.*—See various introductions to New Testament. Cureton has published in his *Remains of a very Ancient Recension of the Four Gospels in Syriac*, etc. (London, 1858), a text of the Peshito older than that of the MSS. on which our printed editions are based. (*b*) *Version of Old Testament.*—Valuable translation, made directly from Hebrew. It is the work of Christian editors, and probably contemporaneous with the version of the New Testament. Editions: *Vet. Test. Syriace*, S. Lee (London, 1823); also many editions of the Psalter. *Literature.*—Perles, *Meletemata Peschitthoniana* (Breslau, 1859), and various introductions to Old Testament.

B. *Philoxenian Version*, a critical version of the New Testament prepared under direction of Xenagas or Philoxenus, bishop of Mabug (488–518), mainly preserved to us through the revision of Thomas of Harkel (hence called "Harklensian Revision"), made in Alexandria A. D. 616. Its design was to render literally the Greek original, which is slavishly followed. Editions: White (Oxford, 1778–1803, 4to). *Literature.*—Bernstein, *De Harklensi N. T. trans. Syriaca* (Breslau, 1854).

C. *Hexaplar Version of O. T.* (formerly called Figurata), made 617 A. D. by Paul, bishop of Tella, from Origen's text of LXX., extremely valuable for textual criticism of LXX. MS. is in Milan. Editions: Various portions of it have been edited by Norberg, Bugati, Ceriani. Recently a photo-lithograph of MSS. has been published.

D. *Syro-Palestine*, a lectionary of inferior importance, in a corrupt dialect of Palestine, and probably belonging to the sixth or the seventh century: discovered by Adler. Editions: *Evangeliarium Hieros. Meniscalchi* (Verona, 1861–64); Ephrem Syrus (306–373), a celebrated Syrian Church Father and a very copious writer in all branches of literature: *S. Ephraem. Syri Opera omnia* (Rom., 1732–46, 6 vols. folio), edited by Petrus Benedictus and S. E. Assemani. Narses (d. 496); James of Sarug (522), *De Vita et Scriptis S. Jacobi Sarugi*, etc.; I. B. Abeloos (Louvain,

1867); Isaac the Syrian; Xenagas or Philoxenus of Mabug (d. 520).

Second Period (636–1318 A. D.).—Period of decay of Syriac; Arabic and Syriac spoken languages. Writers at the close of this period make use of both. James of Edessa (d. 708), learned scholar, celebrated grammarian, and linguist; Barsalibäus (d. 1166); Barhebræus: Gregory Abul' Faradsch (1226–86); best known are his civil and ecclesiastical histories, the great source of our knowledge of Western Asia during many centuries. (a) *Chronicon Syriacum*, ed. Bruns and Kirsch (Leipsic, 1789, 2 vols.). (b) *Chronicon Ecclesiasticum*, ed. Abeloos and Lamy (Louvain, 1873). Besides this he wrote a number of grammars, treatises, commentaries, etc. Ebed Jesus (d. 1318).

Third Period (1318).—Arabic the spoken language; Syriac cultivated only as a learned and ecclesiastical language, chiefly in the Maronite college in Rome. Amira (1644), grammarian; the Assemanis.

(a) Joseph Simon: *Bibliotheca Orientalis* (Rom., 1719–28, 3 pts., 4 vols. fol.), a complete history of Syrian literature, and the source from which our knowledge of it is largely derived. (b) Stephan Evodius: *Acta Sanctorum Martyrorum* (Rom., 1748, fol.).

Syriac MSS.—The chief collections of Syriac MSS. are in the British Museum, the Vatican, the Bibliothèque Nationale in Paris, and the Bodleian in Oxford. The oldest MSS. are of the fifth century. Wright, *Catalogue of Syriac MSS. in British Museum* (1870–72); Zotenberg, *Catalogues des MSS. syriaques, etc. de la Bib. Nat. Paris* (1874).

Printed Books.—See list in *Conspectus Rei Syrorum Lit.*, ed. G. Bickell (Munster, 1871). 16th century: Widmannstadt (see above). 17th century: Editions of N. T. by Frost (Cöthen, 1619); Gutbier (Hamburg, 1664); O. T. in Paris Polyglot (1629–45), London Polyglot (1657); in both an unreliable text. 18th century: Edition of N. T. by Leusden and Schaaf (1708 and 1719); works of the Assemanis; chronicles of Barhebræus (see above); issues of Hexaplar Text by Norberg and Bugati. 19th century: Wm. Cureton (d. 1864), *Gospels* (see above); *Festal Letters of Athanasius* (London, 1848); *Corpus Ignatianum—Complete Collection of Ignatian Epistles* (London, 1845–49); *History of Martyrs in Palestine, by Eusebius* (London, 1861), etc.; Samuel Lee, *V. T. Syriace* (see above); *Theophany of Eusebius* (1842); Lagarde (Paul Anton de), *Libri Veteris Test. Apocryphi Syriace* (Leipsic, 1861); *Analecta Syriaca* (Leipsic, 1858); *Geoponica Syriaca* (Leipsic, 1858); *Clementis Recognitiones Syriace* (Leipsic, 1861); *Didascalia Apostolorum Syriace* (Leipsic, 1854); Wright (Wm.), *Homilies of Aphraates* (London, 1869); Land (I. P. N.), *Anecdota Syriaca* (Leyden, 1862); Martin, *Œuvres grammaticales d'Aboul' Faradj di Bar Hebraus* (Paris, 1872), and valuable grammatical articles in *Journal asiatique;* Nöldeke, Syriac Text and grammatical articles in *Zeitschrift der deutsch. Morgenländ. Gesellschaft.*

T. C. Murray.

Syrian Rite. See United Syrians.

Syrin'ga [Gr. σῦριγξ, a "tube"], a genus of Old World shrubs of the order Oleaceæ, to which the lilacs belong. (See Lilac.) Popularly, the beautiful shrub *Philadelphus coronarius*, of the order Saxifragaceæ, is called syringa, or seringo. It is a native of Japan, often seen in our gardens, and its cream-colored, fragrant flowers somewhat resemble orange-blossoms.

Syr'inge [Gr. σῦριγξ, a "tube"], an instrument identical in principle with the ordinary suction-pump. A vacuum is formed, either by means of a piston or a compressible chamber of india-rubber, fitted with suitable valves. Water or some other fluid now rushes in and fills the vacuum, and a second application of pressure causes a jet of the contained liquid to be thrown out. The syringe is of many forms, chiefly employed in surgery, in horticulture, etc.

Syro-Chaldæan Rite. See Chaldean Christians.

Syros. See Syra.

Syr'tis Major and **Syrtis Minor,** the ancient names of the two large inlets, or rather of the two opposite angles (E. and W.) of the great almost rectangular re-entrant in the southern coast of the Mediterranean, of which the margins are the coasts of Tunis and Tripoli, which now are called respectively the Gulf of Sidra and the Gulf of Cabes. They are shallow and dangerous to navigate on account of quicksands and the uncertainty of the tides.

Syrus (Publius). See Publius Syrus.

Syzran', town of Russia, government of Simbirsk, on the Syzran, near its influx into the Volga, and in the centre of a very fertile district, from which it exports large quantities of corn. P. 20,000.

Szabad (Emeric), b. in Hungary; became secretary of the national Hungarian government in 1849; after the overthrow of the revolutionary movement, went to England, where he contributed to the *Encyclopædia Britannica;* entered the Italian military service, which he left in 1861; emigrated to the U. S.; became a captain in the Union army, serving in West Virginia. He has written for journals, and has published *Hungary, Past and Present* (1854), and *Modern War, its Theory and Practice* (1863).

Szabadka [Ger. *Maria Theresiopel*], town of Southern Hungary, county of Bács, on Lake Palicz, has manufactures of linens and leather, important cultivation of tobacco, and breeding of cattle, and a brisk trade in horses, cattle, sheep, wool, and hides. It consists of the town proper and 16 suburbs, and is rather indifferently built, though it contains several handsome buildings, such as the church of St. Theresa, the beautiful Greek church, the town house, the new barracks, etc. P. 56,323.

Sza'lay (sŏh'loi), (Laszlo), b. at Buda Apr. 18, 1813; studied at the University of Pesth, and was admitted to the bar in 1833; devoted himself to history, jurisprudence, and politics; became editor of various leading reform papers, and published a collection of political essays in 1847, and of political biographies 1847–52; was the most prominent member of the commission for the revision of the Hungarian penal code, a work which earned great admiration outside Hungary; was sent as ambassador in 1848 to the provisional government of Germany in Frankfort; resided subsequently in London and Switzerland, occupied with historical studies; returned to Hungary in 1861. D. at Salzburg July 17, 1864. His principal works are a *History of Hungary* (6 vols., 1850–63), *Esterházy Miklós* (2 vols., 1862–66), etc.

Szar'vas (sŏr'vosh), town of Hungary, on the Körös, was formerly fortified, but its fortifications have now fallen into decay, and it derives its importance mostly from its trade in corn and cattle. It suffered severely during the sieges of 1595 and 1685. The surrounding country is swampy and marshy, but famous for its extensive bee-cultivation. P. 18,917.

Szathmar-Nemethi (sŏt'mar na met'), town of Hungary, on the Szamos, has extensive manufactures of slibowiz, a kind of brandy distilled from plums. P. 18,353.

Széchenyi (sā'ken-yee), (István), Count, b. at Vienna Sept. 21, 1791, of an old and celebrated Hungarian family; served in the Austrian wars with Napoleon, but retired from the army in 1825, and devoted himself wholly to the material and spiritual development of his native country. He took a prominent part in the foundation of the Hungarian Academy of Science, of the first Hungarian theatre, of the conservatory of music in Pesth, etc., and in the erection of the great bridge across the Danube at Buda Pesth, in the regulation of the course of the Danube through the Iron Gates, in the establishment of steam navigation on the Danube and the Theiss, etc. But it was his idea that the progress of Hungary could not be effected unless by the aristocracy and in close alliance with Austria, and he consequently opposed Kossuth very strongly. Nevertheless, in 1848 he consented to be a member of the Batthyanyi-Kossuth ministry, but on the outbreak of the war with Austria he became insane, and was brought to the asylum of Döbling, near Vienna. Here he nearly recovered, but in Mar., 1860, the Austrian police, suspecting him of being the author of a political pamphlet which criticised the government very severely, undertook a search of his rooms and papers, and this excited him so violently that he relapsed, and shot himself Apr. 8, 1860. He was author of several spirited pamphlets.

Szegedin', town of Hungary, at the influx of the Maros in the Theiss, is fortified and has several fine buildings, though in general it is ill built and most of its streets are unpaved. It manufactures soda, tobacco, cloth, and a celebrated kind of soap, and it carries on an active trade in corn, wine, salt, and timber. Its two annual fairs are, next to those of Pesth and Debreczin, the best frequented in Hungary, and exchanges of vast amount are here effected, especially in salt from Transylvania, grain from the Banate, wool and wooden ware. Even at the time of Matthias Corvinus it was one of the most important towns of the country. On Aug. 3, 1849, the Hungarians were defeated here by the Austrians. On its wharves are built the best river boats in Hungary. P. 70,179.

Szeghalom', town of Hungary, on the Berettyó Canal, carries on some trade in corn, wine, cattle, and [illegible]. P. 6112.

Szégszard, town of Hungary, near the Danube, celebrated for its wines. P. 10,500.

Szeklers, or **Szechs.** See Transylvania.

Szigeth', town of Hungary, at the influx of the [illegible] in the Theiss, has large saltworks. P. 6408.

Szolnok', town of Hungary, on the Theiss, has a brisk trade in corn, salt, and timber. P. [illegible].

T.

T, a consonant, classed as a lingual mute. It is subject to numerous interchanges with other consonants. T. as an abbreviation stands for Titus, ton, treble.

Taa'singe, an island of Denmark, in the Baltic, immediately S. of Funen. Area, 27 sq. m. P. 4500.

Tabanidæ. See Horse-Fly.

Tabas'co, state of the Mexican confederation, bordering N. on the Gulf of Mexico, and bounded E. by Yucatan, comprises an area of 15,600 sq. m. The surface is a flat plain sloping toward the sea, and in many places so low that it is regularly inundated. The climate is very hot, and in the marshy and swampy districts very unhealthy. But the soil is exceedingly fertile. The surface is to a great extent covered with primeval forests, and in openings in the forests indigo and cacao grow wild. Sugar, coffee, tobacco, vanilla, and cacao are cultivated; the value of the annual cacao harvest is estimated at from $1,000,000 to $1,500,000. Pop. 83,707, chiefly Indians.

Tabasheer [Pers. *tâbâshir*, "clay"], a natural glass obtained from the hollow stems of certain bamboos. It appears to be the product of an exudation of the silicious sap of the plant into its internal cavity. It is very light, brittle, porous, and has hygrometric properties. There are several varieties. The transparent kinds have the lowest refractive power of all known substances except the gases. Its refraction of the mean yellow ray has the index 1.111. The Hindoos ascribe to it great medicinal virtues.

Ta'berg, p.-v., Oneida co., N. Y. P. 400.

Tab'ernacle, tp., Randolph co., N. C. P. 1296.

Tabernacle, tp., Orangeburg co., S. C. P. 355.

Tabernacle [Lat. *tabernaculum*], **The**, a large and costly tent erected by the Israelites near the close of their encampment at the foot of Mount Sinai, and subsequently carried with them in their wanderings in the wilderness and into the Holy Land. Its construction, together with all its hangings and furniture, was under especial divine direction, even in its minutest details. It was designed as the place where God should especially manifest his presence to his people, and where they should offer to him their sacrificial worship. For the same purposes it was continued in Palestine until replaced under Solomon by the temple, a reproduction of it in more durable material, but with each of its dimensions exactly doubled. In structure it consisted essentially, in ground-plan, of two adjoining rooms, with an outer court surrounding both. The inner room, which was an exact cube, contained the ark of the covenant with its contents; over this were the figures of two cherubim, and between them the Shekinah. The only access to this room was from the outer room, of the same width and height, but just twice the length. Between them hung a veil, which was passed only by the high priest, and by him only on one day of the year, the great day of atonement. In the outer room was the golden censer, the golden altar on which incense was burned every morning and evening, the table of shew-bread, on which were twelve loaves of bread, replaced each week, and the golden candlestick, the lamps of which were trimmed every morning and lighted every evening. Into this the high priest and the priests entered daily in the course of their regular ministrations, but no others. This was entered at the eastern end from the court in front. In the court the principal object was the large brazen altar, on which all burnt-offerings and the appointed parts of other sacrifices were burned. Between this and the sanctuary itself was placed the brazen laver for the frequent ablutions of the priests. This court was entered not only by the priests and Levites, but by all Israelites—who must be ceremonially clean—who came to offer sacrifices. The entrance to this was also by a hanging of curtains gorgeously wrought in colors, supported on pillars, and was 20 cubits in width. The three entrances were thus in one line, all facing eastward. In the temple other courts were added beyond, and in this court were various fixtures for the convenience of the sacrificers. The dimensions of the court were 100 × 50 cubits; it was enclosed on all sides by pillars of brass 5 cubits high and 5 cubits apart, resting in sockets of brass; and on these were hung, by hooks of silver, curtains, one for each side, of "fine twined linen." The sanctuary itself, within the court, was a tent covered with a series of curtains; but under these curtains was a structure 30 × 10 cubits, having its sides and rear of acacia boards 10 cubits high. Each board had at the bottom two silver tenons fitting into silver sockets placed on the ground, and at the top on the outer side a ring of gold through which ran bars of acacia to hold all together. This was divided by a curtain so as to form the holy place, 20 × 10 cubits, and the holy of holies, 10 × 10 cubits. The covering rose in the form of a triangle to an apex over the centre, and extended 5 cubits on each side beyond the boards, and also 5 cubits in front, forming a sort of porch. This covering was formed of four sets of curtains, of which the innermost was of finely-wrought linen and hung down over the front; the next of goats' hair; the third of rams' skins dressed with the wool on, and dyed red; the fourth, which according to Fergusson was only placed over the joint of the last, was of "badgers'" (probably, seals') skins. The two inner coverings were made in strips sewed together, but so as to leave two parts in each, which were joined together with buckles of gold.

The tabernacle in all its structure was arranged for convenient packing, transportation, and setting up; but nevertheless, in size, in beauty of workmanship, and in costliness of material, was a magnificent structure for the wilderness. It was plainly intended to impress immediately upon the people in the strongest way the majesty of God, whose presence was there manifested, and to whom they there drew near in their sacrifices. It was also in every part symbolical of divine truth. The most salient points of this symbolism are expressed in the Epistle to the Hebrews. *Literature.*—Art. "Tabernacle" (Plumptre) in Smith's *Dict. of the Bible*; Neumann, *Die Stiftshütte* (1861); Riggenbach, *Die mosaische Stiftshütte* (1863); Lange's *Commentary* (Schaff's edition) on Lev. xxiv. *seq.* and 1 Kings vi. *seq.* Frederic Gardiner.

Tabernacles, The Feast of, one of the three great festivals at which all the males of Israel were required to present themselves at the sanctuary. It began on the 15th Tisri, the first month of the civil and seventh month of the ecclesiastical year, corresponding to the last part of September or first part of October, and continued seven days, with a supplementary eighth day. On the first and on the eighth day there were "holy convocations," when no *servile* work might be done, although the other activities of life were allowable. On the remaining days there was no legal restriction on labor, but from the manner of keeping the feast it must have been largely suspended.

The feast was pre-eminently a thanksgiving festival after the close of the agricultural labors of the year, and was far more joyously kept than any of the other feasts. Its position, also, five days after the great annual day of atonement, the only fast-day prescribed in the Law, contributed to this result. According to the ordinances of the Law, it was distinguished by two peculiar observances, and in the course of time several others of great significance and beauty grew up around these. The first of these characteristics resulted from the command to the Israelites to dwell in *booths* during the seven days of the feast; the command did not apply to the supplementary eighth day. These booths were to be constructed of the branches of "goodly trees," and were not tents. According to Jewish tradition, the sides were built up of boards, and only the roof made of branches, and they were placed on the roofs and in the courts of the houses, and in any unoccupied places in the streets. As little furniture as possible was to be placed in them, and it was not required that women and children should dwell in them, but only men. Tradition interpreted the word *dwell* to mean taking at least two meals a day in them. This dwelling in booths connected the harvest festival with the national and religious life of Israel, and was expressly made in the Law a remembrancer of their deliverance from Egypt. Some writers have thought that at certain seasons of the year during the wanderings in the wilderness the Israelites escaped from their tents to temporarily-constructed booths; but it seems more likely that the reference is to their first encampments on the march out of Egypt, especially at Succoth (= "booths"), when they had not yet had time to provide themselves with tents. The other legal peculiarity of the feast was in the sacrifices. These were not only of great abundance, but were arranged in a singular manner. There was offered on each day a kid for a sin-offering, with two rams and fourteen lambs for a burnt-offering; but besides this, there was a further burnt-offering of bullocks, thirteen on the first day, twelve on the second, and so on diminishing by one on each successive day, until only seven were offered on the

seventh day. On the eighth day the sacrifices were a goat for a sin-offering, one bullock, one ram, and seven lambs for a burnt-offering. The Law required that at the feast of tabernacles in the sabbatical year the Law should be publicly read to the whole people, men, women, and children.

In addition to the dwelling in booths, it was customary for each Israelite to carry in his hand during the festival the *lulab* or bundle of green branches tied together, and also some fruit, usually understood to be the citron. This custom added much to the joyous scenes of the festival. Two other customs arose at an early date, and are thought to be alluded to in the New Testament. One of the priests drew water in a golden pitcher from the Pool of Siloam, and brought it through the water-gate of the temple to the altar. As he entered, the trumpets sounded, and the people in the mean time had repaired to the temple in holiday attire and with their *lulabs* in their hands. Then, just before the offering of the sacrifices, the water was poured upon the altar, amid the joyous chanting of Ps. cxviii. and the shaking of the *lulabs*. So great was the joyousness of the occasion that it became a rabbinical proverb, "He has never seen joy who has not seen the joy of the pouring out of the water of Siloam." To this custom allusion is made in John vii. 37, 38. In the evening of the day of "holy convocation" the men and women assembled in the courts of the temple expressly to rejoice over the drawing of the water of Siloam in the morning, and gave themselves up to unrestrained hilarity. On this occasion two great lights were set up in the court, each consisting of four lamps, the oil for which was supplied by the sons of the priests, and the wicks made of cast-off priestly garments. The light is said to have reached over nearly the whole city. The passage John viii. 12 is supposed to allude to this light. FREDERIC GARDINER.

Tabernæmontana. See COW-TREE and FORBIDDEN FRUIT.

Tabertown, tp., Cass co., Ind. P. 447.

Taberville, p.-v., St. Clair co., Mo. P. 160.

Ta'bes Dorsa'lis, Phthisis Spinalis, Duchenne's Disease, better known as **Progressive Locomotor Ataxia,** a degenerative condition of the posterior gray column of the spinal cord, usually by the successive steps of fatty degeneration, granular disintegration, and atrophy, from which the terms *tabes* and *phthisis*, denoting "wasting." The term "progressive locomotor ataxia" is descriptive of the chief features of the disease. Ataxia (Gr. α privative, and τάξις, "arrangement" or "order") designates the peculiar loss of control in this disease over groups of muscles which in health are co-ordinated or employed in unison. This deranged, inharmonious action of muscles is limited chiefly to the lower extremities, and manifested when attempting to walk; hence the term "locomotor," while the affix "progressive" indicates the steady and hopeless progress of the malady. The sight aids greatly in the precision and certainty of walking. Hence, in the early stage of ataxia the gait may be unsteady only at night, twilight, or when the eyes are closed. In more advanced stages the patient has not sufficient control to stand with the eyes shut, and, on attempting to walk, the limbs move irregularly and wildly, the feet coming down abruptly with a flapping sound, the patient catching at support or falling. The limbs, though wholly beyond control for walking, are not paralyzed, and retain full power, as demonstrated by the dynamometer. Intense pains, of electric rapidity and lancinating severity, shoot from the feet to the thighs, trunk, and often to the head. The soles of the feet often are anæsthetic, and seem to the patient puffy, as if walking on down or velvet. There may be anæsthesia of other parts. The rectum and bladder may be impaired, and the sexual appetite and power are usually annihilated. There may be local dull pain over the spine, denoting the point of disease, and also a slight sense of constriction at a corresponding level, as if a string were tied round the body. The mind, as a rule, is sound, except so far as long-continued intense pain, sleeplessness, and knowledge of the desperate and hopeless nature of the disease dispirits and demoralizes. Alcohol freely taken relieves the pain, and opium, especially administered subcutaneously. But the pain constantly recurs, and hence either the alcohol or opium habit is apt to become established in ataxic patients. Cold and changeable weather intensifies their distress. Hence, they should be placed in warm, sunny rooms, protected from damp and chilly air, and well housed in winter. This disease of the spinal cord is in some cases induced by intemperance; in others by licentious excess and specific disease; in others it would seem the reflex result of disease of the bowel and the urinary tract, as in stricture of the rectum, hæmorrhoids, urethral stricture, etc. Habitual exposure to inclement weather and the rheumatic and gouty vices of the blood may induce it. When due to specific blood-states, as rheumatism, gout, and syphilis, there is hope of cure or arrest of the disease by specific treatment. But more often the cause is obscure and of slow, insidious approach; it is surely "progressive," and treatment is limited to general tonic and hygienic measures, and assuaging pain by anodynes.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Table Bluff, p.-v. and tp., Humboldt co., Cal. P. 408.

Table-Land, or **Plateau.** See EARTH, by PROF. A. GUYOT, PH. D., LL.D.

Table Mound, tp., Dubuque co., Ia. P. 1137.

Table Mountain, in Pickens co., S. C., 20 miles N. W. of Greenville, rises 4300 feet above tide, and there is on one side a long line of cliffs 1000 feet in perpendicular height. The vicinity abounds in imposing and beautiful scenery, and is becoming a place of summer resort.

Table Rock, tp., Izard co., Ark. P. 257.

Table Rock, p.-v. and tp., Sierra co., Cal. P. 759.

Table Rock, tp., Siskiyou co., Cal. P. 327.

Taboo', or **Tabu',** a Polynesian custom by which persons, places, or things become so sacred that certain persons cannot touch or come near them without becoming defiled and outlawed. The system of taboo penetrates the whole social life of most of the unchristianized South Sea Islands, and is a potent engine in the hands of chiefs and priests for the management and subjection of the people.

Ta'bor, p.-v. and tp., Fremont co., Ia. P. 310.

Tabor College, Fremont co., Ia., was incorporated under the name of Tabor Literary Institute in 1854, and reincorporated under the name of Tabor College in July, 1866. It is an outgrowth of a colony of Congregationalists from Oberlin, O., who formed the settlement at Tabor in 1851 under the leadership of Deacon George B. Gaston and Rev. John Todd. Many citizens of Tabor gave largely of their property to the college at the opening of the college department. The first nineteen donors gave in cash and notes 60 per cent. of the assessed value of their property. In the admission of students no distinction is made on account of sex or race. An academy was opened in 1857, and a college department in 1866. Tabor College includes, besides the college department, a ladies' department, a teachers' department, and a preparatory academy. In all departments the number of students during the year has varied from 156 to 210, about one-fifth the average attendance being in the college course. Rev. Wm. M. Brooks, the present incumbent (1873), was principal of the academy and first president of the college. The college has two buildings, 234 acres of land, a library of 3200 volumes, and a cabinet of 3150 specimens. The endowment, including unpaid subscriptions, is $55,000. The number of students from the first exceeds 1000. WM. M. BROOKS.

Ta'borites [named from *Tabor*, one of their strongholds], a sect of the Hussites organized in 1420 under Ziska. They opposed the Calixtines or Utraquists, no less than the Romanists, and waged long defensive wars. They finally took the name of BOHEMIAN BRETHREN (which see).

Taborit'ic (or **Thaboritic**) **Light.** See HESYCHASTS.

Ta'bor, Mount, an insulated mountain of Northern Palestine, in Galilee, 6 miles S. E. of Nazareth, rises 1000 feet, and commands a large and beautiful view of the surrounding country. It is often mentioned in the Old Testament, and was from the fourth century generally regarded as the scene of the transfiguration of Christ, until recent researches showed that at the time when that event took place, its summit was occupied by a populous town.

Tabreez', town of Persia, capital of the province of Azerbaijan, is surrounded with a brick wall 3½ miles in circuit, but is ill built, with crooked, narrow, and dirty streets, and no remarkable public edifices. Its bazaars are mean buildings, but extensive, and a large and important trade is carried on here, partly in the manufactures of the city itself, silk, arms, shawls, tobacco, and leather, partly as a transient trade between Russia and Turkey and Persia and India. The surrounding country is very fertile and well cultivated, mostly consisting of orchards and vineyards. P. estimated at 50,000.

Tacahout, or **Mahu,** a nutgall which grows on *Tamariscus Indica*, a species of TAMARISK (which see). It is valuable as a prolific source of gallic acid. Large quantities are exported from India and Barbary.

Tac'amahac. (1) The resin of *Fagara octandra*, a tree of Curaçoa and Venezuela; (2) that of the buds of balsam poplar, which grows in the U. S. (*Populus balsamifera*); (3) that of *Calophyllum Calaba*, *C.* [illegible], and *C. Tacamahaca*, Old-World tropical trees, producing East Indian tacamahac; (4) the Mexican [illegible] (which see). These articles are sometimes used in medicine, and but the second are employed in varnishes, incense, etc.

Taché (ALEXANDRE), brother of Sir Etienne P., b. at Kamouraska, Lower Canada, in 1822; graduated at the college of St. Hyacinthe; became a member of the order of the Immaculate Conception; was ordained priest 1845; went as a missionary to the Red River country, and thence among the Indians of the valley of the Saskatchewan; became coadjutor bishop of St. Boniface, Manitoba, 1851, bishop 1853, and archbishop 1871; exerted himself as a peacemaker during the Riel insurrection of 1869–70, and established a college and theological seminary at St. Boniface, opposite Fort Garry. Author of *Vingt Années de Missions dans le Nord-ouest de l'Amerique* (Montreal, 1866), *Esquisse sur le Nord-ouest de l'Amérique* (1869), and numerous reports on Indian missions in the *Annales de la Propagation de la Foi.* —His brother, JEAN CHARLES, M. D., b. at Kamouraska in 1821, is author of several works in French, including *Esquisse sur le Canada sous le Point de Vue économiste* (Paris, 1855), and *Des Provinces de l'Amérique du Nord et d'une Union fédérale* (Quebec, 1859), and works on legal and industrial subjects, in French and English.

Taché (Sir ETIENNE PASCHAL), M. D., b. at St. Thomas, Quebec, Canada, in 1795; served as a militia officer in the war of 1812–15; afterward studied medicine, and interested himself in literature, science, and politics; entered the assembly 1841; was deputy adjutant general 1847, commissioner of public works 1848–49, Speaker of the legislative council 1856–57; was knighted by Queen Victoria Nov., 1858; became colonel and aide-de-camp to the queen 1860. D. at St. Thomas in 1865. Author of *Du Développement de la Force physique chez l'Homme* (1829), *Réflexions sur l'Organisation des Volontières* (1863), etc.

Tachygloss'idæ [from *Tachyglossus* — Gr. ταχύς, "quick," and γλῶσσα, "tongue"—the generic name of the species], a family of mammals of the order Monotremata, confined to Australia and its adjuncts, and represented there by the so-called "hedgehogs," but which must never be confounded with the hedgehogs of Europe. The name *Tachyglossus* refers to the swiftness with which it can use its tongue in protrusion and retraction. *Echidna*, a name often used, was preoccupied in zoology. The general form is somewhat like that of the hedgehog of Europe; the face and jaws are, however, produced into a long and tubular rostrum; at the end of this is the small mouth; teeth are entirely wanting, but on the palate are robust horny spines, pointing backward; the tongue is subcylindrical, and very long, flexible, and protractile, and armed with numerous horny warts; the surface of the body and head above and on the sides is armed with long, stout, tapering, and pointed spines, intermingled with coarse hair, and below is clothed chiefly with simple coarse hair; the limbs are short and robust, each provided with five toes; those of the anterior feet with graduated long, compressed curved claws; those of the hinder feet with abruptly unequal claws—viz. the inner with a broad rounded nail, the second with a very long, and the others with regularly graduated, moderately compressed curved claws (the males are provided with horny spurs to the hind feet, which are wanting in the females); the tail is rudimentary. The family is represented by but one known genus (*Tachyglossus* or *Echidna*), which has representatives in (1) Australia generally, and (2) Van Diemen's Land. The forms of both countries are very nearly allied, and have been designated by some authors (*e. g.* Waterhouse) as distinct species under the names (1) *Echidna aculeata*, and (2) *E. setosa*, and by others (*e. g.* Krefft) as simple varieties. They attain a length of about eighteen inches. They chiefly feed on ants and other small insects, as is indicated by their small mouth and extensible tongue, but sometimes take in grass. They are capable of sustaining life for a long time without food, and are supposed to remain dormant during the dry hot months of summer, as they are at least chiefly seen during winter. They are also said to be to some extent proof against the bites of poisonous snakes. "The strength of the echidnas is most wonderful, and their digging capabilities will scarcely be credited. The animal often appears to be nailed to the ground, and if sheltered in some convenient corner, where the soil is stiff clay, a spade is necessary to dislodge it. In soft alluvial soil or sand an echidna will disappear before the observer's eyes without any apparent effort, gradually sinking out of sight." (*Krefft.*) THEODORE GILL.

Tachygraphy. See STENOGRAPHY, by J. F. MEYER.

Tachypet'idæ [from *Tachypetes*—Gr. ταχυπέτης, "fast-flying"—the name of the only known genus], a family of birds represented by the "frigate-bird" or "man of war" of mariners. The form is essentially the same as that of the pelicans, but the neck is rather shorter, and the anterior position of the legs imparts to the bird a peculiar physiognomy: the bill is moderately long (longer than the head), rather slender and contracted toward the middle, and nearly straight, but with the end strongly hooked; its sheath is composite or grooved, as in all the Pygopodes; the edges are entire: the nostrils are in the lateral grooves and very narrow; the gular pouch is moderately, or even largely, developed; the wings are very long and pointed; the tail is also very long, and is very deeply forked, and has twelve feathers; the legs are inserted unusually far forward (an exceptional shortness of the sternum being co-ordinated with this character), and rather small; the tarsi are very short (much more so than the outer toe), and much compressed and plumose; the toes are slender, and the web between them deeply indented; the claws moderate and curved, and the middle one pectinated. The family belongs to the same group (Pygopodes) with the Phaëthontidæ (tropic-birds), Plotidæ (snake-birds), Phalacrocoracidæ (cormorants), Pelecanidæ (pelicans), and Sulidæ (gannets). (As to habits of species, see FRIGATE-BIRD.) THEODORE GILL.

Tac'itus (C. CORNELIUS). The place and date of his birth are not known, but he married a daughter of C. Julius Agricola in 78 A. D.; was prætor in 88; consul suffectus in 97, and probably survived Trajan, who died in 117. He had already acquired great reputation as an orator when Pliny entered public life. They became intimate friends. Of Pliny's letters, eleven are addressed to him, and it is apparent that his friendship was considered by Pliny as a distinction. As an author he was much appreciated by his own times and the next century. The emperor Tacitus claimed relationship to him, and ordered his works to be placed in all public libraries, and ten copies to be made every year at the public expense and deposited in the Archeia. During the latter part of the Roman epoch and during the Middle Ages, however, he was not much read, and most of his works have come down to us only in a mutilated and corrupted form. The dialogue *De Oratoribus* is his earliest work; its authenticity has been denied by some scholars, but is generally accepted. *Agricola* is a biography of his father-in-law, a masterpiece in artistic respects, and of special interest on account of the fact that Agricola spent so much of his time in Britain. *De Moribus et Populis Germaniæ* is an essay which probably had originally a moral purpose as much as an historical. Of his *Historiæ*, written before the *Annales*, only the first four and a half books are extant, giving the history of the years 69–70 A. D. Of the *Annales*, beginning at the death of Augustus and ending at the death of Nero, only the first four books, parts of the fifth, the sixth, and from the middle of the eleventh to the middle of the sixteenth, are extant. The style of these writings is very peculiar. To the common reader it is harsh and obscure, yet at the same time exceedingly powerful. Scholars who are familiar with the author generally admire not only the intellectual and moral, but also the literary character which these works reveal. Editions by Bekker (1831), Orelli (1846 and 1848), Ritter (1848), and Halm (1863); English translations by Gordon (1728–31), by Murphy (1793), and by Church and Brodribb (London, 1864).

Tacitus (M. CLAUDIUS), Roman emperor Sept. 25, 275–Apr. 9, 276, b. at Interamna, the present Terni, in Umbria, about 200; was noted as one of the oldest senators and one of the wealthiest citizens when the senate, after the death of Aurelian, elected him emperor. He was an upright and honest character, and possessed of great literary interest. It was his idea to reinstate the senate in its former authority, and to check the steadily-increasing licentiousness and confusion in all public affairs; but the task proved too much for his years, and he died 200 days after his election, at Tarsus or at Tyana, of a fever, or, as some say, put to death by the impatient army.

Tack'ing is a doctrine of the English equity jurisprudence whereby a third encumbrancer in good faith of land may, by a union of his own security with a prior one, compel an intermediate encumbrancer to pay off both the liens if he wishes to redeem from the one which is first in order of time. The rule is most frequently applied to the case of three successive mortgages held by different persons, the last having been taken without notice of the second. Under these circumstances the junior mortgagee may purchase and take an assignment of the earliest encumbrance, and, in the language of the books, may "tack" his own to it. If the second mortgagee then desires to redeem, he must not only discharge the first, which is prior, but also the third, which is subsequent to his own. The privilege, however, is not extended to a third encumbrancer by judgment, since he is not regarded as a purchaser; but if his encumbrance is by mortgage, it makes no difference whether the first and second liens are by mortgage or by judgment. The American courts have wholly rejected

this doctrine of tacking, both because they consider it as extremely inequitable, and because it is wholly inconsistent with the statutes concerning the recording of mortgages which have been adopted in all the States.

JOHN NORTON POMEROY.

Tackmahack, or **Tacamahac.** See POPLAR and TACAMAHAC.

Tac'na, town of Peru, South America, on the Tacna, at an elevation of 1700 feet above the sea, in lat. 18° S., lon. 72° 10′ W. It is well built, and carries on an active trade with Bolivia. P. 11,723.

Taco'ma, p.-v., Pierce co., Wash. Terr., the W. terminus of Northern Pacific R. R., on Tacoma Bay, has several churches, 2 schools, 1 newspaper, and 1 saw-mill. Deposits of coal exist in the neighborhood. P. 73.

THOMAS W. PROSCH, ED. "PACIFIC TRIBUNE."

Taconic, or **Taghkanic**, a range of mountains extending nearly N. and S. along the eastern boundary of New York, and uniting the Green Mountains of Western Massachusetts with the Highlands of the Hudson. The "Taconic system" of Prof. Ebenezer Emmons was named from the characteristic strata of this range, a metamorphic rock, which that geologist believed to be older than the Silurian system, and to extend S. W. along the whole extent of the Appalachian chain, attaining sometimes a thickness of above 30,000 feet.

Tactics, Grand. See TACTICS, MILITARY.

Tac'tics, Mil'itary, is defined as the art of bringing troops into action, or of handling them in the presence of an enemy and within range of his fire. This branch of the military art is divided into *grand tactics*, or the tactics of battle, and *elementary tactics*, or those of instruction. The first is on the field of battle what strategy is in the theatre of military operations—simply the art of being the stronger at a decisive point, regardless of the respective strengths, as totals, of the opposing armies. The second is to the first, or ought to be, the simplest means sufficient to the end. Beginning with the individual recruit and "awkward squad," the drillmaster should mould the sentient masses with which the issues of battle are decided, but with methods of drill and details of minor tactical formation this article does not deal.

The tactical "arms" into which modern armies are divided are the ARTILLERY, CAVALRY, and INFANTRY (which see), which, excepting the mobile artillery, in their respective formations still bear strong resemblance to their prototypes in classic antiquity. The grand tactical elements, or units, of these "arms" are battalions of infantry, batteries of artillery, and squadrons (or battalions) of cavalry; and these elements are, as occasion requires, organized into brigades, divisions, army corps, etc., either of the respective arms or of mixed troops.

Grand Tactics.—Battles are general engagements between armies, in contradistinction to conflicts, in which but a small portion of the opposing forces are actually engaged, the latter being called, according to their nature, "affairs," "combats," "skirmishes," etc. Battles are defensive when given in a chosen position by an army awaiting attack; offensive when made on an enemy in position; mixed, or unforeseen, when happening between armies unexpectedly confronted. The principles upon which all battles should be fought are well established, but circumstances, ever varying, present alternations of original and reflex action that, if perceived at all, are simply perplexing to the incompetent commander. The strategy of a campaign may be predetermined in cabinet council; questions of logistics and military engineering may be solved by the assistants; but on the actual field of battle the individuality of the general is made manifest. His plans must be quickly conceived and stubbornly maintained, or readily abandoned for alternatives, as circumstances may demand.

Speaking in general terms, the most promising tactical positions are those neutralizing any superiority that the enemy may possess, and affording facilities for the ready employment of the special arm or arms in which one's own army may be the stronger. The position should allow the concentration of artillery fire on each avenue of approach, should permit the free and unperceived movement of one's own troops and expose the enemy's advance, should afford protection to the flanks, and should not present obstacles to one's own retreat. All of the desirable conditions can rarely be secured in one combination. In securing some of them others must often be yielded to the enemy.

Orders of Battle.—"A line of battle is the general name applied to troops drawn up in their usual order of exercise without any determined manœuvre; an order of battle is the particular disposition given to the troops for a determined manœuvre on the field of battle." These orders may be parallel, oblique, perpendicular, concave, convex, in echelon, or arranged by combinations of two or more formations. The parallel order may be simple, or with a crotchet, as that of the Austrians at Prague, or reinforced on one or both wings, or, as were the Romans at Zama, in the centre. Oblique formations may have the advanced wing reinforced, as in the Theban order at Leuctra. An instance of the perpendicular order is found in Frederick's attack at Rosbach. The English formation at Poitiers was convex, and at Agincourt was a combination of the concave and echelon orders. Echelons are formed on a wing, on the centre, and in rare instances on both wings.

Infantry and cavalry are employed in extended order or thin lines, in lines of battalion or regimental columns, in deep columns consisting of several battalions, and in combinations of lines, squares, columns, etc. Artillery should be distributed so as to concentrate its fire—when upon the defensive on the enemy's columns of attack, and when on the offensive upon his guns or the objective of our own assault. The artillery is purely a pyro-ballistic arm; cavalry, as such in contradistinction to mounted infantry, is in battle a potential force solely by corporal impact; but the infantry is effective both by "fire" and impulsion.

While the principles of grand tactics are immutable, we find in "orders of battle" an habitual adaptation to the prevailing weapons, with special formations designed to meet peculiar conditions in the localities of conflict or disposition of the enemy's forces. Modern formations must recognize the general supremacy of missile weapons, and yet be susceptible of ready transformation into orders of mobility. With improvement in range, accuracy, and rapidity of fire there has been a corresponding tendency, especially for defensive purposes, to extended orders of battle; but for both cavalry and infantry this extension implies corresponding immobility in the recognized tactical units, and may be carried to consequential impotence. The extended order, if carried, as some theorists advocate, to a general adoption of the loose order or "skirmish line" formation, will, to prevent disintegration, demand a maximum amount of discipline and instruction in the troops, supplemented by exceptional intelligence and entire self reliance on the part of the individual soldier. These conditions are wellnigh irreconcilable. The sort of discipline that enabled Wellington at Almeida to swing his army as on a pivot with perfect order on a plain four miles in breadth and in presence of a hostile army, is obtainable only at the expense of individuality; and the individuality and exceptional intelligence of our Revolutionary sires were of no avail, under ordinary circumstances, against the British regulars. In fact, it was not till the Prussian drillmaster (Steuben) had introduced the drill and discipline of the great Frederick into the American armies that they were capable of any grand tactical movements before an enemy of respectable force.

At the beginning of the present century troops were successfully handled in masses that would now invite certain destruction from a well served artillery; and to-day is advocated a dispersion of troops in such open order as practically constitutes each *man* an autonomic tactical unit; and, singularly enough, this formation is assumed to be particularly suitable for the undisciplined and ignorant novice in the art of war. Between the two extremes is undoubtedly the common sense, and therefore the true tactical, mean.

ROBERT N. SCOTT.

Tactics, Naval. See NAVAL TACTICS, by CAPT. S. B. LUCE.

Tacun'ga, or **Lactacunga**, town of Ecuador, South America, on an elevated plateau, is well built, and has a good college with a well arranged chemical laboratory. Saltpetre and powder are produced. P. about 16,000.

Tacusah, tp., Christian co., Ill. P. 1182.

Tade'ma (LAURENZ ALMA), b. at Dronryp, West Friesland, Holland, Jan. 8, 1836; was educated in the gymnasium of Leeuwarden, where he especially devoted himself to the study of Roman and Egyptian antiquities; entered in 1852 the academy of fine arts at Antwerp; studied painting under Leys, and settled in 1870 in London. The most prominent of his pictures are—*Ancient Egyptian Festival* (1862), *Entrance to a Roman Theatre* (1866), *A Roman Siesta* (1868), *Claudius Imperator* (1870), *The Last Egyptian Plague* (1872).

Tadmor, or **Thadmor.** See PALMYRA.

Tadoli'ni (ADAMO), b. at Bologna in 1789, studied the art of sculpture first in his native city, afterward at Rome under Canova. Prominent among his works are *Venus and Cupid*, *The Abduction of Ganymede*, *A Bacchante*, and a statue of Washington.

Tadousac, p.-v., Saguenay co., Quebec, on the N. shore of the St. Lawrence, just below the mouth of the

river Saguenay, [illegible] miles below Quebec. It is a place of summer resort, has [illegible] sublime scenery, good salmon fishing, and a large lumber trade. Here stands a stone church, the last built in Canada. P. of sub-district, 765.

Tad pole, (1) a name given primarily to the larval or young stage of the frogs (Ranidæ), which is distinguished by the long, broad, compressed tapering tail, and (in the younger stage) want of legs. (2) The name is also applied to the corresponding stage in other amphibians. (3) It is further employed for the larvæ of many ascidians, because of a superficial resemblance to the tadpoles of frogs. (See also BATRACHIA, FROG, TUNICATA.)

Tael, a Chinese measure of weight equivalent to $1\frac{1}{3}$ ounces avoirdupois, employed as the standard of foreign coin, and as applied to silver is equal to 1.386th of a Mexican dollar.

Tænia. See TAPEWORM.

Tænioi'dea [Gr. *ταινιοειδής*, "like a ribbon"], a family of sterelmintoid intestinal worms, of which the type is the TAPEWORM (which see).

Tae-Ping Rebellion. See CHINESE EMPIRE, by C. W. GREENE, M. D.

Ta'fel (JOHANN FRIEDRICH LEONHARD), PH. D., b. at Sulzbach, Würtemberg, Germany, Feb. 6, 1800; graduated at the University of Tübingen 1820; was professor of languages for many years in gymnasia at Stuttgart, Ulm, and Schorndorf; introduced the Hamiltonian interlinear method of teaching languages, publishing textbooks for French, Spanish, Italian, Latin, and Greek; edited Livy (3 vols., Stuttgart, 1823); translated into German Xenophon and Dion Cassius, many novels of Sir Walter Scott, and select works of Cooper, Dickens, and Thackeray; wrote two theological treatises and edited several periodicals. In 1853 he came to the U. S.; was for three years professor in Urbana University, O., and ultimately settled at St. Louis, Mo. With his son, Ludwig H., he published *A New and Complete English German and German-English Pocket Dictionary* (Philadelphia, 1870).—His son, RUDOLPH LEONHARD, PH. D., professor of languages at Washington University, St. Louis, b. at Ulm, Germany, Nov. 24, 1831; came to the U. S. in 1847; was joint author (with his father) of *Latin Pronunciation and the Latin Alphabet* (1860); published *Emanuel Swedenborg as a Philosopher and Man of Science* (Chicago, 1867), and contributed to the American Philosophical Society's *Proceedings* a treatise which was also separately published with the title *Investigation into the Laws of English Pronunciation and Orthography* (1862).

Taffe, tp., Wayne co., Neb. P. 182.

Tafilet', or **Tafilelt,** a division of Morocco, extending S. E. of the Atlas Mountains, comprises several oases—Tassimi, Sahra, etc.—of which that of Tafilet is the largest, situated between lat. 30° 45′ and 31° 10′ N., and between lon. 3° 3′ and 3° 25′ W., and inhabited by about 100,000 Arabs, Berbers, and Jews. It is traversed by two rivers, which are lost to the S. in the sands of the desert, but it is sufficiently watered only during the winter and spring seasons; in summer-time the water is often consumed before reaching Tafilet, and a perfect desert climate, with droughts, sandstorms, etc., sets in. Dates, wheat, and barley are raised, sheep and goats are reared, carpets and woollen stuffs are manufactured, lead and antimony are produced, and a considerable trade is carried on with Morocco and Algeria. The principal town is Abuam.

Taganrog', town of Russia, government of Yekaterinoslav, on the northern shore of the Sea of Azof, opposite the mouth of the Don. It was founded by Peter the Great, and was the favorite residence of Alexander I., who died here; and it has many monuments, edifices, establishments, and institutions which remind one of the two czars. Its harbor is shallow, and ships must load and unload in barges half a mile from the shore, yet it carries on a considerable export-trade in corn, timber, flax, and hemp. P. 25,027.

Taggarts, tp., Wood co., West Va. P. 1050.

Taghkanic, p.-v. and tp., Columbia co., N. Y. P. 1485.

Tagliacozzi (GASPARO). See TALIACOTIUS.

Tagliacoz'zo, town of Italy, province of Aquila degli Abruzzi, on the slope of a hill about 12 miles N. of Avezzano. It was a strong mediæval fortress, generally held by the Colonna family, and it gave its name to the famous battle which took place in its vicinity, and in which Conrad was taken prisoner by Charles of Anjou. P. 7407.

Taglio'ni, the name of a celebrated family of dancers and ballet-masters, of Italian origin, but principally connected with the royal theatre of Berlin. The most illustrious member of this family was MARIA TAGLIONI, b. at Stockholm in 1804. She made her début in Vienna in 1822, danced subsequently in all the capitals of Europe, and created a great enthusiasm, especially by her performance of the title rôle in her father's ballet *La Sylphide*, in which she completely succeeded in producing the impression of being borne along by her wings. She retired in 1847, and lives partly in Venice, partly at Lake Como.—Her brother, PAUL TAGLIONI, b. at Vienna in 1808, ballet-master at the royal theatre of Berlin, composed the ballets *Sardanapal*, *Satanella*, *Flick und Flock*, etc.

Ta'gus, one of the principal rivers of Spain, rises in the Sierra Albarracin, in lat. 40° 38′ N., lon. 1° 35′ W., flows mostly in a western and south-western direction through Spain and Portugal, and falls into the Atlantic at Lisbon, after a course of about 540 miles. It is navigable 115 miles from its mouth.

Tahi'ti, or **Otahei'te,** the principal of the SOCIETY ISLANDS (which see), is in the Pacific Ocean, in lat. 17° 29′ S., lon. 149° 29′ W. It is high, its highest point rising 8500 feet, but traversed by beautiful and fertile valleys, in which all tropical plants grow luxuriantly. It is 120 miles in circumference, and has about 13,800 inhabitants, who have been converted to Christianity, and are described as industrious, peaceable, honest, and cheerful.

Tah'lequah, p.-v., cap. of Cherokee Nation, Ind. Ter., in the valley of Illinois River, a tributary of the Arkansas, distant 15 miles E. from Missouri Kansas and Texas R. R., has 2 schools, a weekly newspaper in Cherokee and English, and a capitol, a brick edifice, built at a cost of $20,000. P. about 3000.

Tail, Estate. See ENTAIL, ESTATE, and FEE.

Taillandier' (RENÉ GASPARD ERNEST), generally known under the name SAINT-RENÉ TAILLANDIER, b. at Paris Dec. 16, 1817; studied philosophy and literature in Paris and Heidelberg; was appointed professor of foreign literatures at Strasbourg in 1841, at Montpellier in 1843, at the Sorbonne in 1863, and became in 1870 secretary in the department of public education. Besides poems, he wrote *Scott Érigène* (1843), *Histoire de la jeune Allemagne* (1849), *Études sur la Révolution en Allemagne* (2 vols., 1853), *Michel Lermontoff* (1856), *Maurice de Saxe* (2 vols., 1865), etc. D. Feb., 1879.

Tail'or, a name applied in the U. S. to different species of fishes. I. At and in the neighborhood of Philadelphia, Baltimore, and Washington, as well as along other parts of the coast, it is given to the *Pomatomus saltatrix* (*Temnodon saltator* of most old authors), known at New York and designated in most angling works as bluefish. (See BLUE-FISH.) II. About Washington and at some other places the name is employed either alone or qualifying herring (tailor herring) for the *Pomolobus mediocris*, a species of the herring family. It is probably applied to the blue-fish on account of its sharp cutting teeth, but its applicability to the clupeid is not apparent. THEODORE GILL.

Tailor-Bird, the English name of the *Orthotomus longicauda*, a representative, according to some, of the family Turdidæ, or, according to others, of the family Luscinidæ. It is a small bird, about five inches long, with a slender subtrihedral and slightly decurved bill, short and rounded wing, and very long cuneiform tail composed of narrow feathers; the color is an olive-green above and white beneath on the body, and bright red on the top of the head. Its name is due to the manner in which it makes its nest, and sews, as it were, the leaves which it uses in the composition of it. Generally, two leaves at the end of a bough are brought in contact, or a dead one with a living one, and sewed together by the bill, vegetable fibres being used as the threads; sometimes a large leaf is rolled together and sewed at its margins. Within the cavity thus formed are deposited soft downy or cottony vegetable substances, and the nest is then completed for the reception of the eggs. From six to eight eggs are laid. The bird is insectivorous, like the other members of the family. It is an inhabitant of India, as well as Ceylon and Burmah. About fourteen species of its genus are known, but it is uncertain to what extent the other species resemble the *O. longicaudus* in habits. THEODORE GILL.

Taine (HIPPOLYTE ADOLPHE), b. at Vouziers, in the Ardennes, France, Apr. 21, 1828; was educated at the Collége Bourbon and the normal school of Paris, and became professor of æsthetics in the school of fine art in 1864. His earliest writings, *Essai sur Tite Live* (1854) and *Les Philosophes français du XIX^e^. Siècle* (1856), attracted much attention by their originality and their polemical tendency. His *Essais de Critique et d'Histoire* (i., 1857; ii., 1865) and *De l'Intelligence* (2 vols., 1869) have a similar character. Free of polemics are his *Philosophie de l'Art en Italie* (1866), *Voyage en Italie* (2 vols., 1868), *L'Idéal dans l'Art* (1867), *Philosophie de l'Art dans le Pays Bas* (1868), *Philosophie de l'Art en Grèce* (1870), etc. His principal works are *Histoire de la Littérature anglaise* (4 vols., 1864) and

Les Origines de la France contemporaine (i., 1875). He has also been a frequent contributor to the *Journal des Débats* and the *Revue des Deux Mondes*. Most of his works have been translated into English.

Tainter, tp., Dunn co., Wis. P. 206.

Tait (Archibald Campbell), D. D., LL.D., b. at Edinburgh, Scotland, Dec. 22, 1811; educated at the high school and academy at Edinburgh, at the University of Glasgow, and at Baliol College, Oxford, where he became public examiner; was one of the leading opponents of the "Tractarians" or "Puseyites;" took orders in the Church of England; was head-master of Rugby School from 1842 to Apr., 1850, when he accepted the deanery of Carlisle; was at the same time a member of the Oxford University commission; succeeded Dr. Blomfield as bishop of London Aug., 1856; originated in 1863 the successful scheme of raising a fund of £1,000,000 for supplying the deficiencies of church accommodation in London, and succeeded Dr. Longley as archbishop of Canterbury 1868. Author of *The Dangers and Safeguards of Modern Theology* (1861) and *The Word of God and the Ground of Faith* (1863), besides addresses, sermons, etc.

Tait (Peter Guthrie), b. in England about 1825; graduated at Cambridge; became fellow of St. Peter's College, professor of mathematics in Queen's College, Belfast, and in 1862 professor of natural philosophy in the University of Edinburgh. Author of *A Treatise on the Dynamics of a Particle* (1856), in conjunction with William J. Steel; of *An Elementary Treatise on Quaternions* (1867), *Thermodynamics* (1868), *An Elementary Treatise on Natural Philosophy* (vol. i., 1867), in conjunction with Sir William Thomson; and of *The Unseen Universe* (1875), in conjunction with Prof. Balfour Stewart.

Tai-Wan′, a large but declining town of China, capital of Formosa, on the south-western coast of that island, in lat. 23° N. Its trade was formerly considerable, but its harbor has now been entirely silted up, and only coasting vessels of very small draught can visit it.

Tai-Yuan′, town of China, province of Shan-Si, on the Fuen-Ho, an affluent of the Hoang-Ho, in lat. 37° 53′ N. It was for a long time the residence of the emperor, and contains many magnificent tombs and mausoleums. Its manufactures of sword-blades and knives are celebrated.

Talave′ra de la Rey′na, an old but well-built town of Spain, province of Toledo, on the Tagus, in an exceedingly fertile plain, covered with vineyards and olive groves, and has some manufactures of silk and earthenware. P. 9285. Here was fought a severe battle on July 28, 1809, between the French and the allied Spaniards and Englishmen, in which the latter were victorious.

Talbert's, tp., Edgefield co., S. C. P. 1117.

Tal′bot, a breed of snow-white hounds now nearly extinct. The Talbot had very long ears, a very broad muzzle, and seems to have been kept for show rather than for use, but was sometimes used in the chase.

Talbot, county of Western Georgia, drained by Flint River and several other streams, and traversed by South-western R. R.; surface hilly, soil fertile. Staples, Indian corn, cotton, hay, and live-stock. Cap. Talbotton. Area, 524 sq. m. P. in 1870, 11,913.

Talbot, county of Eastern Maryland, bounded W. by Chesapeake Bay; surface generally level, soil very fertile; Maryland and Delaware R. R. terminates at the county-seat. Staples, Indian corn, wheat, and wool. Cap. Easton. Area, 250 sq. m. P. in 1870, 16,137.

Talbot (James), LL.D., F. R. S., Baron Talbot de Malahide, b. in Ireland Nov. 22, 1805; educated at Trinity College, Cambridge, where he obtained a scholarship, and graduated with high honors in mathematics and classics; was chosen to Parliament 1832; succeeded to his father's Irish peerage 1850; was made a baron of the United Kingdom 1856; is a distinguished archæologist; has been president of the Geological and Zoological societies of Dublin, of the Royal Irish Academy, and of the Archæological Society of Great Britain and Ireland, in which capacities he has rendered distinguished services to science.

Talbot (Matthew), b. in England about the middle of the eighteenth century; became a wealthy currier at Leeds, and spent his leisure in distributing the verses of the English Bible according to their sense, publishing as a result *An Analysis of the Holy Bible, containing the whole of the Old and New Testaments, collected and arranged systematically in 30 Books, which are subdivided into 285 Chapters and 4144 Sections* (Leeds, 4to, 1800). This work was reproduced in the U. S. by Rev. Nathaniel West, D. D. (New York, 1853), reducing the books to alphabetical order and adding a consulting apparatus of nine tables and indexes; and the latter edition was made the basis of the *New and Complete Analysis of the Holy Bible* (New York, A. J. Johnson, 1869), prepared by Rev. Roswell D. Hitchcock, D. D., which has been accepted as a standard manual for biblical reference.

Talbot (Richard). See Tyrconnel.

Talbot (Silas), b. in Rhode Island about 1750; at the beginning of the war of the Revolution was captain in a Rhode Island regiment, and was present at the siege of Boston; in 1776 accompanied the army to New York, where he conducted operations against the British shipping, for which he received a commission as major and the thanks of Congress; was severely wounded in 1777 at the defence of Fort Mifflin, and in 1778 aided Gen. Sullivan by transporting the American forces from the main land to Rhode Island; he captured the British floating battery, the Pigot, and was appointed captain Sept., 1779; in 1780 was made prisoner and sent to England, but was exchanged in Dec., 1781; was a member of the New York legislature, and in 1793 Representative in Congress; when the navy was reorganized in 1794, he superintended the construction of the frigate Constitution, which was his flagship during a cruise in the West Indies in 1799. His *Life* has been written by H. T. Tuckerman (1850). D. at New York June 30, 1813.

Talbot (William Henry **Fox**), LL.D., b. at Chippenham, Wiltshire, England, Feb. 11, 1800; graduated at Trinity College 1821; sat for Chippenham as a Liberal in the first reformed Parliament 1832–34; pursued for some years from 1833 a series of experiments which resulted in Sept., 1840, in the discovery of the essential principle of the art of photography; received in 1842 a medal from the Royal Society, and has of late years devoted himself to antiquarian pursuits and philological studies, being one of the few scholars who have successfully deciphered the Assyrian cuneiform inscriptions. Many of his versions from the Assyrian are found in the *Transactions* of the Royal Asiatic Society, of the Society of Biblical Archæology, and of the Royal Society of Literature, as also in the series of volumes known as *Records of the Past* (1874 *seq.*). Author of *Hermes, or Classical and Antiquarian Researches* (vol. i. 1828; vol. ii. 1839), *Legendary Tales in Verse and Prose* (1830), *The Antiquity of the Book of Genesis illustrated by some New Arguments* (1839), *The Pencil of Nature, a Collection of Genuine Specimens of the New Art of Photography* (6 parts, 1844–46), etc. D. Sept. 21, 1877.

Tal′botton, p.-v., cap. of Talbot co., Ga., in the W. central part of the State. It has 5 churches, a seminary and high school, 1 newspaper, and a healthful climate. P. 796.

W. E. Munford, Ed. "Standard."

Talbotype. See Talbot, W. H. F., and Photography.

Talc (Ger. *Talk*; from the same root, possibly, as our English word *tallow*, which in German and Swedish is *Talg*; in Dutch *talk*, and in Danish *talg*, and having reference to the greasy, tallow-like *feel* of the mineral), a highly-important mineral species, a silicate of magnesia, usually somewhat hydrated, which sometimes makes up the mass of great geological formations. Talc, when crystallized, is right rhombic. It belongs to the softest of minerals, ranking with graphite in this respect, and is used as the lowest member, No. 1, of the *scale of hardness*, classing minerals according to their hardness. It is not often found well crystallized, but usually in compact or in foliated masses, the foliation arising sometimes from the cleavage of the mineral, which is micaceous in its character. Its most usual color is a light green, due usually to ferrous oxide associated with the magnesian base; but this color and this constituent are not essential, and it is found perfectly white, sometimes with a silvery lustre. The massive varieties are called Soapstone (which see). The average composition of the commoner varieties of talc is stated as $O_{16}Si_5Mg_6.2H_2O$; but there is an anhydrous talc, not separated from this species by Dana and other authorities, and which, according to analyses of Genth, Scott, Lychnell, and Kersten, computes distinctly to the formula $O_{16}Si_6Mg_4$. Dana suggests that *quartz* may have been present, as an impurity, in these; but this would not account for the entire absence of water from many of the analyses; and, moreover, what is entirely conclusive, the *density* would be diminished by quartz, whereas one of Lychnell's anhydrous talcs gave the maximum density of all, 2.795. The other extreme of the range of authoritative densities is a hydrous talc, a *rensselaerite*, from Charleston Lake, Canada, for which Sterry Hunt gives the figure 2.[illegible]44. By investigation of the molecular volumes the writer discovers that one of the anhydrous talcs, that of Scott, from Kittelsthal (D. = 2.691), contains the magnesium—the invariable electro-positive molecule—in its heaviest [illegible] volume; while the heaviest hydrous talc, that of Scheerer, from Piedmont (D. = 2.79), contains the magnesium in the more

condensed [illegible] *kieserite*, and some others [illegible] less condensed, however, than it [illegible] and other heavier magnesian [illegible]. See VOLUMES, MOLECULAR.

HENRY WURTZ.

Tal'ca, [illegible] capital of the province of Talca, on the [illegible] in 1742, and is a well-built and [illegible]. It has several educational institutions [illegible] and a good trade. P. 17,900.

Tal'cott, [illegible], Roanoke tp., Charlotte co., Va., on [illegible] Danville R. R.

Talcott (ANDREW), b. in Connecticut about 1798; graduated at the U. S. Military Academy July 24, 1818, when appointed brevet second lieutenant in the corps of engineers; after a year's service on construction duty, he accompanied Gen. Atkinson, as engineer, on the expedition to locate military posts on the upper Missouri and Yellowstone rivers; returning to duty with his corps in 1821, was then afterward engaged in the construction of the defences of Hampton Roads, Va., Fort Delaware, etc., until 1835; from 1832 to 1836 was also engaged as astronomer for determining the boundary-line between Ohio and Michigan, and was in charge of the improvement of the Hudson River 1834–36; resigned from the army Sept. 21, 1836, to become division engineer on the Erie R. R.; in 1837 returned to duty in a civil capacity under the government as superintendent of the improvement of the delta of the Mississippi River 1837–39; member of commission for exploration and survey of the N. E. boundary of the U. S. 1840–43; of joint army and navy board to visit the Portsmouth and Pensacola navy-yards and prepare plans for drydocks and other important works 1844–45; from 1848 to 1855 was chief engineer of the Richmond and Danville R. R.; of the Ohio and Mississippi R. R. 1856–57, in which year he went to Mexico as chief engineer of the proposed railroad from Vera Cruz, *via* the City of Mexico, to the Pacific Ocean.

Talcott (GEORGE H.), b. in New York in 1811; graduated at the U. S. Military Academy in 1831; ordered to Florida, and engaged against the Seminoles Dec. 31, 1835; was transferred to the ordnance bureau July, 1838; in the war with Mexico served at Cerro Gordo, Contreras, Churubusco, and Molino del Rey, where wounded and disabled; in July, 1848, was reinstated as captain of ordnance; was in command of Augusta arsenal, Ga., 1851–54. D. at Indian Springs, Ga., June 8, 1854.

Talcott (JOHN), b. in England; came to Connecticut when young, about 1636; was ensign in the militia in 1650, and captain in 1661; representative in the legislature 1660; represented the State in the congress of the New England colonies 1669, 1673, and 1676; distinguished himself in the Indian war of 1676, saving the town of Hadley from an attack by 700 savages. D. July 23, 1688.

Tal'ent [Gr. ταλαντοι], an ancient Greek weight containing 60 minæ, about 82 pounds avoirdupois. There was a Babylonian and an Æginetan talent, which were to the Attic as 5 to 3; the Euboic talent was to the Attic nearly as 4 to 3; the Tyrian was equal to the Attic; the Cilician was half the Attic, etc. The above is often called the great or silver talent. There was also a gold or Sicilian talent of about three-fourths of an ounce avoirdupois, called also the little talent. A talent in money was originally a talent's weight of silver or of gold, but the talent finally became a money of account. It was among all the Greeks the monetary unit. Its value varies with the kind of talent used and with the purchasing power of gold and silver. The Attic silver talent was smaller than the commercial talent, 72 pounds of silver, worth some $1056 of our money.

Tal'fourd (Sir THOMAS NOON), D. C. L., b. near Stafford Jan. 26, 17[illegible], was the son of a wealthy brewer; studied at a dissenting grammar school, and afterward under Dr. Valpy; was entered at the Middle Temple; studied law with Chitty, the celebrated pleader, and was called to the bar in 1821; practised on the western circuit, acting at the same time as law reporter for the London *Times*; in 1835–41, and again in 1847–49, was a member of Parliament for Reading, and in 1849 was made a judge of the common pleas. In Parliament he was especially distinguished for his advocacy of the custody-of-infants act and of the English copyright act of 1842. He was among the earliest admirers of Wordsworth, and an intimate friend of Charles Lamb, whose biographer he became, and of nearly all the prominent authors of his day. He published many speeches and essays, some of which have been collected under the title *Critical and Miscellaneous Essays of Thomas Noon Talfourd* (1842). Among his works are—*Poems on Various Subjects* (1811), *An Attempt to estimate the Poetical Talent of the Present Age*, one of the earliest public tributes to the genius of Wordsworth (1815); *History of Greek Literature*, *History of Greece*, and *History of the Roman Republic*, all originally published as articles in the quarto edition of the *Encyclopædia Metropolitana*, and afterward issued as separate volumes in the cabinet edition of that work; several distinct volumes relating to the life and writings of Charles Lamb, subsequently put forth as one work, *Memoirs and Correspondence of Charles Lamb* (1837); *Final Memorials of Charles Lamb* (1848); four tragedies—*Ion* (1835), *The Athenian Captive* (1838), *Glencoe* (1840), and *The Castilian* (1854); *Recollections of a First Visit to the Alps* (1842), *Vacation Rambles* (1844), and *Supplement to Vacation Rambles* (1846). While judicially addressing the grand jury at the Stafford assizes, he was stricken by apoplexy, and d. almost before he could be carried from the court-room, Mar. 13, 1854.

Taliaco'tius (GASPAR), b. about 1546; renowned for his autoplastic method of restoring lost lips, noses, ears, etc., explained in his *De Curtorum Chirurgia per Insitionem Libri II.* (Venice, 1597). D. at Bologna in 1599.

Taliaferro (pron. tol'liver), county of N. E. Georgia, drained by affluents of Little and Ogeechee rivers, and intersected by Georgia R. R.; surface hilly, soil generally fertile; granite, gneiss, sulphuret of iron, and magnetic ore are found. Staples, Indian corn and cattle. Cap. Crawfordsville. Area, 185 sq. m. P. in 1870, 4796.

Taliaferro (BENJAMIN), b. in Virginia about 1751; during the war of the Revolution served with marked distinction in Morgan's rifle corps in the actions at Saratoga and Monmouth, and at the siege of Savannah. In 1780 he acted as volunteer aide to Gen. Lincoln at Charleston, S. C., where he was taken prisoner. He took up his residence in Georgia in 1784; was a Representative in Congress 1799–1802, a delegate to the Georgia constitutional convention of 1798, and subsequently president of the State senate and a judge of the superior court of the State. D. in Wilkes co., Ga., Sept. 3, 1821. A. H. STEPHENS.

Tal'iesin, a Welsh bard, said to have flourished during the twelfth century, and whose name has been handed down, together with that of the two Merlins, as the three principal Christian bards, Taliesin being styled *Pen Beirdd*, "the chief of the bards." Many compositions ascribed to him are preserved in the *Archæology of Wales*.

Tal'ipat Palm, the *Corypha umbraculifera* and *C. Talliera*, noble East Indian trees. The first mentioned affords great leaves, which are used for covering houses, making umbrellas, and for making a substitute for writing-paper extensively used in the East, as well as for many other purposes. The pith affords a kind of sago. The tree grows in Malabar and Ceylon.

Talipes. See CLUB-FOOT.

Tal'isman [Arab., from the Gr. τέλεσμα, "tribute"], a charm more powerful than an amulet. It is a figure cut in stone or metal at the proper astrological conjunction and with appropriate magical ceremonies. It especially averts disease and a violent death from the wearer.

Tallade'ga, county of N. E. Alabama, drained by Coosa and other rivers, and traversed by Selma Rome and Dalton R. R.; surface moderately hilly, soil fertile. Staples, Indian corn, cotton, and wheat. Cap. Talladega. Area, about 700 sq. m. P. in 1870, 18,064.

Talladega, city and tp., cap. of Talladega co., Ala., on Selma Rome and Dalton R. R., 110 miles N. E. of Montgomery, contains 6 churches (2 colored), Talladega College, a fine graded school for freedmen, a synodical institute, 1 bank, 2 newspapers, 1 hotel, and is the fifth city in the State. Pop. 1933; of tp. 2640.

EDWARD BAILEY, ED. "OUR MOUNTAIN HOME."

Talladega, tp., Jefferson co., Ark. P. 526.

Tallahal'a Creek, tp., Jefferson co., Miss. P. 280.

Tallahas'see, city, cap. of Leon co. and of the State of Florida, at the junction of St. Mark's branch with Jacksonville Pensacola and Mobile R. R., beautifully situated on high ground, and regularly laid out with wide, well-shaded streets and squares, has a State capitol building, a court-house, the West Florida Seminary, a State institution, with separate male and female departments, 5 churches, 2 weekly newspapers, several free public schools, the railroad car and machine shops, and a cotton-factory. P. 2023.

Tallahatch'ie, county of N. W. Mississippi, intersected by Tallahatchie River, and partially traversed by Mississippi and Tennessee R.R.; surface level and swampy, soil fertile. Staples, Indian corn, cotton, live-stock, lumber. Cap. Charleston. Area, about 750 sq. m. P. 7852.

Tallahatchie River rises in Tippah co., Miss., and after a devious course of more than 250 miles, in a generally S. S. W. direction, unites with the Yallobusha to form the Yazoo. Throughout more than half its extent it is navigated by steamboats at all stages of water.

Tallapoo'sa, county of E. Alabama, intersected by Tallapoosa River and traversed by Savannah and Memphis R. R.; surface hilly, soil in some parts fertile. Staples, Indian corn, cotton, and live-stock. Cap. Dadeville. Area, about 700 sq. m. P. in 1870, 16,963.

Tallapoosa River rises in Paulding co., Ga., and finally joins the Coosa to form Alabama River. It is 250 miles long, and is navigable by steamboats some 40 miles.

Tallassee, tp., Elmore co., Ala. P. 2048.

Tallegalla. See BRUSH TURKEY and MEGAPODIDÆ.

Talley (ALEXANDER NICHOLAS), M. D., b. in Washington, Ga., Oct. 27, 1827; graduated in the South Carolina Literary College 1848, and received his medical degree at the college in Charleston; subsequently pursued his professional studies in Europe, and on his return settled in Columbia, S. C., where, in conjunction with another physician, he established in 1858 a preparatory medical school; during the civil war he resided in Richmond, president of the army medical board. At its close he was elected professor of practice in the South Carolina State University; in 1870 was president of the State Medical Association. PAUL F. EVE.

Talleyrand'-Périgord', de (CHARLES MAURICE), DUKE, prince of Benevento, b. at Paris Feb. 13, 1754; was compelled by his family to renounce his right of primogeniture on account of his being lame, and was educated for the Church. He studied at St. Sulpice, the Sorbonne, and at Rheims, and attracted much attention by his wit and other brilliant gifts. In 1775 he received the abbey of St. Denis, and was ordained priest in spite of the notorious licentiousness of his life; and in 1780 was chosen agent-général for the clergy. This position brought him into connection with the chiefs of the government, and so great was the admiration which his extraordinary business talent excited that in 1788 the king made him bishop of Autun. Elected a deputy to the States General, he was one of the first of the clergy who joined, and prompted his colleagues to join, the *tiers état*, and in intimate harmony with Mirabeau and Siéyes he took a prominent part in the debates of the Assembly. Oct. 10, 1789, he proposed the confiscation of all Church property, and Feb. 13, 1790, the suppression of all religious orders; July 14, 1790, he officiated at the grand national festival in the Champ de Mars, read the mass with the tricolor over the episcopal robe, and consecrated the new colors of the national guard; Dec. 28, 1790, he took the oath to obey the constitution, and when the pope excommunicated him (May 1, 1791), he resigned his episcopal see. In the Representative Assembly his speeches on the issue of assignats, on the introduction of a uniform system of weights and measures, and on public instruction, etc., evinced an intellect of the highest order, and exercised great influence immediately and afterward. Nevertheless, a rumor came out that he was conspiring with the duke of Orleans, and his friends saved him only by procuring for him a kind of diplomatic mission to London. A letter was found from Laporte, the royal steward, in which he was mentioned as a man "willing to serve the king," and his name was immediately placed on the lists of *émigrés*. He lived for some time in London, afterward in the U. S., but returned to Paris in 1796; was one of the most frequent and most conspicuous visitors of Madame de Staël-Holstein's salon, and became minister of foreign affairs in July, 1797, which office he held to Aug., 1807, with one short interruption. He had a wonderful intuition with respect to Napoleon. He recognized the immense force involved in his character, and gave him his support loyally in his struggle onward to power. He understood his plans, even before they were unfolded to him, and carried them out with eminent success. He negotiated all the various treaties of peace of this epoch—the concordat with the pope, who relieved him from excommunication and secularized him; the confederacy of the Rhine, after which he was made prince of Benevento, etc. But he also understood the faults of Napoleon. He disapproved his English policy, opposed his plans with respect to Spain, and when, after the Peace of Tilsit, an alliance was formed between France and Russia, he resigned his office and retired to his estates at Valençay. Before the Russian disaster he perceived the downfall of Napoleon, and entered into communication with the Bourbons; and during the last three years of Napoleon's career he was one of his most active and most dangerous enemies. He negotiated the first Peace of Paris, and represented France at the Congress of Vienna. Here he succeeded in dissolving the general feeling of concord with which the powers met, and produced a confusion of jealousy, mistrust, rivalry, and hatred which he understood how to use to the advantage of France. After the second restoration, however, he fell into disgrace. The reason is not well understood, but during the reigns of Louis XVIII. and Charles X. he took very little part in public life. In Sept., 1830, Louis Philippe sent him as ambassador to London, and he completely succeeded in establishing a cordial and intimate relation between the courts of St. James and the Tuileries, and concluded the quadruple alliance between England, France, Spain, and Portugal Apr. 22, 1834. Shortly after, he returned to France. D. at Paris May 17, 1838. His *Mémoires* were intended by him to be published thirty years after his death, but in 1868 the publication was postponed for twenty-two years on the proposition of Napoleon III. His political principle was the constitutional monarchy, and he seems to have worked consistently and loyally for it. But the means he employed were intrigue and deception. He had a marvellously sharp eye for the weak point in a man's character, and he imposed on all with unfailing success because he never let anybody into his secrets, never allowed an angry word or a vain mien to hint that he knew anything which was not known to the whole world. Of this peculiarity, which originated simply as an elegance of manners, but which in the course of time became part and parcel of his mental organization, like the lameness of his bodily constitution, he himself has given a characteristic expression by saying, and often repeating, that "men speak only in order to conceal their thoughts."

CLEMENS PETERSEN.

Tallien' (JEAN LAMBERT), b. at Paris in 17[illegible]; became noted in 1792 as the editor of a Jacobin journal, *L'Ami du Citoyen*; received some appointment in the municipal government of Paris; was elected a member of the Convention by the department of Seine-et-Oise; sided with Marat; advocated the condemnation and immediate execution of Louis XVI., and attacked the Girondists with senseless fury. In 1793 he was sent to Bordeaux to exterminate the moderate party, but here he became acquainted with Madame de Fontenay, one of the most beautiful women of that time, witty, kind-hearted, generous, and frivolous, and this acquaintance suddenly changed him from an extreme radical to a decided moderate. He was immediately recalled, his name was erased from the lists of the Jacobin Club, Madame de Fontenay was thrown into prison, and he himself seemed utterly lost. But in this emergency he rallied the partisans of Danton and Hebert, and by his energy and coolness at the decisive moment the overthrow of Robespierre and the Terrorists was accomplished July 27, 1794. He now became one of the most conspicuous figures in the republic, and married Madame de Fontenay. Treated as a traitor by the republicans, and, after the fusillading of the royalists at Quiberon, also considered a traitor by the monarchists, he was driven out of the Council of Five Hundred under the Directory, and very glad to accompany Bonaparte on his campaign to Egypt as savant. Gen. Ménou, however, sent him back to France in 1800. He was captured by some English cruisers and brought to London, and here he enjoyed the last triumph of his life, being feasted and flattered by the Whig party as a hero. On his return to Paris he was divorced from his wife (who formerly had been divorced from M. de Fontenay, and afterward married the prince of Chimay) and received a pension from the First Consul. D. at Paris Nov. 16, 1820.

Tal'lis (THOMAS), b. about 1520; was perhaps organist to Henry VIII., and certainly gentleman of the chapel to Edward VI., Mary, and Elizabeth, and organist to the last; and has been styled "the father of English cathedral music." In conjunction with his pupil, William Byrd, he put forth *Cantiones Sacræ*, etc. (1575), which are masterpieces, and were protected for twenty-one years by Elizabeth, this being the first patent of the kind granted by her. There are also extant his *Order of Daily Service* (ed. by Bishop, 1843, and by Rimbault, 1847), *Full Cathedral Service* (ed. by Rimbault, 1847), and *Order for Morning Prayer, etc.* [illegible] newed. 1844. It is said that a portion of his Service he was indebted to Peter Mudeck, organist of Windsor. D. Nov. 23, 1585.

Tall'madge, p.-v. and tp., Ottawa co., Mich., on Grand River. P. 1[illegible].

Tallmadge, p.-v. and tp., Summit co., O., on Atlantic and Great Western R. R. P. 1277.

Tallmadge (BENJAMIN), b. at Setauket, L. I., [illegible] 17[illegible]; graduated at Yale College 1773; [illegible] at Wethersfield, Conn.; entered the [illegible] outbreak of the war of the Revolution [illegible] tenant June, 1776; soon after [illegible] mately colonel, of a Connecticut [illegible] performed a brilliant exploit in crossing the Sound [illegible] turing 300 Tories at L[illegible] Neck, L. I., Sept. [illegible] without the loss of a man [illegible] executed the capture of [illegible] destruction of British [illegible] on Long Island May, 17[illegible]

was engaged in several prominent battles; was a member of the military family of Gen. Washington, whose entire confidence he enjoyed; was entrusted with the custody of Maj. André, and superintended his execution; became after the war a successful merchant, and was a member of Congress 1801–17, and was one of the last survivors of the Revolutionary war who had attained any celebrity, and during his closing years enjoyed a wide and deserved veneration. D. at Litchfield Mar. 7, 1835. His *Memoirs* were published in 1859 by his son, Frederick A. Tallmadge.

Tallmadge (FREDERICK AUGUSTUS), son of Col. Benjamin, b. at Litchfield, Conn., Aug. 29, 1792; graduated at Yale College 1811; studied law under Judge Tapping Reeve at Litchfield, where he was admitted to the bar; commenced practice in New York City 1814; soon became one of the most successful advocates, and filled many public posts, including those of member and president of the State senate, judge of the supreme court of errors, recorder of New York, member of Congress 1846–48, superintendent of the metropolitan police 1857, and clerk of the court of appeals 1862–65. He became best known for the energy he displayed while recorder in suppressing the "Astor-Place riot" of May, 1849. D. at New York Sept. 17, 1869.

Tallmadge (JAMES), LL.D., b. at Stamford, N. Y., Jan. 28, 1778, son of Col. James (1744–1821), an officer of the Revolution; graduated at Brown University 1798; studied law, which he practised several years, but gave his chief attention to agriculture; was for some time private secretary to Gov. George Clinton; held a military command in New York City during the war of 1812–15; was member of Congress 1817–19; introduced an amendment to the bill admitting Missouri excluding slavery from the region W. of the Mississippi; took a prominent part in the New York constitutional conventions of 1821 and 1846; sat in the assembly 1824; was lieutenant-governor 1826–27; visited Europe 1835; was instrumental in introducing into Russia several American mechanical inventions, especially cotton-machinery; was one of the founders of the University of New York; was for nineteen years president of the American Institute, and was a leading exponent of the Whig doctrine of protection to American industry. D. in New York City Sept. 29, 1853. He published a number of speeches and addresses.

Tallmadge (NATHANIEL P.), b. at Chatham, N. Y., Feb. 8, 1795; graduated at Union College 1815; studied law; was admitted to the bar 1818; chosen to the New York assembly 1828; State senator 1830–33, U. S. Senator 1833–44, and governor of Wisconsin Territory 1844–55. D. at Battle Creek, Mich., where he had resided for some years, Nov. 2, 1864. He published some political speeches and miscellaneous writings.

Tal'low. This term includes the hard fat of animals, more properly called *suet*, and also those fats of a less degree of hardness; *e. g.* lard and grease, as distinguished from oils. The fats obtained from the "rendering" of animal fats of all kinds are technically known as "tallow," and are chiefly used by the tallow-chandler for the production of soap and candles. The animal fats are hard in proportion as they contain more stearine and palmitine and less of oleine. The quality of animal fats is much influenced by the mode of feeding and the quality of the food. The quality of tallow is also very dependent on its being "rendered" at a low temperature by steam, and the cleanliness of the operation, the character of the animals treated, etc.

Vegetable tallow is found in the seed of many plants, as its name implies. Chinese vegetable tallow is from the husk about the berries of *Stillingia sebifera*; the berries contain a liquid fat. The solid commercial product is white, sp. gr. 0.818, and melts at 99° F.; it is rich in palmitine. *Bayberry tallow*, from *Myrica cerifera*, also called "myrtle wax," is a pale green, brittle, solid fat from the berries of the plant. It moulds in the fingers like wax when warm. It contains myristic acid in a free state, and also combined with glycerine, and a large quantity of palmitic acid, but no [illegible] of volatile acids (*Moore*). Other hard vegetable fats are found in nutmeg, palm oil, Japan wax, cacoa butter, cocculus grains, and various species of *Bassia*, for a description of which see Gmelin, *Handbook*, xvi. 385–400. (See also FATS, SUET, STEARINE, and under OILS.) B. SILLIMAN.

Tallow, Mineral. See MINERAL TALLOW.

Tal'low-Tree (1) of the Southern U. S. and of China, see STILLINGIA; (2) the *Pentadesma butyracea* of West Africa, a guttiferous tree whose fruit yields a kind of yellowish tallow; (3) a name of the piny dammar tree of India, *Vateria indica*, a huge dipterocarpaceous tree, whose seeds on boiling yield an excellent white tallow.

Tallula, p.-v. and tp., Menard co., Ill. P. 339.

Tallulah, p.-v. and tp., Issaquena co., on the Mississippi River, Miss.

Tal'ly, a stick on which are notches and other marks indicative of an account, pledge, or other commercial transaction. In the British exchequer tallies consisting of bits of peeled wooden rods were used until 1783. The tally was split in such a way as to divide certain of the notches cut on it. One half the tally was given to the payer and one half retained by the exchequer; and the transaction might be verified at any time by fitting the two halves together, when the notches would be found to *tally* with each other if the check had not been tampered with. This rude and antiquated system, we are told, served its purpose admirably.

Tally Ho, p.-v. and tp., Granville co., N. C. P. 2138.

Talma' (FRANÇOIS JOSEPH), b. at Paris Jan. 15, 1763, the son of a dentist; was educated partly in London, partly in Paris in his father's profession, but was irresistibly drawn to the stage, and made his début in 1787 at the Comédie Française as Séide in Voltaire's *Mahomet*. His début was successful, but he produced the first great impression by his performance of the title-rôle in Marie-Joseph Chenier's tragedy, *Charles IX.*, Nov. 4, 1789, from which date he rapidly rose in the estimation of the public until in the first decade of the nineteenth century he stood acknowledged by the whole world as the greatest tragedian of his time. He was a favorite with Napoleon, who liked to converse with him, and whom he accompanied to Erfurt in 1808, where he played for a parterre of kings, and to Dresden in 1813. The Bourbons also showed him great favor, and in his art he continued unrivalled and improving till his death, Oct. 19, 1826, some of his last rôles, Sylla, Oreste, etc., being also his grandest creations. As in all manifestations of art which strike people as new and great, the novelty and greatness of his acting depended on a deeper conception of human nature and a closer, more energetic, and more veracious expression of the conception; and in one point at least his influence became decisive. Before his time the tragic heroes, Brutus, Cæsar, Catiline, Nero, etc., always appeared on the stage in a sort of fancy costume, not very different from the costume of the age, and with high powdered peruke on the head. Talma was the first to throw away the peruke and put on a correct costume. He wrote *Réflexions sur Lekain et sur l'Art théâtral* (1815), and left an *Autobiography*, which was edited by Alexander Dumas in 4 vols. (1849–50).

Talmadge Plantation, tp., Washington co., Me. P. 80.

Tal'mage (Rev. THOMAS DE WITT), D. D., b. in Boundbrook, Somerset co., N. J., Jan. 7, 1832. He entered New York University in 1849, graduating in 1853, and graduated from New Brunswick Theological Seminary in 1856, and the same year was called to the Reformed church, Belleville, N. J. In 1859 he became pastor of the Reformed church in Syracuse, N. Y. In 1862 he was called to the Second Reformed church of Philadelphia. In 1869 he accepted the call of the Central Presbyterian church of Brooklyn. In 1870 a new church was built of wood and iron, semicircular in form, holding over 3000 people. This was known as "the Brooklyn Tabernacle." In 1871 this building was enlarged, but was destroyed by fire Dec. 22, 1872. On Feb. 22, 1874, a massive structure of brick and stone was dedicated, and, an appeal being made, $40,000 was raised by the audience, which cancelled its debt. The new tabernacle is Gothic in style, retains the semicircular form, and has sittings for 4600. It is the largest Protestant church-building in America. In 1872, Mr. Talmage organized in the old church-building a Tabernacle Lay College for training young men who desire to enter the ministry, but cannot afford the time and expense of a regular collegiate course. The college is open to all of evangelical belief. Instruction is given by a corps of professors in general literature, sacred history, natural and systematic theology, sacred rhetoric, and the evidences of Christianity. Since Sept., 1873, he has edited an undenominational religious journal, *The Christian at Work*. He has also published 5 volumes of sermons, besides *The Almond Tree*, *Crumbs Swept Up*, *Abominations of Modern Society*, *Around the Tea-Table*, *Old Wells Dug Out*, *Sports that Kill*, and *Every-Day Religion*. M. H. BRIGHT.

Tal'mud, a work whose authority was long esteemed second only to that of the Bible, and according to whose precepts the whole Jewish people, with the single exception of the Karaites, have continued to order their religious life down almost to the present day. In reality, it is composed of two distinct works, which were compiled at different epochs—namely, the Mishna and the Gemara. The word *Talmud* is of Hebrew origin (derived from *lamad*, to "learn"),

and had at first the same signification as *Mishna*—*i. e.* "doctrine"—but in the course of time the word, as technically applied, underwent various important modifications of meaning. In the oldest terminology of the schools Talmud came to mean "a deducing one thing from another," and designated more especially the process of seeking in the sacred writings support for laws not expressly provided therein. On this account, the Mishna, which embodied these deductions, and contained in many instances not only the new enactments, but also the scriptural authority from which they were derived, was also known as Talmud. (See Aruch, *s. v. Talmud.*) Later on, when learned disputations upon and discussions of the Mishna became more frequent in the Jewish academies, the name Talmud, as applied to the Mishna, disappeared altogether, and was then employed in a new sense, to denote these more recent discussions in contradistinction to the Mishna proper. They were also called Gemara (the Chaldaic equivalent of Talmud). It was only at a very late epoch, when for the sake of convenience the Mishna and the Gemara were no longer transcribed separately, when the Mishna was divided into short paragraphs, and to each of these paragraphs the portions of the Gemara proper to it were immediately subjoined,—it was then only that it became customary to apply the name Talmud to the whole great work consisting of both Mishna and Gemara.

A. *Mishna.*—The name Mishna does not signify, as has been erroneously held by some, the second—*i. e.* the oral—law as distinguished from the written law of the Pentateuch. Greek writers have indeed rendered it δευτέρωσις, but this is due to a misapprehension of its proper meaning. It signifies simply "doctrine." It was used to designate, first, each individual ordinance; secondly, a group of interconnected ordinances; lastly, the entire system of ordinances; and thus it came to be used for the whole great compilation now known as the Mishna. In the Talmud of Palestine, however, each individual Mishna is called Halacha.

(*a*) *The Structure and Arrangement of the Mishna.*—It consists of six divisions (*Sedarim*, literally, "orders"): (1) *Seraim*, seeds and products of the field; (2) *Moed*, festival celebrations; (3) *Nashim*, laws relating to women; (4) *Nesikin*, legal provisions; (5) *Kodoshim*, sacred things; (6) *Toharoth*, the distinctions of clean and unclean. Each division is subdivided into *Mesachtoth* ("tracts"), of which the first division has 11; the second, 12; the third, 7; the fourth, 10; the fifth, 11; the sixth, 12—being altogether 63 tracts. (Maimonides and others count three tracts of the fourth division as one; and this explains why the whole number of tracts is occasionally given as 61.) Each tract is again subdivided into *Perakim* ("chapters"), of which the total number is 523, and each chapter into paragraphs. The order of sequence of the Sedarim, as well as that of the tracts which belong to each, is fixed and undisputed. (There is no conclusive evidence to support the assertion of Brück (*Pharisäische Volkssitten*, p. 10) that the original subdivision of the Sedarim differed from our own.) Concerning the sequence of tracts and chapters, however, and the proper subdivision of the latter into paragraphs, the same unanimity does not exist. In this respect some difference appears between the two versions of the Mishna (that of Palestine and that of Babylon), as well as among the early commentators, and also in the various editions of the Talmud.

A strictly methodical arrangement and disposition of the subject-matter of the Mishna is not apparent. Matters are occasionally brought up for discussion in tracts to which they do not belong, and are omitted elsewhere where we have a right to expect them. The same thing is repeated twice and even three times in different places, and discussions relating to the most diverse subjects are connected into a single series with sole regard to a general resemblance in the didactic forms of presenting the subject. On the whole, however, the plan of the work is clear and lucid, and, considering the vast material which it was intended to embrace, amply deserves our admiration.

(*b*) *The Origin, Enlargement, and Close of the Mishna.* During the whole epoch of the first Temple the Mosaic religion was almost entirely neglected. After the return of the Jews from captivity in Babylon, Esra the Sofer ("scribe") was actually the first to recall it to life. But he was compelled by the altered circumstances of the time to enlarge, complete, and in many respects remodel it. A system of theocracy like that laid down in the Pentateuch, intended to embrace the entire public and private life of man, could not but require important modifications when nearly all the relations of life had undergone change. Not only the forms of temple-worship, the many dietary laws, and laws of Levitical purity, but even the agricultural regulations and the whole judiciary code, had to be included in the work of reconstruction. A thousand problems urgently demanded solution: and Esra solved them. His word became law. His successors, called after him Soferim ("scribes"), otherwise known as the "Men of the Great Assembly," continued his work in the spirit of the master. That which they taught and ordained received the sanction of popular practice, and came to be looked upon as the rule of life. When they retired from the scene, the Sanhedrin of Jerusalem took their place, became the chief tribunal, and decided whatever doubts and difficulties arose. From its decisions there was and could be no appeal. Thus, in the course of several centuries a vast stock of laws and usages had accumulated, which the Tora did not directly authorize, but which had been transmitted orally from generation to generation, till at last the accumulated mass became too unwieldy for the unassisted memory. Academies arose for the cultivation and propagation of this stock of tradition, and simultaneously efforts began to be made to found the traditional enactments upon a biblical basis and support. This tendency received an additional impetus by the fact that the germs of Sadducean opinions began to manifest themselves, and men arose who unhesitatingly declared everything not founded on the words of the Law a dangerous and blameworthy innovation. The discussions in the academies became more frequent, opinions conflicted, and finally the mass of traditions, together with the discussions to which they gave rise, threatened to become a labyrinthine chaos. Then arose Hillel the Elder, also called the Babylonian, because descended from a noble Jewish family in Babylon. After he had been installed (B. C. 32) as patriarch in Palestine, and at the same time became the head of a numerous and learned school, he arranged the mass of traditional laws in six Mishnic divisions; and this general arrangement was accepted by all his successors. He was also the first to lay down hermeneutic rules, seven in number, for expounding the written law and widening its scope. But, while Hillel introduced a new method of interpreting Scripture for the sake of extending its provisions, he did not himself pursue his method to the utmost limits. In like manner, in the arrangement of the traditional laws in six main groups he confined himself to the proposal of the general plan—a plan to which he no doubt adhered in his own teaching, leaving, however, to later authorities the task of further applying and perfecting it. It was long, indeed, before such authorities arose to continue his work. For almost a century and a half history is silent about any efforts in this direction. R. Elieser b. Jacob, head of a school which flourished shortly after the destruction of the Temple, is, it is true, mentioned with commendation because his Mishna was *kab venaki* (brief and concise), but it is doubtful whether the words "his Mishna," as here used, refer to a collection of Mishnas, or merely to his mode of instruction. At all events, even if the former is meant, we are only justified in concluding that R. Elieser was the author of a kind of epitome, not that he elaborated a complete work. It was R. Akiba, the celebrated martyr to his religion and patriotism, who first took up the task which Hillel had begun. He was the greatest of the Talmudists of his own and of succeeding times—the man of whom, as the legend says, even Moses was for a moment jealous when in a vision he surveyed the generations of the distant future. His keen and penetrating intellect enriched the substance of tradition with many valuable deductions of his own. But besides this, being impressed with the importance of systematic arrangement, he also instituted a more correct division and a more skilful disposition of the material which had thus far accumulated; and in this way laid the foundation of the Mishna as it now exists. Among all his distinguished disciples, R. Meir holds the highest rank. His real name was *Nehorai*, "the enlightened one," but his contemporaries preferred to call him *Meir* ("the enlightening one.") He continued to build up the work of the Mishna in the spirit of his master; and [illegible] the most ancient of the Gemarists agree in ascribing the majority of the anonymous canons contained in the Mishna. Yet with all these endeavors the great work still remained a mere fragment.

Then arose R. Jehuda, also called simply "Rabbi." Since the year 120 A. D. he had been clothed with the patriarchal dignity; he was a descendant of Hillel in the seventh generation, and a man of uncommon ability and lofty virtue. He made it the business of his life to establish a code of undisputed authority among his people

* Long after the close of the Talmud a number of tracts, composed in the form of the Mishna and treating of different questions of the Law, made their appearance which are appended to our editions of the Talmud under the general title of "Minor Tracts." Besides these, seven lesser tracts were edited in 1851 in Frankfort-on-the-Main, by R. Kirchheim, from an ancient manuscript; and others of the same kind are said to exist in Northern Africa (see Jost, *Geschichte des Judenthums*, ii, p. 288). They are all of Palestinian origin, of obscure authorship, and have never been regarded as authorities.

in order to ensure unity of religious observance. With this end in view, he undertook to bring to a close the work which his predecessors had begun, and even considerably advanced, but which still remained unfinished, and therefore failed to command general recognition. Although strictly adhering to the traditional arrangement, he examined anew the whole vast accumulation of ordinances which centuries had contributed to heap up, and sifted and arranged them. He abridged in one place and amplified in another; now he gives merely the canon, without mentioning the name of its author, and again he quotes his name and title in full; contenting himself sometimes with stating only the conclusion arrived at, repeating at other times the whole argument; and in still other instances adding his own decision to the record of conflicting opinions. In short, his indomitable energy and rare independence of spirit enabled him to master the whole difficult subject. He was the last, the most devoted, the true author of the Mishnic compilation. It is deserving of remark that Rabbi preserved the teachings of the Fathers not only in their general purport, but that he incorporated them into his work, so far as they met with his approval, in exactly the form in which he had received them. In this way the diversity of style and mode of expression which the Mishna exhibits in different places is explained, and the critic is thus enabled frequently to distinguish its component parts, separating the older from the more recent. Thus, the greater antiquity of the opening passages of the tracts is attested beyond a doubt by their terseness and the peculiar grammatical forms and constructions employed. The like certainty is, of course, no longer attainable throughout. The compilation of the Mishna was finished by Rabbi. Here and there a few additions were made by later teachers, of which the greater part fall under the head of Hagada. They are chiefly to be found at the end of the tracts. Whether the division of the Sedarim into tracts was the work of Rabbi or of his predecessors whom we have mentioned above, it is impossible to decide. Certain it is, that the tracts, as such, were known to the doctors of the Gemara, since the Gemara occasionally cites them by name and argues the question of their proper order of sequence. As regards the division of the tracts into Perakim, Frankel has conclusively shown (*Darke ha-Mishna*, p. 264) that the Babylonian Gemara was already familiar with it. The arrangement of the chapters, however, in their present order was (according to Seder Tanaim We Amoraim: see *Kerem Chemed*, iv, 189) the work of the Saburæans. The precise year in which Rabbi applied the finishing-touch to his work cannot be ascertained. Certain it is, that late in life he undertook a complete revision, and prepared, as it were, a second edition of the Mishna, in which (according to Tr. Shebuoth, p. 4) he not only inserted many new canons, but even such as directly contradicted decisions in the previous edition, without cancelling the former. Whether this was done with a distinct purpose in view, or from mere inadvertence, we cannot tell. Thus, the origin of various discrepant statements in the Mishna becomes clear. The period of time which includes the men who are mentioned as authors of canons in the Mishna extends over five and a half centuries—namely, from the last of the scribes to the death of Rabbi; and the number of those thus distinguished by name, taking no account of such general quotations as "the scholars say," "the school of Shamai," "the school of Hillel," "the ancient doctors," and the like, amounts to more than 100. In the post-Mishnic epoch the name Tanaim (teachers) was applied to those who had advanced opinions of their own in the disputations of the academies. The line of Tanaim commences with the foundation of the academies—*i.e.* with Shamai and Hillel; it extends through six generations, over a period of 210 years.

(c) *Language of the Mishna.*—The language of the Mishna, though essentially Hebrew, differs from the more ancient Hebrew of the Bible in important particulars. This difference is due partly to the natural development which the language had undergone, and partly to its fusion with the Aramaic dialects, especially with the Syriac and Samaritan. The advanced stage of the Hebrew of the Mishna appears first in the fact that new and modified meanings have, in numerous instances, sprung up by the side of the old; secondly, in the invention of new terms to express more modern and more comprehensive notions; lastly, in the formal changes which biblical words had undergone in order to adapt them to the expression of new modes of thought. These changes consist mainly in the formation of new derivatives from biblical primitives, and, conversely, in the employment of ancient derivatives to serve in turn as primitives. At the same time, it would be wrong to refer words and word-meanings to the invention of the Mishnic epoch simply because, at first sight, they appear to be wanting in the vocabulary of Scripture. Many of them are no doubt relics of the time when Hebrew was the vernacular, such as still lingered in the memory of the people. On this account the language of the Mishna may frequently be applied with advantage to the explanation of difficult passages of Scripture, as the example of the oldest commentators and many of the best Jewish grammarians and exegetists of later times amply proves. As to the influence of the Aramaic of which we have spoken above, suffice it to say that not only were Aramaic words received bodily into the language of the Mishna, but in its grammatical forms and syntactical constructions the latter bears also the deep impress of its sister dialect.

Besides this, the direct intercourse of Palestine with lands of Grecian culture favored the introduction of many Greek terms, and also, indirectly, of some Latin ones. These were used especially to designate objects and ideas till then unknown, and being familiarly employed in the language of the common people, they were admitted into the Mishna as well. Most of them, however, passed through Syrian channels on their way to Palestine, and they appear more or less modified in form to suit the exigencies of the Syriac. This explains why in the case of some such words the corresponding Greek word and its meaning are evident at the first glance, while others, though their Greek origin is equally evident, are quite uncertain in meaning, and admit of widely divergent explanations.

(*d*) *The Composition of the Mishna.*—That the Mishna was not cast in a single mould must be plain to every one who is acquainted with its contents, form, and language. It is a composite work. It consists of ancient and more recent elements: it embraces fragmentary compendiums in which the premature attempts of a previous age at codification are apparent. The manifest and manifold incongruities which the work exhibits in every direction are capable of explanation on no other hypothesis. We have already observed above how in many places the Mishna simply lays down the Law, omitting to mention the conflict of opinions that existed in regard to it, and which is sometimes reported in other parts of the work, while elsewhere even the slightest diversity of opinion is carefully noted. Often a mere summary of the ordinances and disputations is deemed sufficient: then again, the whole argument in all its details is repeated. Could we for a moment attribute inconsistencies such as these to so thoughtful and circumspect an author as the editor of the Mishna, supposing him to have been fettered by no other consideration than that of compact and logical arrangement? But there are other and more remarkable anomalies to be noticed. Let us briefly indicate a few of the most important. *Repetition.* (1) Certain ordinances are twice and three times repeated in various connections, and form parts of various distinct series. The principle of unity which governs such a series may be that of common authorship, whether of an individual teacher or a school; it may be the uniform employment of some particular method of deduction: it may be nothing better than mere outward agreement in the form of expression. (2) Occasion offering, the whole of a series is repeated, or a part only. (3) Either all or some few of the ordinances thus repeated are abridged or developed and enlarged, while again, at other times, the repetition takes place without any modification at all. (4) One and the same ordinance is sometimes supported by totally different arguments in the different places in which it occurs. (5) Certain ordinances are omitted in those tracts to which they properly belong, and are introduced in others where their connection is purely formal. All this points with unmistakable certainty to the conclusion that a considerable number of minor compilations already existed in the days of the compiler of the Mishna—that he adopted them as he found them into his larger work, and arranged and inserted them in such order as seemed to him most fitting.

(e) *Reduction of the Mishna to Writing.*—It was an undisputed principle with the men of the Talmud that the traditional law, elaborated in their academies, ought not to be committed to writing. There was to be one holy "Scripture" only. It is a fact that, nevertheless, the Mishna and the Gemara were actually written down. Later writers seek to reconcile the two facts by explaining that upon the authority of a certain passage in the Bible it was deemed better to transgress a single precept than to suffer the whole body of traditional precepts and laws to fall into neglect and be forgotten. Concerning the exact time at which the Mishna was written down, diversity of

* The assertion of Zuckermandel (Grätz, *Monatsschrift*, 1874, and *Die Erfurter Handschrift der Tosefta*, [illegible] 187[illegible]) that the Mishna is not the work of R. Jehuda, but was compiled in Babylon, made as it is in bold opposition to the overwhelming testimony of both Gemaras, and founded as it is simply on the wildest hypotheses, need only be stated to be at once rejected by common sense.

opinion has prevailed among the most eminent Jewish scholars during the last nine centuries. Rabbi arranged the Mishna in his own mind without the help of pen, delivered it, the same in form and contents as it stands to-day, in his academy, and thus transmitted it by word of mouth to his disciples. They again delivered it to succeeding generations, and it was thus preserved with verbal accuracy down to the time (exactly when no one can say) when the academies sank in importance, and the authorities of the day (who these were is again uncertain) found it necessary to fix the existing stock of traditions in writing. Such is the opinion of the "spirits that deny," at their head Sherira the Gaon (tenth century), in his celebrated *Iggereth* ("Epistle"). He was followed by Sal. Jizchaki, called Rashi (eleventh century), in his commentary on Baba Mezia, 33 *a*, and on Erubin, 62 *b*; by Moses Coucy (thirteenth century) in the preface to his *Book of Commandments*; by Tosaphoth on Megilla, 32 *a*; by Jac. Chagis (seventeenth century) in the preface to his commentary to the Mishna; in modern times by S. D. Luzzato in the preface to *Oheb Ger* and in *Kerem Chemed*, iii. p. 62; by Rapoport, *ibid.*, p. 48, and vii. p. 157; by Reggio, *ibid.*, p. 80; by Hirsch Chajuth in *Mebo Ha Talmud*, p. 27 *a*, and in *Torath Nebiim*, p. 7; lastly, by Jost, *Gesch. d. Judenth.*, ii. p. 121; Grätz, *Gesch. der Juden.*, iv. p. 241, and in Frankel's *Monatschr.* for 1862, p. 272, and 1873, p. 35. Opposed to these we find a series of scholars, no less eminent, who affirm—some of them also adducing proof—that Rabbi himself wrote out the Mishna in full. They are the following: Samuel the Nagid (eleventh century) in the introduction to his *Mebo Ha-Talmud*; Mose ben Maimon, called Maimonides, in the preface to his commentary on the Mishna, in the preface to his *Mishneh Torah*, in his notes to *Mishna Sanhedrin*, 5, 2, and in the *Iggereth*, p. 53 *a*; Bechaij ben Asher (thirteenth century) in his commentary on the Pentateuch, *Ki Thissa*, p. 122; David ebn Simra (sixteenth century) in the *Responses*, iii. 232; Lippman Heller (seventeenth century), notes to *Mishna Yebamoth*, 3, 6; finally, in our own day, Geiger in *Wissensch. Zeitschr.*, iv. 412, and Frankel, *Darke Ha-Mishna*, 217. A unique and peculiar view, forming a compromise, as it were, between the opposing parties, is that maintained by Gedalja ibn Jachija in his *Shalsheleth*, p. 23 *b*. He holds that Rabbi did, indeed, commit his work to writing, but not as a well arranged whole, but in scattered sheets which were afterward united. In our opinion, the arguments which Geiger and Frankel have adduced in support of their opinion ought to convince every impartial judge. Those who are still inclined to reserve their judgment in the matter may find additional proof in the foregoing paragraph on the composition of the Mishna.

(*f*) *Authenticity of the Mishna.*—The text of the Hebrew Bible was guarded with jealous care by the Masorah: its letters were counted, and every trifling detail rigorously investigated and determined. Yet it did not escape important modifications in the course of time, as the numberless diverse readings of the manuscripts attest. Such alterations may be looked for in still greater profusion in a work like the Mishna, which never enjoyed the same advantages, and which passed through the hands of so many copyists and compositors. The Mishna is to-day before us in three recensions—one embodied in the Babylonian Talmud, another in the Talmud of Palestine, the third being the complete collection of the Mishna, published separately, without the commentaries of the Gemara. All three differ, not only in points of style and verbal expression, but often even in the subject-matter. As appears from the writings of the older commentators, the text of the Mishna which was before them differs in many places from that of any of the three recensions mentioned above. Negligence and misapprehension proved fruitful sources of confusion. Especially was this the case with respect to the names of the doctors. As it was for the most part customary to designate these names by abbreviations, as many of the names, moreover, were closely akin in sound, the chances of error were multiplied, and the true authorship of various ordinances rendered uncertain—a circumstance which has contributed not a little to impede the progress of investigation. However, we ought not to charge the inroads upon the work of Rabbi solely to the transcriber and the printer. Frankel has shown (*Mebo*, p. 20) that even during the lifetime of Rabbi, and soon after his death, the great authorities in Palestine did not scruple to subject his work to revision, making such additions and alterations that in the very next generation no less than three different redactions of the Mishna existed in Palestine. Under these circumstances it does not appear strange that criticism of the text of the Mishna should have begun at a time when textual criticism in any other field was utterly unknown. It plays an important part in both the Gemara of Babylon and of Palestine, but with a remarkable difference. The doctors of Babylon were acquainted with the Mishnic text in one shape only—that, namely, which R. Abba, commonly called Rab, had brought to Babylon about 219 A. D. They were thus led to indulge in the most far-fetched combinations, to adopt the most impossible conjectures, whenever some difficult or corrupt passage came up for explanation; and even where these means did not avail, and a correction of the text seemed absolutely necessary, they nevertheless contented themselves with merely suggesting the correction, without daring to alter the inviolable text itself. The doctors of Palestine, on the other hand, being familiar with several redactions of the Mishna, were accustomed to employ greater freedom in dealing with a text thus uncertain, and but too often solved a knotty point by the arbitrary method of changing the reading to suit the occasion. Tiberias, the chief seat of Palestinian learning, which did so much toward securing and preserving the text of the Bible, was culpably lax in dealing with a work that had arisen on its own soil. It can hardly be hoped that the acumen of scholars will ever succeed in restoring the Mishna to its original form.

(*g*) *Commentaries on the Mishna.*—The Mishna being the stock and essential component of the whole Talmud, the attention of Jewish scholars was directed at a comparatively early period to its elucidation. Maimonides (twelfth century) heads the list with his commentary, written in Arabic (though it has been published only in a Hebrew version). He was followed by R. Tanchum of Jerusalem, who wrote a lexicon of the Mishna, also in Arabic, which has never been published at all. The only four copies of the MS. extant are contained among the treasures of the Bodleian Library at Oxford. Since then an uninterrupted series of Hebrew commentaries, written by prominent rabbis, either upon the whole or some select few of the Mishnic tracts, have continued to appear down to the present day: and it is but just to these authors to remark that, though differing in scientific capacity, they have all conceived their task worthily, and have faithfully striven to fulfil its requirements. They have all, without exception, aimed at a clear, simple, and correct understanding of the text, nowhere suffering themselves to be betrayed into mere scholastic subtlety.

(*h*) *Translations of the Mishna.*—Since about the middle of the seventeenth century the desire to become acquainted with the contents of the Mishna was manifested also by Christian scholars, and from this time we may date the period of *translations*. Such translations have at various times been given to the world in the Latin, Spanish, Italian, French, English, and German languages. They embrace either all or only single portions of the Mishna, some being accompanied by annotations, while others are without them. The middle of the eighteenth century beheld a further step in advance in the beginnings of a methodical investigation of the Mishna in the interest of linguistic studies. A number of Christian scholars attempted, though with slender success, to determine the character of the Mishnic idiom. It was reserved for the present century, and more particularly for the last few decades, to see eminent men like Hartmann, Landau, Loewisohn, Geiger, Dukes, Luzzato, Frankel, and others turn their efforts into this channel. They explored the whole territory of the Mishna in different directions, pursued their investigations with energy, ability, and devotion, and in various valuable works laid down the results of their labors. For the details of this literature, as also for an account of the numerous editions of the text of the Mishna, see Fürst's *Bibliotheca Judaica*, ii. p. 10 *sq.*) We may add, as a literary curiosity, that some one has gone to the trouble to provide every word of the Mishna with accents of vocalization, probably because it was customary to recite it in the schools to the accompaniment of a kind of chant. The work has not been printed, but was seen and mentioned by Jos. Sal. del Medigo (b. 1591). (See *Mazref la Chochma*, p. 22.)

B. *The Gemara.*—The term *Gemara* is of Aramaic origin, and its signification is the same as that of Talmud, "teaching." Like the latter term, it is frequently employed to designate the method of deduction current in the schools of the rabbis. It was also used in the sense of tradition, the teaching communicated by one doctor to another. In common parlance it denotes the whole body of [illegible] and teachings which arose in the academies [illegible] the close of the Mishna, and which, being [illegible], now form the second and major part of the [illegible] the Talmud. There are two different Gemaras: the one [illegible] in the academies of Babylon, the other [illegible] time to its birthplace. The [illegible] to the latter, "the Gemara of Jerusalem," [illegible]. After the destruction of the temple by Titus, no [illegible] existed in Jerusalem, and it was, in truth, [illegible] which pre-eminence as the chief seat of Palestinian learning rightfully belonged.

(*a*) *The Gemara in its Relation to the Mishna.*—The relation of the Gemara to the Mishna is commonly described as that of a commentary to the text; and this description, though by no means complete, is correct enough as far as it goes. The Gemara invariably attaches its discussions to the words of the Mishna, explains terms and things wherever necessary, seeks to elucidate difficulties and to fortify the Mishnaic ordinances by adducing proofs for the same. It endeavors to harmonize discrepant statements, and to refer anonymous decisions to their proper authors. At times it takes occasion to trace the plan adopted by the Mishna in arranging and grouping its contents. In explaining the Mishna the Gemara never loses sight of extra-Mishnaic compilations in which the same subject is treated, and discusses at length whether and to what extent both may be brought into agreement. Furthermore, it formulates new ordinances, these being in part based upon previous decisions, in part distinct and independent productions. Finally, it reports in full the harmonious or divergent opinions, and the controversies that took place in the academies in respect to all these and kindred subjects. To this extent the Gemara is, indeed, a vast and comprehensive commentary on the Mishna. On account of this, its most distinctive feature, the authorities of the Gemara who lived subsequently to the close of the Mishna, are called *Amoraim* ("expounders") in contradistinction to the Mishnic authorities, who are known as *Tannaim* ("the original teachers").

But the Gemara is more than a mere commentary. It has sedulously gathered, without any reference to their connection with the Mishna, whatever utterances had for centuries dropped from the lips of the great masters, whatever tradition had preserved concerning their life and actions, whatever bears directly, or even distantly, upon the great subjects of religion and ethics. Thus, it contains *legal enactments, homiletical exegesis of Scripture, gnomes, moral maxims, popular proverbs, parables, tales, manners and customs*, both of the Jews and of other nations. Beside these, there are also *medical, mathematical, astronomical, scientific* data, etc. (Dogmatic doctrines, like those of revelation, of reward and punishment, the future state, the resurrection of the body, the judgment of the dead, the coming of the Messiah, and the like, are taken for granted in the Gemara, and seldom mentioned. Only a few of these points are now and then brought up for discussion.) This vast and complex material is distributed throughout the different portions of the great work, as the name of an author, a casual quotation from Scripture, or some other coincidence in thought or style presents the semblance of a *point d'appui*.

The Talmud itself assigns its various component elements to two distinct classes, which are distinguished both in name and in substance. To the one class belong all laws and regulations that bear upon the practice of religion. These include the ritual and ceremonial, the civil and criminal laws, and also the chief heads of ethics. This class is called *Halacha*, a term meaning originally "custom," then "law." Everything else is embraced under the term *Hagada*, or, as it is written in Chaldaic fashion, *Agada* (and also *Agadetha*), meaning "that which is narrated," "delivered in a discourse." In general, the term Hagada refers to mere individual utterances in which no general and binding authority resides. There are, however, some Hagadistic sentences which, entering deeply into the region of faith, became so hallowed by tradition, so profoundly rooted in popular belief, that even the Halacha does not scruple to employ them as the basis of some of its enactments. (See *Tr. Arub.*, 43 *b.*) Of the two classes mentioned above, the Mishna is exclusively occupied with Halacha. A few Hagadistic elements crop out sporadically in its pages, chiefly at the end of the tracts, but they were undoubtedly later additions. A single Mishnic tract (*Aboth*, "Fathers"), and that one of pre-eminent importance, is exclusively devoted to Hagada; but this too is of later origin, as Frankel has rightly conjectured (*Darke Ha-Mishna*, p. 216).

(*b*) *Ancient Elements in the Gemara.*—Shortly before and after the close of the Mishna a number of prominent authorities undertook to prepare various collections of ordinances and disputations. They interspersed the sterner Halacha with more or less Hagada. They differed in the methods employed. A few of these compilations, though considerably expanded by later writers and greatly corrupted in the course of time, are still preserved. They are—the *Tosephta*, composed after the manner of the Mishna, the *Mechilta*, *Siphra*, and *Siphri*, all three arranged in the form of a running commentary on the Bible. Other collections there were of the same kind, which, though they have long since disappeared, were still extant, and more or less esteemed, in the time of the Amoraim. They bore the general title of *Mathnitha* ("collection of teachings"), rarely *Beraitha* (meaning "extraneous productions," with reference to their being extra-Mishnic compilations). In the post-Talmudical period, however, the name *Beraitha* came to be applied to them to the exclusion of their former title. These Beraithoth are often quoted in the Gemara, sometimes for the purpose of throwing light upon obscure passages of the Mishna, at other times with a view to determining their own value or the reverse, and not unfrequently for the sole purpose of extending the scope of the disputation. The Beraithoth, as they appear in the Gemara, present a spectacle of sad confusion, and offer no little difficulty to the student. Some of them are similarly repeated in both the Palestinian and Babylonian Gemara; others, again, differ largely in expression and in the subject-matter. Nay, the same Beraitha as cited in the two Gemaras appears as containing contradictory assertions. When a Beraitha occurs both in Tosephta, Mechilta, etc., and in the Gemara, its reading sometimes agrees with that of the Babylonian, sometimes with that of the Palestinian Gemara; at other times it diverges from both. We may add that many Beraithoth, quoted from the lost collections above referred to, are to be found in the Gemara of Babylon only, others exclusively in that of Palestine. At all events, the Gemara deserves credit for having preserved these ancient elements. It is the business of the critic to determine how far they have been correctly transmitted, and to restore, if possible, their original shape.

(*c*) *Scope of the Two Gemaras.*—The Gemara of Babylon does not cover more than thirty-seven of the Mishnic tracts. Of the first and sixth divisions, one tract only in each has been supplied with Gemara, evidently because, with the exception of those two tracts, the laws with which these divisions are concerned had become obsolete after the destruction of the temple. The like cause did not prevent the tracts of the fourth division from being commentated, though they deal for the most part with the laws of sacrifice, and on this account appear to be no less antiquated than the others. The reason is, that, in the opinion of the Talmudists, the sacrificial rite was not restricted to the temple proper, but might at any time be resumed on its former site; also, because the study of the sacrificial law was deemed equally meritorious with the performance of the sacrifice itself. (See Rashi, notes to *B. Mez.*, p. 114 *b.*) Gemara is wanting for the tract Shekalim of the second division, which likewise treats of matters relating to the temple and the hierarchy; also for two tracts of the fourth and two of the fifth division. In the latter instance the omission is partly due to the same cause which has just been described, partly to other and subtler causes too complex to be included within the scope of the present article. It would be erroneous, however, to suppose that the tracts omitted in the Gemara were on that account entirely neglected by the Amoraim of Babylon. On the contrary, most of the topics of these tracts are frequently mentioned in the Gemara of other tracts, and have there become the subjects of elaborate disputation; and yet the claims of these tracts were not considered equally urgent with others, and the editor of the Gemara contented himself with the assurance that whatever they contained of any importance had received sufficient attention by its casual discussion in diverse scattered portions of the work.

The Gemara of Palestine, as we possess it, extends over thirty-nine tracts, among which are all the tracts of the first division, and the tract *Shekalim*, wanting in the Babylonian Gemara. On the other hand, in the Palestinian Talmud there is no Gemara for any tract of the sixth division, and all the tracts of the fifth division, though fully discussed in the Babylonian Gemara, are wanting in the Gemara of Palestine. The text of the Palestinian Gemara is full of gaps, even in the tracts which it annotates, and sometimes whole chapters are missing. Considering both what it still contains and what has perished, we are led to conclude that the Palestinian Gemara was originally designed to embrace, and actually did embrace, the whole of the Mishna without any exception, and that so much of it has been irretrievably lost is due to the force of adverse circumstance that weighed so long and so heavily upon the Jews of Palestine and their academies. Apart from these considerations, we find abundant evidence in the writings of the elder commentators to show that they were acquainted with portions of the Palestinian Gemara which are now missing.

(*d*) *The Language of the Two Gemaras.*—The ancient Aramaic branched off in the course of time into East Aramaic or Chaldaic, and West Aramaic or Syriac. The former continued to preserve its close relationship to the Hebrew; the latter diverged gradually more and more from it. On this account, the Babylonian Jews, while in general they accepted the Chaldaic vernacular, introduced Hebrew words and phrases bodily into it, and also "Chaldaicized" Hebrew terms. In a certain sense they spoke a mixed dialect of Hebrew-Chaldaic, somewhat as the German Jews in the Middle Ages originated a so-called Jewish-German dialect. In this mixed Hebrew-Chaldaic dialect

the Babylonian Gemara is written. It is a Chaldaic idiom, nearly approaching the Hebrew, but it has suffered so much from popular caprice and negligence that it appears quite impossible to refer its linguistic phenomena to strict grammatical rules. The Palestinian Gemara is written in the popular dialect which prevailed in Palestine at the time of the Amoraim—*i. e.* in the Syriac, with but a very slight sprinkling of Hebrew. This vulgar Syriac dialect is marked by the following peculiarities: first, letters belonging to the same organ of speech frequently interchange, especially in the case of gutturals and labials. Secondly, words are abbreviated; two or even three short words are combined into one, whole syllables are omitted at the beginning of words—*e. g. mar* for *amar*, *ba* for *abba*. By the joint effect of interchange and omission the original *Abba* was even attenuated to *Wa*. Thirdly, many Greek words and phrases occur, for which the dominion of the Greeks, and, at a later period, of the Romans, in Syria easily accounts. These foreign words were greatly corrupted in the speech of the people, and their etymology is therefore encumbered with very serious difficulties.

(*e*) *The Form of Discussion in the Two Gemaras.*—In *style* and *form* both Gemaras exhibit the common attribute of pregnant brevity and succinctness; elliptical expression is a constantly recurring feature; whole sentences are often indicated by only a single word in the text. Thus, *e. g.*, *minai*, "whence," stands for "whence do you draw the proof of your assertion?" *Miklal*, originally only meaning "from other statements"—*i. e.* "from other statements it follows"—enlarged its meaning in the later terminology of the schools, came to mean inference in general, and in this sense is to be rendered by the phrase "from which we may conclude."* One of the features of this excessive brevity of expression is that question and answer are stylistically so closely interwoven, and there is such an entire absence of any indication of the separating line, that the practised eye of an experienced scholar alone can distinguish where the one ends and the other begins. The Palestinian Gemara is even still more economical in the use of words. Examples will be found in Frankel's *Mebo*, p. 17 *seq.* In the *material and method* of discussion a characteristic difference divides the two Gemaras—a difference which, however, appears already between the more ancient and younger Amoraim of Babylon. The former aim at condensation, seek to elucidate the subject-matter by following the prevailing rules of exegesis and deduction, and, as for the rest, restrict themselves to the use of plain and simple terms. The younger Amoraim, particularly since the days of Abaye and Raba (about the middle of the fourth century), are far less anxious to discuss only for truth's sake. They argue for the sake of the mental exercise, and are fond of indulging in intellectual tournaments; they love to raise artificial difficulties where none are apparent, to intertwine the threads of argument and to unravel them again, and thus, with a prodigious display of hair-splitting dialectics, to raise a towering mountain of discussion on the basis of the merest trifle. It is true, the Babylonian Gemara affirms its preference for plain, matter-of-fact learning (though in this it simply endorses a dictum of Palestinian origin), which it symbolically calls "Sinai," and places it above dialectical shrewdness, which it designates figuratively as "the uprooting of mountains." (See end of Berachoth and Horioth.) And yet the latter obtained the ascendency both in the discussions of the schools and in practical life. While in former times it had been customary to follow the older school of Amoraim in cases of conflicting authority, the decisions of the younger being practically ignored, the rule was reversed since the days of Abaye and Raba. So much for the Babylonian Gemara. That of Palestine refrained altogether from all such attempts at unbridled dialectics, and from first to last confined itself within the proper limits of calm and temperate discussion. We have observed that sobriety on the one hand, and extravagance and subtlety on the other, are the distinguishing features that mark the Halacha of the Palestinian and Babylonian schools. The same traits are no less evident in their respective treatment of the Hagada, only that in this case each method reveals advantages and disadvantages of its own. The Palestinian Hagada is purer, more rational, freer from superstition and mysticism, little interested in demons, magical arts, and supernatural things in general. On the other hand, it is often prosy, unattractive, and rarely appeals to any deeper emotion; while the Babylonian Hagada, with all its gross exaggerations, and with all the superstitious rubbish which it borrowed from the Parseeism that surrounded it on all sides, and which it mingled with the noblest moral principles and dicta, yet exhibits greater vigor and a richer fund of sentiment; and in consequence of these its method of presentation is often suffused with a poetic coloring.

(*f*) *The Teachers of the Two Gemaras.*—From the time of the older Amoraim (end of the second century) to the middle of the fourth century, when the disorders of war and the insecurity of the roads put an end to regular intercommunication, an unbroken bond of friendly reciprocity had connected the high schools of Palestine and Babylon. Young students from Babylon, eager for knowledge, and with them many a riper scholar, sought the Palestinian academies, to return to their homes after years of absence and after enriching themselves with fresh learned material. Occasionally, though less often, it would happen that Palestinian scholars emigrated to Babylon and enriched the minds of their brethren with the new stores of erudition which they brought with them. This explains how it happens that names and teachings of Palestinian authorities are met with in very considerable number in the Gemara of Babylon; while, conversely, though not to the same extent, the opinions of Babylonian masters found a place in the Gemara of Palestine. Even the surprising fact that the words of Palestinian authorities are in some instances reported only in the Babylonian Gemara, those of Babylonian teachers exclusively in that of Palestine, presents no real difficulty after what has been said. It is quite plausible that some one individual student, having received a casual communication from his master, did not repeat it until he had arrived in his new home, and in consequence it never became known in its original home. However, inaccuracies and errors of various kinds could hardly be avoided when ideas were carried from one country to another through the uncertain channel of verbal communication, and in some instances, too, by immature minds. The Babylonian and Palestinian Gemaras sometimes ascribe a given ordinance to different Babylonian Amoraim, and the same confusion exists in the two Gemaras with regard to Palestinian authorities. Even palpable contradictions are not wanting; *e. g.* that the same teacher is made responsible for opposite statements in the two Gemaras. On the whole, it would be fair to assume that the Gemara of Babylon is correct where Babylonian teachers are concerned, and that of Palestine where the teachers mentioned belong to the Holy Land. But the corruption of the texts, and especially of the Palestinian, renders even this criterion uncertain.

(*g*) *The Compilers of the Gemaras, and the Date of their Compilation.*—The concurrent testimony of ancient chronicles has established, and the results of modern investigation have confirmed, that the compilation of the Babylonian Gemara took place toward the close of the fifth century of our era, and that its editor was R. Ashi (d. 427), who for more than fifty years presided over the academy of Sura, and whose uncommon zeal in the propagation of knowledge secured him the just and general esteem of his contemporaries. By this, however, we are not to understand that R. Ashi was the first, last, and only one engaged in the work. Some of the tracts of the Gemara differ so strikingly from others in shape, style, and course of thought that they cannot possibly be the work of a single writer. Besides, the repetition and dissimilar treatment of the same topic in different tracts hardly leave room to doubt the conjecture of Chajoth (*Mebo*, p. 28) that many if not all the tracts had been previously edited by various Amoraim before the time of R. Ashi, and that the latter only re-examined, arranged, corrected, and perhaps also completed them. Moreover, that R. Ashi by no means completed the compilation of Gemara is already recognized by tradition, which mentions as co-editor R. Abina, though he survived the former about fifty years; and it is confirmed beyond the possibility of doubt by the circumstance that a number of authorities are mentioned in the Gemara who belong to the half century succeeding R. Ashi's death. The whole Gemara of the tract *Tamid* is, according to Frankel's masterly research (*Monatsschrift*, x, p. 193), and also Chajoth (*Mebo*, p. 27 *b*), the work of the Saburæans, or of the still more recent Gaons, having been patched together from scattered passages in the Gemara into a single tract. To say that the Gemara was closed by R. Ashi, or by any one else, is therefore too broad a statement to be literally true. The work was never formally closed: it was simply interrupted by the adverse circumstances of the time, then taken up again and carried forward by some until the progress flagged and the work remained unfinished. It was not even intended by the authors of the Gemara to be closed up in the sense of setting it up thenceforward as an infallible canon from whose provisions there should be no departure. Nowhere is there a trace of such a design. The motive of its compilation was evidently only the preservation of the accumulated store of learning, without a thought of curtailing the independent expression of opinion by future teachers. All this has long since been correctly set forth by

* Even the Mishna already uses a single word, *e. g. Hanc* (B. K. 1, 1), with which it was customary to begin a deduction, as a technical term to denote the general idea of proof.

Maimonides in the preface to his *Mishne Tora*. It is a simple fiction, contrary to all the facts of the case, when Grätz asserts (*Gesch. d. Juden*, iv. p. 171), speaking of those who, as he says, completed the edifice of the Talmud, "They sent forth the compilation which they had undertaken . . . as finished and complete in itself, to which further additions and extensions could no more be admitted." Such additions and extensions were actually made in great number over and above those which we have already mentioned. Some of these may be recognized at the first glance; others can only be discovered by comparing old and authentic manuscripts or by searching criticism. Not only have marginal notes crept into the text, but even whole passages of Halachic tendency, not to speak of numberless Hagadas, have been purposely interpolated into the Gemara by competent as well as incompetent parties. Illustrious rabbis of the Middle Ages did not hesitate to acknowledge these facts, and scientific inquiry has contributed farther discoveries in the same direction. (See Rapoport in *Ker. Chemed*, vi. p. 249 *seq.*, and *Erech Millin*, p. 5 and p. 10 *seq.*) It became a mooted point whether R. Ashi himself wrote down the Gemara, or whether he only arranged it verbally, and it was written out considerably later; and eminent names may be cited in support of the latter view, among them, Rashi in the notes to *Bab. Mez.*, p. 33 *b*, although he does not undertake to say exactly when the work was reduced to writing. In modern times the learned Luzzato has taken the same ground in the preface to his *Oheb Ger*. Wiesner (*Gib. Jerushal*, p. 5) is of opinion that the first written copy of the Gemara was prepared about two centuries after R. Ashi. To us it appears that sound common sense must regard it as impossible that so voluminous a work, and one, too, full of such intricate controversies, should have been orally arranged, fixed, and transmitted with perfect accuracy from generation to generation. There exists, besides, an authentic tradition (*B. Bathra*, p. 157) that R. Ashi revised and somewhat modified the Gemara in a second edition, as Rabbi had done in the case of the Mishna.

The Palestinian Gemara displays far greater uniformity in language, style, and methods than the Babylonian, and this leads us to expect less difficulty in determining the questions of its authorship and the date of its completion; but this is decidedly not the case. Both questions are involved in dense obscurity, and the light of scholarship has hitherto struggled in vain to pierce it. By an ancient tradition, that is still frequently cited, the authorship of the Palestinian Gemara is ascribed to R. Jochanan (end of the second century). A glance at any page of this Gemara is sufficient to prove the incorrectness of this tradition, for everywhere we meet the names of Amoraim who flourished centuries after R. Jochanan. To save the tradition, some have interpreted it to mean that Jochanan made a beginning, laid the foundations of a Gemara. Frankel believes (*Mebo*, p. 48) that the passage cited does not refer to Jochanan personally, but to the academy of Tiberias, of which he was the founder. But this is a mistake, as the said academy had undoubtedly existed and attained celebrity long before Jochanan. The probability is, that the tradition we speak of referred originally to the form of the Mishna which is contained in the Palestinian Talmud (and which frequently diverges from that in the Babylonian Gemara, as we have shown above), and indicated that R. Jochanan was the author of this recension. This seems to be its true purport, but by some later misunderstanding this tradition was made to extend to the Gemara of the Palestinian Talmud. In the mean time, the question of the authorship of this Gemara is at present involved in the greatest obscurity.

The same uncertainty prevails with regard to the date of its composition. Isaac Alfassi, the celebrated epitomist of the Babylonian Talmud, in his *Halachoth* (end of the tract *Erub.*), obviously relying on the received opinion of R. Jochanan's authorship, asserts that the authors of the Babylonian Gemara were already acquainted with the Gemara of Palestine, and during the whole period of the Middle Ages all deferred to his authority. From the time that critical study first began to be applied to the texts, down to the present, this subject has been carefully investigated, without, however, any definite results having been thus far achieved. Zunz (*Die gottesdienstlichen Vorträge*, etc., p. 53) only expresses himself guardedly to the effect that the Palestinian Gemara certainly was not edited before the last third of the fourth century. Jost (*History of Judaism*, ii. p. 124) declares quite apodictically, and without a shadow of proof, that it was edited barely 100 years after the close of the Mishna; and he even commits the absurdity to present it as uncertain (p. 201, *ibid.*) whether the Palestinian Gemara may not have been composed in Babylon. There are more thorough and thoughtful scholars, like Rapoport (*Bikkure ha-Ittim*, 1831, p. 66) and Chajoth (*Mebo*, p. 28 *b*), who agree with Alfassi, because they thought that they had proved that the Babylonian Gemara presupposes certain portions of its Palestinian rival, and has even occasionally copied directly from it. Frankel (*Mebo*, p. 48 *b*) refutes their arguments, but concedes that the close of the Palestinian Gemara preceded that of the Gemara of Babylon by several centuries. Wiesner, on the contrary, labors to prove (*Gib. Jerushal*, p. 7) that the Palestinian Gemara frequently presupposes the Babylonian, and places the date of its compilation several centuries after that of the latter; on p. 52 he assigns to its completion even so late a period as that between 760 and 900. Krochmal's investigations (in *Jerushal. habennjah*, p. 30) lead him to believe that the close of the Palestinian Gemara was simultaneous with the abolition of the patriarchate of Tiberias in the last quarter of the fifth century. The only conclusion that can be drawn from these contradictory critical researches is, that the date of the composition of the Palestinian Gemara is a problem which is still unsolved.

(*h*) *The Condition of the Text of the Gemaras.*—We should hardly expect to find the text of so comprehensive a work as the Babylonian Gemara, and which has passed through the hands of so many copyists and compositors, to be entirely correct. The most loyal intentions and attention would not prevent the creeping in of errors and misapprehensions. But the disfigurement of the text as it stands is great beyond all expectation—greater than in the case of any other work which has been handed down to us from ancient times. In numerous instances well-meaning but incompetent men have foisted the marginal notes of some anonymous writer upon the text; others, no doubt from mere inadvertence, have omitted whole sentences, which, fortunately for us, have been in part discovered in the writings of the older commentators (see Chajoth, *Mebo*, p. 251; others, again, making light of their task, have confused names and things in such fashion that the Talmud now abounds in contradictions and other difficulties which have cost its learned expounders much toil and trouble. Nor has the number of those self-conceited, would-be critics been small who early began to make uncalled-for changes in the text to suit their pleasure, which abuse is already complained of by Hai the Gaon. For nearly 900 years the ablest commentators, at their head R. Chananel, labored to restore the text to at least approximate correctness, without any permanent success; later copyists and printers caused ever-new confusion. Recently, R. Rabbinowicz has collated a Munich MS. of the Talmud of the year 1334 with the standard editions, and began to publish the *variæ lectiones* in his valuable work, *Dikduke Sopherim*. The astonishing number of these *variæ lectiones* which he has gathered from a single MS. gives us some faint conception of the wealth of new and important readings which we might expect to find were we fortunate enough to possess other and older MSS. That we have them not is due to the bigotry of the mediæval popes, who often consigned whole cartloads of Talmud MSS. to the flames. The disordered condition of the text, bad enough in itself, was still more complicated by the interference of pious censors, who continued to pursue the literature of the Jews with fanatical hatred down almost to the present time, and found a peculiar pleasure in venting their spite upon the Talmud. Ignorant and over-zealous as most of them were, they not only expunged the few passages that refer to the founder of Christianity, but also many others which in their opinion seemed to reflect upon Christians and their belief. Such, for instance, as treat of idolatry and idolaters, or make mention of Babel, Rome, Greece, the Gentiles, and the like, were looked upon as disguised attacks upon Christianity, and mercilessly cut out. Suspicion is easily aroused in the minds of the ignorant, and in the case of the Talmud many an innocent paragraph fell a prey to its ravages. Matters arrived at such a pass that even Jewish editors and proofreaders, in fear of the censor and of the frequent accusations and persecutions, undertook of their own accord to suppress and erase whatever a mournful experience had taught them was liable to give offence. In this way they sometimes changed the names of nations and of sects that might possibly be suspected, and in general toned down any too pointed expressions. There is a single exceedingly rare edition of the Talmud—and, we regret to say, one only—which has escaped defacement at the hands of the censors, having been printed in Holland. Fortunately, the most important passages, those which have elsewhere been expunged or disfigured, have been extracted from this edition and published separately. The editors, however, were deficient in scholarship, and their work leaves much to be desired.

Since the invention of printing there have been published forty-five complete editions of the Talmud, not to speak of hundreds of single tracts, of which certainly no two editions are quite alike. The complete editions are for the most part in twelve folio volumes. (For an enumeration and description of them see Rabbinowicz, *Dikduke*

Sopherim, 1829, p. 42.) We may here remark that A. Geiger (*Posthumous Works*, ii. pp. 18 and 20) assumes two different recensions of the Babylonian Gemara to have existed—the one, Oriental-Spanish, represented by Maimonides; the other, Italian-French, represented by Rashi, the text we now possess being derived from the latter. No evidence is given to bear out this assertion, and we fear it would be difficult to discover any valid proof in its favor.

If the Babylonian Gemara has been unfortunate, the Palestinian has fared still worse. The corruption of its text is visible on every page. It has been less accessible to censorial interference, and has suffered less from mistakes of copyists; for during a long period it remained unknown, even in the foremost of the high schools, and then, even after it had become known, was barely noticed, much less critically studied, by scholars. (See Frankel, *Mebo*, p. 132 *b*.) The great source of injury in its case seems to have been, first, the Syriac idiom in which it is written, and which few of its readers or transcribers were capable of understanding; secondly, the want of proper attention. Errors and arbitrary alterations, when once they had been introduced, remained fixed. It was not favored, like the Babylonian Gemara, with a Chananel or one like him to undertake the arduous task of purifying its text. As a further consequence of this deplorable neglect, the text was open on all sides to the inroads of incompetent persons, who freely availed themselves of its unguarded condition to interpolate at pleasure. That the Palestinian Gemara is actually full of spurious passages, especially in its Hagadistic portions, has not escaped the notice of modern critics. Wiesner even undertakes to say (*Gib. Jerushal*) that many passages which are evidently aimed against the reputation of the great bearers of Talmudic tradition were surreptitiously introduced by the Karaites, whose chief seat was, as we know, in Palestine. (See Geiger, *Zeitschrift*, viii. p. 227 *seq*.) A somewhat disguised passage in *Tr. Challa*, 2d chap., we are inclined to think, points more directly to Karaite interference with the text. Two Amoraim are engaged in discussion. The point of difference between them is the same as that which mainly divides the sects of the Pharisees and Sadducees; the coincidence, however, is not referred to. In the end, the very argument which in the Babylonian Gemara (*Rosh Ha-Shanah*, 13 *a*) finally disposes of the objections of the Sadducees is here triumphantly refuted. The point in dispute relates to the words "on the morrow after the sabbath"—the day, namely, when, according to Lev. xxiii. 11, the sheaf of first-fruits is offered by the priest, and the people are thereupon permitted to partake of the new harvest. The Pharisees interpret the word "sabbath" here in the general sense of "day of rest," and explain that it designates the first day of the feast of Passover. The Sadducees retain the word in its ordinary signification, the seventh day of the week. Now, in the passage of the Palestinian Gemara to which we refer a certain R. Bun takes occasion to quote Josh. v. 11, where it is plainly stated that the people partook of the new harvest on the day after the Passover, and thus to argue by implication, though ostensibly in connection with another subject, in defence of the Pharisaic opinion. In replying to him, R. Elasar ingeniously remarks that the word *Pessach*, where it occurs in the Bible without further qualification, does not at all refer to the festival, but rather to the sacrifice of the Passover, which is offered on the day before the Passover feast. He proves his point conclusively by quoting Num. xxxiii. 3, and with this rebuttal of the Pharisaic argument the discussion closes so far as the Palestinian Gemara is concerned. As a point of curious interest, we add that Aben Esra, in his notes to Lev. xxiii. 11, speaking in the name of a certain scholar of Rome, details what is exactly the argument of R. Bun, just mentioned; and on his part refutes it exactly in the manner of R. Elasar. Maimonides, too, though he was thoroughly versed in the Palestinian Gemara, and frequently adopted its decisions, and though he greatly valued Aben Esra's works, as appears from one of his letters,* yet in his *Mishne Tora* (*Tmidin*, vii. 11) again repeats the verse from Joshua in reply to Sadducean objections, just as R. Bun and the "scholar of Rome" had done before him. Maimonides seems to have totally overlooked that what he considers an invincible argument had already been successfully combated both in the Palestinian Gemara and in Aben Esra's commentary. It is interesting to note in this connection that Juda Rosanis, in his notes to the *Mishne Tora* of Maimonides, exclaims, exultingly, that the above argument "is original on the part of Maimonides, and every way worthy of his fame," while, in truth, it is neither original nor tenable. In leaving this subject we may remark that R. Moses of Coucy (*Book of Commandments*, No. 199) ascribes the argument of R. Bun and of the "scholar of Rome" to R. Meshullam ben Calonymos. As the family of Calonymos had originally settled in Rome (see Rashi, notes to *Tr. Beza*, p. 24 *b*), and during several generations had been renowned for the erudition of its members, and as, moreover, this R. Meshullam flourished but a short time before Aben Esra (see W. Heidenheim, *Piutim and Paitanim* s. v. *Meshullam*), it is safe to conclude that "the scholar of Rome" and R. Meshullam Calonymos were identical persons.

* Perhaps this may serve as an additional argument to prove that the above-mentioned letter of Maimonides is spurious. (See Rosin, *Ethic des Maimonides*, p. 21, n. 9.)

(*i*) *The Literature of the Talmud.*—For full thirteen centuries, with rare exceptions of local and temporary character, Jewish thought moved within a sphere whose centre is the Talmud. What Scripture says of Israel in Egypt is true of the intellectual activity of the Jews in later times: the more it was oppressed by its enemies, the more fruitful did it become. An immense literature has grown out of the Talmud. A bare list of those works which have at various times been published would alone fill a bulky volume, leaving aside the far greater number of those that have never been given to the world, and all those others that have perished in the course of time. We shall content ourselves with noting merely the main groups to which the vast mass of writings that have accumulated up to the present day may be respectively referred. They are (1) Epitomes (*Halachoth*); (2) Commentaries, primary and secondary; (3) Novellæ (extended disquisitions on Talmudic topics); (4) Digests and commentaries on them; (5) Books of commandments (containing the Talmudic ordinances in peculiar arrangement); (6) Questions and answers; (7) Collections of Hagadas and their commentaries; (8) Religious discourses; (9) Polemical and apologetic writings; (10) Lexica and encyclopedias; (11) Collections of proverbs; (12) Bibliographical works; (13) in modern times also monographs and larger treatises of a scientific character; (14) Critical investigations in various directions. This great literature is written mainly in Rabbinical Hebrew, but a large number of works have appeared in Arabic, and latterly in almost every European language. The German especially has during the last half century been employed by scholars of the first rank as a medium of communicating the results of their labors.

(*k*) *Some Auxiliaries to the Study of the Talmud.*—The composite character of the dialect of the Babylonian Gemara and the manifold corruption of its text, to which we have frequently referred above, render the work of preparing a Talmudical grammar unusually difficult. No one has hitherto been courageous enough to attempt the task, and almost all the researches that have been made in this direction are contained in stray articles dispersed in various periodicals. Of separate treatises which are adapted to the needs of the beginner we may mention A. Geiger, *Lehr- und Lesebuch zur Sprache der Mischnah* (Breslau, 1845); L. Dukes, *Sprache der Mischnah* (Esslingen, 1846); S. D. Luzzato, *Elementi Grammaticali del Caldeo Biblico e del Dialetto Talmudico Babilonese* (Padua, 1865); J. H. Weiss, *Mishpat Leshon ha-Mishnah* (Vienna, 1867); M. J. Landau, *Geist und Sprache der Hebräer nach dem zweiten Tempelbau* (Prague, 1822); A. Stein, *Talmudische Terminologie* (Prague, 1869). As to lexica, we are more favorably situated. They are the following: The *Aruch*, by R. Nathan of Rome. This work received at a later time some additions at the hands of Benjamin Musaphia, and in modern times it has been again edited, somewhat enlarged, and supplied with definitions in German by M. J. Landau (Prague, 1819-24. See Rapoport's scholarly and comprehensive review of Landau's work in *Biccure ha Ittim*, 1830). Buxtorf, *Lex. Talmudicum*. This lexicon has been latterly reprinted, with numerous corrections, and considerably enlarged by B. Fischer (Leipsic, 1875). S. and M. Bondi, *Or Esther* (Dessau, 1812); J. Levi, *Chaldäisches Wörterbuch über die Targumim und einen grossen Theil des rabbinischen Schriftthums* (Leipsic, 1867). For the Palestinian Gemara, excepting only what is contained in Frankel's *Mebo*, nothing whatsoever has yet been done.

(*l*) *General Character and Importance of the Talmud.*—To define an object in brief and wholly adequate terms, so as to include its entire scope, and nothing beyond, is acknowledged to be among the most difficult tasks of the scientific investigator. Where the object, by the very complexity and comprehensiveness of its nature, eludes the grasp of logical definition, we are frequently compelled to resort to symbolical terms. This has been done in the case of the Talmud. From early times it has been known among scholars as the "Ocean of the Talmud," and the metaphor does indeed express, as no definition could, the distinctive features of this work, so gigantic in proportions, so unique in the world's literature. The Talmud is an ocean, vast in extent, unfathomable in depth—no less in depth of thought than of sentiment and soul. Whatever streams have flown from the fountain head of Jewish

thought have during many centuries mingled their waters with this ocean and contributed to increase its volume. Like the sea, it swarms with a thousand varied forms of life, and on its ever undulating surface new aspects of existence are for ever rising and disappearing in endless succession; for the interests of nations and individuals in all their actual and conceivable relations, from the cradle to the grave, are here made the subject of minutest discussion. The intellectual current, too, which encircles and pervades the whole is again an intensely living force. The Talmud is no dry handbook, no mere register of traditional controversies between individual scholars or schools, but it reflects in its greater part the very life of the debate. Here we meet with no long speeches. The arguments are as compact as they are weighty; they follow blow with blow; there is an intellectual battle, a continued attack and repulse, a persistent struggle for victory in the realm of ideas. Besides all this, there is another particular in which the Talmud resembles the ocean, to which it has been compared, though the men who originated the comparison would hardly have admitted its application in such a sense. Innumerable pearls and much priceless treasure is hidden in its depths, but it also covers much that is lifeless, and occasionally casts up putrid and refuse matter. The Talmud is the mirror of its age, and the men of the Talmud, however exalted they may have been in intellect and character, were none the less children of their age, and they cannot be expected to be altogether free from its influence.

He who would navigate securely this sea of the Talmud must be familiar with the compass and the rudder; *i. e.* he must be intimately acquainted with its language and modes of thought and of discussion. And even when one is provided with all this apparatus, it requires prolonged practice under the eye of an experienced master to meet with success. Many have ventured upon this Talmudic sea, and were shipwrecked on treacherous shoals. Many of the best and most faithful of Christian scholars have attempted the study of the Talmud, and have given it up in course of time on account of the insurmountable difficulties which seemed to bar their progress. Others, deceiving themselves, proceeded some distance, came back reporting marvellous discoveries, and covered themselves with ridicule. But he who sets out upon the Talmud ocean fully equipped, thoroughly trained, and with experience to guide him need not fear the dangers of the voyage, and will return in the end with many precious stores of valuable knowledge. Let us take a general survey of the treasures hidden in the Talmud.

(*m*) *Science.*—The religion of Judaism has in the course of time become a religion of life in the most comprehensive sense of the word: it accompanies its adherent from the cradle to the grave in all his doings, prescribes observances for every possible situation in health and disease, for every class of society, for occurrences of every kind, and in this manner its ceremonial forms surround not only man, his inner emotions and his outer development, but also the whole actual world around him. The Talmud, therefore, whose very object it was to develop religion to that extent and culmination, had not rarely, in its Halachic part, to touch and treat of questions of general science, and hence it affords us an insight into the state of a number of scientific pursuits of the men of that time. The Hagada offers further scientific material in abundance, with which the Halacha has nothing to do. The following branches of knowledge are amply represented, and sometimes treated of at length, in the Talmud:

(1) *Mathematics.*—Apart from scattered allusions, entire chapters of several tractates are devoted to it for the purpose of fixing various religious observances. (For writings on mathematical subjects in the Talmud see Steinschneider, *Ha-Mazkir*, 1875, p. 128.)

(2) *Medicine*, which is treated of in numerous places in the Talmud, but until now no one possessed of the necessary knowledge has arisen to collect all this information and to display it for the benefit of science. A scanty beginning has been made by J. Wunderbar in *Biblisch-talmudische Medicin* (Riga and Leipsic, 1860). See also S. Cohn, *De Medicina Talm.* (Breslau, 1846).

(3) *Botany.*—This is represented in great abundance in the Talmud—in the tract *Kilayim* alone 53 species of plants are mentioned—but this field still lies entirely fallow, and has not yet attracted the attention of scientific workers.

(4) *Zoology.*—It has been treated by L. Lewysohn in *Zoologie des Talmud* (1858).

(5) *Astronomy.*—In addition to scattered notices on the subject, it is specially discussed in the tractate *Rosh Ha-Shanah* in its relation to fixing the new moon.

(6) *Technology.*

(7) *Law.*—In this direction the Talmud offers vast material, which has long since attracted the attention of the learned and given rise to numerous valuable monographs. The most thorough and reliable contributions have naturally been furnished by Jewish scholars of modern times. We mention Frankel, *Der Gerichtl. Beweis nach mosaisch-talmudischem Rechte* (Berlin, 1846); idem, *Zur Kenntniss des mosaisch-talmudischen Criminal- und Civilrechts* (Berlin, 1860); idem, *Grundlinien des mosaisch-talmudischen Eherechts* (Breslau, 1860); H. Fassel, *Das mosaisch-rabbinische Gerichtsverfahren in civilrechtlichen Sachen* (Gross Kanizsa, 1859); Bodenheimer, *Das Testament*; M. Duschak, *Das mosaisch-talmudische Strafrecht* (Wien, 1869); Mayer, *Die Rechte der Israeliten, Athener und Römer* (Leipsic).

(8) *History.*—For this the Talmud is a prolific mine, a treasury of traditions, a collection of decisions and institutions, products of the labor of the Jewish mind during a period of 1000 years; it, and it alone, offers us the means to follow and to understand the religious formation, the growth, and the entire course of the development of Judaism from the close of the Bible to the close of the Babylonian Gemara; and not only the history of the religion of the Jews, but also that of their culture and civilization in general, in various countries and at various times, is lighted up in numerous directions by data contained in the Talmud. Much information may also be derived from it toward completing our historical knowledge of those nations with which the Palestinian and Babylonian Jews of that time came into contact. The Talmud offers generous archæological material which awaits research and publication. The Talmud is especially important to a proper understanding of original Christianity, on which so much has lately been written. Many legends and sayings in the New Testament, as in the Koran, have their source in the Talmud. It alone presents the Jewish sects, with which Jesus was in frequent intercourse, in their proper light. But, even apart from this, the whole ground from which Christianity originally grew is Jewish ground, and the spirit of the time which assisted at its birth was the spirit which at that time animated and ruled Jewish life, and which is reflected in the pages of the Talmud. It is also certain that essential germs of Christianity are to be sought for in the philosophy of the Alexandrian Jews, which again cannot be completely understood without a knowledge of its connection with the Jewish views that prevailed at the time in Palestine, and to which the Talmud furnishes the key.

(9) *Geography.*—As may be expected from a work that contains such rich historical materials, the Talmud also furnishes geographical information of Palestine, Syria, Babylonia, and other countries in great abundance and of decided value to science—a fact that has long been known, but has been almost neglected. (Comp. Zunz, *Gesammelte Schriften*, i. p. 152–154.)* It is only recently that a work has at last appeared in which the vastly scattered material has been collected, sifted, and treated with masterly ability; it is Adolph Neubauer's *La Géographie du Talmud* (Paris, 1868), which received the prize of the French Académie des Inscriptions.

(10) *Pedagogics.*—Among all the nations of the earth, the education of youth dates back farthest and was most universal among the Jews. Even before the destruction of the temple in Jerusalem, elementary schools for children and higher schools for adults existed all over Palestine. It follows, therefore, almost as a matter of course, that the Talmud has preserved many sayings and precepts on the subjects of schools and instruction. They have been collected and published by S. Marcus, *Zur Schulpädagogik des Talmud* (Berlin, 1866).

(*n*) *Ethics.*—With the consideration of the ethical significance of the Talmud we approach the highest level, the crowning portion of the whole work. Not but that we meet with passages that must be rejected by a pure morality; prevailing views and embittering experiences have certainly exercised a disturbing influence on the ethical views of various spiritual heroes of the Talmud; but these are isolated phenomena, and disappear, compared with the moral elevation and purity of the overwhelming majority of the men of the Talmud, and compared with the spirit that animates the work as a whole. What is laid down as the moral law in the Talmud can still defy scrutiny at the present day; and the very numerous examples of high moral views and actions on the part of Talmudists are such as cannot be found in any work of antiquity, and must still excite the admiration of the reader of the present day, in spite of the ceremonial fetters which they bore, and in spite of the occasional narrowness of their point of view. Certainly, in former times there was no want of accusations against the ethics of the Talmud, but they proceeded from persons who knew them only from hearsay, or

* Even the many scholars who have occupied themselves with the geography of Palestine alone, with the exception of Munk and Schwarz, did not avail themselves of the great resources of the Talmud in this direction.

who garbled them intentionally to serve their malicious purposes. Men acquainted with its contents, and free from prejudice, such as Reuchlin and his associates, were ever its strenuous defenders; scholars of the first order, such as Buxtorf (in *Florilegium Hebraicum*), Herder, and a host of German authors, have endeavored to garner from the overflowing store of Talmudic legends, sayings, and proverbs the grains of gold, and to offer them to the reading public as elements of culture. To characterize the moral height on which the Talmud stands, it is sufficient to point to the single sentence, "The pious of all nations participate in the bliss eternal," in which the central idea of religion is pointed out as resting not on belief, not on ceremonial observances, but on morality alone. But there is a still more speaking and conclusive witness to this fact —the Jewish people. The long centuries of the Middle Ages did all that was possible to break down the spirit and the moral strength of this people, to degrade it intellectually, morally, and in its emotional life to the lowest level. They have not succeeded; it was saved by the Talmud, which was almost their exclusive means of culture, which furnished them with light in their darkness, and whose spirit passed over to them and became part of their own.

We close this article with the words of Buxtorf (dedication of his *Lexicon*): "The Talmud contains many legal, medical, physical, ethical, political, astronomical, and other excellent documents of sciences, which admirably commend the history of that nation and time; it contains also luminous decisions of antiquity; excellent sayings; deep thoughts, full of grace and sense; and numerous expressions which make the reader not only better, but also more wise and learned, and which, like unto flashing jewels, grace the Hebrew speech not less than all those Greek and Roman phrases adorn their languages." SAMUEL ADLER.

Talpa. See TALPIDÆ.

Talp'idæ [from *Talpa*—the Latin name of the mole—the typical genus], a family of mammals of the order Insectivora, generally understood to embrace two quite distinct types: (1) the moles, and (2) the desmans, or shrew-like animals. Contrasted with the Soricidæ (their nearest relatives), they present the following characters: The ears are rudimentary, and the eyes very small; the skull is nearly smooth, and the posterior ridges are obsolete; the foramen magnum is oblong, and inclined far forward below; there are no distinct postglenoid processes; the tympanic elements form auditory bullæ; the infraorbital canals are extensive transverse apertures arched over by very narrow osseous bars; the zygomatic arches are slender rods; the lower jaw has erect ascending rami destitute of cavities at the bottom of the coronoid processes (as are developed in Soricidæ); the teeth are in number M. $\frac{3}{3}$, P. M. $\frac{3-5}{3-5}$, C. $\frac{1}{1}$, I. $\frac{2-3}{1-3} \times 2$, and also diversiform in development; in the upper jaw the true molars mostly (*i. e.* M. 1 and M. 2) have each four primary external and two primary and more elevated internal cusps (the outer and inner connected together by oblique ridges, and thus circumscribing two triangular areas pointed inward), and an internal ledge bearing a cusp along its inner wall, but no secondary lower ledge behind the principal internal one; in the lower jaw the true molars have each two primary external cusps (anterior and posterior), and three primary internal ones (anterior, antero-median, and posterior), connecting, and by their union circumscribing, triangular areas; the other teeth vary much in the several groups; the vertebræ are characteristic in that the cervical have no hypapophyses, and the dorsal and lumbar no hyperapophyses; the sternum has a broad and keeled manubrium; the anterior members are generally developed more than the posterior (in the Talpinæ much more so; in the Myogalinæ, little); the carpi are more or less enlarged, and have at least each an additional ossicle developed as an os intermedium; the scapulæ are long and narrow. Such are the characters shared in common by all the members of the family. These, however, differ greatly in external appearance as well as osteological modifications, and have been therefore segregated into two sub-families—(1) Talpinæ, and (2) Myogalinæ. (1) The Talpinæ include the moles, and have, all, the form familiar in connection with the common species—*i. e.* the body is large and subcylindrical, the neck short, and the fore limbs short and very wide, and eminently adapted for digging; the skull is inflated at the pterygoid regions, and has no distinct pterygoid fossæ; the lower jaw is contracted under the ascending rami; the incisor teeth are in good number $(\frac{3}{3-2})$; the sternum has a very elongated manubrium; the clavicles are short and broad, the humeri broad, and enlarged at their angles; and the carpi have each an enlarged, sickle shaped bone. (2) The Myogalinæ are in external appearance considerably like the shrews or long-snouted mice; the skull is not inflated at the pterygoid regions, and has distinct pterygoid fossæ; the lower jaw is extended below under the ascending rami; the incisor teeth are in reduced number ($\frac{3}{2}$ or $\frac{2}{1}$); the sternum has a manubrium of moderate size; the clavicles are elongated; the humeri sub-cylindrical; and the carpi have no sickle shaped bones. The family is entirely confined to the northern hemisphere, the so called golden moles of Africa (Chrysochloridæ, belonging to a very different group, and each great region is characterized by peculiar forms. Of the moles, the typical species (forming the group Talpæ, distinguishable by dental characters, are represented by five genera in Europe and Eastern Asia, and aberrant groups (Condyluræ and Scalopes) are exemplified by three genera in North America—viz. *Condylura*, *Scalops*, and *Scapanus*. Of the Myogalinæ, one genus (*Desman* or *Myogale*) is represented by species in certain parts of Europe (*e. g.* Pyrenees) and Asia; another (*Uropsilus*) is peculiar to Southern China or Thibet, and a third (*Urotrichus*) has species in Japan and America W. of the Rocky Mountains. The moles, as is generally known, are expert diggers, and lead chiefly an underground life, burrowing with great vigor and rapidity in search of worms, which are their ordinary prey, and forming long ways in the earth. They also make under ground and under hillocks their domiciles, or so-called fortresses, and (at least in case of the European species) form two circular galleries (an upper, smaller, and lower, larger), with radiating and transversely communicating outlets and inlets, and in the centre of all, and communicating with the upper circular gallery, is the abode of the animal, which also has a communication from beneath with the highway. They are very voracious in appetite, and are rather beneficial than injurious to farmers. The Myogalinæ (or at least the typical species) are aquatic animals, and depend chiefly on water-insects and mollusks, as well as frogs and fishes, for their food. They have well developed musk-glands, and the large species are sometimes called musk rats, but are by no means to be confounded with the musk-rat of the U. S., which belongs to the family Muridæ. THEODORE GILL.

Talpinæ. See TALPIDÆ.

Ta'ma, county of Central Iowa, intersected by Iowa River and Chicago and North western R. R.; surface undulating and well timbered, with good water power; soil fertile. There are manufactories of carriages, saddlery, furniture, lime, marble, and flouring products. Staples, wheat, Indian corn, oats, wool, and live stock. Cap. Toledo. Area, 720 sq. m. P. 16,131.

Tama, v. of Otter Creek tp., Tama co., Ia. P. 1161.

Tama City, p.-v., Tama co., Ia., on Chicago and North-western R. R., near the centre of the State, has 3 churches, 2 school-houses, 2 banks, 2 newspapers, fine water power, 3 hotels, 1 foundry, plough and butter tub factories, 2 flouring and 3 saw mills, a sash and blind factory, 1 pump and 2 broom factories, and a park. P. about 500. F. J. M. WONSER, ED. "HERALD."

Taman'dua, a corruption of the name applied among Brazilian aborigines to a species of ant eater (family Myrmecophagidæ), distinguished by its arboreal habits, long and prehensile tail, and the development of five teeth in the upper and four in the lower jaw on each side; the hair is short; the color of the head, shoulders, fore limbs, hind limbs outside, and tail along the middle is white; a stripe from each side of the neck over the shoulder and remaining part black. The native name has been accepted as a generic term, and the species is now known as *Tamandua bivittata* (Gray). (See MYRMECOPHAGIDÆ.) THEODORE GILL.

Tama'qua, p.-v., Schuylkill tp., Schuylkill co., Pa., on Catawissa R. R., and at the terminus of several other railways, in the midst of a mining district, and with considerable manufactures. There is a national bank, a State bank, a daily and a weekly newspaper. P. 5960.

Tamarack. See HACKMATACK and LARCH.

Tam'arin, a name sometimes applied to species of the monkey family, MIDIDÆ (which see).

Tam'arind [Arab. *tamar*, a "palm," and *Hind*, "Indian," hence "Indian palm or date"], a beautiful leguminous tree, *Tamarindus indica*, from Southern Asia and Africa, now naturalized in most warm regions. The pods are filled with a pleasant sour pulp. This pulp is preserved with sugar, and is used for making a drink for fever patients, etc. The wood is very hard and handsome.

Tam'arisk [Lat. *tamariscus*, [illegible], diminutive of Arab. *tamar*, "palm"], a name applied to the trees and shrubs of the order Tamaricaceæ. They belong to the genera *Tamarix*, [illegible], and [illegible]. They are found in the northern half of the eastern hemisphere only.

and abound in the desert regions and in the Mediterranean basin. They have tonic properties, and some yield nutgalls; *Tamarix mannifera* affords a sort of manna.

Tamaroa, village and tp., Perry co., Ill., on Illinois Central R. R., has a bank and newspaper. P. 937.

Tamauli pas, state of the Mexican confederation, bounded N. by Texas and E. by the Gulf of Mexico. Area, 30,[illegible] sq. m. P. 108,778, mostly mestizoes. The coast-land is low, separated from the sea by a belt of sand banks. Farther inland the ground rises and becomes by degrees mountainous. In the coast land the climate is hot and unhealthy; in the more elevated parts it is temperate and healthy. All cereals, fruits, and vegetables of the tropic and temperate zones are grown, immense herds of cattle are fed on the extensive pastures, and many horses, mules, sheep, and goats are reared. The mineral wealth of the country is considerable, but of the thirty mines of gold, silver, and copper which formerly were worked, only four are worked at present, the rich resources of the state being very little developed on account of the thin population. Much salt is manufactured along the coast. Cap. Victoria.

Tambourine′ [Fr. *tambourin*], a musical instrument resembling a drum, consisting of a wooden or metallic hoop over which a parchment is stretched, and furnished with a set of bells; is held in either hand, and beaten with the knuckles or fingers of the other hand, or sometimes also with the elbow. It has been in use from time immemorial in the Basque provinces of Spain and in the retired regions of Italy, especially in the Abruzzi, and is chiefly known from its employment by gypsies and wandering musicians, being a favorite instrument for accompanying their dances.

Tambov′, government of European Russia, in the south eastern part of the country, on the Oka. Area, 25,542 sq. m. P. 2,150,971. Here are found large forests yielding fine timber and excellent pasturage. Woollen fabrics, tallow, and spirits are largely manufactured.

Tambov, town of European Russia, capital of the government of Tambov, on the Zna, was founded in 1636, and is well built, though most of its houses are of wood. It has a college, an ecclesiastical seminary, a high school for ladies, a military academy, and several other educational institutions, and it manufactures woollen cloth, tallow, spirits, etc., and has an active trade. P. 28,617.

Tamburi′ni (PIETRO), b. at Brescia in 1737; studied theology, and was appointed director of the Irish college at Rome in 1772, director of the Germano-Hungarian college at Pavia in 1772, professor of ethics and international law at the university of that city in 1797, and dean of the faculty of law in 1818. D. at Pavia in 1827. He wrote *Idea della Santa Sede* (1784), *Introduzione allo Studio della Filosofia* (1797), *Lezioni di Filosofia morale* (4 vols., 1806–12), *Elementa Juris Naturæ* (1815), *Cenni sulla Perfettibilità dell' Umana Famiglia* (1823).

Tamative′, city of MADAGASCAR (which see).

Tame Animals, Law as to. The common law has always made a broad distinction between wild and tame animals. The former can be the objects of property only while they are in the actual possession of the party exercising dominion over them. Complete property, as in respect to any other chattels, may be had in animals perfectly tamed and domesticated, and used for burden, food, or husbandry, such as horses, cattle, sheep, and the like; while an inferior or more limited property may be had in those others, which, though partly domesticated, never wholly lose their wild nature and instincts, such as dogs and cats. The following special rules have been applied to all tame and domesticated animals—in addition to those which include them and all other kinds of chattels—because they possess the power of locomotion, and of acting within a certain extent according to the guidance of their own wills or instincts. From a very ancient period the common law provided for the seizure and impounding of cattle found wrongfully straying upon the lands of another, and for their release and surrender to their owner upon his making an application in a proper form, and his paying the damage done by the estrays to the crops, etc. of the landed proprietor. This common-law doctrine of "estrays" has been reduced to a statutory form in most of the American States, while in some of them the injured proprietor has been clothed with powers far in excess of those conferred by the common law. This latter form of legislation has been sustained or condemned in different States according as it has been held to fall within or to transgress the constitutional provisions which protect the rights of property by forbidding summary proceedings which violate the "due process of law." The doctrine also prevails throughout the U. S. and England that the owner of a *vicious* animal is liable for the damages done by it, either to the person or property of another; but in order that such liability may arise, the owner must have a previous knowledge of the vicious habit or propensity which was the immediate cause of the injury: and this knowledge may be proved by direct or by presumptive evidence. In many of the States special legislation has recently provided for the punishment of cruelty to animals, whether perpetrated by their owners or by others.

JOHN NORTON POMEROY.

Tamerlane. See TIMUR.

Tamil′, its Language and Literature. Tamil is one of the most highly cultivated, ancient, logical, exact, and generally interesting languages of India. Considerable attention must be devoted to it, as it is the queen of Dravidian tongues, much in the same way as Sanskrit is the king of the Aryan dialects. In connection with this article the reader should consult the 2d ed. of the *Comparative Grammar of the Dravidian Languages*, by the Rev. R. Caldwell, D. D., LL.D., etc.; Dr. Caldwell *On the Substitution of the Roman for the Indian Characters* (*Madras Journal of Literature*, 1858–59); Dr. Bower, on *Tamil Language and Literature* (*Calcutta Review*, vol. xxv.); *Lecture on Auvciyar, a Tamil Female Poet*, by the same author; Sir George Campbell's *Ethnology of India* (*Journal of the Bengal Asiatic Society*, vol. xxxv.), and his *Specimens of the Languages of India* (Calcutta, 1874); Kasi Chetty's *Tamil Plutarch* (Jaffna, Ceylon, 1859); Mr. Gover's *Folk-Songs of Southern India* (Madras, 1871); Dr. Graul's *Tamil Grammar; Der Kural des Tiruvalluvar*, by the same author; Dr. Gundert's *Dravidian Elements in Sanskrit* (*Journal of the German Oriental Society for 1869*); Dr. Hunter's *Comparative Dictionary of the Non-Aryan Languages of India* (London, 1868); Rev. Mr. Kennet's *Notes on Early Printed Tamil Books* (*Bombay Indian Antiquary*, 1873); Dr. Kittel's *Dravidian Element in Sanskrit Dictionaries* (*Bombay Indian Antiquary*, Aug., 1872); Dr. Murdoch's *Classified Catalogue of Tamil Printed Books, with Introductory Notices* (Madras, 1865); all of the Rev. Dr. G. U. Pope's works on Tamil, especially his *Grammar* and *Handbook* (published at Madras); *Inscriptions in Tinnevelly and Travancore*, by His Highness Râma Varma, first prince of Travancore (*Indian Antiquary*, Dec., 1873); Col. Yule's *Marco Polo* (2d ed., London, 1875); Col. Yule's *Map of Ancient India* (see Dr. Smith's *Atlas of Ancient Classical Geography*, London, 1875); Dr. Winslow's *Tamil Dictionary* (Madras, 1862); and Mr. R. C. Caldwell's papers on *Tamil Popular Poetry*, in the *Bombay Indian Antiquary*, Apr., etc., 1872. A word of explanation may be offered with reference to the foregoing list of works which ought to be consulted. Though it looks so large, it is really very incomplete, and necessarily so. Tamil, though an ancient language, has only lately been carefully studied with a view to its origin, history, grammar, literature, methodical arrangement, affinities, and genius. Year by year new beams of light are thrown upon it by scholars in all parts of the world, and the list given above might be enlarged.

Tamil is a *cultivated* Dravidian dialect. In its phraseology it is rich and copious. When a scholar is heard to speak it, it does not perhaps sound mellifluous like Telugu, the Italian of India, but it has a robust and sonorous power that is unmistakable. Of course, the lower orders speak it very differently, but we would not go to the mine or dockyard or remote fishing village to hear English correctly pronounced. There are two kinds of Tamil—the Shen-Tamil and the Kodun-Tamil—which vary greatly. A Tamil poetess speaks of "*Sanga Tamil mûndru*"—viz. "three kinds of Tamil, authorized" (by the Holy Synod of Literature, which was wont to be held in Madura, the sacred city of Tamil-land), but on this and kindred points there is little need to enter into a discussion which only a very few scholars could appreciate. Throughout all of the vast plain of the Carnatic, Tamil in some form or other is spoken. From a little N. of Madras to where triple lines of white breakers flash over the nets of Tinnevelly and Travancore fishermen who ply their trade round about Cape Comorin, Tamil is the common vernacular. It is spoken by 14,500,000 Hindus. Though Southern India is the home of the Tamil, it is also spoken where enterprising bands of the natives of Southern India penetrate. Tamil is thus spoken in Ceylon, at Cannanore in the Malayalam country, at Bangalore in Mysore, at Secunderabad, the British station in the nizam of Hyderabad's territory, in Pegu, Penang, and Singapore, in many a colony of Africa, in Mauritius, and in parts of the West Indies. Tamil may frequently now be heard in the dockyards of London and Liverpool; and Americans who have lived in Southern India often bring their old and trusted Tamilian servants to New York. It is a great mistake, committed by such eminent writers as Max Müller and Hunter, to affirm that Tamil and "Malabar" were not identical names of the same language. Malabar was the

name given three centuries ago to Tamil by the Portuguese. Tamil land is marked down in the Peutingerian Tables as *Damirice*. Peutinger discovered the Roman maps which bear his name, and these maps are invaluable as elucidating the ancient geography of the south of India, where Tamil has from time immemorial been spoken. The meaning of the word *Tamil* is supposed to be "sweetness" or "a fragrant odor." This is a very poetical but a hardly defensible derivation. Tamilians love to speak of their own language as "*teli-tên Tamil*"—literally, "honey-clear Tamil," and certainly poetical and polished Tamil is very sweet and mellifluous. In ancient times Tamilians were divided into three great subdivisions—namely, the Chôlas, the Chêras, and the Pândyas. The Pândya kings ruled over a part of the Malabar coast during the time of Pliny; and Strabo mentions the name of the Indian king who sent an embassy to the Roman emperor Augustus as "*Pandion*" (Tamil, *Pândiyan*). Megasthenes speaks of a country in India called Παιδαίη, which is evidently Pândya-land, a part of Tamil land. The same old author speaks of pearls being procurable in Πανδαίη; and to the present day the pearl-fishery of Southern India is famous. The Chôla dynasty (in Tamil, "*Chôra*") is spoken of by Ptolemy as the Σῶραι. The Chêras were the people of Kêrala, but it is difficult to distinguish them clearly from the other two subdivisions of Tamilians. Mussulmans call Tamil *Araram* (*a rara*, "destitute of sound"), probably because Tamil is the only Indian language which is totally devoid of aspirates. But this is a point which it is avowedly almost impossible to determine.

Tamil may be described as an aboriginal Indian language. It was spoken in Southern India before the flood of Aryan invasion came into India from the North-west. When Sanskrit thus entered Hindustan, Tamil may have been driven farther S.; indeed, it is almost reasonable to suppose that many tracts of Central or even Northern Indian hill-country were primitively occupied by tribes who spoke modifications of the Tamil language. It seems perfectly certain that Tamil was spoken in India 1000 years before Christ. When the fleets of Solomon traded with that ancient emporium of the East, Ophir, the Israelite mariners must have come across the Tamil trader. We read of "peacocks" being a part of the merchandise these mariners brought back to Palestine—"gold and ivory, apes and peacocks." The Hebrew word in the Bible for peacocks is almost identical with the old Tamil word "*tôkei*," the peacock—*i. e.* "the bird with the (magnificent) tail." The ships of Tarshish, sailing southward from some port of the Red Sea, must, in all probability, have touched at some South Indian harbor where Tamil was spoken, or at Ceylon, at Galle harbor, according to Sir Emerson Tennant's ingenious theory. Certainly, Galle was in very ancient times an important Oriental emporium, and in the present day Tamil is almost as generally spoken there as is Singhalese. It is true that sites distant from South India have been ascribed to Ophir, but the testimony which links that port with some ancient South Indian one is too strong to be overlooked lightly.

Classical Tamil differs almost as widely from ordinary colloquial Tamil as Latin does from Italian. The vocabulary of the most ancient, most polished, and most poetical forms of the Tamil language is most exhaustive, precise, and extensive. Centuries must have elapsed before the methods elaborated could have become crystallized and authoritative in the literature of the language. Dr. Caldwell, speaking of the antiquity of Tamil, says: "Shen Tamil grammar is a crowded museum of obsolete forms, cast-off inflexions, and curious anomalies." He goes on further to state: "The extraordinary copiousness of the Tamil vocabulary is shown by the fact that a school lexicon of the Tamil language, published by the American missionaries at Jaffna, contains no less than 58,500 words; notwithstanding which, it would be necessary to add several thousands of technical terms, besides provincialisms, and thousands upon thousands of authorized compounds, in order to render the list complete."

Tamil has an enormous number of synonyms. As a language it must be affiliated with Scythian, and not the Indo European family of tongues. The whole of this question is exhaustively reviewed in Dr. Caldwell's *Comparative Grammar*. The Tamil also is the language which stands at the head of those South Indian or Dravidian tongues which are thus affiliated. It is also the language which best represents the primitive condition of the Dravidian tongues. There is reason to believe that ancient Tamil and Malayalam were identical; and there are the clearest evidences that the cultivation of the other Dravidian languages of India was long subsequent to that of Tamil. This is most plainly proved by the early Tamil inscriptions which exist. These are always in Tamil character, and no Sanskrit inscriptions are to be met with in Tamil land with an antiquity higher than that of the fourteenth century A. D. But in Telugu and Canarese countries it is different. We there come across no Dravidian inscriptions of early date, and all early inscriptions are in the *Nâgari* or Sanskrit character. We have already alluded to the earliest written relic of the Tamil language—namely, that to be found in the *tukki*, *tâki* (the peacock) of Kings and Chronicles in the Hebrew Bible. It has also been remarked that *arisi*, the Tamil word for husked rice, is identical with ὄρυζα, the common Greek word for the name. Ctesias speaks of καρπιον, and Herodotus of καρφεα, when they allude to cinnamon; and *kârppu* is Tamil for the spice. (See Dr. Caldwell's *Dravidian Grammar*, Introduction, p. 9.) Dr. Caldwell gives a score of other instances in which Tamil names of places, etc. became early petrified into Greek and Latin; and these are extremely interesting, as showing the ancient cultivation of the Tamil language, and the date at which South India began to be slowly revealed to the foremost pioneers of European civilization.

We have now briefly to speak of Tamil literature. This is of large extent, but all the more ancient portion of it is composed in intricate and elaborate verse. Every treatise, whether relating to ethics or grammar, medicine or theology, astronomy or any science or art, was by the unalterable law of custom written in metre. It is only of late years that a Tamil prose literature has been springing up and flourishing. Tamilians ascribe the formation of their alphabet to the sage Agastya. To this somewhat mythical personage they also ascribe a number of small poems, which, unfortunately, bear the plainest internal evidence of being recent compositions. The fact is, we have no specimen at present extant of the earliest Tamil classics. Written upon leaves, rarely copied, passed from hand to hand, frequently composed in stormy times, they have passed away, and left no trace behind them. The earliest work, probably, which we still possess is the old grammar called the *Tol Kâppiyam*—*i. e.* "the ancient poem." Yet this work, as Dr. Caldwell remarks, "must have been preceded by many centuries of literary culture." It is full of rules of prosody which could not well have been framed did no poems exist at the time. But as for the precise date of the rise of Tamilian literature nothing is known with absolute certainty. The works of the greatest writers might have been composed a century or two earlier than computed, or a century or two later. The ripest Tamilian scholars can do no more than guess when any question of date crops up with regard to many of the chief authors whose works have made the language they study and built up its stately literature. Take, for instance, the greatest work (as most esteem it) in the Tamil language. It is entitled the *Kural* of Tiruvalluvar. ("Kural" literally means "spout." Perhaps the Latin title "*brevia*" comes up nearly as possible to its meaning.) It is a magnificent ethical poem of 1,330 distichs. Each distich is a poetical aphorism of rare beauty—some of them of such beauty as will bear comparison with the finest passages of the poets of Europe. Yet the precise date of the production of this noble work is still involved in mist. All that can be said with any degree of certainty is that it was composed in every probability *before* the tenth century A. D. How many centuries before it is impossible to determine with absolute certainty. Tiruvalluvar, the author of the *Kural*, was a pariah. His name signifies "the sacred pariah priest." Most remarkable legends are current with respect to him. In his days the great Madura college flourished. This was a synod of the first literati of the day, who used to meet at Madura, and pass their opinions on literary works submitted to them. Their power in the world of Tamil literature was unbounded, and no work could pass into the language as a recognized classic without the imprimatur of the savants of Madura. They were in number forty, and sat on a golden bench on the border of the sacred temple tank of the city. One day the pariah poet came to them with his poem in his hand. Could they, Brahmins of the Brahmins, deign even to touch the book of an outcast? So the legend goes on to relate how they drew back with horror from the contaminating touch of the volume. But Tiruvalluvar boldly approached, and laid it on the sacred golden bench. Suddenly a miracle was performed. Light gleamed about, music and celestial fragrance filled the air. The bench shrank, so as to be large enough only for the new poem. The judges were flung off [illegible], and, filled with chagrin, straightway [illegible] in the tank. Such is the legend; the kernel of it is evidently the truth that the work of a pariah poet exceeded all others in Tamil. The following two stanzas are from the *Kural*:

> "'The flute is sweet,' 'The lute is sweet,' say they
> Who have not heard the prattle of their own children."

"Sweeter than the sweetness of nectar
Is the commonest rice-water to those
Whose children's little fingers have dabbled therein."

Many better and higher examples of Tiruvalluvar's poetry might be quoted, but the above will be sufficient to show the pure domestic sympathies of the poet. Latter day Brahmins gloss over Tiruvalluvar's birth. They declare him to be an avatar or incarnation of Yama.

Auvaiyar, or Auvei ("the venerable matron"), was a Tamil poetess who was reputedly Tiruvalluvar's sister. She is the Sappho of Southern India, and many of her writings possess the highest poetic beauty. The following may be quoted:

"Gold vessels, broken, still *as gold* we prize,
And wise men in adversity are wise;
But worthless men, when ruined, what are they?
Vessels of clay, when broken, *are but clay*."

Two of the greatest works, as also the oldest, are the *Nâladi* and the *Chintâmani*. The former is an ethical poem, and is remarkable for great sweetness of rhythm. It is composed in stanzas of four lines each throughout. The *Chintâmani* ("the jewel which gratifies every wish") is by far the greatest epic poem in the Tamil language. It contains some 15,000 lines. The versification is sonorous and striking, but the phraseology in which it is couched is of great difficulty, abounding in archaic forms and obsolete idioms. Another great poem is the *Ramâyana*, in Tamil. The version is by Kamban, one of the most fluent and ornate of Tamil classical writers. The Tamil *Ramâyana* is not a slavish translation of Valmiki's great Sanskrit epic, but it is rather an adaptation—the great poem of a great Tamil poet composed on the model of a great poem in another language by another great poet. Pope's *Iliad* falls much farther short of Homer's than Kamban's *Ramâyana* does of Valmiki's. Two other famous Tamil poets of Kamban's time are Pugalêndi and Ottakkuttan. For some two centuries after the death of Kamban there appear to have arisen no great Tamil authors, till suddenly there sprung up a literary revival. A new poet, Athivirarama Pândya, now flourished, and this elegant writer produced the *Neidadam*, the *Kâsikandam*, and *Vettri Verkei*—the latter a small poem which has attained enormous popularity. About this time, too, Villiputturâr translated the Sanskrit *Mahabhârata* into Tamil verse. At this period, too, was probably composed the greatest of the Vedantic poems in Tamil, the *Gnâna Vâsishtham*. Not much later than this time were written those elegant poems, full of similes, and metaphors, and pleasant moral aphorisms, which are now taught in every Tamil vernacular school in the Madras presidency. About and after this time the Sittar school of Tamil poets flourished—men who openly taught anti Brahminical doctrines. Amongst others, Tirumûla and Konkanar occupy a prominent position in this school. But the foremost place must be ascribed to Pattira Giriyar and Sivavâkkiar. Pattira Giriyar's chief poem is entitled *Lamentations*. Some of the stanzas are highly poetical. For example, the poet, tired of the trammels of earthly life, cries out:

"Ah! when shall I my weary being steep
In that Existence which is sleepless sleep?"
"Ah! when shall I, with eyelids dropt, ascend,
And with God's being my own being blend?"

Such thoughts, couched in mellifluous Tamil, are very striking. Sivavâkkiar is a bolder poet, more original, more uncompromising—an iconoclast at heart, a hater of shams, and one who deigns only to worship the unseen "Audar-Kôn," the "Shepherd of the Worlds," to whom the sun and stars are but as sheep, which he guides whithersoever he willeth. Sivavâkkiar has a contempt for stocks and stones; and those who fancy all Orientals to be image-worshipping heathen should consider the following lines, which are translated *verbatim* from Sivavâkkiar's poem entitled *Words about God*:

"Stones resonant ye fashion
To idols; then adore:
With flowery wreaths adorn them,
With ashes smear them o'er:
The stone upon your threshold
Grows worn out, being trod;
But of these two stones, neither
Affords delight to God."

Since the beginning of the eighteenth century several writers of the highest eminence have flourished in Tamil-land. Amongst these Pattanathu Pilla need not be included, as, although a melodious writer, he does not occupy a very high place amongst South Indian poets. But Tayumânavar of Trichinopoly and Beschi of Madura have left an imprint of their genius on the literature of Tamil which will not be erased as long as that literature exists. Tayumânavar is perhaps the purest and chastest of Tamil writers; his style is a model of elegant simplicity. His poems have a high philosophic and religious tone, and in some of them distinct traces of the influence of Christian ideas are to be met with. Beschi was an Italian of the order of Jesus. Shortly after arriving in India he exhibited a wonderful linguistic talent, and in the course of a quarter of a century composed more than a work a year in many different languages, and some of them grammars and dictionaries, the composition of which must have entailed immense labor. He also composed a large number of controversial treatises, as well as a Tamil satirical novelette, the first in the language. It is greatly owing to Beschi that Tamil possesses now a prose literature. But it was especially as a poet that the learned Italian left his mark upon Tamil. His great poem, the *Tembâvani*, is recognized by the most learned Hindus as a Tamil classic of the highest merit. Brahmin pandits named him Vira Mâmuni, "the heroic devotee." No European has ever been able even to rival Beschi in his own department. Dr. Mill of Calcutta comes next to him, but the *Christa Sangita* of that author is, as a work of genius, vastly inferior to the striking and sonorous epic of the great Jesuit. The three chief personages of the *Tembâvani* are Christ, the Blessed Virgin, and St. Joseph. The whole poem is marvellously rhythmical, and full of those never-ending flowery images, similes, metaphors, assonances, and harmonious combinations of sounds which so please the voluptuous literary taste of the Oriental. Since Beschi's time the literature of Southern India has been enlarging itself at a prodigious rate, but though there is a large quantity of works produced, their quality has sadly fallen off. However, some dozen works might be mentioned, but we may content ourselves with one. The new revised edition of the Tamil Bible possesses a literary excellence not frequently met with in translations from a European language into an Oriental one. R. C. CALDWELL.

Tamise' [Flem. *Temsche*], town of Belgium, province of East Flanders, on the Scheldt, manufactures salt and sailcloth, and has several flax and cotton spinning factories. P. 8188.

Tam'many Society, an institution originally organized for charitable purposes in New York City May 12, 1789, deriving its name from a Delaware chieftain who had recently died at the age of above a hundred years, and who for his reputed virtues was in the latter years of the Revolution facetiously chosen patron saint of the new republic. Secret societies under the auspices of St. Tammany were organized in Philadelphia and other cities: but the institution soon fell into oblivion except in New York, where it was soon turned to account as a political lever, and it ultimately became the principal instrument of the managers of the Democratic party in New York City, exerting a considerable influence also upon State politics. The society was much discredited by the participation in its honors of William M. Tweed and his accomplices in fraud, but it was reorganized, and to some extent reformed, after the Tweed prosecutions. The officers and members of the society are still known by the names of sachems, sagamores, warriors, etc., and much is said about tomahawks, war-paint, and calumets. Tammany Hall is on Fourteenth street, near Union Square.

Tam'pa, p.-v. and tp., cap. of Hillsborough co., Fla.

Tampa Bay, on the W. coast of Florida, is chiefly in Hillsboro' co. Its upper portion is divided into two parts, Old Tampa Bay and Hillsboro' Bay. It is some 35 miles long and from 6 to 15 miles wide. A line of keys fences its entrance from storms, so that it constitutes a safe, spacious, accessible, and excellent harbor. The bay contains many small islands, and abounds in fish and turtle. On Egmont Key, at the entrance, stands a brick lighthouse 86 feet high, lat. 27° 36′ N., lon. 82° 45′ 15″ W.

Tampi'co, town of Mexico, state of Tamaulipas, on the Panuco, 5 miles from its mouth in the Gulf of Mexico, is well built, with broad and airy streets, and, though good drinking-water is scarce and yellow fever now and then occurs, it is much healthier than Vera Cruz. On account of the bar at the mouth of the Panuco, its harbor is not accessible for large vessels, which must anchor in an open roadstead: nevertheless, its trade is considerable and steadily increasing. P. 7000.

Tampico, p.-v. and tp., Whitesides co., Ill. P. 634.

Tampico, tp., Darke co., O. P. 67.

Tamworth, tp., Carroll co., N. H. P. 1344.

Tan'agers, a group of passerine birds dignified by most authors as a family with the name Tanagridæ, but whose true distinctive characters yet remain to be given. The following have been assigned: the bill is usually thick and conical, sometimes depressed and attenuated, usually more or less triangular or dilated at base, and with the cutting edges not much inflected, and generally notched or

toothed behind the tip; the angle of chin is not far forward; the nostrils are placed very high; the wings are moderate, angulated, have nine primaries, and the inner secondaries are not produced; the legs are short, with tarsi clothed with undivided plates on the sides, with front toes short and stout, and with the hinder ones stout and comparatively long. The outer lamellæ of the palatine bones are developed in a vertical plane, with the hinder border more or less emarginated, and the anterior palatine processes are broad and united, by a truncated border, to the high and broad upper mandible, as in the Fringillidæ (*Carus*), from which the species are indeed scarcely separable as a family. The colors are in almost all the species quite brilliant and positive. The group is peculiar to the New World, and is chiefly developed in the tropical regions. Over 300 species have been described and arranged under 43 genera. Messrs. Sclater and Salvin, in their *Nomenclator Avium Neotropicalium*, admit 292. One genus (*Pyranga*) is represented in the U. S. by four species, the most conspicuous of which are the scarlet tanager (*Pyranga rubra*) and summer redbird (*Pyranga æstiva*). The species feed upon grains as well as insects, etc. THEODORE GILL.

Tanais. See DON.

Tanaka Fujimaro, b. in the province of Owari, Japan, about the year 1843; was highly educated in the Japanese and Chinese classics; was at one time a secretary attached to the cabinet or councillors; visited America with the imperial embassy in 1871, and went to Europe on a special mission connected with education: on his return to Japan devoted himself with great zeal to the cause in which he had enlisted, and was made vice-minister of the department of education, in which highly responsible position he was still serving at the close of the year 1875.

F. A. P. BARNARD.

Tananarivo. See ANTANANARIVO.

Tan′cred, one of the most celebrated heroes of the first crusade, b. in Sicily in 1078, a son of Odo and Emma, the sister of Robert Guiscard; in 1096 raised an army in Apulia and Calabria, crossed over to Epirus, joined his cousin, Bohemund of Tarent, and distinguished himself greatly by his valor, sagacity, piety, and chivalric forbearance toward a defeated enemy during the campaigns in Asia Minor and Syria, but still more at the conquest of Jerusalem, July 19, 1099, and in the battle of Askalon, Aug. 12. He was made prince of Tiberias, and governed with great wisdom not only his own principality, but also that of Bohemund, who had been captured by the Saracens; but most of his time was taken up in petty warfare, partly with Baldwin and the other Christian princes, partly with the Saracens. D. at Antioch in 1112. His exploits have been narrated in prose and verse by Raoul de Caen in his *Les Gestes de Tancrede*. He also plays a conspicuous part in Tasso's *Gerusalemme Liberata*.

Ta′ney, county of S. W. Missouri, bordering on Arkansas, and drained by White River and its affluents; surface hilly, soil fertile, and there is a gold-mine. Staples, Indian corn, wool, and live-stock. Cap. Forsyth. Area, about 700 sq. m. P. 4407.

Taney (ROGER BROOKE), LL.D., b. in Calvert co., Md., Mar. 17, 1777; graduated at Dickinson College in 1795; studied law, and was admitted to the bar in 1799, commencing practice in Calvert co., from which he was chosen a delegate to the general assembly of Maryland; removed to Frederick, Md., in 1801, and in 1816 was elected to the State senate; removed in 1822 to Baltimore, where he resided until his death. Originally belonging to the Federal party, he became in 1824 a supporter of Gen. Jackson, by whom in 1831 he was appointed U. S. attorney general, and in 1833 was nominated as secretary of the treasury in place of Mr. Duane, who had been dismissed in consequence of his disagreement with the President in the matter of the removal of the public deposits from the U. S. Bank; but the Senate, by a vote of 28 to 18, refused to confirm the nomination, although he had for nearly nine months exercised the functions of secretary and had ordered the removal of the deposits. Chief-Justice Marshall having died in 1835, the President appointed Mr. Taney as his successor, and the administration having secured a majority in the Senate, the nomination was confirmed in Mar., 1836, he taking his seat upon the bench in the following January, and occupying it until his death. In the administration of this office his most noted act was his decision in the DRED SCOTT CASE (which see) in 1857. Chief-Justice Taney again came somewhat prominently into notice in May, 1861. A Mr. John Merryman had been arrested in Baltimore by order of a Federal general for alleged treason: the chief-justice issued a writ of *habeas corpus* to bring the prisoner before him; the officer in charge of Merryman refused to obey, on the ground that he had been empowered by Pres. Lincoln to suspend the execution of the writ of *habeas corpus*; whereupon the chief-justice wrote out a formal opinion to the effect that the President had no constitutional authority to suspend the writ, and that this could be done only by the legislative authority. D. in Washington Oct. 12, 1864. A notice of his career is contained in Santvoord's *Sketches of the Lives and Judicial Services of the Chief-Justices of the United States* (1854), and a memoir, embodying an autobiography down to 1801, has been written by Prof. Samuel Tyler (1872). A bronze statue of him, ordered by the State of Maryland, was inaugurated at Baltimore Dec. 10, 1872.

Tancytown, p.-v., Carroll co., Md. P. 413.

Tanganyika, a lake of Central Africa, S. of Lakes Albert and Victoria, between lat. 3° and 9° S. and between lon. 29° and 32° E., extends for about 400 miles from N. E. to S. W. It was first discovered by Burton and Speke in 1858, and afterward explored by Livingstone and Cameron. It has an elevation of 2711 feet above the level of the sea, deep and clear water, and a very irregular form, its width varying from 10 to 60 miles. Its shores are generally rich in beautiful scenery, especially those of the northern part, which are set with mountains and hills covered with a luxuriant vegetation. The surrounding country is in many places densely peopled. The most important town is Ujiji, on the eastern shore.

Tan′gencies [Lat. *tangere*, to "touch"]. The problem of the tangencies appears to have been first propounded by Apollonius Pergæus, who lived A. C. 247. He described them as ten in number, the last being to draw a circle tangent to three circles. By supposing either of these to become either a point or right line, all the other problems are stated. Sir Isaac Newton, in his *Universal Arithmetic*, problems 45, 46, and 47 (Horsley's ed. of Newton, pp. 133–136), gave some algebraic solutions. But Descartes, who died in 1650 (when Newton was eight years old), had already obtained a geometrical solution of the highest problem in the tangencies—viz. "To draw a sphere tangent to four spheres." (See Cousin's *Œuvres de Descartes*, vol. vi. p. 99.) Cousin, who, it is said, published the most perfect edition of Descartes's works, gives the date of his letter announcing it to Mersenne as Apr. 15, 1630. Descartes had also (see Montucla, p. 264) applied algebraic analysis to the problems in circles, obtaining some unsatisfactory expressions. Fermat, who lived 1601–65, published a geometrical dissertation on the tangencies of spheres, and classified the problems as fifteen in number. (See Lawson's trans. of Vieta's *Apollonius on the Tangencies*, with a supplement giving a translation of *Fermat on Spherical Tangencies*, London, 1771.)

In general, eight circles can be drawn tangent to three given circles, and sixteen spheres tangent to four given spheres. Of algebraic solutions, M. Chasles (in his *Rapport sur les Progrès de la Géométrie*, p. 31) records the following: First, two solutions of Euler in 1779, to the Academy of St. Petersburg; second, Carnot's in his *Géométrie de Position*, of which Chasles says, "He proposes to determine the radius of the sphere sought by a trigonometrical solution very simple, but of painful length (*longueur pénible*);" third, by J. Français; fourth, by Poisson; fifth, by J. Binet; sixth, by Hachette. The two solutions of Euler (who died in 1783) were not published until 1810, in the *Mémoires de l'Académie de St. Petersbourg*, vol. ii. pp. 17 and 24. As evincing the attention paid to this subject, we add that the papers of Binet and Hachette and Gaultier occupy 112 pages in the 9th and 10th vols. of the *Journal de l'École Polytechnique*. M. Hachette claims that the first analytical solution of the problem of the tangencies of spheres was that of Poisson (*Bulletin de la Société Philomathique* for 1812, p. 141).

But the first to present a general geometrical solution was Gaultier de Tours in 1812. (See 9th vol. *Journal de l'École Polytechnique*, p. 124–244.) His paper was entitled *Memoir to construct graphically a Circle determined by three conditions, and a Sphere determined by four conditions*. He in this memoir announced his important discovery of the curious properties of "radical axes and radical centres, and axes of similitude."

J. D. Gergonne in the 4th vol. (1814) of *Annales de Mathématiques* gave the most elegant general solution (both in circles and in spheres) which had appeared. It had previously been published in the memoirs of the Academy of Turin. It was arrived at analytically, being revised and completed in the 7th vol. of the same journal for 1817. In fact, Gaultier had nearly obtained the same solution. But J. B. Durrande, in the 11th vol. (July, 1820) of *Annales de Mathématiques*, reached by a purely geometrical construction the same solution as Gergonne. Gergonne states the points of contact in circles substantially as follows: Each axis of similitude is the radical axis of a pair of the

required circles. The pole of this axis of similitude for one of the given circles must lie on the line joining the points of contact, and this line must pass through the radical centre. Thus, find for each of the four axes of similitude the pole within each given circle: join the radical centre with said pole, and the points in which the line cuts the circumference are the required points of contact for that pair of the required circles. There are four such axes, and thus eight solutions in all.

In Durrande's construction he calls "the polars of similitude" of two of the given circles two right lines (perpendicular to the line joining their centres), having the common pole, in reference to these two circles, one of their centres of similitude. These "polaires" are called internal or external according as the centre of similitude which is the common pole is internal or external. To find the required points of contact, determine for any one of the given circles its "polars of similitude" with the two others, having care to take the external polaire for the circles which ought to be touched in a similar manner, and the internal for that which ought to be touched in a different manner by the circle sought. These polaires will intersect in a certain point, and the homologous polaires relative to the two other circles (and parallel to the other polaires) will intersect in a second point. Join those two points by a line; this line will cut the first-mentioned circle at the points of contact of that pair of the required circles. It must also pass through the radical centre.

Thus, the method of Durrande is only a way of arriving at the pole referred to by Gergonne, but it leads him to add to the very curious properties of circles, first made known by Monge and Gaultier, the new lines called "polars of similitude."

In the question in spheres, Gaultier and Heegmann (*Mémoires d'Académie de Lille*, 1823; J. A. Serret, *Crelle*, vol. xxxvii.) have founded their demonstrations on the theorem of Dupuis—viz.: "When a variable sphere touches constantly in the same manner three fixed spheres, each of the three points of contact describes a small circle on the corresponding fixed sphere." But Rouché and Comberousse in part 2, p. 244, of their *Traité de Géométrie*, show that it is only a corollary of the solution of Gergonne.

Gergonne gives (4th vol. *Annales de Mathématiques*, p. 354) an analytical solution to the problem of the tangencies as applied to three given circles upon the surface of a sphere. His solution, with analogous properties of radical axes, etc., has been readily extended to that question upon the surface of a sphere. A like extension is given by Steiner of his solutions in the 1st vol. of *Crelle* (Berlin, 1826), whose discussions are in the main founded on "radical axes" and other properties deduced from the discoveries of Gaultier.

The radical axis of two circles is the handle, as it were, by which the relations of two circles to each other are known and discussed. It is the common chord if they intersect. If they do not intersect, it is the line (perpendicular to the line joining the centres) from any point of which all the tangent lines to the two circles will be equal to each other. In that case their intersection becomes imaginary, and this consideration leads to interesting results. The radical centre (which is the centre of the orthogonal circle, and the axes of similitude of three circles are in like manner the means of discussing the relations of three circles to each other. The radical centre of four spheres (which is the centre of the sphere orthogonal to four spheres) and the planes of similitude have equally important properties in reference to those spheres. Justly did Gaultier de Tours take a pride in his discovery, and record the day (June 15, 1812) in which it was first read to L'École Polytechnique.

A very valuable analytical exposition of these fruitful properties is given in the 9th chapter of *Conic Sections*, by George Salmon (3d ed., London, 1855). Steiner, in his papers, calls the radical axis "the line of equal powers;" if from any point of it a right line is drawn cutting one of the circles, the product of the secant into its external segment is constant (viz. equal to the square of the tangent to either circle. To find the radical axis of two circles, draw any circle cutting both circles; the secants drawn through the points of intersection will unite on said line: draw a second auxiliary circle, and two points of said line are thus obtained. If there were three given circles, the radical centre of those circles would, in like manner, be obtained by the use of two auxiliary circles, the radical centre being the point at which the three radical axes of the several pairs will unite.

An analytical solution of the problems in the tangencies of spheres is given by C. W. Bauer (in *Journal de Schlomilch*, Leipsic, vol. v.); one in the tangencies of circles in George W. Hearn's *Researches on Curves of the Second Order* (p. 22, London, 1846); one in tangencies of circles and spheres by George W. Coaklay of New York University, in vol. ii. p. 116 of *Mathematical Monthly* for Jan., 1860. H. A. Newton of Yale College gave a solution of the problem in circles, "provided two of the given circles cut each other, by the method of transformation of curves by reciprocal radii vectores," in vol. i. p. 239 of *Mathematical Monthly* for Apr., 1859. Gen. J. G. Barnard of U. S. engineers presented to the National Academy of Science in 1864 an analytical solution of the problem in circles and in spheres, containing some interesting geometrical interpretations of his results.

A memoir was published by the present writer, entitled *The Tangencies of Circles and of Spheres*, in the 8th vol. of *The Smithsonian Contributions to Knowledge*, published in 1855. It is a geometrical solution based on the principle to which he has since given the name of "The Principle of the Converging Chords"—viz. "If a fixed circle is cut by any circle which passes through two fixed points in the plane of the given circle, the common chord passes through a fixed point on the line passing through the two fixed points." He claims that this is immediately derived from the well-known fundamental principle of tangencies, that the "tangent circle is the limit of all secant circles." In a memoir not yet published he has extended the use of "the principle of converging chords" to a generalization of the question of the intersection of circles and of spheres, the tangency being only a case where the angle of intersection is 0° or 180°.

After a recent diligent search, the first record found of any solution embracing (not in name, but in fact) the principle of converging chords, is in the *Monthly Review* (London) for Oct., 1764 (name of the author not given), in solving the question to draw a circle through two points tangent to a given circle. Thus, the writer claims not the first use of the principle, but the first generalization of all the problems as based upon it. He cannot learn that it was ever before applied to spheres. It was used by him as early as 1835. It appears as a porism in the *London Mathematician* for Nov., 1843. In the same number, p. 29, are two papers, one by William Rutherford and one by Stephen Fenwick, giving analytical solutions of the question "to find a sphere tangent to four given spheres which are in mutual contact." The books have numerous modifications of the original problems in the tangencies; *e. g.* that the required tangent sphere should have a certain radius and fulfil three other conditions. But the purpose of this sketch has been to enumerate the principal papers on the original questions. BENJAMIN ALVORD.

Tan'gent. A line is tangent to a curve when it touches it at a single point: this point is called the *point of contact*. The tangent to a curve at a point may be regarded as the limit of a secant through that point; for, suppose a secant to be drawn through the point of contact and any other point of the curve; then let the second point be moved along the curve toward the first; the secant will continually approach the tangent, and when the second point falls on the first, the secant will become a tangent; if the motion of the second point is continued, the line will become a secant on the other side. From this explanation we infer that only one tangent can be drawn to a curve at a given point. There is, however, an exception to this principle, for in the case of a multiple point there may be two or more tangents. (See SINGULAR POINTS.)

According to the theory of the infinitesimal calculus, a curve is to be regarded as a broken line whose sides are infinitesimal; the consecutive vertices of this polygonal line are called *consecutive points*, and the prolongation of any side is a *tangent*; we therefore say that a tangent to a curve is a line passing through two consecutive points of the curve. The first point in the order of generation is the point of contact. Continuing this view of the subject, we say that two curves are tangent to each other when they have two consecutive points in common, in which case they will have a common rectilineal tangent. We also say that two surfaces are tangent to each other when two lines of the one are respectively tangent to two lines of the other at a common point. If two surfaces are tangent to each other, every secant plane through the point of contact cuts a line from each surface, and these lines are tangent to each other at the point of contact of the two surfaces. These principles form the basis of the theory of tangents in descriptive geometry. In trigonometry the tangent of an arc is the tangent to the arc at one extremity, and limited by the prolongation of the diameter through the other extremity. W. G. PECK.

Tangent Galvanometer. See ELECTRICITY.

Tangential Co-ordinates. See TRILINEAR CO-ORDINATES.

Tan'ghin, an ordeal poison formerly in vogue in Madagascar. It is the exceedingly poisonous seed of *Tanghinia venenifera*, an apocynaceous tree of that island, one of the most powerful poisons known. A small portion of the

powdered seed was administered to the suspected person, whose only hope was in the emetic action which the drug sometimes exerts.

Tangier′, an old but decaying town of Morocco, beautifully situated on an inlet of the Straits of Gibraltar. It is surrounded with walls and defended by forts, but it is miserably built, and with the exception of some Mohammedan mosques and Jewish synagogues, and the houses of the foreign consuls, it contains hardly any decent edifices. Its harbor was in 1871 visited by 461 vessels of 50,858 tons burden, going in, and 463 vessels of 50,814 tons burden cleared. P. about 12,000.

Tangier, tp., Somerset co., Md. P. 1563.

Tangipahoa, parish of S. E. Louisiana, bounded by Mississippi River and Lakes Pontchartrain and Maurepas, intersected by Tangipahoa River, and traversed by New Orleans Jackson and Great Northern R. R.; surface low and flat, soil in some places fertile, in others sandy. Staples, cotton, Indian corn, sweet potatoes, rice, and livestock. Cap. Amite City. Area, about 720 sq. m. P. 7928.

Tangipahoa, p.-v. and cap. of Tangipahoa parish, La. P. 236.

Tan′gle and **Sea-Tangle,** names for several seaweeds, but especially for *Laminaria digitata*. The young shoots are sometimes used as food and forage, and the plants are employed in the production of iodine. The stalks of the European sea-tangle are used in making uterine tents for surgeons' use, but those growing on the North American coast have been found unfit for this purpose.

Tan′häuser, the hero of a German legend of the early Middle Ages; spent some years in wild dissipation at Venusberg, but was finally smitten by conscience, and went to the pope to get remission of his sins and escape damnation. The pope, however, answered that his sins could as little be forgiven as the wand which he (the pope) held in his hand could become green again; and Tanhäuser walked back to Venusberg to forget his despair in new dissipations. But a few days after, the pope's wand suddenly began to sprout. The connection between the legendary hero and the minnesinger Tanhäuser of the beginning of the thirteenth century is well established, but not of any interest. The legend has often been treated poetically by the Germans—by Tieck, Richard Wagner, and others.

Tanis. See ZOAN.

Tanjore′, town of British India, capital of a district of the same name in the presidency of Madras, on a branch of the Cavery, in lat. 10° 50′ N., lon. 79° 15′ E. It is a large city, 6 miles in circumference, well built and strongly fortified, carrying on a lively trade and extensive manufactures of silks, muslins, and calicoes, and containing many fine buildings and magnificent monuments. Its great pagoda, rising pyramidically and surmounted by a lofty dome, is one of the finest specimens of Hindoo architecture, and its colossal bull statue of black granite, 16 feet long and 12 feet high, is the greatest and most finished work of Hindoo sculpture. P. about 80,000.

Tank-Worm. See GUINEA-WORM.

Tan′nahill (ROBERT), b. in Paisley, Scotland, June 3, 1774; bred as a weaver, he worked at the loom all his life; wrote occasionally for periodicals, and in 1807 published *The Soldier's Return, with other Poems and Songs, chiefly in the Scottish Dialect*, which was received with considerable favor; but the publisher hesitating to issue a new and enlarged edition, he fell into a fit of despondency, burned all the new poems which he had written, and drowned himself in a pool near Paisley May 17, 1810. A complete collection of his writings, with a memoir by Ramsay, was published in 1838, and new eds. in 1848 and 1874.

Tanneguy-Duchâtel. See DUCHÂTEL (C. M. T.).

Tannehill (WILKINS), b. at Pittsburg, Pa., Mar. 1, 1777; removed to Lexington, Ky., thence to Nashville, Tenn.; was co-editor of the Nashville *Whig*, and for many years editor of the Nashville *Herald*, the first newspaper in Tennessee which supported Henry Clay for the Presidency; afterward established the *Orthopolitan*, a literary journal, and in 1848–49 conducted the *Portfolio*, a journal of Freemasonry. During the later years of his life he was entirely blind. He published the *Freemason's Manual*, a standard work; *Sketches of the History of Literature from the Earliest Period to the Revival of Letters in the Fifteenth Century* (1827); and *Sketches of the History of Roman Literature, from the earliest Period to Constantine the Great* (1815). D. at Nashville June 2, 1858.

Tan′ner (HENRY S.), b. in the State of New York in 1786; removed to Philadelphia, where he resided till 1850; engraved and published many atlases and separate maps, and contributed geographical and statistical articles to various periodicals, and was a member of the geographical societies of Paris and London. Among his numerous maps are—*New American Atlas* (1817–23), *Map of North America* (1822), *The World on a Globular Projection* (1825), *The United States of America* (1827), *General Atlas*, of 76 maps (1828). He also published *Memoir on the Recent Surveys in the United States* (1830), *View of the Valley of the Mississippi* (1832), *American Traveller* (1836), *New Picture of Philadelphia* (1840), and *Description of the Canals and Railroads in the United States* (1840). D. in New York in 1858. Although not a conchologist, he formed a fine private cabinet of shells.

Tanner (THOMAS), D. D., b. at Market Lavington, Wiltshire, in 1674; was educated at Oxford, and was made fellow of All Souls in 1696; entered holy orders; became successively rector of Thorp, prebend of Ely, archdeacon of Norfolk, canon of Christ Church, and in 1732 bishop of St. Asaph. His principal works, published posthumously, are—*Notitia Monastica*, an account of the religious houses, colleges, hospitals, etc. founded in England and Wales before 1540 (1744), and *Bibliotheca Britannico-Hibernica*, an account of the writers who flourished in England, Scotland, and Ireland up to the beginning of the seventeenth century (1748). He left a large collection of MSS., which he bequeathed to the Bodleian Library. D. in 1735.

Tanner's Creek, tp., Norfolk co., Va. P. 2989.

Tannery West, a suburb of MONTREAL (which see), included in the municipality, is situated at an important junction of the Grand Trunk Railway, and has some manufactures. P. about 4000.

Tannhäuser. See TANHÄUSER.

Tan′nic Acids, or **Tannins** [Ger. *Gerbsäuren*; Fr. *acides tanniques*]. These are astringent principles which are very widely disseminated in the vegetable kingdom. The most important sources of these compounds are the barks of varieties of the oak and pine, sumach, gall and valonia nuts, kino, divi-divi, and catechu; the bark and berries of many forest and fruit trees, such as the elm, the willow, the horse-chestnut, the plum, the pear. Numerous shrubs and roots, such as the whortleberry, the tormentilla, and the bistort, contain notable proportions of some modification of tannic acid. Less important in this respect are coffee, tea, nettles, etc. All of the forms of tannic acid were formerly supposed to be identical with the tannin contained in the gall nut, the differences in chemical composition presented by them being accounted for by the presence of accidental impurities; but at present there is no doubt of the existence of several distinct acids, which possess, however, many properties in common.

The tannins produce characteristic precipitates in solutions of ferric salts; these precipitates are usually of a bluish black color, which in presence of a free acid acquire a dark greenish hue; but some tannins, as those obtained from catechu, give a green precipitate, while others, such as that contained in the common nettle, cause a grayish precipitation. They have an acid reaction, and are further characterized by the intense astringent taste they possess; by their forming insoluble compounds with gelatine, albumen, fibrine, and the vegetable alkaloids; and by the avidity with which they are oxidized and converted into colored products when moist or in presence of alkaline solutions. The term "pathological tannins" has been applied to those obtained from diseased vegetable excrescences, such as the gall-nut; those which are contained in barks, etc., being designated as "physiological tannins." The latter only are adapted to the manufacture of leather. The most important and best investigated form of tannin is that known as *gallotannic* acid. Other modifications are *caffetannic*, *catechutannic*, *moritannic*, *quercitannic*, and *quinotannic* acids, which, although very similar in many properties, possess different compositions.

Gallotannic acid occurs in the gall nut, an excrescence produced by the puncture of a small hymenopterous insect upon the leaves and stalks of the species of oak *Quercus infectoria*, sometimes in a proportion as high as 60 per cent. of the mass. The tannin of the sumach, although formerly considered identical with gallotannic acid, appears to be a distinct compound. The acid is extracted by digesting the pulverized gall nuts with aqueous [illegible], to which a small quantity of alcohol is sometimes added. The fluid is decanted, and allowed to remain [illegible] time, when it separates into two layers, the [illegible] possesses a yellow color, and consists of a [illegible] solution of the tannin. This operation [illegible] as the lower layer continues to increase [illegible] the upper [illegible] which contains the gallic acid present [illegible] with ether, alcohol, and a small quantity of tannin [illegible] being then removed, and the solution of gall [illegible] washed with ether and evaporated *in vacuo*, when [illegible] is obtained as a porous mass. Pure gallotannic acid [illegible]

the composition $C_{14}H_{10}O_9$. Prepared as above, it is an amorphous buff-colored solid, easily soluble in water; it also dissolves in aqueous alcohol, but only with great difficulty in pure ether. It has an intense astringent taste, imparts a strong red color to litmus, enters into double decomposition with bases, and liberates carbonic acid from the carbonates. It is difficult, however, to obtain the gallotannates in a state of purity, owing to the tendency they exhibit to become oxidized on exposure to the air, and converted into compounds identical with that produced by gallic acid under similar conditions. Gallotannic acid is precipitated from its aqueous solution by the addition of potassic, sodic, and ammonic chlorides and many other salts, and by sulphuric and hydrochloric acids; by the action of nitric acid it is decomposed into oxalic and saccharic acids. In diluted aqueous solution it slowly absorbs oxygen from the air, and is converted into gallic acid; the change is facilitated by the action of a peculiar ferment present in the gall nut. When boiled with dilute sulphuric or hydrochloric acid, or with a strong alkaline solution, a similar reaction occurs, gallic acid and carbonic acid being produced. The exact change that takes place is not clearly settled. It is highly probable that gallotannic acid is not a glucoside, as formerly believed, and that the glucose formed by its decomposition originates from accidental impurities; indeed, natural tannin frequently contains ready formed sugar, from which it can be completely separated only with great difficulty; and Schiff has quite recently prepared absolutely pure gallotannic acid which, on treatment with hydrochloric acid, was entirely converted into gallic acid, no glucose being formed. On heating gallotannic acid to 325° C., pyrogallic and metagallic acids are produced with evolution of carbonic acid:

$$\underset{\text{Gallotannic acid.}}{C_{27}H_{22}O_{17}} = \underset{\text{Pyrogallic acid.}}{3C_6H_6O_3} + \underset{\text{Metagallic acid.}}{C_6H_4O_2} + 3CO_2.$$

The formation of pyrogallic acid is characteristic of gallotannic acid, the other tannins (notably those which turn ferric salts green) giving pyrocatechine, $C_6H_6O_2$, when submitted to dry distillation. Gallotannic acid is tribasic, and forms neutral, acid, and basic salts. Of the gallotannates, the ferric salt is especially characteristic and important. It is obtained, upon adding a solution of the acid to a solution of a ferric salt, in the form of a violet-black precipitate. This reaction is exceedingly delicate. The basis of common writing ink is ferric gallotannate. In common with most forms of tannin, gallotannic acid forms with gelatine an insoluble compound. The affinity of the acid for gelatine is so great that when a skin is immersed in its aqueous solution all the tannin is ultimately removed. This property of gallotannic is often utilized in its quantitative estimation in nut-galls, etc., a standardized solution of gelatine, with a small quantity of alum or ammonic chloride, being employed for this purpose.

Caffetannic Acid.—The magnesium and calcium salts of this acid are contained in the coffee-berries in a proportion varying from 3 to 5 per cent.; it also occurs in Paraguay tea. The formula first assigned to caffetannic acid was $C_{16}H_{18}O_8$, but Gerhardt prefers $C_{35}H_{38}O_{17}$, which would indicate that it is a homologue of gallotannic acid, differing from it in composition by $8CH_2$.

Catechutannic acid is prepared from the aqueous extract of catechu. Its composition is $C_{18}H_{18}O_8$.

Moritannic acid is obtained from fustic (*Morus tinctoria*) by treatment with boiling water, when it is deposited in a light-yellow pulverulent form, consisting of microscopic prisms. It is soluble in water, alcohol, and ether; the aqueous solution has an acid, astringent taste. The formula is probably $C_{13}H_{10}O_6$, although when dried at 100° C. it has the composition $C_{13}H_{10}O_6.H_2O$.

Quercitannic acid is the tannin of the oak-bark. It gives with ferric salts the same reaction as gallotannic acid, but differs from this by not being converted into gallic acid by acids, and by not giving pyrogallic acid when submitted to distillation. Its composition is unknown. The most important compound of quercitannic acid is the one it forms with gelatine, which is the basis of leather.

Quinotannic acid occurs in the cinchona-bark. It is light yellow, hydroscopic, with a sour, astringent but not a bitter taste—composition [illegible]. It gives the same reaction with gelatine as gallotannic acid, but imparts a green color to ferric salts. J. P. BATTERSHALL.

Tanning and Tawing. See LEATHER, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Tan'nin [Fr.], **Medicinal Uses of.** Tannin is a powerful astringent, peculiarly characterized by its freedom from the irritant properties of the mineral astringents, such as the persalts of iron and salts of silver, copper, zinc, and lead. Taken internally, it is also devoid of any poisonous action. Its uses in medicine are solely as an astringent to catarrhal mucous membranes, and occasionally as a styptic to control bleeding from small vessels. Locally, it may be applied dry, as powder, or in solution in water or glycerine. Internally, for diarrhœal affections, it is most commonly given in pill. EDWARD CURTIS.

Tann, von der (LUDWIG), BARON, b. at Darmstadt June 18, 1815; was aide-de-camp to the crown prince Max of Bavaria when, in 1848, in the Schleswig-Holstein war, he organized a corps of volunteers; became chief of staff to Prince Eduard of Saxony in 1849, and chief of staff to Gen. Willisen in 1850, but left the Schleswig-Holstein army soon after; returned to the Bavarian service, and was made a lieutenant-general and adjutant-general to the king. In the war with Prussia in 1866 he was chief of staff of the Bavarian army, and the failure of the war was generally ascribed to him by public opinion. In 1869 he was made a general of infantry, and he commanded the first Bavarian corps in France. Here he distinguished himself in the battles of Wörth, Beaumont, and Sedan, and in the battle of the Loire. AUGUST NIEMANN.

Tan'rec, the French name given to certain insectivorous mammals of the genus *Centetes*, for which it is used as the equivalent in French works. In external appearance and size the species considerably resemble the hedgehogs (*Erinaceus*), but are very different anatomically. Their head-quarters are the island of Madagascar, and there they are esteemed by the natives as food, although they emit a strong musky odor. THEODORE GILL.

Tan'sy [Fr. *tanaisie*] (*Tanacetum vulgare*) is a perennial plant bearing doubly-pinnatifid leaves and yellow flowers, blossoming from July to September. It was originally introduced into the U. S. from Europe, where it is indigenous. It is cultivated in gardens, but also grows in fields. It possesses a very strong, not unpleasant, odor, and an acrid and aromatic taste; which properties are exhibited by its aqueous and alcoholic infusions. The leaves contain, besides the usual proportions of chlorophyll, lignine, stearine, resin, tannin, etc., a peculiar volatile oil and an acid termed *tanacetic acid.* The latter is crystalline, forms salts with potassium and sodium, and precipitates solutions of calcic, zincic, argentic, and mercuric salts. The volatile oil of tansy has a sp. gr. of 0.92; when distilled with potassic chromate and sulphuric acid, it yields a volatile crystalline substance isomeric with ordinary camphor; it possesses poisonous properties. The seeds and leaves of tansy are employed, to a slight extent, as medicinal agents. J. P. BATTERSHALL.

Tantal'idæ [from *Tantalus*—a mythological name—the representative genus], a family of birds comprising the ibises and related kinds. The general form is that familiar in connection with the ibis; the bill is very long, more or less slender, compressed, and decurved toward the tip, or even sickle-shaped; the gape extends nearly as far back as the eyes; the nostrils are lateral, but near the culmen and the base of the bill, and linear; the wings are obtuse, but long (the humeri turned backward, passing beyond the acetabula); the tail moderate or small and even; the legs elongated, with the tibiæ exposed, and toward the knees featherless, and with the tarsi covered in front with transverse or hexagonal scales, and behind as well as on the sides with small scales; the toes are all well developed, the anterior connected by deeply-cut webs, the posterior free; the claws are arcuate and well developed. The family is most nearly related to the Ciconiidæ (storks) and Plataleidæ (spoonbills), and have been by some authors combined with them in one family (Ciconiidæ). The species are chiefly inhabitants of warm countries in all parts of the world. Thirty-one species are known, which have been arranged by Gray in two sub-families and three genera—viz. (1) Tantalinæ, with the single genus *Tantalus* (5 species), and (2) Ibidinæ, with the genera *Ibis* (7 species) and *Geronticus* (19 species). The species whose range extends more or less within the limits of the U. S. are *Tantalus loculator* (the wood ibis), *Ibis rubra* (the red ibis), *Ibis alba* (the white ibis), *Ibis Ordii* (the glossy ibis), and *Ibis guarauna* (the bronzed ibis). The species of the family mostly live on the borders of lakes and rivers, and subsist, some on fishes and reptiles chiefly, and others on worms and insects for the most part. They are birds of passage, and change their resorts with the seasons. The females build nests, some on the ground and some in trees, and lay but few (generally two or three) eggs. (See also IBIS.) THEODORE GILL.

Tan'talum [Lat. *tantalus*], one of the rarer elements, a metal discovered in 1802 by the Swedish chemist Ekeberg in two Swedish minerals, one of which was *tantalite*, composed mainly of tantalic oxide, Ta_2O_5, and ferrous oxide. Ekeberg named the metal and mineral after the mythological being Tantalus, in jocular allusion to the tantalizing difficulties he encountered in analyzing the mineral. For many years it was confounded with the COLUMBIUM (which

see) of Hatchett. Tantalum is found also as tantalate of yttria in the mineral *yttro-tantalite*; in the American, Bavarian, and Greenland *columbites*, with columbic acid; in Nordenskjöld's *hjelmite*; in *euxinite*, *aeschynite*, etc. H. Rose obtained metallic tantalum as a black powder, of density 10.78. Its equivalent weight is accepted as 182 from determinations of Marignac. *Tantalic pentoxide* (Ta_2O_5), which forms tantalic acid by reacting with water, and tantalates by combining with bases, is an infusible white powder, which has been obtained by different methods in a number of modifications, varying in density from 7 (*Hermann*) up to 8.26 (*H. Rose*). There is another oxide known, TaO_2, and a sulphide, TaS_2, which is black and brass yellow when burnished. A solid yellow chloride, $TaCl_5$, is known, which may be sublimed. HENRY WURTZ.

Tan'talus, in Grecian mythology, a wealthy king of Argos, Corinth, Phrygia, or Paphlagonia, who committed some great crime against the gods, either by divulging their secrets entrusted to him, or by stealing nectar and ambrosia from their table, or by testing the omniscience of Zeus by cooking his own son Pelops and serving him as a dish for the god. As a punishment, Tantalus was placed in a lake in the lower world whose waters receded from his lips whenever he tried to drink, surrounded by rich fruits which withdrew whenever he attempted to eat of them, and with a huge rock suspended over his head and always threatening to fall and crush him.

Tan'tum Er'go [Lat.], a popular eucharistic hymn in Latin, is a portion of the PANGE LINGUA (which see). It is sung in Roman Catholic churches during eucharistic services at the benediction.

Tan Yard, tp., Pike co., Ala. P. 1140.

Taormi'na [anc. *Tauromenium*], town of Sicily, province of Messina, situated on Monte Tauro near the seashore. Founded by the Siculi, besieged in vain by the elder Dionysius, for a time in the hands of Carthage, it became under Andromachus one of the powerful cities of Sicily. With Syracuse it fell under the Roman dominion (212 B. C.), but its population never equalled that of Messina or Catania. The principal antiquities of interest are—the ancient theatre, originally Greek, but rebuilt by the Romans, and in some respects one of the most perfect existing; the so-called naumachia, also Roman; the sepulchres; five Roman reservoirs, of which one is still in good condition. There are also some Saracenic and mediæval ruins worthy of notice, besides the actual walls and towers, which are mostly of Saracenic construction. The castello or citadel occupies the highest point of the old town. The modern village is of no interest except for the almost unrivalled beauty of its position and climate. A very good hotel has recently been opened here. P. 3000.

Ta'os, county of N. W. New Mexico, bordering on Colorado and Arizona; watered by the Rio Chama, the San Juan, and the Rio Grande, and crossed by several spurs of the Rocky Mountains. There are quartz gold mines. Staples, Indian corn, wheat, and wool. Cap. Fernandez de Taos. Area, about 7500 sq. m. P. 12,079.

Tapa, a kind of paper cloth made by the South Sea islanders from the bark of small branches of the paper mulberry (*Broussonetia papyrifera*). The natives take the moistened slips of the bark, beat them together, and then suffer them to dry. The same material affords the excellent paper of Japan.

Tapa'jos, river of Brazil, rises in the S. of the province of Matto Grosso under the name of Jaruenna, assumes the name of Tapajos after its entrance into the province of Para, and joins the Amazon, after a northward course of about 1100 miles, in lon. 55° W. It is navigable till within a few miles from its sources, and these are only a few miles distant from the Paraguay.

Tap'estry [Gr. ταπης, a "carpet," Fr. *tapisserie*], an ornamental carpet work for decorating walls and furniture, brought into general use in Western Europe by the Saracens of Spain, from whom it was often called in French *sarrazinois*. The oldest known specimen is the BAYEUX TAPESTRY (which see), commemorating the Norman conquest of England. In the fourteenth and fifteenth centuries the fabrication of tapestry by the loom became an important industry in Flanders, and was introduced into England early in the sixteenth century. The most important manufactory at the present time is that of the Gobelins. (See GOBELINS TAPESTRY.)

Tape'worm, a parasitic worm of flattened, tape-like form, living in the intestines of man and many of the lower animals. It belongs to a group of worms distinguished by the fact that they [illegible], having no resisting integument; that they are without an intestinal canal, and consequently have neither mouth nor anus; and that the sexes are united, the male and female [illegible] in the same [illegible]. The anterior extremity or "head" of a tapeworm is [illegible] spheroidal or [illegible] lateral cavities or [illegible], and [illegible] movable, sharp pointed, [illegible] by means of which [illegible] mucous membrane. Next the head [illegible] like portion, and beyond this [illegible] becomes thicker and wider [illegible] gular divisions or articulations. The [illegible] more distinct and completely organized [illegible] from the situation of the head. Each [illegible] both male and female generative organs, [illegible] dating, so that those which are [illegible] eggs enclosing living embryos. The [illegible] vided with muscular fibres, both [illegible] verse, and are capable of contraction [illegible] various directions. Underneath the [illegible] bedded a large number of smooth, rounded, [illegible] tive, calcareous granules. A double [illegible] canals, containing a limpid colorless fluid, run [illegible] with each lateral edge of the tapeworm, [illegible] with each other in each articulation by transverse [illegible]. These vessels are undoubtedly connected with the [illegible] of nutrition, but their exact function is not understood. As there is no mouth, the absorption of nutriment [illegible] from the exterior must take place through the [illegible] tegument. The whole tapeworm thus forms a long [illegible] row, ribbon-like chain of articulations, attached by the head to the intestinal mucous membrane. It is not regarded as a single animal, but as a colony composed of many individuals, all belonging to the same species, but differing in structure and function. The so-called head is adapted for holding the colony in position. It also has the power of developing the other parts by a budding process, the successive articulations thus formed producing at last eggs and embryos, and in this way continuing the species by sexual generation. The mature [illegible] remain connected with the colony until their eggs and embryos have reached a certain grade of development. They then discharge their eggs, and are themselves [illegible], or else they are detached entire, still retaining [illegible] ent vitality. In either case, the eggs and [illegible] finally set free, to continue their growth in a [illegible] cality. This constitutes an important feature in the development of the tapeworm. The eggs or [illegible] leaving the intestine of the animal in which they [illegible] produced, are devoured by some other animal [illegible] kind, and while within its body reach a [illegible] stage of development in an encysted form [illegible] the flesh of the second animal [illegible] the original species, and these [illegible] rived in an intestine suitable [illegible] ment, again reproduce the tapeworm [illegible]. Thus the parasite exists naturally under two [illegible] ly, a small, encysted, sexless form in the [illegible] animal, and a largely developed, sexual [illegible] the intestine of another. These two [illegible] with each other in the regular [illegible] both are equally essential to the continued [illegible].

The numerous [illegible] animals are included in two [illegible] *Tænia* and *Bothriocephalus* [illegible] by species infesting the human [illegible].

I. *Tænia* [illegible] genus is distinguished by the [illegible] by the position of [illegible] [illegible] n, provided each with th[illegible] [illegible] inch in diameter [illegible]

ing their eggs and embryos, separate one by one from the parent colony and pass out of the intestine, either spontaneously or with the evacuations. If deposited upon the ground in a damp place and protected from desiccation, they may retain their vitality and power of locomotion sufficiently to attach themselves to the neighboring herbage or low-growing plants, and are thus liable to be devoured by [illegible] animals. Such contractile movements have been [illegible] observed in separate articulations for a [illegible] time after their expulsion, and, according to Küchenmeister, the articulations may be kept alive for eight days in occasionally renewed white of egg. There is reason to believe that the eggs may also continue for a time uninjured when suspended in watery fluids, even after the substance of the articulation has become lacerated, or decomposed and diffluent. These circumstances indicate the probable mode in which the tapeworm articulations or their young brood may become mingled with the food and drink of inferior animals. The species in which they usually reach their next stage of development is the pig. When introduced into the stomach of this animal, the substance of the articulation is dissolved by the digestive juices, and the embryos are set free. They then begin an active emigration from the cavity of the intestine, penetrating its walls and the neighboring tissues, and dispersing in this way throughout the body. This passage is effected by a boring process by means of the three pairs of spicules with which the embryos are provided and the contractile movement of their membranous walls. When once disseminated through the cellular tissue of the body and limbs, they become encysted, by the formation of an external envelope from the neighboring parts. They then increase in size, and pass into their next stage of development. They lose the six spicules which mark their previous condition, and acquire instead a neck and head with four suckers and a crown of hooks, like those of the adult tapeworm. The head and neck, however, at this time are inverted upon themselves, and thus enclosed in the interior of a globular vesicle, the enlarged spherical body of the embryo. If the external cyst be now opened, the contained parasite may be turned out of its bed in the form of a globular vesicle with a superficial depression at one spot, marking the situation of the inverted head. By gentle compression the inverted parts may be gradually extruded, and the organism then presents the appearance of a fully-developed tapeworm head and neck, terminating behind in a dilated vesicular extremity. In this condition it is known by the name of *cysticercus* (Gr. κυστις, "vesicle," and κερκος, "tail") or "bladder tail," and from its locality in the cellular tissue it is called the *Cysticercus cellulosæ*. When the flesh of the pig is thus infected with *Cysticercus cellulosæ*, it is sprinkled more or less abundantly throughout with thin-walled, semi-transparent cysts, and in this condition it is known as "measly pork." When about one month old, the cysts are $\frac{1}{20}$th of an inch in diameter; when fully grown, they may attain the size of one-third of an inch, or even more, and are sometimes so numerous in certain spots as to touch each other. After reaching this stage of development, the parasites remain for an indefinite time encysted in the cellular tissue. While in this situation they undergo no further change, unless it be a very gradual process of atrophy, with partial collapse and calcification of the cyst, which may occur after the lapse of several years.

The subsequent history of this species relates to the reintroduction of the *Cysticercus* into the human intestine, and its development there into the adult tapeworm. When a portion of swine's flesh containing *Cysticercus* is swallowed by man in an uncooked or imperfectly-cooked condition, the enveloping sac is digested by the gastric juice, and the parasite is set free. On arriving in the upper part of the small intestine, the head attaches itself to the mucous membrane, and the neck, absorbing nourishment from the intestinal fluids, increases in length and width. The transverse wrinklings of its substance become more distinctly marked, and regular articulations make their appearance, assuming the form of a continuous chain, and exhibiting finally the characteristic sexual organs, with mature eggs and embryos. The human subject is therefore infected with tapeworm by swallowing the live *Cysticercus*, usually derived from measly pork. It is not, however, the most thoroughly diseased pork which is the most dangerous in this respect, since its unhealthy appearance is too marked to escape notice. In many instances the cysts are comparatively few and scattered, and such meat may be prepared for food without the presence of the parasite being observed. Butchers, sausage-makers, and provision-dealers are also liable to infect themselves by careless handling of the fresh meat, placing between their lips the blade of the knife used in cutting it up, or tasting food while at their work or immediately afterward without washing their hands. By such means they may easily, without knowing it, introduce one or two small *Cysticerci* directly into the mouth, or contaminate with them bread and other articles of food. This mode of infection is the more likely to produce tapeworm because there is no protection by cooking, which in the meat itself, when used for food, is generally sufficient to destroy the vitality of the parasite.

When a *Tænia solium* is fully established in the human intestine, it becomes a source of annoyance and sometimes of marked distress. A great variety of symptoms are enumerated as having been observed in cases of *Tænia solium*, but none of them are sufficiently definite or uniform to give any certain indication of its presence. All writers agree that the only sure sign of the existence of a *Tænia* in any given case is the discharge of its articulations from the intestine. The truth seems to be, that in robust and otherwise healthy persons it may be present for an indefinite time without causing any serious effects; but in those of an enfeebled constitution or irritable temperament it may give rise to abdominal pains, indigestion, loss of flesh, restlessness, and even hysterical convulsions. The treatment consists in the administration of drugs intended to destroy the vitality of the worm, and thus cause the head to loosen its hold upon the mucous membrane. This is essential to the cure; for, although ordinary purgatives or an accidental diarrhœa may detach and bring away considerable portions of the articulated body, if the head remain the articulations are in time reproduced, and the parasite is again as large as before. But if the head be discharged, no reproduction takes place and the malady is at an end. The most successful remedies for this purpose are the bark of the pomegranate-root and the extract of the root of the male fern. According to Küchenmeister, the best results are obtained by administering a mixture of both these drugs in two or three successive doses, followed by an ordinary aperient to bring away the detached worm.

It is a circumstance of some importance in this connection that *Cysticercus* also occurs in the human subject. Though never present in man as abundantly as in the pig, it is not unfrequently found singly, and sometimes in greater numbers. Its different localities are, in the order of their frequency—the cellular tissue beneath the skin, between and in the tissue of the muscles, the surface and the interior of the brain, the envelopes and inner chambers of the eyeball, the heart, the lungs, the mesentery, and the lymphatic glands. The effects produced by its presence depend on the importance of the organ invaded and on the abundance of the parasite in a given locality. In the subcutaneous cellular tissue it is nearly or quite harmless, while in the eye even a single one may produce serious disturbance of vision, and in the brain the local irritation may cause vertigo, paralysis, or convulsions.

The mode in which *Cysticercus* happens to be developed in the human system is undoubtedly from the accidental swallowing of the ripe eggs of *Tænia solium*. It is not likely that it ever comes directly from a tapeworm in the intestine of the same person; for even when such a tapeworm exists, its mature articulations are detached and discharged with the eggs still contained in their interior; and the young embryos, so far as we know, are never set free within the intestine harboring the parent tapeworm. It seems to be necessary that the detached articulation should pass anew into the alimentary canal and undergo stomach digestion, or in some other way suffer disintegration, before the embryos can be liberated from their envelopes. In an individual infested with *Tænia solium* the detached articulations sometimes pass out of the bowels by themselves, independently of the alvine evacuations. Such an articulation, if roughly handled, is liable to be ruptured, and its microscopic eggs may then adhere to the fingers of the person handling it, and may be afterward transferred to various articles of food, especially in households where the usual precautions of cleanliness are habitually neglected. The person harboring a tapeworm may thus indirectly infect himself or other members of his family with *Cysticercus cellulosæ*. Another probable source of this infection is the use of fresh, uncooked vegetables, such as lettuce, radishes, and the like, when imperfectly washed. The evacuated tapeworm articulation is liable, as above mentioned, to attach itself to low-growing herbaceous plants, and even after its disintegration its eggs may remain for a time protected by the shade and moisture of the leaves. Unless the plants, therefore, when gathered, are thoroughly cleansed before use, they may thus convey into the system the germ of *Cysticercus cellulosæ*.

II. *Bothriocephalus* (Gr. βοθριον, a "furrow," and κεφαλή, "head").—This genus is distinguished from the preceding, first, by the structure of its head, which is elongated in form, destitute of the crown of hooks, and, instead of the four orbicular suckers, has usually two narrow lateral pits or furrows; and secondly, by the position of its genital orifices, which are seated on the flat surface of each articulation,

in the median line. The species met with in man is *Bothriocephalus latus*, so called from its width and the shape of its mature articulations, which are considerably broader than long. The worm is found in the cavity of the small intestine. It is of a bluish-white color, often brownish in its middle parts. Its length is often very great, amounting to over 2000 articulations, and its width in the lower part of the chain averages about one inch. The head is a long oval, $\frac{1}{25}$th of an inch in its transverse diameter, but very contractile, and capable of assuming considerable variations of form. Its two lateral furrows are long and narrow, presenting the appearance of longitudinal fissures. The male and female genital openings are distinct from each other on the surface of each articulation, the male orifice being situated more in front, the female behind. The mature eggs are oval in form, $\frac{1}{370}$th of an inch in length, and provided with an operculum or lid at one extremity, which on opening allows the escape of the embryo. The outer membrane of the embryo is covered with movable, hair-like filaments or cilia; and within it is a vesicular body, with three pairs of spicules like those in the embryo of *Tænia*. The mature articulations do not separate one by one, but are thrown off in chains or fragments of considerable length, and only after they have discharged their eggs. They are consequently evacuated in an empty and more or less deformed and collapsed condition. The symptoms to which this worm gives rise are similar to those caused by *Tænia solium*, and the treatment required is the same for both.

The history of development of *Bothriocephalus latus*, subsequently to the expulsion of its eggs, has not yet been ascertained, and consequently the source of infection by this worm for the human species is unknown. It is suspected by naturalists that it passes through its intermediate condition, as an encysted parasite, within the bodies of certain kinds of fish or of some aquatic invertebrate animals liable to be used as human food. The grounds for this supposition are that most species of *Bothriocephalus* inhabit the bodies of fish, while they are very rare in terrestrial mammalians. In this respect they differ from *Tæniæ*, which are quite frequent in mammalians and birds, but rare in fish. In some fishes, as in the stickleback, the *Bothriocephalus* parasite is in an incomplete and unsexual condition, occupying the cavity of the abdomen, but, according to Siebold, becomes a fully-formed sexual tapeworm in the intestine of birds or of larger predaceous fish which feed upon the smaller ones. The existence of an enveloping membrane with movable cilia in the embryo of this species also indicates that it is adapted for temporary migration in a watery medium, and is thus enabled to reach the interior of the animal in which it is to become encysted. It has long been noticed that while *Tænia solium*, as a human parasite, is found in the most different countries—in Europe, Asia, and Africa, and on both sides the Atlantic—the occurrence of *Bothriocephalus latus* is limited in Europe to particular regions. It is most frequent in Western Switzerland, especially about Geneva, next in the N. of Russia, in Sweden and Poland, and occurs also in Holland and Belgium. It is very rare in England, and is never found in the U. S. except among foreigners from the above-mentioned European localities. No doubt, some habit of life or kind of alimentation common to these districts is the immediate cause for the production of *Bothriocephalus*, but what it is has not yet been determined with any approach to certainty. J. C. Dalton.

Tapio'ca, the starch of the *Janipha* (or *Jatropha*) *manihot* (cassava-plant), from which it is prepared by pressing the washed and dried roots under water, when it is obtained in a mealy form, which is converted into a granular condition by drying over hot plates. Upon drying and pressing the pulp remaining in the water, *cassava-bread* is obtained. This, when pulverized, is known as *manjok flour*. Tapioca is largely consumed as an article of food. J. P. Battershall.

Tapioca Starch. See Tapioca.

Tapir. See Tapiridæ.

Tapir'idæ [from *Tapirus*—a Latinized form of a Brazilian aboriginal name—the typical genus], a family of mammals of the order Ungulata and sub-order Perissodactyla, related to the rhinoceroses and horses (Equidæ), and not at all to the hogs (Suidæ) or hippopotamuses, as is popularly believed. In form, however, the tapirs perhaps more resemble the hogs than their nearer relations, but they are peculiar in that the hind quarters or buttocks project notably backward, and the snout is produced into a rudimentary flexible proboscis; the nostrils are at the end of the proboscis: the ears are erect and moderately developed; the neck abbreviated: the tail very short: the anterior feet have each four toes, the posterior three. The teeth are in almost full number—viz. M. $\frac{3}{3}$, P. M. $\frac{4}{3}$, C. $\frac{1}{1}$, I. $\frac{3}{3} \times 2 = 40$; all the molars, as well as premolars in part (P. M. 2, 3, 4), are nearly similar, squarish, and each with the anterior crest marginal, but with an anterior cingulum terminating in a cusp at the antero-outer angle of the tooth; the hindermost molars (M. 3) have no posterior lobes; the outer incisors of the upper jaw are enlarged, and like canines: the true canines very small; the incisors of the under jaw uniform; the canines large. The skull has a nasal aperture very large, and encroaching far behind into the frontals and on each side of the nasal bones, leaving apparent sideways the septum between the nares, and separated from the orbits only by the thin frontal bones; the axis formed by the basioccipital and basisphenoid bones is very narrow; between it and the periotic elements are large vacuities; the periotic bones are free from (not ankylosed with) the squamosal and tympanic; the tympanic are "exceedingly rudimentary, forming a small irregular floor to the tympanic cavity, with an oval lip for the attachment of the membrana tympani, and always become detached in macerated skulls" (*Flower*); the post-tympanic processes elongated, and connected with them halfway are the paroccipital processes of the exoccipitals; between the two behind are narrow projections of the mastoid bones; the nasal bones, when fully developed, form together a hastiform figure, broad behind and tapering forward; they are enclosed by the mesethmoid, whose upper edge is correspondingly dilated, and which becomes more or less ossified in the adult; the supramaxillary bones are free and enrolled at their upper margins, or laminar and clasp the mesethmoid; the intermaxillaries are well developed and tectiform; the orbits separated from the temporal fossæ only by slight angular processes of the malar bones; the lower jaw has moderately deep rami, whose angles are convex and project considerably backward. These are the principal characteristics of this well-marked family, and which contrast with the Equidæ and Rhinocerotidæ. It is at present represented by five and possibly more species—viz. (1) *Tapirus terrestris*, a species widely spread over South America in the lowlands, and extending from the Isthmus of Panama to Paraguay; (2) *Tapirus pinchaque*, confined to the Andes of South America, especially Ecuador and New Granada; (3) *Rhinochœrus Indicus*, an inhabitant of the Malaccan Peninsula, Sumatra, and Borneo; (4) *Elasmognathus Bairdii*, a native of the Isthmus of Panama, and extending northward into Southern Mexico; and (5) *Elasmognathus Dowii* (a somewhat doubtful form), found in Nicaragua. The *Tapiri* and *Rhinochœri* have the margins of the upper jaw rolled inward, but the *Elasmognathi* have them spread out so as to firmly embrace the mesethmoid. All the species are denizens of deep forests, but near where water abounds, to which they love to resort. They vary in size from that of a small ass to that of a moderate horse, the *Tapirus pinchaque* being the smallest, and the *Rhinochœrus Indicus* the largest. The *Elasmognathus Bairdii* is the largest American species. All the species (except possibly *E. Dowii*) are striped or spotted in early youth, but soon assume the uniform or bicolored livery of full age. Although now represented by species so singularly isolated as are the American and Malaccan species, in the Tertiary epoch the family was widely diffused, and species roamed over Europe and America far to the northward. The species, too, are the nearest relations of the Eocene Lophiodontidæ, which are among the oldest of known placental mammals.

Theodore Gill.

Tappahan'nock, p.-v. and port of entry, cap. of Essex co., Va., on the S. bank of Rappahannock River, 64 miles below Fredericksburg, has 2 churches, excellent schools, 1 newspaper, a large sumac and bark mill, a carriage factory, and 2 hotels. There are steamers twice a week each way from Norfolk and Baltimore. P. about 800. A. R. Micou, Ed. "Index."

Tap'pan (Arthur), b. at Northampton, Mass., May 22, 1786, son of Benjamin (1748–1831), a Revolutionary patriot and merchant; received a good common-school education; served at Boston a seven years' apprenticeship (1800–07) to the hardware business, after which he set up for himself in the same line at Portland; soon removed to Montreal, Canada, and became a successful importer, but closed up the business at a great sacrifice upon the outbreak of the war of 1812; established himself in New York as an importer of British dry goods 1814; built up a prosperous business; became widely known for public spirit and philanthropy, and as a liberal patron of religious organizations; was one of the chief founders of the American Tract Society, and the largest donor for the erection of its first building; was a liberal benefactor of the American Bible Society, and originator of the effort to place a Bible in the hands of every family in the U. S.; endowed Lane Seminary at Cincinnati, a professorship at Auburn Theo-

logical Seminary, erected Tappan Hall at Oberlin: joined his brother Lewis in founding the New York *Journal of Commerce* 1828, furnished the money for establishing the *Emancipator* newspaper at New York in the spring of 1833; formed at his own rooms the nucleus of the New York City Anti-Slavery Society, which was publicly organized under his presidency at Clinton Hall Oct. 2: was the first president of the American **Anti-Slavery Society, formed at** Philadelphia Dec. 4, 1833, and contributed to that society for several years $1000 per month, but withdrew from it in 1840 on account of the aggressive spirit manifested by many members toward the churches and the Union; was obliged to suspend payments in the great crisis of 1837, but **by great sacrifices ultimately met all his engagements; was** nevertheless forced to go into bankruptcy in 1842, when he caused the whole of his personal property to be sold; incurred the hatred of Southern slaveholders by his frequent aid given to fugitives and by his rescuing Garrison from imprisonment at Baltimore. During his later years he was connected with the "mercantile agency" established by his brother Lewis. D. at New Haven, Conn., July 23, 1865. (See his *Life*, by Lewis Tappan, New York, 1871.)

Tappan (Benjamin), **brother of Arthur, b. at North**ampton, Mass., May 25, 1773; learned the arts of copperplate engraving and printing and portrait painting; subsequently studied law; settled in Ohio 1799; was chosen to the legislature 1803; was aide-de-camp to Gen. Wadsworth in the war of 1812–15; was for seven years president **judge of the fifth Ohio circuit; was appointed U. S.** district judge by Pres. Jackson 1833; published a volume of *Reports* (Steubenville, 1831) of cases at common pleas; was U. S. Senator 1839–45; was an active Democratic politician, and joined the Free-Soil movement of 1848. D. at Steubenville Apr. 12, 1857.

Tappan (David), **D. D., b. at Manchester, Mass., Apr.** 21, 1752; graduated at Harvard College in 1771; studied **divinity, and in 1774 became pastor of a Congregational** church in Newbury, Mass., where he remained until 1792, **when he was chosen Hollis professor of divinity in Har**vard University, a position which he held until his death. **He printed several occasional sermons and discourses, and** after his death were published—*Sermons on Important Topics*, with a biographical sketch by Rev. Abiel Holmes (1807), and *Lectures on Jewish Antiquities*, delivered at Harvard University. D. Apr. 27, 1803.

Tappan (Henry Philip), **D. D., b. at Rhinebeck, N. Y.,** Apr. 23, 1805; graduated at Union College in 1825; studied theology at Princeton, and after having been a year associate pastor of a Dutch Reformed church in Schenectady, became in 1828 pastor of a Congregational church in Pittsfield, Mass.; in 1832 became professor of moral philosophy in the University of the City of New York; resigned in 1838, and opened a private school, and in 1852 was elected chancellor of the University of Michigan; resigned in 1863, and has since resided chiefly in Europe. He published—*Review of Edwards's Inquiry into the Freedom of the Will* (1839), *The Doctrine of the Will determined by an Appeal to Consciousness* (1840), *The Doctrine of the Will applied to Moral Agency and Responsibility* (1841), *Elements of Logic* (1844; revised and enlarged 1858), *Treatise on University Education* (1851), and *A Step from the New World to the Old, and Back Again* (1852).

Tappan (Lewis), **brother of Arthur and Benjamin, b.** at Northampton, Mass., May 23, 1788; engaged in com**mercial business and cotton manufacture at Boston; re**moved to New York 1827; aided his brother in founding the *Journal of Commerce* 1827, and was sole owner of that paper 1828–31; had his house sacked by a mob in consequence of his anti-slavery sentiments July, 1834; was involved like his brother in the financial crisis of 1837; afterward established a "mercantile agency," the first of the kind in the U. S.; was prominent for many years in anti-**slavery, religious, and philanthropic associations, especially in the American Missionary Association, founded** chiefly through his efforts, of which he was long the treas**urer, and ultimately president; was an early member of** Plymouth church, Brooklyn, and published a *Life* of his brother Arthur in 1871. D. at Brooklyn June 21, 1873.

Tappan (William Bingham), **b. at Beverly, Mass.,** Oct. 29, 1794. His early advantages were limited, but he acquired a sound education, and was for six years a successful teacher in Philadelphia; in 1826 removed to Boston; became general agent of the American Sunday-School Union, and was licensed as a preacher in 1840. He published *New England and other Poems* (1819), and several other volumes of poems at later periods, and *Memoirs of Capt. James Wilson* (1842). Nearly all of his poetical works, with his final revisions, are comprised in the following volumes: *Poetry of the Heart* (1845), *Sacred and Miscellaneous Poems* (1846), ***Poetry of Life*** **(1847),** ***The*** *Sunday School, and other Poems* (1848), and ***Late and Early Poems*** **(1849). D. at West Needham, Mass., June** 18, 1849.

Tappan Sea, or **Tappan Bay** [Dutch, *Tappaan Zee*], is an expansion of Hudson River. Its lower end is 24 miles N. of New York. It is 12 miles long, and its greatest breadth is 4 miles. It extends from Teller's Point to Piermont.

Tap'ping (*Paracentesis*), in surgery, is the piercing of the walls of a cavity so as to draw off a dropsical or other collection of fluid. The abdomen, chest, scrotum, and even the head, are often tapped for the removal of such effusions. The trocar and canula answer for the performance of the operation in many simple cases. In some others the contained fluid has to be removed by an instrument acting as a pump or syringe. Tapping often affords great relief, and occasionally is of great service toward recovery, especially in cases of pyothorax and hydrothorax.

Tapsfield, tp., Washington co., Me. P. 463.

Tap'ti, river of British India, presidency of Bombay, rises in lat. 21° 46′ N., flows W. through Surat, and falls into the Bay of Cambay after a course of 441 miles. It is navigable only for a short distance from its mouth, and only for small vessels.

Tar, Coal, or **Pitch.** The term *pitch* is applied to a variety of solid resinous substances of dark color and bril**liant lustre: (1) mineral pitch, called asphaltum and bitu**men, abundant at the Dead Sea ("Jews' pitch"), Barbadoes, Trinidad, Mexico, Cuba, Ritchie co., West Va. (grahamite), Albert mine, Nova Scotia (albertite), Peru, Cali**fornia, etc. (see** Bitumen**); (2) Burgundy pitch, the melted** resin of *Abietis resina* or *Thus*; (3) wood tar pitch, pre**pared by boiling down (distilling off the naphthas) wood**tar; (4) coal-tar pitch, prepared in the same way from coal-tar. Little is known with regard to the chemical composition of pitch: that from pine-wood tar is resinous. **Pitch is used in medicine and for roofing, paving, calking** ships, making varnishes, etc. C. F. Chandler.

Tara, or **Taro** (which see).

Taraika. See Saghalien.

Tar'antism, an epidemic dancing mania, formerly prevalent in Apulia, and especially at Taranto, whence its name. It was popularly believed to be caused by the bite of the Tarantula (which see), and doubtless the fright attending the bite may have aggravated the nervous symptoms of the patient. Not only dancing, but catelepsy, was one of the symptoms. It was believed that the patients possessed an ardent passion for music and the dance and for bright and beautiful objects. The most successful cure was from hearing and dancing the music of the tarantella, **the national dance of the Sicilians. It also prevailed in** Barbary.

Ta'ranto [Gr. Τάρας; Lat. *Tarentum*], town of Italy, province of Lecce, in lat. 40° 26′ N., lon. 17° 16′ E., at the N. extremity of the large gulf of the same name which forms the hollow below the heel of the *Boot*. The town is **built on an island connected with the mainland by two** stone bridges, and on both sides a deep bay sweeps inland, thus forming a double basin, that to the W. being called the Mar Grande, that to the E. the Mar Piccolo. Two low islands (anc. *Choerades*), San Pietro and San Paolo, lie as a protection across the harbor, which, if not the finest in Italy, is at least second only to that of Spezia. The main entrance is between Cape S. Vito and the island of S. Pietro, and admits shipping of the heaviest tonnage; the N. W. **passage is practicable only for small vessels. With a few** not very expensive improvements, this port, from its advantageous situation with respect to the Suez Canal, and **as the most favorable marine station in Southern Italy, will** doubtless become of great commercial importance. At present the whole number of vessels entering the harbor annually is only about 1500, and the town lacks good hotels and many of the comforts necessary to modern civilization. **There is little to interest the visitor beyond the exception**ally beautiful views of sea and land to be had at many points, and the abundance and richness of the almost tropical vegetation, which can hardly be less luxuriant now than when Horace wrote his *Ode* 6, b. ii. Even the datepalm bears fruit here, though not in its perfection. The honey, the oil, and the fruits of the neighborhood have as great a reputation as ever, and the waters abound in excellent fish of many varieties. The remains of the ancient town, the largest of all the cities of Magna Græcia (founded 707 B. C.), and once boasting an army of 30,000 foot and 3000 horse, besides a strong navy, are very insignificant. Taranto is not without a place in mediæval history, and is especially remembered as the fief of Bohemond the Norman crusader. P. 27,546.

Taran'tula [from TARANTO, which see], a name applied to several different kinds of animals. (1) Primarily, it was given to the *Lycosa tarantula*, a spider of Southern Italy. Its bite was supposed to cause the disease called TARANTISM (which see), but by modern observers it is pronounced less severe than the sting of the common wasp. (2) In warm, temperate, and tropical countries it is extended by the English-speaking races to sundry large spiders, and especially those of the genus Mygale (family Mygalidæ). (3) Some lizards are also popularly styled tarantulas, and there is a genus, *Tarentola*, of the family Geckotidæ, having representatives in warm climates.

Tarare', town of France, department of Rhone, on the Tartine, is celebrated for its manufactures of muslins, shawls, and silks. P. 11,569.

Tarascon', town of France, department of Bouches-de-Rhône, on the left bank of the Rhone, has large manufactures of linen, cotton, woollen, and silk fabrics, brandy, oil, and vinegar. In its vicinity teasles, madder, almonds, and fruits are extensively cultivated. P. 13,489.

Taraxacum. See DANDELION.

Tarazo'na, town of Spain, province of Saragossa, on the Queiles, has a fine cathedral with a spire of brick, and about 6000 inhabitants, mostly engaged in agriculture.

Tarbagatai', town of China, in Toorkistan, near the Russian frontier, in a fertile plain in lat. 46° 8' N., lon. 82° 38' E. It has hardly 4000 inhabitants, but a very important trade between China and Russia is carried on here.

Tarbes, an old but well-built and handsome town of France, capital of the department of Hautes-Pyrenées, on the Adsur, has several good educational institutions, and some manufactures of oil, leather, paper, cutlery, and copperware, and carries on an active general trade. P. 16,535.

Tar'boro', p.-v. and tp., cap. of Edgecombe co., N. C., on a branch of Wilmington and Weldon R. R., 60 miles S. E. of Raleigh, has 4 churches, male and female academies, 1 bank, 1 newspaper, 1 hotel, agricultural implement manufactory, and a fire insurance company. Pop. of v. 1340; of tp. 3102. W. P. WILLIAMSON, ED. "SOUTHERNER."

Tardigra'da [from Lat. *tardus*, "slow," and *gradus*, "walk"], a name proposed as a family term by Illiger in 1811 for the sloths, but adopted by later writers as a subordinal designation for the existing Bradypodidæ (sloths) and extinct Megatheriidæ. The principal superficial characters by which they are distinguished from the other members of the order Edentata or Bruta to which they belong are as follows: (1) The integumentary appendages are developed as simple hairs; (2) the facial portion of the skull is more or less abbreviated; (3) teeth are developed in small and definite numbers (*e. g.* $\frac{5}{4}\times 2$) in the supramaxillary and dentary bones, but never in the intermaxillary or front of the lower jaw; (4) these teeth are composed of a large central axis of vascular dentine, with a thin investment of hard or unvascular dentine, and a thick outer coating of cement (*Owen*); (5) the teeth are also monophyodont—*i. e.* only one set is developed; (6) they are adapted for an herbivorous or rather phyllophagous (leaf eating) regimen; (7) the placenta is discoid and deciduate, and much resembles that of the anthropoid Primates (man and monkeys). There are two families, Bradypodidæ and MEGATHERIIDÆ (which see). THEO. GILL.

Tardigrada, the name used by Doyère in 1840, and subsequently by a number of others, for a group (order or sub order) of mite-like animals of the class of arachnids. They have been defined by Claus as hermaphrodite arachnids with sucking and stinging mouth-parts, and short, stumpy legs, and destitute of heart and respiratory organs. Only one family is admitted—*i. e.* Arctiscidæ. They resemble the rotifers in habits, and have been associated with them in classification, but, as is now evident, erroneously. THEODORE GILL.

Tare, a name of various leguminous plants, especially applied to some of the species of *Vicia*. Some of them are common weeds in the cultivated grounds of the U. S. and Europe. *V. sativum* is itself cultivated as a forage plant. Its rather scanty herbage is very nutritious. It does well on poor lands, but in the U. S. is best known as a weed. It is probable that the plant called tare in the English New Testament is either DARNEL or CHESS (which see).

Tarentum. See TARANTO.

Tarentum, b., Allegheny co., Pa., on Allegheny R. R., has a national bank. P. 961.

Tar'get [Fr. *targe*], commonly designates the object shot at in practice with firearms or in archery. Target practice is of the utmost importance since the introduction of the recently-improved "arms of precision," both for infantry and artillery. In Great Britain the principal seat of rifle target-practice is at Wimbledon, England. In the U. S. the most complete establishment of the kind is that at Creedmoor, L. I., N. Y.

Tar'gums [Chaldee for "interpretation"], the name of certain paraphrases of the Hebrew Scriptures, written in the popular or Aramaic tongue, and giving the rabbinical and traditional interpretation of the text. They are of very ancient and obscure origin. The Targum was at first oral. The Babylonian Targum, as it exists now, consists of parts of several ancient redactions of this oral Targum. The Targum of Onkelos belongs to the Babylonian Targum. That of Onkelos is the most important paraphrase of the Pentateuch that has come down from an early date. There are also extant large fragments of a later Jerusalem Targum, full of curious rabbinical lore.

Tari'fa, town of Spain, province of Seville, on the Strait of Gibraltar, is the southernmost city of Europe. It is surrounded by walls and defended by an old Moorish castle and a modern fort. Its harbor is shallow, but its tunny and anchovy fisheries are very important. P. 12,000.

Tar'iff, a table or list of duties, drawbacks, and bounties charged or allowed on the importation or exportation of goods from one country, state, or city to another. The name is derived from the Moorish town of Tarifa, N. of the Strait of Gibraltar, where duties were collected upon the objects of African commerce. In the U. S. the term is exclusively applied to a law of Congress fixing the amount of the duties on imports.

Tar'iffville, p.-v., Hartford co., Conn., at the junction of several railroads.

Tar'ki, or **Tschanchalova,** town of Russia, in Transcaucasia, is picturesquely situated on an eminence on the western coast of the Caspian Sea, and is fortified. P. about 12,000.

Tar'kio, tp., Page co., Ia. P. 363.

Tarkio, tp., Atchison co., Mo. P. 1120.

Tar'latan, a very delicate fabric of cotton, often dyed or printed, and used for ladies' dresses for evening parties and balls. Switzerland and France are the seats of its manufacture. Great quantities are made at Tarare.

Tar'leton (Sir BANASTRE), b. in Liverpool Aug. 21, 1754, son of the mayor of Liverpool; commenced the study of law, but at the beginning of the Revolution purchased a cornetcy in the dragoon guards; served under Howe and Clinton in the campaigns of 1777 78; rose to the rank of lieutenant-colonel and to the command of the British Legion, with which he served under Clinton and Cornwallis in the South. "The war in the Carolinas was the principal service of Tarleton, and to this hour his name is employed by black nurses to terrify white children into submissive silence." (*Blackwood.*) His American antagonists on the Waxhaw and in the swamps of the Carolinas, MARION and SUMTER (which see), rivalled his exploits, happily without achieving an equal notoriety for cruelty. He took part in the battles of Camden and Guilford Court-house, receiving there his only severe wound, the loss of half his right hand, and at the battle of the Cowpens, Jan. 17, 1781, was defeated by Col. Morgan, and in the pursuit was slightly wounded by the hand of Col. William Washington. He served with Cornwallis during the remainder of the war, being among those surrendered at Yorktown. Returning to England, he was promoted to the rank of colonel, and in 1790 was returned to Parliament for Liverpool, and became an intimate and partisan of the prince of Wales in the unhappy differences with the king, George III.; in 1798 married the daughter of the duke of Ancaster. He was promoted to be major-general 1794, lieutenant-general 1801, general 1812, having previously been appointed governor of Berwick and Holy Island, and was created a baronet and a G. C. B. in 1818. He published a *History of the Campaign of 1780 81 in the Southern Provinces of North America* (1787). D. Jan. 23, 1833. (The reader is referred to *Interesting Revolutionary Incidents and Sketches of Character, chiefly in the Old North State*, by Rev. E. W. Caruthers, D. D., and also to article "Sir Banastre Tarleton," *Blackwood's Mag.*, Oct., 1874.)

Tarl'ton, tp., Pickaway co., O. P. 407.

Tar'ma, town of Northern Peru, has greatly declined since the times of the Spaniards, when it was a flourishing place; but it is still celebrated for the exquisitely fine woollen stuffs it manufactures, and is much resorted to by invalids on account of its fine climate. P. about 5000.

Tarn, department of South western France, on both sides of the river Tarn, an affluent of the Garonne, comprises an area of 2185 sq. m., with 352,718 inhabitants. The ground is elevated, and the surface is mostly an undulating plain, except in the south eastern part, which is covered with spurs of the Cevennes. Forests of oak and beech are numerous, and large crops of wheat, wine, and

hemp are raised. Coal and iron abound and are extensively worked; 1,140,200 cwts. of coal are annually raised, and 11,000,000 gallons of wine of good quality produced. Of 45,435 children of school age, 16,532 received no school education in 1867. Cap. Albi.

Tarn-et-Garonne, department of South-western France, between the rivers Tarn and Garonne, comprises an area of 1405 sq. m., with 221,610 inhabitants. The surface is an elevated and undulating plateau, traversed by several deep valleys along the rivers. The soil is very fertile, and the climate temperate and healthful. Agriculture is the principal occupation, and wheat and wine the principal products; manufactures are rather insignificant. Of 24,330 children of school age, 9898 received no school education in 1867. Next to Vaucluse, Tarn-et Garonne is the smallest department of France, of course with exception of that of the Seine. Cap. Montauban.

Tarno'pol, town of Austria, in Galicia, on the Sered, is celebrated for its horses and horse-markets, which are the most frequented in the country. P. 17,210.

Tar'now, town of Austria, in Galicia, on the Dunajec, has a fine cathedral and many good educational institutions. P. 8159.

Ta'ro [the native name], the root of *Colocasia macrorhiza*, of which many varieties are grown in the Pacific Islands. The tops are used as a potherb, and the starchy root is one of the most important articles of food in Polynesia. In New Zealand the same name is applied to *Pteris esculenta*, a fern whose roots afford an edible starch.

Tarpeia. See TARPEIAN ROCK.

Tarpei'an Rock, at Rome, was the southern portion of the Capitoline Hill. Here Tarpeia was buried, a vestal virgin who during the reign of Romulus betrayed the Capitoline citadel to the attacking Sabines, having obtained from them the promise that they would give her what they wore upon their left arms, meaning certain gold ornaments. But they kept their promise by crushing her beneath their shields. In later times it was customary to hurl from the Tarpeian Rock persons condemned for treason or the exercise of dangerous political powers.

Tarquin'ius, the name of a Roman family which, according to legend, played a very important part in the earliest history of the city of Rome, and two of whose members became kings. The family was of Greek origin. Demaratus emigrated from Corinth and settled at Tarquinii, a town of Etruria. His son, Lucumo, married Tanaquil, an ambitious and cunning woman, daughter of one of the most prominent Etruscan families, and she induced him to emigrate to Rome, where he soon acquired the rights of citizenship and assumed the name of (1) LUCIUS TARQUINIUS PRISCUS. His wealth and his wisdom made him one of the most prominent citizens. The king, Ancus Marcius, appointed him guardian of his children, and after the death of Ancus Marcius, in 616 B. C., the senate and people unanimously elected him king. His reign was very glorious. He waged successful wars against the Sabines, Latins, and Etruscans, and extended the power of Rome. He built the Cloaca Maxima, laid out the Circus Maximus and the Forum, and commenced the Capitoline temple and the stone wall around the city. He instituted the Roman games, added 100 new members to the senate, etc. But the sons of Ancus Marcius hated him, and fearing that he would try to secure the succession to the throne for his son-in law, Servius Tullius, they assassinated him in 578 B. C. They did not accomplish their purpose, however; Servius Tullius became his successor.—(2) His son, LUCIUS TARQUINIUS SUPERBUS, assassinated Servius Tullius in 534 B. C., and seized the crown, probably by the aid of an aristocratic reaction. At all events, his first act as king was to abolish all the democratic reforms which Servius Tullius had introduced, and to punish with death or exile those senators who had sanctioned the reforms. Tarquinius was, as his surname, *Superbus*, the "Proud," indicates, a very high-handed master. The vacant places in the senate were not filled, and the advice of this body was very seldom asked, and at the same time that he slighted the higher classes he sorely oppressed the lower by heavy taxes and forced labor. The result was that a very embittered sentiment pervaded the whole nation, and neither his successful foreign policy nor his brilliant public edifices were able to propitiate the feelings of the people. Finally, the rape of LUCRETIA (which see) became the occasion of a general outbreak. Tarquinius was deposed and the monarchical government abolished in Rome. He made three attempts to reconquer his power by the aid of the Tarquinii, of Porsenna, and of the Latins, but in vain. Died a wretched old man at Cumæ in 495 B. C.

Tar'ragon [Sp. *taragona*], an aromatic perennial herb of the family Compositæ, a native of Northern Asia, but acclimated in European gardens, where, especially in France, it is cultivated for the sake of the young shoots, which are used in the dressing of salads and for the flavoring of vinegar with an infusion of its leaves, which have a taste resembling anise. Tarragon vinegar, thus prepared, is an article of commerce.

Tarrago'na, town of Spain, capital of the province of Tarragona, at the mouth of the Francoli in the Mediterranean, consists of an upper town, surrounded with walls, and a lower and modern town, defended by two castles. Its harbor is accessible only for small vessels, yet it carries on a considerable trade in corn, wine, oil, and fruit; large quantities of nuts, almonds, figs, and oranges are annually exported. The city was taken in 1810 by the French after a long siege, and nearly destroyed. P. 18,433.

Tar'rant, county of N. W. Texas, intersected by the W. fork of Trinity River; surface undulating, partly timbered, and partly prairie; grazing is the principal occupation. Staples, live-stock, Indian corn, and oats. Cap. Fort Worth. Area, 900 sq. m. P. 5788.

Tarra'sa, town of Spain, province of Barcelona, on the Ripoll, has large manufactures of kerseymeres, broadcloth, and flannel, and holds annually two large fairs. P. 8721.

Tar River rises in Granville co., N. C., and after a somewhat indirect E. S. E. course falls into Pamlico Sound. Its wide estuary, for some 40 miles, is called Pamlico River. The Tar has a rapid current, is 180 miles long, and is navigable for steamboats 85 miles, to Tarborough.

Tar'rytown, p.-v., Westchester co., N. Y., on the Tappan See (Hudson River) and upon New York Central and Hudson River R. R., 26 miles N. of New York City, has 11 churches, excellent schools, 1 national and 1 savings bank, and 2 newspapers. It is celebrated as containing the home (Sunnyside) and burial place of Washington Irving. Sleepy Hollow is included within its precincts, and there are a number of elegant mansions along its heights.

M. D. RAYMOND, ED. "ARGUS."

Tar'shish is often mentioned in the Old Testament as a large and important commercial emporium, but it is doubtful where it was located, whether in Cilicia (*Tarsus*), or in the Grecian archipelago (*Thasos*), or in Spain (*Tartessus*), or in Ceylon, or somewhere else.

Tar'sia, or **Intarsiatu'ra,** a kind of mosaic made of pieces of wood of different colors, so disposed as to form regular patterns or more artistic designs, and then strongly glued together. These designs are sometimes inlaid in tablets of walnut or other wood; in other cases the work is wholly composed of sections varying in size according to the character of the effect to be produced. In architectural scenes and landscapes, in the representation of birds, fruits, flowers, etc., the pieces employed are in general very small, while in parquette floors, etc., they are larger. Very fine tarsia may be seen in many church choirs in Europe, especially in Italy, where the climate ensures its durability. The cathedral of Siena contains remarkable works of this kind, executed early in the thirteenth century, still fresh and perfect. This town retains her old reputation for skill in this art, and the tarsia manufactory there is still celebrated. Sorrento is now famous for the manufacture of small objects in wood-mosaic of great beauty, such as tables, writing-desks, fancy boxes, etc. In Nice this work is also carried to great perfection. The exquisite inlaid work in ebony and ivory now executed in Rome is usually called *tarsia*, and even the *lavoro commesso*, or Florentine mosaic, though entirely of stone, as well as inlaying in metal, sometimes receives this name. (For a very full account of this art see Count Demetrio Carlo Finocchietti, *Delle Industrie relative*, etc., Florence, 1869.)

Tarsier. See TARSIIDÆ.

Tarsi'idæ [from *Tarsius*—so named from the length of the tarsi—the representative genus], a family of mammals of the order Primates and sub-order Lemuroidea or Prosimiæ, distinguished by the length of the tarsi and the dentition. In external appearance they present nothing peculiar in contrast with the Lemuridæ, except the very long hind limbs and very long tail, and the female has inguinal mammæ; the teeth are in number 34—viz. M. $\frac{3}{3}$, P. M. $\frac{3}{3}$, C. $\frac{1}{1}$, I. $\frac{2}{1} \times 2$; the true molars have the lobes, the crowns, especially the outer ones, produced into acute points; the premolars are conical, and successively increase in size from first to last; the canines are normally developed, those of the lower jaw not being incisiform as in the lemurs; the median upper incisors are longest. The skull has the orbits slightly closed behind by the union above of the alisphenoid with the malar bone; the fibulæ are partially ankylosed with the tibiæ; the hind feet or pedes have their second and third toes armed with subulate nails, and the rest provided with flattened pointed nails. Thus is the family distinguished from the lemurids. Only one

species is known, the *Tarsius spectrum*, an inhabitant of the forests of the islands of Borneo, Celebes, and Banka, sometimes called malmang, spectre lemur, and (adopted from the French) tarsier. Its size is about that of the common rat. It feeds chiefly on insects. THEO. GILL.

Tarsiped'idæ [from Lat. *Tarsipes*—*tarsus*, "tarsus," and *pes*, "foot"—the name of the only known genus], a family of mammals of the order Marsupialia and sub-order Syndactyli, and so called on account of a fancied (not real) resemblance of their hind feet to those of the Tarsiidæ. The general form of the animal is similar to that of a rat; the head, however, is at once distinguishable by its elongated slender conic snout; the tongue is very long, slender, and exsertile; the fore and hind limbs differ but little in length, although the latter are somewhat longer; the feet, front as well as hind, have each five toes; those of the front are rather small, slightly enlarged toward their tips, and provided with minute scale-like nails, "impressed, as it were, into the flesh, on the upper surface of the toe;" of those of the hind feet, the inner toe is thumb like, slender, and destitute of a nail, the second and third very short (joined together as usual in the sub-order), and armed with small nails which are directed upward almost at right angles to the toes, and the fourth and fifth larger (free), and furnished with scale-like nails; the tail is long and slender, scaly, like that of a rat, and sparsely hairy. The teeth are very small and simple, and not functionally differentiated as incisors, canines, and molars; morphologically, however, there are, according to Waterhouse, M. $\frac{3}{3}$ (or more), C. $\frac{1}{0}$, I. $\frac{2}{1} \times 2$; they are separated from each other by greater or less intervals, except the lower incisors, which are largest and proclivous, as in other families. The stomach is small and simple, and has very thin walls; the intestine has no cæcum. The skull is very thin and almost papery; the lower jaw has very slender and almost straight rami, without distinct coronoid or angular processes, and with elongated foramina in their posterior halves. This type is one of the most extraordinary and exceptional of mammals. But one species—the *Tarsipes rostratus*—is known. It is about as large as a mouse. It is an inhabitant of Western Australia, and "is generally found in all situations suited to its existence, from Swan River to King George's Sound," but is very rarely obtained. It is nocturnal in its habits, and in the night is very active. It is insectivorous and mellivorous, and it will dart at passing flies and kindred insects with great celerity; having caught one, it retires to a corner or rests on the spot on its hind legs, holds the fly between its front paws, and proceeds leisurely to eat it. It is also very fond of honey, which it extracts from flowers by means of its long tongue.

THEODORE GILL.

Tarsus. See FOOT, STRUCTURE OF, by PROF. E. HITCHCOCK, A. M., M. D.

Tar'sus, town of Asiatic Turkey, on the Cydnus, 12 miles from its mouth in the Mediterranean, was for several centuries before and after Christ the most important city of Asia Minor, the capital of the Roman province of Cilicia, and celebrated both as a seat of learning and as a centre of commerce. The apostle Paul was born here, and Julian the Apostate was buried here. But in the confusion of the Middle Ages, and under the mismanagement of the Turkish government, the city has greatly declined, and more than half of the space it formerly occupied is now covered with ruins and rubbish. It has still some importance, however, as the place from which are exported the rich harvests of cotton, wheat, and fruits which the fertile districts in the neighborhood produce, but its progress is impeded by its unhealthy site. During summer poisonous evaporations from the delta of the Cydnus compel the inhabitants to leave the city, and thus its population may vary between 4000 and 30,000. A new port, Mersin, is building now some miles farther S.

Tar'tar [Gr. τάρταρος, "nether world"], a term applied to all salts of tartaric acid, but more especially to the acid tartrate of potassium or hydric-potassic tartrate. Crude tartar or ARGOL (which see) is obtained as a deposit in the interior of the casks in which fermenting wines are stored in the form of a hard crystalline crust, possessing either a light-pinkish or a deep-red color, according to the color of the wine from which it is formed. The best varieties of crude tartar contain from 77 to 85 per cent. of acid tartrate of potassium, the chief impurities being tartrate of calcium and coloring or mucilaginous matters. From these latter it is purified by dissolving in hot water, and precipitating the flocculent matter by means of finely powdered clay and charcoal; the solution is then concentrated and crystallized. The purified commercial article usually contains from 85 to 98 per cent. of the acid tartrate. The name *cream of tartar* is given to the product purified by re-crystallization. This salt, which is the pure hydric-potassic tartrate, has the composition $KHC_4H_4O_6$. It forms oblique rhombic prisms, which are very sparingly soluble in cold water, 180 parts, but dissolve in 15 parts of boiling water. It has an acid reaction, and forms double tartrates with numerous metallic oxides. Upon calcining in a closed vessel it is converted into a mixture of potassic carbonate and unconsumed carbon; this product, which is known as *black flux*, is frequently employed in the laboratory. If the salt be calcined with an excess of nitre, *white flux*, or potassic carbonate, is formed. Tartar is extensively employed in the manufacture of tartaric acid and as a mordant in the dyeing of wool; it is also used in the preparation of potassic carbonate, and to some extent in cookery. J. P. BATTERSHALL.

Tartar, Cream of. See CREAM OF TARTAR, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Tartar Emetic, Tartarized Antimony, Stibiated Tartar, or **Potassio-antimonous Tartrate.** This well-known salt (formula $2K.(SbO).C_4H_4O_6 + Aq.$) is made by boiling acid potassium tartrate (cream of tartar) with antimony trioxide in water. It forms in transparent crystals, which become white and opaque by exposure to the air, but in the shops it is generally kept in the form of powder. It dissolves in 20 parts of cold water, and in between 2 and 3 of boiling, but all aqueous solutions spontaneously decompose on keeping. It is insoluble in alcohol, but soluble in proof spirit or wine. If pure, a solution of tartar emetic yields no precipitate with barium chloride, nor, when diluted, with argentic nitrate, nor does it turn blue with potassic ferrocyanide. Tartar emetic can be recognized as an antimonial compound by the following tests: Heated on charcoal before the blowpipe with sodic carbonate, it yields a brittle globule of metallic antimony, and at the same time a white deposit of antimonous oxide. In the presence of hydrosulphuric acid or ammonic sulphide an orange or reddish-brown precipitate of antimonous sulphide is formed, soluble in excess of ammonic sulphide. The same precipitate, dried, is insoluble in ammonia, but dissolves in boiling hydrochloric acid. A little of this solution, if the acid be not in excess, will, on being added to a considerable bulk of water, throw down a white flaky precipitate of the oxychloride (powder of algaroth). Dilute nitric, hydrochloric, or sulphuric acid, added to a solution of tartar emetic, throws down a white precipitate, soluble in an excess of the acid, and soluble in a solution of tartaric acid. Ammonic hydrate also throws down from a solution of tartar emetic a white precipitate, in this case insoluble in excess of the reagent. When boiled in water containing one-sixth part of hydrochloric acid, a bit of metallic copper immersed in the boiling fluid becomes covered with a gray deposit of metallic antimony, or in cold solution with 10 per cent. of the same acid a strip of bright tin-foil becomes similarly covered with a black coating. Tested in Marsh's apparatus (see ARSENIOUS OXIDE), antimoniuretted hydrogen is formed, which, ignited, yields a metallic stain upon a cold porcelain plate under the same conditions that arseniuretted hydrogen does, but the antimonial film is distinguishable from the arsenical by being generally a dull black in the centre, by insolubility in solution of calcic hypochlorite, and by other characteristics.

Tartar emetic has rather a nauseous, harsh metallic taste, and upon the animal system is both a local irritant and a powerful constitutional poison. Applied to the skin, as in ointment, it causes burning pain, redness, and finally the eruption of a crop of painful pustules. Taken internally, small doses, as a small fraction of a grain, tend to reduce the force and frequency of the pulse and promote perspiration. Somewhat larger quantities cause nausea and vomiting, with relaxation of the bowels and of the muscular system, reduced action of the heart, and a general feeling of depression and weakness. Still larger doses cause an intensification of the above symptoms, with burning pain in the stomach, the induction of a choleraic state, characterized by violent and prolonged nausea, vomiting, and serous purging, colic, cramps, great enfeeblement of the heart and general strength, and finally collapse and death. After death decided inflammation of the stomach and bowels is generally found. Sometimes, however, both this lesion, and the irritative symptoms dependent upon it, are absent even in fatal poisoning. Death does not generally occur until several days after the poisoning. The minimum fatal dose is not known, but is probably somewhere between 10 and 40 grains. Yet two grains once killed an adult already debilitated by disease, and four grains produced very profound poisoning. In cases of tartar emetic poisoning, tannic or gallic acid, or some vegetable infusion containing the same, such as green tea, decoction of oak bark, of cinchona, etc., should be administered, and free vomiting promoted. The inflammation and great cardiac and constitutional depression which the poison occasions must be treated on general medical principles. Tartar emetic is a well-

known remedy in medical practice, but is at present much less used than formerly. It has been much employed in minute doses to reduce the pulse and promote sweating in acute fevers, but less harsh vegetable drugs are now supplanting it. It is often made an ingredient of mixtures to relax the inflamed mucous membrane and promote free secretion in the early stages of bronchitis, and may also be employed as an emetic. But from its depressing effects, and the prolonged nausea and vomiting it occasions, other emetics are generally preferable. Locally, it is sometimes used in ointment to produce pustulation for the purpose of persistent counter-irritation, and here, again, less violent means are usually found sufficient. EDWARD CURTIS.

Tartar'ic Acid [Fr. *Acide tartrique ;* Ger. *Weinsäure ;* the acid of TARTAR (which see): Sax. *teart ;* D. *taart :* Sp. *tarta*. It is not impossible that these words, as applied to the acid and deposit from sour wines, may have been derived from the Latin *Tartarus*, "hell," as if such sour wines were suitable only for that region]. At present six acids isomeric with the tartaric are known, which have the same composition and possess nearly the same chemical properties, but differ essentially in their crystalline structure and in their behavior toward polarized light.

Ordinary tartaric acid (dextrotartaric or dextroracemic acid) is quite widely disseminated in the free state in various plants and berries; its chief source, however, being the grape, in which it occurs as the hydric-potassic tartrate (cream of tartar). It is prepared by dissolving crude tartar in boiling water, and slowly adding pulverized chalk as long as the mixture effervesces. Usually, 1 part of chalk is sufficient to decompose 4 parts of tartar. Insoluble calcic tartrate and soluble potassic tartrate are formed by this operation. Upon filtering, and adding the equivalent quantity of calcic chloride, all the tartaric acid is obtained as a precipitate of calcic tartrate. The two precipitates are then united, washed, and decomposed into insoluble calcic sulphate and free tartaric acid by 3 parts of sulphuric acid diluted with 7 of water for every 5 of the salt taken. The filtrate is evaporated in leaden pans, and allowed to crystallize. This acid can also be artificially produced by the oxidation of milk-sugar, glucose, starch, gum, etc., with nitric acid. Dextrotartaric acid has the composition $H_2.C_4H_4O_6$, being dibasic. It forms colorless transparent rhombic prisms, which become strongly electrical when gently heated. It is easily soluble in water and in alcohol; the aqueous solution becomes mouldy on standing, and is gradually converted into acetic acid. Dextrotartaric acid is distinguished from its isomeres by the fact that in aqueous solution it exerts a strong right-handed rotation on polarized light. In its crystalline structure it bears an interesting relation to the isomeric lævotartaric acid. The crystals of the two acids resemble one another perfectly in form, excepting that ordinary tartaric acid presents hemihedral faces on the right of the crystal, which in lævotartaric acid are situated on the left or opposite side; so that the reflection of a crystal of the dextro-acid represents one of the lævo-acid. The dextro- and lævo-tartrates exhibit the same difference in their crystalline form. In pyro-electrical relations also crystals of dextrotartaric acid present properties opposite to those of the lævo-acid. Dextrotartaric acid precipitates solutions of the caustic alkaline earths; also solutions of plumbic, argentic, and potassic salts. The precipitate with potassium compounds (cream of tartar) serves for the detection of the acid in the presence of other organic acids. Potassic acetate is the most advantageous precipitant, the addition of alcohol, in which the precipitate is insoluble, and of a little acetic acid if the fluid be neutral, being also advisable. Boiling tartaric acid reduces argentic, auric, and platinic salts, and prevents the precipitation of the salts of copper and iron by the alkalies, the latter property being frequently utilized in chemical analysis. Dextrotartaric acid melts at 338° F.; at a higher temperature it is converted into several isomeric acids. By increased heat, pyruvic (or pyroracemic, $H_2.C_6H_6O_6$) and pyrotartaric ($H_2.C_5H_6O_4$) acids are produced. When heated with the alkalies, it loses water, and the oxalate and acetate of the base are formed. By oxidation dextrotartaric acid is decomposed into carbonic and formic acids; when treated with reducing agents, either one or two atoms of hydrogen are eliminated, and malic or succinic acid is obtained. Tartaric acid is formed on the tetratomic type, but it is, for the most part, a dibasic acid, two of the hydrogen atoms being also replaceable by acid or alcohol radicals. It forms acid, neutral, and double salts. Three varieties of the latter are well defined—those containing monatomic metals, such as Rochelle salt, $KNaC_4H_4O_6.4H_2O$, which is analogous to cream of tartar; those formed from monatomic and diatomic metals, in which the oxide of the latter is combined with the same proportion of acid as the monatomic element, such as potassio-ferric tartrate, $K.FeO.C_4H_4O_6$; and those analogous to tartar emetic, such as argento-antimonious tartrate, $Ag.SbO.C_4H_4O_6$. The only quadribasic tartrates as yet prepared are those of lead and zinc. The dextrotartrates possess the peculiar crystalline, rotatory, and pyro-electrical characters of the dextro-acid. The neutral tartrates of the alkalies are easily soluble in water; those of the earthy and heavy metals are, for the most part, insoluble. When strongly heated, all tartrates are carbonized and emit the odor of burnt sugar.

The isomeric *lævotartaric acid* is obtained upon neutralizing equal parts of racemic acid, one with soda, the other with ammonia, mixing the fluids, and allowing the double salt to crystallize; half of the crystals formed possess the hemihedral faces common to dextrotartrates, the remainder showing those characteristic of the lævo-salts. Upon mechanically separating the two varieties, dissolving them in water, adding plumbic nitrate, and decomposing the precipitates with sulphuric acid, solutions of the dextro- and lævo-acids are obtained. Lævotartaric acid is also produced by the complete fermentation of racemic acid, by which the dextro acid present is decomposed, and by the fractional crystallization of cinchonicine racemate. It turns the plane of a ray of polarized light to the left, but possesses the same chemical properties as the dextro-acid, excepting that it gives with asparagine a gummy compound, whereas the analogous dextro-salt is crystalline. When equal amounts of the dextro- and lævo-tartaric acids are mixed and evaporated, racemic acid is produced; in the same manner racemates are obtained from mixtures of dextro- and lævo-tartrates.

RACEMIC ACID has already been described under that head. It has lately been obtained upon heating the dextro-acid with water for some time in sealed glass tubes.

Tartaric acid is extensively used in dyeing and in the preparation of effervescing drinks and baking-powders. Some of the tartrates, such as tartar emetic, Rochelle salt, and the potassio-ferric tartrate (*tartarus chalybeatus*), possess valuable medicinal properties. J. P. BATTERSHALL.

Tar'tars, or, more properly, **Tatars,** is not a strictly-defined ethnological name, but used by some in a wider, by others in a narrower, and always in a somewhat vague, sense. The word *Ta-tar* is of Chinese origin, and was first applied to those Mongolian tribes who on their swift horses descended from the Altai plateaus into the Chinese lowlands, robbing and plundering. When adopted by the Europeans, the word was changed into *Tar-tar*, with an allusion to the classical Tartarus, and it was applied to all those tribes and races which Genghis Khan had brought under his sway and led into Europe, including not only Mongolian, but also Tungusian and Turkish races. At present, the name is used partly in a wider sense, comprising all the various tribes and races inhabiting the plateaus of Central and Northern Asia, and not belonging to the Aryan family; partly, in a more restricted sense, comprising the Kirgheez, the Oozbeks, and some other tribes inhabiting Toorkistan and the adjacent regions.

Tar'tarus is used synonymously with *Hades* by the later Greek and Latin writers, but with Homer it means a separate place, as far below Hades as the heavens are above earth, into which Zeus had thrown the worst offenders against his authority. Later poets, however, sometimes make a distinction between Tartarus and the Elysian Fields as two divisions of Hades, the former occupied by the criminals, the latter simply inhabited by the dead. As a personification, Tartarus is represented as the son of Æther and Gea (air and earth), and by his mother he was father to the Gigantes, Typhoeus and Echidna. The appellation *pater Tartarus* is used for Pluto.

Tar'tary, one of those geographical names which change meaning according to time and place, but which never and nowhere attain any well-defined signification. In the Middle Ages the name denoted the whole central part of Eastern Europe and Asia from the Dnieper to the Sea of Japan. Later, a division into European and Asiatic Tartary took place, and the name of European Tartary was soon confined to the territory now called Crimea, while that of Asiatic Tartary first signified the whole empire of Genghis Khan and his successors, then Toorkistan alone, with the exclusion of Toorfan, Mongolia, and Mantchooria, and now only that part of Toorkistan which does not belong either to Russia or to China.

Tarti'ni (GIUSEPPE), b. at Pirano, Istria, Apr. 12, 1692; studied law at the University of Padua, where he led a very wild life, and finally eloped with the niece of Cardinal Cornaro; kept concealed for two years in a monastery of Assisi, where he studied music under Father Boëmo; continued subsequently his musical studies under the violinist Veracini, and became the first violinist of his time. He lived for some time in Prague and Vienna at the court of the emperor Charles VI., afterward in Padua, where he d. Feb. 16, 1770. Of his compositions, his *Sonate du*

Diable is still performed now and then; he also wrote a couple of treatises on music.

Tartrates. See TARTARIC ACID.

Tarudant′, town of Morocco, province of Soos, near the southern slope of the Atlas Mountains, 4 miles from the river Soos and 44 miles from the Atlantic. It is surrounded with walls, has several fine mosques and a citadel, but is else poorly built. Its dyeworks and manufactures of leather and copperware are important. P. estimated at 30,000.

Tascherau′ (ELZÉAR ALEXANDRE), D. D., b. at Quebec, Canada, in 1818; studied divinity in the seminary of that city; ordained a Roman Catholic priest 1842; professor of mental philosophy, director of studies, and superior of the seminary; appointed professor of canon law in Laval University 1856; administrator of the diocese 1870, and consecrated archbishop of Quebec Mar. 19, 1871.

Taschereau (JULES ANTOINE), b. at Tours Dec. 19, 1801; became very early a frequent contributor to the Parisian press, and was one of the founders of the *National*; entered the civil service of the government shortly after the revolution of July, 1830, but soon returned to his journalistic activity; was one of the editors of *Historiettes de Tallemant des Réaux* (6 vols., 1833-34), and founded the *Revue rétrospective* (20 vols., 1833-37); was a member of the Chamber of Deputies 1838-42, and of the Constituent Assembly 1848; received an appointment at the National Library in 1852, and became its director-general in 1858. D. at Paris Nov. 11, 1874. He published editions of the works of Molière, Boufflers, etc.; superintended the publication of the catalogue of the National Library, and wrote *Histoire de la Vie et des Écrits de Molière* (1825) and *Histoire de la Vie et des Ouvrages de Corneille* (1829), both of which have been reprinted several times.

Tashkend′, capital of the Russian dominions in Toorkistan, and the most populous city in Central Asia, in a gently-sloping, well-watered, fertile plain, covered with numerous fruit trees, at the foot of the Alatan and Chatkal mountains, and has 76,072 inhabitants (1871), of whom 46,000 are Sartes—that is, descendants of the ancient Persian population of the country; the rest consist principally of Kirgheez, Tatars (Oozbeks), some Jews, and merchants from other parts of Asia, who, like the Russians, numbering from 2000 to 3000, inhabit separate quarters of the city. The old city is surrounded with a wall 7 miles long and pierced by nine gates; it forms an oval whose greater axis lies in the direction W. to E., and which is bent inward to the S. In the hollow thus formed the Russian town, the so-called European town, is built. It is laid out after the manner of European cities, and regularly built; the streets are broad, well lighted, and lined on both sides by canals of running water and rows of shady trees. S. W. of the European, and S. of the Asiatic city, is situated the Russian citadel, an immense construction, with barracks and military stores, and surrounded by a bastioned wall. Many houses in the European city were built after European fashion by Sartes, and are let out by them to foreigners. The new great caravanserai forms the centre of the wholesale business. The Asiatic city has narrow, crooked, and ill-paved streets, lined with houses with flat roofs. Tashkend is one of the oldest and largest cities of Central Asia, from old times the seat of an important agriculture and a brisk trade. Here the roads from Kashgar meet with those which lead S. from Samarcand, N. from Orenburg and Siberia, into Central Asia. The value of foreign goods exchanged in the city amounted during the second half of the year 1873 to 10,600,000 rubles; the principal articles of exportation and importation are cotton fabrics, metal ware, and silk. The Arab geographers of the Middle Ages called the city *Shash*; from the sixteenth to the eighteenth century it was the capital of the Kirgheez Kosaks; in 1810 it was taken by the khan of Khokan, and Sept. 12, 1867, it was occupied by the Russians.

E. SCHLAGINTWEIT.

Tas′man (ABEL JANSSEN), b. at Hoorn, province of North Holland, probably in 1600; was sent by the governor-general of the Dutch East India Company, Van Diemen, to circumnavigate the Australian continent; left Batavia Aug. 14, 1642; passed Mauritius Oct. 8; discovered Nov. 24 the island which he called Van Diemen's Land, but which now is called Tasmania; Dec. 13, the southern island of New Zealand; Jan. 6, the Friendly Islands; Feb. 6, the Fejee Islands; and returned to Batavia June 15, 1643. Of this voyage he published an account which was reprinted at Amsterdam in 1722, together with the voyage of Coreal. Jan. 29, 1644, he set out on a new voyage along the coasts of New Guinea and New Holland, but from this voyage he never returned, and no particulars concerning it were ever received.

Tasma′nia, an island belonging to Great Britain, situated to the S. E. of Australia, between lat. 40° 44′ and 43° 38′ S., was called Van Diemen's Land up to 1854; comprises an area of 26,215 sq. m., and has the form of an irregular quadrangle, with steep, rocky coasts indented with numerous bays, which afford good harbors. Three mountain-ranges, of whose highest peaks the Humboldtsberg reaches 5200 feet, the Benlomond 4700 feet, traverse the island in the direction from N. W. to S. E., but the general character of the surface is that of a plateau diversified by hills and valleys, tolerably well watered, and covered almost entirely with forests. The principal rivers are the Tamar, Derwent, and Arthur, which flow through fertile plains rich in meadows. The climate does not allow the cultivation of tropical plants, but is favorable to all the plants and fruits of Central Europe; agriculture and cattle-breeding are carried on with success. The mountains are rich in iron and copper ore, coal, marble, alum, and crystals. Characteristic among the native animals are the emu, an ostrich-like bird, and the kangaroo, but they have of late been so ruthlessly hunted that they have now become nearly extinct. The original inhabitants were Papuans, and in 1815 they still numbered 5000, but they have been treated so cruelly by the foreigners who settled in the island that, although colonization did not begin until 1803, the native population is now wholly exterminated; the last Papuan died in 1869. Dec. 31, 1874, the population mustered 104,176, of which 55,117 were males and 49,054 females. The immigration is inconsiderable; 6265 immigrated in 1874, but 7714 emigrated. Agriculture and cattle-breeding are the principal occupations. Mar. 31, 1875, there were under cultivation and in crops 57,633 acres of wheat, 5129 of barley, 32,704 of oats, 29 of rye, 5174 of peas, 511 of beans, 96 of tares, 6978 of potatoes, 1777 of turnips, 109 of carrots, 1041 of mangel-wurzel, 52 of onions, 1803 of artificial grasses, 30,486 of hay, 2 of tobacco, 658 of hops, 5976 of gardens and orchards, 1058 of green forage, 93,176 of permanent artificial grasses, 22,512 of bare fallow, 59,629 of other cultivated land; total land in cultivation, 326,486 acres, of which 3880 acres were new land broken up during the year, 13,880 under rotation of crops. In the year ending Mar. 31, 1875, there were produced 1,066,861 bushels of wheat, 125,469 of barley, 877,243 of oats, 474 of rye, 99,556 of peas, 12,312 of beans, 1378 of tares, 23,031 of artificial grass-seed, 150,978 of apples, 31,020 of pears, 26,169 tons of potatoes, 12,603 of turnips, 1021 of carrots, 12,569 of mangel-wurzel, 182 of onions, 41,144 of hay, 2150 pounds of tobacco, 811,476 of hops. In 1874 an acre of crown-land was bought for £1 2*s*. 1½*d*. in the country, and for £9 10*s*. in the city. Mar. 31, 1875, the colony possessed 23,208 horses—22,849 on private property, 359 on crown-land; 110,450 horned cattle—105,416 on private property, 5034 on crown-land; 1,714,168 sheep, including lambs—1,590,511 on private property, 123,657 on crown-land; 2579 goats, 10 mules, 13 asses, 51,468 pigs. In trades and manufactories 3391 persons were engaged as masters—namely, 105 bakers, 177 blacksmiths, 322 boot and shoe makers, 200 butchers, 179 carpenters, 308 general dealers, 153 grocers, 102 hawkers, 402 publicans, etc. In 1874, 185 persons were engaged in gold mining, and the value of the product amounted to £18,491, of which £8899 was in Mathinna and £9592 in Nine Miles Springs; 9276 tons of coal were raised, 14,000 cubic feet of flagstone, 877 tons and 24,920 cubic feet of freestone, 1400 tons of iron ore, 7612 bushels of lime, 445 tons of limestone, 250,000 slates, and 490 tons of tin ore. The commerce, chiefly carried on by the cities of Hobart Town and Launceston, is very brisk: 214 vessels, of 63,302 tons burden, entered, and 228 vessels, of 62,302 tons burden, cleared the harbor of Hobart Town in 1874; 393 vessels, of 51,404 tons burden, entered, and 392 vessels, of 57,548 tons burden, cleared the harbor of Launceston. Including the minor ports of Stanley, Wynyard, Leith, and Torquay, the total entrances amounted to 607 vessels, of 119,706 tons burden, the total clearances to 620 vessels, of 119,801 tons burden. Three vessels were from the U. S., the rest from Great Britain and her colonies. The value of the imports amounted to £1,257,785, of the exports to £925,325. The principal articles of exportation are bark, bran, and pollard, butter and cheese, flour, fruit, gold, grain, hides, skins and leather, hops, horses, sheep, oatmeal, oil, timber, vegetables, wool. The value of the wool exported amounted to £350,713. The internal traffic is very limited. There is only one railway, the Launceston and Western, 45 miles long, and belonging to the government. Its construction and equipment cost £427,946; its revenue and expenditure in 1874 amounted to £18,328 4*s*. 10*d*.; 91,261 passengers and 24,802 tons of goods were carried over it. In 1874 the postal department had 163 stations, 186 officials, 1530 miles of post-roads, and carried 1,282,854 letters, 34,617 packets, and 990,588 newspapers; its revenue was estimated at £12,700, its expenditure at £20,002. The telegraph had

23 stations, carried 12,092 messages, earned £7901 5*s.* 11*d.*, and spent £6348 17*s.* 3*d.* A submarine cable connects Low Head at the mouth of the Tamar with Queensland. Of great importance for the internal traffic are the exertions to make the Tamar navigable above Launceston; after several years' labor the Whirlpool Reach Rock, 390 feet long and 24 feet broad, has been blasted. In administrative respects Tasmania is directly under the British colonial secretary, has a governor and commander in-chief, an executive council, legislative council, and a house of assembly to which each electoral district sends a deputy. Hobart Town is the seat of government. The budget of the colony for 1874 showed a revenue of £327,925, an expenditure of £371,078, and a public debt of £1,176,700. With respect to education and religion, Tasmania has 147 public schools, with about 8000 pupils. In 1870 there were 55,959 persons who could read and write, 13,945 who could only read, and 29,444 who could neither read nor write. There were 316 churches, chapels, etc.: 53,047 persons belonged to the Church of England, 22,091 to the Roman Catholic Church, the rest to other sects. Among the charitable establishments may be mentioned the general hospitals in Hobart Town, Launceston, Campbell Town, and New Norfolk, the queen's asylum for destitute children, the Cascade pauper establishment, the invalid dépôt in Launceston, etc.

History.—Tasmania was discovered in 1642 by the Dutch explorer Tasman, and called Van Diemen's Land, after the Dutch governor of the East Indies. In 1803 it was colonized from Sydney. Gov. Ring sent Lieut. Bowen hither with 3 soldiers and 10 male and 6 female convicts, and these settled near the point where now Hobart Town stands. A few months later two English vessels arrived, and the settlement was increased by a number of convicts. Hard times came, full of famine, robbery, murder, fights among the colonists themselves and with the natives, with bushrangers, escaped convicts, etc., and the importation of convicts continued to be very heavy. In 1842, 59,000 free and 20,000 convicts lived in Tasmania. In 1825, Tasmania was separated from New South Wales and established as an independent colony, and from that time it has progressed steadily though very slowly. August Niemann.

Tassaert' (Nicolas François Octave), b. at Paris July 26, 1800; studied painting at the school of fine art and under Girard and Lethière; began to exhibit in 1831, and painted, besides portraits, historical and genre pieces, of which the most remarkable are *Funérailles de Dagobert à Saint-Denis* in the museum of Versailles, *Le Marchand d'Esclaves*, *Le Sommeil de l'Enfant Jésus*, etc. D. Apr. 26, 1874.

Tassisudon', the capital of Bootan (which see), in lat. 27° 30' N., lon. 89° 40' E., on the Gaddada, an affluent of the Brahmapootra. It contains a palace for the two rajahs, of whom the dherma-rajah lives in a high tower, together with a beautiful idol, and the deb-rajah in a square edifice which encloses the tower. The whole palace is furthermore surrounded by rows of smithies, in which metallic idols are manufactured, and outside of these factories extends the town. The style is thoroughly theocratic.

Tas'so (Bernardo), b. at Bergamo Nov. 11, 1493, of a noble family; received an excellent education; accompanied the prince of Salerno as secretary to Tunis and Flanders; married in 1539 the beautiful and wealthy Porzia de' Rossi, and settled at Sorrento, where he wrote his great epic in 100 cantos, *L'Amadigi*, founded on the story of Amadis de Gaul. In 1547 he left Sorrento, having lost his wife and being persecuted by the Spanish Inquisition. He entered the service first of the duke of Urbino, afterward of the duke of Mantua, and d. as governor of Astiglia in 1569. His lyric poems were much admired, but his fame as a poet was subsequently overshadowed by that of his son, Torquato Tasso. His letters, edited by Seghezzi (3 vols., Padua, 1733–51), are of great interest for the literary history of that time.

Tasso (Torquato), b. at Sorrento Mar. 11, 1544, a son of the preceding; educated first by the Jesuits at Naples, Rome, and Bergamo, then at the court of the duke of Urbino in Pesara, finally by his father at Venice, and entered the University of Padua in 1557 to study law. He felt himself more attracted, however, to literature and poetry. In 1562 he published a romantic epic, *Rinaldo*, in 12 cantos, and the applause with which it was received determined him to give up jurisprudence altogether and devote himself entirely to poetry. He repaired to Bologna, where he studied philosophy, especially Plato, and commenced work on his great epic, *Gerusalemme Liberata*. In 1565 he entered the service of Cardinal Este, whom he accompanied to Paris and on other diplomatic missions, and who brought him into connection with his brother, Alfonso II., reigning duke of Ferrara. In 1570, at which time he had finished the first eight songs of his epic, he left the cardinal, received a kind of court appointment and a pension from Alfonso II., and settled at Ferrara, where he lived very happily for several years, enjoying the intimate friendship of the duke and his two sisters, Lucrezia and Eleonora. *Aminta* was written and performed at the court with great splendor, and in 1575 *Gerusalemme Liberata* was completed. But in the mean time a peculiar melancholy had developed in his mind, and it sometimes burst into open lunacy. His relation to the ducal family had been disturbed, whether on account of a vehement passion for the princess Eleonora or from some other cause is not known. The criticisms, rivalries, and intrigues which as a poet and a courtier he could not escape overwhelmed his imagination; he grew suspicious toward all, saw a secret enemy in everybody, and finally fled from the court in 1577. He sought refuge with his sister at Sorrento, and here his mind soon became calm and clear again. He now yearned for Ferrara, wrote to the duke, and, although the answer he received was very cool, he returned. But he had hardly arrived before the disease again seized his mind. Once more he fled, and once more he returned. His anxiety to re-establish the old relation to this family became more and more passionate as it became more and more evident to him that such a re-establishment was impossible. His manners, his denunciations, became finally so provoking that the duke confined him in a lunatic asylum in 1579. Here he remained seven years, while his great work was read not only in Italy, but all through Europe, and made his name one of the first of his age. At last, in 1586, the duke released him, and he now resided for a short time in Mantua, and then settled at Naples. He was poor, sick, and suffering. In 1594, Pope Clement VIII. invited him to come to Rome and be crowned on the capitol, but he died before the solemnity took place, Apr. 25, 1595, and lies buried in the church of San Onofrio in Rome. Besides the above-mentioned works he wrote *Torrismondo*, a tragedy, a number of beautiful lyrical poems, some dialogues and essays, some letters, etc. A complete edition of his works appeared in 33 vols. at Pisa (1821–32); a select edition in 5 vols. at Milan (1823–25). Biographies have been written by Manso (Naples, 1619), Serassi (Rome, 1785), Black (Edinburgh, 1810), Milman (London, 1850). (See also Richard Henry Wilde, *Conjectures and Researches concerning the Love, Madness, and Imprisonment of Torquato Tasso* (2 vols., New York, 1842). English translations of *Gerusalemme Liberata* by Edward Fairfax (London, 1600) and by J. K. James (2 vols., 1865).) Clemens Petersen.

Taste. See Senses and Histology, by Col. J. J. Woodward, M. D.

Tatars. See Tartars.

Tate, new county of N. W. Mississippi, formed in 1873 from De Soto and Marshall, is traversed by Coldwater River and by Mississippi and Tennessee R. R., has a rolling surface, and a fertile soil productive of wheat, Indian corn, sweet potatoes, and cotton. Cap. Senatobia. Area, 406 sq. m. P. about 12,000.

Tate, tp., Clermont co., O. P. 2678.

Tate (Nahum), b. in Dublin in 1652; was educated at Trinity College; went to London, devoted himself to literature, and in 1692 fitly succeeded Shadwell as poet-laureate; fell into pecuniary straits, and died in the precincts of the Mint, where debtors were privileged from arrest. He assisted Dryden in the composition of *Absalom and Achitophel*, most of the second and poorer part belonging to Tate; perpetrated an alteration of Shakspeare's *King Lear*, which kept the stage for a long time in place of the original; as poet-laureate produced commonplace birthday odes and elegies; and put forth several works in prose and verse, among which are about half a score of dramatic pieces. He is chiefly known as a psalmodist, the versions of the Psalms executed by him and Nicholas Brady being still retained in the English *Book of Common Prayer*; these first appeared under the title, *Essay of a New Version of the Psalms of David, consisting of the first Twenty, by N. Brady and N. Tate* (1695), which was followed by *The Book of Psalms, a New Version in Metre, fitted to the Tunes used in the Churches, by N. Tate and N. Brady* (1696), and *A Supplement of Church Hymns* (1700). D. at Southwark Aug. 12, 1715.

Tate (Thomas), b. in England about 1820; became professor of mathematics and lecturer on chemistry in the National Society's Training College at Battersea, and subsequently in the Kneller Training College at Twickenham; is a member of several scientific associations, and a contributor to their *Transactions* and to various periodicals. Author of an extended series of mathematical textbooks in high repute in England, and of *Exercises on Mechanics and Natural Philosophy* (1846), *Outlines of Experimental Chem-*

istry (1850; new ed. 1854), *Elements of Mechanism* (1851), *Hydrostatics, Hydraulics, Pneumatics* (1851), *Mechanical Philosophy* (1853), *Electricity for Beginners* (1854), *Magnetism and Electro-Dynamics* (1854), *Light and Heat* (1854), *Mechanics and the Steam-Engine* (1855), *Philosophy of Education* (1854; 3d ed. 1860), *The Little Philosopher* (4 parts, 1855–58), and other educational works.

Tat'ham (WILLIAM), b. at Hutton, England, in 1752; emigrated to Virginia in 1769, and entered a mercantile establishment on the James River; served as adjutant-general of militia against the Indians, and wrote biographical sketches of some of their principal warriors; served during the Revolution as colonel in the Virginia cavalry, and was one of the party who stormed the redoubt at Yorktown Oct. 14, 1781; and in 1780, in connection with Col. John Todd, compiled the first trustworthy account of the Western territory. He afterward studied law, was admitted to the bar in 1784, and two years after established himself at Lumbarton, N. C., and in 1787 was elected to the legislature of North Carolina. He visited England in 1789, and again in 1798, and in 1801 became superintendent of the London docks. Returning to Virginia in 1805, he became a military storekeeper in the U. S. service. In his old age he was reduced to penury, and on the anniversary of Washington's birthday, Feb. 22, 1819, after indulging in festivities at the Richmond arsenal, in which he was employed, he flung himself before the mouth of a cannon just as it was fired off, and was instantly killed. Among his publications are—*Memorial on the Civil and Military Government of the Tennessee Colony, Analysis of the State of Virginia* (1794), *Plan for insulating the Metropolis by Means of a Navigable Canal* and *Remarks on Inland Canals* (1798), *Political Economy of Inland Navigation* (1799), *Communications on the Agriculture and Commerce of the United States* (1800), and *History and Practical Essay on the Culture and Commerce of Tobacco* (1800), the last five published in London.

Tatia'nus, b. about 130 A. D. in Syria or Assyria; studied philosophy and rhetoric; went to Rome about 162; enjoyed the friendship of Justin Martyr; was converted by him to Christianity, and wrote one of the earliest apologies for Christianity against the pagan philosophers, *Oratio ad Græcos*, which is still extant, edited by Worth (Oxford, 1700). After the death of Justin (166), Tatian returned to the East, adopted very strange, heterodox ideas, and formed a sect which attracted considerable attention. The dogmatical views of Tatian he had borrowed from various systems of gnosticism; his morality was asceticism. He forbade marriage, animal food, wine, etc.; in the celebration of the Eucharist the sect used water, whence they were often called Hydroparastatai. (See Daniel, *Tatian der Apologet*, Halle, 1837.)

Tatler. See ADDISON and STEELE.

Tat'nall, county of S. E. Georgia, lying between Altamaha and Cannouchee rivers, and intersected by the Great Ohoopee; surface level, soil poor and sandy. Staples, live-stock, wool, Indian corn, oats, sweet potatoes, and a little cotton. Cap. Reidsville. Area, about 1200 sq. m. P. 4860.

Tatnall (JOSIAH), b. at Bonaventura, near Savannah, Ga., in 1762; was sent to school at Nassau, island of New Providence, but ran away from it; in 1782, at the age of eighteen, joined the army of Gen. Wayne at Ebenezer, Ga.; was made colonel in 1793 and brigadier-general in 1800; took an active part in the military affairs of the State, and was several times elected to the legislature; was U. S. Senator from Georgia 1796–99, and governor of the State 1801–02. D. at Nassau, New Providence, June 6, 1803.

Tatnall (JOSIAH, JR.), son of Josiah, b. at Bonaventura, Ga., Nov., 1796; entered the navy; served under Decatur against the Algerines; commanded a gunboat in the expedition against the West Indian pirates; was made commander in 1838, and stationed at the navy-yard at Charlestown, Mass.; in the Mexican war participated in the attacks on Tampico, Panuco, and Vera Cruz; in 1850 was promoted captain, and in 1856 was sent as flag-officer of the East India squadron; in 1859 aided the British in the capture of the Peiho forts, near Canton, China; in 1860 brought the Japanese ambassadors to the U. S.; was stationed at Sackett's Harbor, N. Y., in 1861, when Georgia seceded; entered the Confederate service; was subsequently commander of the iron-clad Virginia; after the close of the war resided in Nova Scotia for several years, when he returned to Savannah, where he was elected harbor-master. D. at Savannah June 15, 1871.

Ta'ton's, tp., Columbus co., N. C. P. 879.

Tat'ta, town of Sinde, Hindostan, in the delta of the Indus, in lat. 24° 46′ N., lon. 68° E., has some manufactures of silk and cotton, and one noteworthy building, a mosque of brick, but else it is a miserable place, surrounded by ruins of its former splendor. P. estimated at 10,000.

Tat'tam (HENRY), D. D., LL.D., F. R. S., b. in Ireland Dec. 28, 1788; educated at Trinity College, Dublin, and at the universities of Göttingen and Leyden, where he received his doctorate respectively in laws, theology, and philosophy; took orders in the Church of England; was rector of St. Cuthbert's, Bedford, 1818–45, also rector of Great Woolstone, Bucks, during a portion of that time; became archdeacon of Bedford 1845, and rector of Stamford Rivers, Essex, 1849, and was afterward a chaplain in ordinary to the queen. D. at Stamford Rivers Jan. 8, 1868. During his travels in the East, early in the century, Dr. Tattam laid the foundation of an intimate knowledge of Oriental languages, concerning one of which, the Coptic, he became the chief modern authority. He discovered at the convent of Nitria in the N. W. desert of Egypt, and secured for the British Museum, a splendid collection of ancient Syriac MSS., which now constitutes the basis of recent researches in that language. Author of *A Compendious Grammar of the Egyptian Language, etc.* (1828), *Lexicon Ægyptiaco-Latinum ex veteribus Linguæ Ægyptiacæ Monumentis, etc.* (Oxford, 1835), *Duodecim Prophetarum Minorum Libros, in Lingua Ægyptiaca, vulgo Coptica seu Memphitica Latine, etc.* (1836), *The Ancient Coptic Version of the Book of Job the Just, translated into English and edited* (1847), *The Apostolical Constitutions in Coptic, with an English Translation* (1849), *Prophetæ Majores in Dialecto Linguæ Ægyptiacæ* (Oxford, 2 vols., 1852), and several charges and theological treatises. Among the Syriac MSS. secured by him were the *Ecclesiastical History of John, Bishop of Ephesus* (Oxford, 1853), and the *Epistles of Ignatius* (1845), both edited in the Syriac text by Dr. William Cureton, and the former translated into English by Dr. R. Payne Smith (1860).

Tat'tler, a name applied to numerous birds of the snipe family. At least, as the terms are practically employed, there is no valid distinction between the tattlers and the sandpipers, many birds being by some writers called by the one or the other name at random. The tattlers are of several genera and many species. Some of them are very fine game-birds.

Tauch'nitz (KARL CHRISTOPH TRAUGOTT), b. at Grosspardau, near Grimma, Saxony, Oct. 29, 1761; learned the printing trade at Leipsic; worked for some time in Unger's establishment in Berlin, and opened in 1796 a printing-house in Leipsic, to which was added in 1798 a book-store, in 1800 a type-foundry, and in 1816 the first stereotype-foundry in Germany. From his establishment, which soon grew and became one of the largest of the kind in Germany, issued those celebrated editions of Greek and Latin authors which in correctness, convenience, and cheapness surpassed all other editions which had hitherto appeared.—After his death (Jan. 14, 1836) his son, KARL CHRISTIAN PHILIPP TAUCHNITZ, b. at Leipsic Mar. 4, 1798, continued the business until 1865, when on his retirement it was broken up or went into other hands.—His cousin, CHRISTIAN BERNHARD TAUCHNITZ, b. Aug. 25, 1816, established a publishing-house in Leipsic in 1837, from which issued the well known *Collection of British Authors*, of which over 1000 vols. have been published. He was made a baron in 1860.

Tauism and **Tauists.** See LAOU-TSZE, by C. G. LELAND, A. M.

Tau'ler (JOHANNES), b. at Strasbourg in 1290; entered the order of the Dominicans in 1308, and studied theology at the University of Paris. The scholastic method, however, of the theology of that time did not satisfy him; he felt himself drawn toward the mystical and speculative writers on religion and philosophy; and this tendency was still more strengthened within him after his return to Strasbourg, where he met with Meister Eckart. Eckart's pantheism, however, as well as Suso's sentimentalism, remained foreign to him. His character was of a more practical turn, and it is the moral bearing of the religious ideas which forms the essence of all his writings. With the exception of a few excursions to Cologne, Bâle, etc., he lived and worked in Strasbourg to his death, June 16, 1361, enjoying the reputation of being the greatest preacher of his time, and setting a rare example of Christian courage, self-denial, and persistency during times of papal ban, of plague, and other hardships. His writings, consisting of sermons, the celebrated work on *Following the Lord's Life of Christ*, etc., were first collected in 1498. A translation into new High German was given by Schlosser (Frankfort, 1826). (See Schmidt, *Johannes Tauler von Strasburg* (Hamburg, 1841), and Miss Winkworth, *Life and Times of Tauler* (1857), containing 25 of his sermons; American reprint, ed. by R. D. Hitchcock, 1858.)

Taun'ton, an old but well-built town of England, county of Somerset, on the Tone, has some manufactures of cotton and silk, and trade in agricultural and dairy produce. P. 15,466.

Taunton, city, port of entry, and cap. of Bristol co., Mass., incorporated as a town in 1639, as a city in 1864, is situated in the valley of Taunton River, and is distant 33 miles S. from Boston, in the centre of a prosperous agricultural and manufacturing community. Its business interests are diversified. Principal manufactures, locomotives, cotton machinery, nails and tacks, stoves and hollow-ware, copper, yellow metal, cotton cloth, cutlery, crucibles, stove-linings, fire-brick, silver and britannia ware, cotton yarns, machinists' tools, steam-engines, oilcloth, and brick. The city has 3 national banks, 2 savings banks, public library, paid fire department, fire-alarm telegraph, 1 daily and 2 weekly papers, and a system of waterworks in process of completion. It is the centre of a system of railroads connecting it with Boston, New York, Providence, and the East and West, and carries on an extensive trade in coal and grain with the interior. The Bristol County Agricultural Society possesses a fine estate in the centre of the city, which is annually the scene of a most successful agricultural and mechanical exhibition. The charitable institutions are a home of aged ladies, and a city mission with commodious chapel. Within the city limits there are 20 incorporated companies, doing business with an aggregate capital of $2,675,000, besides a large number of unincorporated manufactories. There are 19 churches, a system of public schools, and an incorporated academy maintained by a fund. Valuation of city, $18,000,000. P. 18,629.
WM. REED, JR., ED. "DAILY GAZETTE."

Taunton River, a pleasant navigable stream, is formed by the union of Matfield and Winnetuxet rivers near Halifax, Mass. Passing Taunton, it expands into a wide estuary, which opens into Narragansett Bay.

Tau'rida, government of Russia, bordering on the Dnieper, the Black Sea, and the Sea of Azof, comprises an area of 25,856 sq. m., with 658,549 inhabitants, and consists of the peninsula of the CRIMEA (which see) and some extensive districts of the mainland. The north-western part of the Crimea and the mainland are desert steppes interspersed with salt lakes; they are inhabited by Tartars, who contrive to feed large herds of cattle and sheep on the steppes and cultivate some millet. The south-eastern part of the Crimea is beautiful, resembling Italy, producing olives, wine, etc., and inhabited by Russians, Greeks, and Jews.

Tau'rine [Lat. *taurus*, "bull"], a neutral organic compound, occurs in the bile of the ox and other animals, in which it is formed by the action of acids and alkalies upon taurochloric acid; it is also contained in certain mollusks. Upon treating ox-bile with hydrochloric acid, filtering the liquid, and evaporating the filtrate, it is obtained in crystals mixed with sodium chloride, from which it is separated by crystallization. Taurine has been looked upon as an amide of isethionic acid, from which it can be artificially formed by heating the ammonic salt:

$$\underset{\text{Ammonic isethionate.}}{H_4NC_2H_5SO_4} - H_2O = \underset{\text{Taurine.}}{C_2H_7NO_3S}.$$

The composition of taurine is $C_2H_7NO_3S$: it forms large and transparent monoclinic crystals, which dissolve in water, especially when hot, but which are nearly insoluble in alcohol. It is isomeric with sulphite of aldehyde-ammonia. Although taurine contains about 25 per cent. of sulphur, it is a remarkably stable compound. By the action of nitrous acid it is converted into isethionic acid, nitrogen being evolved:

$$\underset{\text{Taurine.}}{C_2H_7NO_3S} + HNO_2 = \underset{\text{Isethionic acid.}}{H.C_2H_5SO_4} + H_2O + 2N.$$

J. P. BATTERSHALL.

Tauromenium. See TAORMINA.

Tau'rus [Lat., "bull"], a constellation, one of the twelve signs of the Zodiac, occupying the region corresponding to the sign Gemini, and chronologically to the month Apr. 20–May 21. It includes the remarkable groups of stars the Pleiades and Hyades, and is rich in telescopic stars. (See ZODIAC.)

Taurus, the name of a range of mountains in Asia Minor, stretching in an E. to W. direction from the Euphrates to the Gulf of Adalia. By the Alma-Dagh it communicates with the Lebanon Mountains in Syria, and by one branch of the Anti-Taurus with the Caucasian Mountains. It rises in terraces from the Mediterranean to a height of 10,000 feet, and encloses between itself and Anti-Taurus an elevated plain, arid, dotted with salt lakes, and evincing the same character as the plateaus of Central Asia.

Tauss, town of Bohemia, has breweries, distilleries, tanneries, and manufactures of cotton and linen fabrics. P. 7382.

Tautog', a corruption of the aboriginal name (*Tautoga onitis* or *nigra*), a well-known fish of the eastern American coast, of considerable economical importance. It belongs to the family Labridæ and sub-family Labrinæ, and is related to the wrasses of Europe, but is the only member of its genus. It is an oblong fish, with small smooth scales; the opercular bones scaleless, and the cheeks with few, distant, and imbedded scales; the teeth on the jaws conical and in two rows, and none behind developed as canines; the dorsal spines numerous (17), and only three anal spines; the rays are D. xvii.–10, A. iii.–8; the color in the adult is sometimes an almost uniform black, but generally more or less blotched, and in the young banded and otherwise decorated. It is common on the Atlantic coast from Massachusetts to Carolina, and rarer farther northward and southward. Its average weight is not over two pounds, but it frequently weighs nine or ten pounds, and an exceptionally large one of twenty-two pounds has been noticed. It makes its appearance in large numbers and in shallow waters on the New England and New York coasts between the months of April and November, and is most abundant in May and October. It is then, on some parts of the coast, the most abundant of the larger fishes, and is a staple market-fish, and sells for about twelve to fifteen cents a pound. It spawns in May or June. When it first makes its appearance in shallow water, it refuses the hook, but soon takes it readily, and is one of the most frequently caught of the salt-water fishes. It prefers rocky places and slight currents. It keeps near the bottom, and preys upon crustaceans and mollusks. In the spawning season, which takes place in June, it seeks weedy places and where eel-grass grows, and therein deposits its eggs.
THEODORE GILL.

Tavern. See HOTEL, by C. G. LELAND, A. M.; HOTELS IN AMERICA, by L. P. BROCKETT, A. M., M. D.; and INNKEEPERS, by PROF. J. N. POMEROY, LL.D.

Tav'ern, tp., Pulaski co., Mo. P. 796.

Tavernier' (JEAN BAPTISTE), b. at Paris in 1605; undertook while still a very young man extensive journeys in the Low Countries, Germany, Hungary, and Italy, and made from 1630 to 1633 his first great journey to the East —from Constantinople, through Erzeroom, Tabreez, Ispahan, Bagdad, and Aleppo, to Rome. Subsequently, from 1638 to 1669, he made five more voyages to the East, through Asia Minor and Persia to Hindostan, and as far as Batavia. He possessed great skill in valuing precious stones, and by trading in jewelry he amassed a great fortune. He also promoted French commerce in the East Indies in various ways, and on his return from his last voyage Louis XIV. made him a baron. His fortune, however, he lost, and, being a Protestant, was compelled to seek refuge in Switzerland after the Revocation of the Edict of Nantes. He afterward went to Berlin, and was made director of an East Indian company which the elector of Brandenburg was founding. On a seventh journey to the East he d. at Moscow in July, 1689. A report of his first six voyages was edited by Chappuzeau (2 vols., 1676–77), and a third by La Chapelle (1679), under the title *Les Six Voyages de J. B. Tavernier.*

Tavi'ra, town of Portugal, province of Algarve, at the mouth of the Sequa, is well built and handsome, and carries on a general trade and considerable fisheries. P. 9000.

Tav'istock, town of England, in Devonshire, on the Tavy, has some few manufactures of serges and coarse linens, and 7720 inhabitants, mostly engaged in agriculture.

Tavoy', town of British Burmah, capital of a province of the same name, at the mouth of the river Tavoy, in lat. 14° 7′ N., on the Tenasserim coast, Farther India. It is described as a neat and handsome town, of a thoroughly Indian character, built of bamboo and on piles, half concealed by luxuriant orchards and fruit-gardens, and standing in the centre of rich ricefields, that fill the air with malaria, which, after emaciating people by intermittent fever, kills them by dysentery. The population of the whole province is 54,074; that of the town is unknown.

Tawas, tp., Iosco co., Mich. P. 1381.

Tawas City, p.-v., Tawas tp., cap. of Iosco co., Mich., on Tawas Bay, 65 miles N. E. of Bay City, has 2 churches, a graded school, a fine court-house, 1 newspaper, 4 hotels, and several mills. Principal business, manufacturing and shipping lumber. Rich deposits of salt exist, and it has one of the finest natural harbors on the chain of lakes. P. about 1000. H. E. HOARD, ED. "IOSCO CO. GAZETTE."

Tawing and **Tanning.** See LEATHER, by PROF. C. F. CHANDLER, PH. D., M. D., LL.D.

Tax'ation [Lat. *taxatio*, from *taxare*, to "rate," to "value," to "estimate"], the means employed to gather from a people the contributions needed for the purposes of its government. The prosperous industry through which men acquire wealth, and the well-ordered condition of society by which men are made secure in the possession and happy in the enjoyment of wealth, depend on good government efficiently administered. Every individual of the state has therefore an interest with regard to his own well-being in the maintenance of government, and it is wise and right that he contribute a portion of his wealth to its support. Since the government, as an agency for promoting the general good, represents a common public interest, superior to any private interest, its claim very properly takes precedence of all others, and in a sense it has a first lien on the entire wealth of the nation. The rightfulness of taxation in the abstract stands thus on incontestable principles of sound economy and of essential justice. In despotic governments the will of the ruler determines arbitrarily both the methods and the measure of taxation. The people's wealth is consequently exposed to the unrestricted plunder of an army of tax-gatherers, and great inequality and oppression prevail. It is a fundamental principle of free government, however, that taxes shall be imposed by representatives of the people alone, through proportional and reasonable assessments on all estates, and shall be collected through uniform and responsible agencies, acting under defined powers and direct accountability.

To devise and carry out an equitable system of taxation is one of the profoundest problems of political economy. A perfect result has never yet been attained. Every scheme hitherto proposed involves more or less of injustice, or gives place to evasions and frauds which render it in application unequal. Hence there is found to be an advantage in combining different systems, so that the defects of one shall be balanced by the defects of another, while the advantages of all are secured. In studying the problem, taxation should be regarded with respect simply to its one object—viz. the raising of a revenue for the state. Whether or not it can be wisely employed, also, as a means of protecting and encouraging particular industries or of regulating extravagant expenditures are distinct and independent questions. (See FREE TRADE, PROTECTION, and SUMPTUARY LAWS.) The one thing to be aimed at is to make the burdens laid on the people as light and equable as possible, consistently with providing means ample for the support of the government. This involves two things: (1) fair and impartial assessments; (2) efficient and economical collection.

Adam Smith laid down the four following maxims with regard to taxes in general: "(1) The subjects of every state ought to contribute toward the support of the government as nearly as possible in proportion to their respective abilities; that is, in proportion to the revenue which they respectively enjoy under the protection of the state. (2) The tax which each individual is bound to pay ought to be certain, and not arbitrary. The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor and to every other person. (3) Every tax ought to be levied at the time or in the manner in which it is most likely to be convenient for the contributor to pay it. (4) Every tax ought to be so contrived as both to take out, and to keep out, of the pockets of the people as little as possible over and above what it brings into the public treasury of the state." It may be questioned whether it is true, as seems to be implied in the first maxim, that the abilities of different individuals are measured in due proportion by their respective actual revenues or incomes. It is obvious that the abilities of one whose income is $500, and of another whose income is $50,000 per year, to pay a tax of 2 per cent. on their respective revenues, are not equal. Hence the need of some further discrimination in estimating abilities. With this qualification, these maxims of Mr. Smith are believed to embody principles of equity, and have met with general approval as furnishing a test to which various schemes of taxation may be referred.

The terms *direct* and *indirect* are used to distinguish two prominent methods of taxation. According to J. S. Mill, "a direct tax is one which is demanded from the very persons who it is intended or desired should pay it. Indirect taxes are those which are demanded from one person in the expectation and intention that he shall indemnify himself at the expense of another." A poll-tax, a tax on land, and, strictly speaking, an income-tax, are examples of direct taxes; though, according to the interpretation adopted by Congress, an income-tax is not a direct tax in the sense of the term used in the U. S. Constitution with respect to the apportionment of direct taxes among the States. Duties laid on imports and excises on articles of home manufacture are examples of indirect taxation, the importer or manufacturer who pays the tax adding the amount of the tax to the price of the goods, to be ultimately paid by the consumers. Direct taxation, with fair assessments and honest returns of property, may be most fully conformed to the equitable principles embodied in the maxims just stated. But if applied to all kinds of property, it involves much labor and expense in collection, and is apt to prompt concealment and evasion, and to provoke dissatisfaction and complaint on the part of tax-payers, because they know precisely when and how much they have to pay. Indirect taxes, on the other hand, are more cheerfully submitted to, and more easily collected, because laid on the goods at the port of entry or at the manufactory, and no one thinks of the tax he pays when he buys the goods. But under this method the burden is imposed very unequally, each one's proportion being determined not at all by his ability, but by his necessities. So, often, a poor man with a large family to provide for actually contributes more for the support of the government than his neighbor with ten times his wealth and ability. It is only a partial relief to this inequality which is gained by a discrimination that lays heavier duties and excises on luxuries than on necessities; for the proportion which each bears of the burden is still determined not by his ability, but by what he consumes. In most countries it is now adopted as a rule of indirect taxation that those commodities, such as intoxicating liquors, the consumption of which is regarded as injurious, shall be most heavily taxed. Actual experience has shown that the consumption of such articles is not materially diminished by the tax. But when the tax is so high as to raise the price of an article considerably above the cost of production, the temptation to smuggling and illicit manufacture is very great, the expense of maintaining the law and collecting the tax is immensely increased, and corruption more or less on the part of revenue officers is almost inevitable.

In the U. S. there are two general systems of taxation: (1) That instituted by the national government; (2) that instituted by the State governments, including all local taxes imposed under authority of the State by counties, cities, towns, and school districts. The Constitution authorizes the Federal government to impose taxes in every form, subject only to the qualification that direct taxes must be apportioned to the several States according to their respective populations, and that all duties, imposts, and excises shall be uniform throughout the U. S. It expressly forbids any State to lay any imposts or duties on imports or exports except for executing its inspection laws. In consequence of these constitutional provisions, the taxes laid by the national government have been hitherto, with only slight exceptions, indirect, while the State governments rely almost exclusively on direct taxes. The proceeds of duties on imports proved sufficient to meet the needs of the general government for the most part until the recent civil war. Since then it has been found necessary to impose excises on various domestic manufactures. Duties are imposed by act of Congress establishing a tariff—*i. e.* a list of articles to be taxed—and the tax is collected by government officers at the ports of entry as the goods come into the country, before they pass into the hands of the importer or consignee. The duties are either *specific*—*i. e.* so much per pound, yard, etc.—or *ad valorem*—*i. e.* a percentage charged on the value of the goods as invoiced. The tariff, as now adjusted, embraces a great number of articles, and both kinds of duties, specific and ad valorem duties, being often applied to the same article. Hence the system is exceedingly complicated and the collections expensive. Excises are imposed by act of Congress on certain articles specified, and are collected by the sale of stamps to be affixed by the manufacturer or by an officer of government before the goods are thrown upon the market. The number of articles thus taxed is now quite small, liquors and tobacco yielding the greatest part of the internal revenue from this source. The following table shows the amount and distribution of taxes collected by the national government for the fiscal year ending June 30, 1875:

Customs duties		$157,167,722.35
Taxes on distilled spirits	$52,081,991.12	
" fermented liquors	9,144,004.41	
" tobacco	37,303,461.88	
" banks and bankers	4,097,248.12	
Adhesive stamps	6,557,229.65	
Penalties, etc	281,107.61	
Back taxes under repealed laws	1,080,111.44	
Total internal revenue		110,545,154.23
Tax on circulation and deposits of national banks		7,268,379.16
" seal-skins		317,494.75
Total of taxes		$275,298,750.49

A large portion of the revenue of the British government is derived from excises and stamps. The following tables, showing the results of these forms of taxation in that country, are of interest in this connection:

Statement showing in terms of U. S. Money the Amount of Revenue collected from Excise in the United Kingdom during the year ending Mar. 31, 1875.

Spirits	$72,490,254.97
Malt	37,699,510.21
Licenses	17,031,562.58
Other receipts	5,410,905.62
Total	$132,632,233.38

Statement showing the Amount of Revenue derived from Stamps in the United Kingdom for the same year.

Deeds and other instruments	$9,712,521.77
Probates of wills	10,481,453.10
Legacies and successions	16,547,924.94
Marine insurance	607,018.01
Bills of exchange, bankers' notes, etc	5,083,039.78
Receipts and drafts	3,636,740.32
Other receipts	5,261,825.26
Total	$51,330,523.18

Under State authority all taxes are direct, laid upon persons by poll-taxes and upon property by assessment. The poll-tax is ordinarily a small amount levied upon every male inhabitant who has reached his majority. It recognizes the protection which the government extends to the persons as well as to the property of its citizens. It is made in theory a condition of the electoral franchise, he who pays the tax and votes being regarded as the head of a family, in both acts representing a household. It is objected to this tax that to collect it of all is difficult and expensive, so that the theory is not carried out; and further, that it is unjust to give to those who pay only a poll-tax, on that ground, an equal and direct vote respecting public expenditures, since they have no personal interest in such expenditures, except it may be the hope of profitable employment. Many of the States lay no poll-tax. The method of imposing taxes on property is essentially the same in all the States. The State authority, by statute, requires the election or appointment annually of assessors in every town and city, who make a valuation of all property which the law subjects to taxation. Real estate and such articles as are open to their inspection are estimated by the assessors. Personal property is returned in prepared lists by the owners, who may be required to make oath to the truthfulness and completeness of their returns. The usage of different States varies, but commonly real estate is set down at from 25 to 50 per cent. less than its market-value. Since assessors in different places may adopt different standards of valuation, the original assessments are, in most of the States, referred to boards of equalization appointed for each county, and their judgment is subsequently reviewed by a general board for the State. Upon the basis of the valuation of property so determined, the taxes to be raised for the purposes of the State are apportioned to each county, city, or town. By general statute or by special city charters each county, city, town, and school district is authorized to levy taxes for local purposes. These also are apportioned on the basis of the State valuation, except in case of certain improvements in cities, such as opening, paving, and lighting streets, which are charged upon the adjoining property in proportion to the benefit conferred. Generally, all of these taxes for the State, the county, the city, the town, and the school district are collected in each town or city ward by one collector at one time, he being furnished with a tax-list covering all. If other means fail, he is authorized to levy upon goods to secure the tax, and according to forms prescribed by law, lands may be sold for delinquent taxes, the title thus given being made complete and valid after a certain period allowed the original owner for redemption. (See Tax Sales.)

This direct local taxation by State authority has been thus far adjusted on the principle generally admitted, that equitable taxation requires that property of every kind shall be assessed. In actual experience it is found, however, that property in the form of real estate bears by far the larger share of the burden. Personal property can be easily concealed or moved by those who wish to evade their share of contributions to the public weal. On this matter the prevalent moral sentiment is low, and consciences are weak to resist the strong temptation to make false statements, and even to commit perjury when detection is almost impossible. The difficulty of attaining a perfect result is aggravated by the complexity of our government. Property, such as railroad and bank stocks, being within the jurisdiction of one State, while the owner resides in another, is liable to assessment in both States. So, too, in the case of evidences of debt, such as mortgages; if the real estate pledged is taxed to its full value, and the mortgage is also taxed as personal property, there seems to be a double taxation, since there is in reality but one property, of which the mortgagor and the mortgagee are joint owners. These and other like considerations have given occasion recently to much earnest discussion on the part of political economists and financiers respecting the accepted principles and methods of taxation. In theory, it is admitted that taxation to be equitable must draw in due proportion from all kinds of property, but the attempt fairly to apply the theory fails, and involves such manifest and glaring inequality that a cry is raised for some radical reform. This is not the place to enter into the discussion of the questions raised. The drift of thought in the direction of change is indicated by the proposition to abandon all attempt to assess personal property, urged by one who has given much study to the subject, thus: *First.* "The assumption that it is necessary to assess everything in order to tax equitably involves an impossibility, and therefore unavoidable inefficiency, injustice, and inequality in administration. *Second.* As popularly used in respect to matters pertaining to taxation, the term *property* is made to apply equally to entities and to symbols or non-entities, which in itself is an absurdity. *Finally.* The outcome of all this is a system which powerfully contributes to arrest and hinder national development, to corrupt society, and is without a parallel in any country claiming to be civilized." Another says, in answer to the question, What should be taxed, and how should it be taxed? "Never tax anything that would be of value to your State that could or would run away, or that could or would come to you." The world is not ready to accept at once these proposed innovations. But there is hope that from the interest and attention now awakened on the whole subject, and from investigations and discussions now carried on, there will come action intelligently and wisely taken to correct defects and equalize more perfectly the public burden.

Questions are also rife respecting taxing the property of savings banks and other banking institutions, of railroad corporations, insurance companies, and the like. These are comparatively new problems, the wise solution of which will no doubt be reached by further experience and discussion. Present usage varies much in different States. (For the particular presentation of certain other methods of taxation see Income-Tax, License Laws, Succession, etc.) The facility with which a considerable revenue may be raised by a very slight stamp-tax laid on various instruments and forms of business, such as bank checks, deeds, contracts, etc., commends that method for a wider application than is given it in our country. Such a tax, once properly instituted, is hardly felt, and by scarcely any other method is a more just and equitable distribution of the public burden secured. It touches directly the wealth of the country in transition, and naturally diffuses itself through the whole community.

The following are the chief exemptions made in legislation for taxes: (1) Public property of both the State and the nation, including public lands, custom-houses, court-houses, public-school buildings, parks, etc.; (2) the property of incorporated institutions of learning endowed by private beneficence; (3) houses of worship, and to some extent other church property; (4) cemeteries belonging either to towns or to chartered corporations; (5) personal property of individuals, so far as to cover the necessities of life. The propriety of continuing exemptions in the second and third cases named is now much questioned and discussed. In favor of these exemptions it is urged that the prime object of all taxation is the public welfare, and that educational and religious institutions are most intimately identified with the public welfare, as they furnish the foundation of national prosperity by fostering general intelligence, virtue, and godliness; furthermore, that the public spirit of a people is promoted by encouraging voluntary sacrifices and contributions in this form for the public good; that these agencies bring in special influences of the highest importance to qualify and improve all that is done by the instrumentality of the state for the intellectual and moral culture of its people; and that such a favor, granted impartially to all religious denominations, precludes the support of the state to any one order or class more than to others, and holds it in its true position as the guardian of freedom of conscience for all, while it recognizes, fosters, and protects religion in all legitimate forms as a source of stability and purity for the commonwealth. Great benefits are secured at the least possible expense by the slight increase of the general assessments caused by these exemptions. On the other hand, it is urged that these institutions are not properly agents of the state, nor controlled by the state, but are maintained for special private ends of various religious corporations; that the exemptions favor a portion of the community at the expense of others not interested; that the policy involves a union of Church and State at variance with the fundamental principle of our government; and that it involves a liability to the accumulation of great wealth, to be held in mortmain by never-dying corporations independent of the state, possibly subject to foreign control, which may be

used against the best interests of the public. The agitation of this question is healthful, as it calls attention to real dangers. It will no doubt lead to some careful qualifications and limitations of these exemptions.

(For the full presentation of this subject of taxation in its modern phases see recent works on political economy, the special treatises of writers in England, as Leone Leri, Sir Morton Peto, R. Dudley Baxter; of American writers, R. S. Blackwell, Francis Hillard, William Endicott, Enoch Ensley, George H. Andrews, David A. Wells; the reports of commissioners and State officers in Massachusetts, Virginia, Rhode Island, New York, Delaware, and Maine; and for the actual legislation of different countries, *Archives de Droit international et de Legislation comparée*.)

A. L. Chapin.

Tax'idermy [Gr. τάξις, "arrangement," and δέρμα, "skin"], a term applied to the art of preserving and mounting for exhibition skins of animals. Before the year 1828 taxidermy was probably not practised, if indeed it was known, as an art in America. In that year an Englishman named Scudder established a museum in the "Old Almshouse" on Chambers street, New York, where he prepared in the rude manner of the time birds and quadrupeds. Charles Waterton did much to elevate taxidermy to a high position, and through the genius of Titian R. Peale the art in this country improved. The late Jules Verreaux of Paris brought it to a degree of perfection that fairly rivals some of the best examples of the higher plastic art. Certain appliances are used that give expression to the skins of quadrupeds, and if the operator have the artistic faculty, the result is quite within the realms of art. The same faculty produces similar results with the feathered kind. The skin is drawn over a form which is moulded to counterfeit nature as closely as possible: the material is not so tractable, yet it is the sculptor's art that fulfils the highest requirements of taxidermy. The African lion and the long-tailed sheep in the American Museum at Central Park, work of the late Jules Verreaux, are examples of the highest rank. The late Dr. Kaup of Germany attained remarkable skill in expressing action and the characteristic attitudes of birds, effecting a wonderful similitude to the living in the act of singing.

Desirable as it certainly is that this art should attain all that is possible in the artistic or æsthetic sense, much more important is the mode of preparation of the skin. There are numerous books on the subject published both in this country and in Europe; the scope of this article will not allow of a detailed account of the processes; we therefore refer the reader to them. The Smithsonian Institution at Washington will supply a concise treatise on the subject which has been prepared for use in the field. This includes all of the various manipulations required for the preservation of birds' eggs, the mounting of insects, curing of alcoholic specimens, etc., as well as directions for skinning and mounting birds and quadrupeds. Swainson's "Taxidermy" in Lardner's *Cabinet Encyclopædia* is regarded as good authority. The Illinois State Natural History Society at Bloomington issued an illustrated pamphlet on the subject for private use, in which the author, Mr. Richard H. Holder, gives the results of a long and ripe experience, rendered additionally valuable from association with Audubon and Bell. As the latter is by far the best book we have seen, an outline is here presented.

In a preliminary chapter on hunting the author recommends No. 6, 8, and 10 shot. For humming-birds, sift No. 10 through a common meal-sieve; a few charges of "dust shot" to each pound may be obtained. A pair of short-bladed, sharp-pointed scissors; a large, strong pair; a pair of spring forceps; and a pair of forceps with long blades,—these tools are quite necessary. Wire cutters, plyers, needles, and some other items will be readily suggested to an ingenious operator. The bird or quadruped that has been killed for mounting should immediately be examined, and all shot-holes and natural openings plugged securely with cotton to prevent the blood or ejecta from soiling the exterior. In the field cones of paper are serviceable to keep the birds smooth and free from injury; place the bird head downward in a cone, and fold the loose paper neatly over the tail. Specimens that require cleansing from blood or grease may be washed in soap and *tepid* water; plaster of Paris proves exceedingly valuable then to absorb the moisture; it may be used in large quantities; rub it off repeatedly, and add the plaster until the feathers are dry and found to be free from blood or grease. The whitest plumage may be made entirely clean by this process. Having the bird in hand, you separate the feathers upon the breast, where they are sparsely set—that is, on a line parallel with the breast bone—whilst with the knife make an incision, just through the *skin only*, from the lower end of the breast bone to the vent. Sprinkle a little plaster upon the exposed surface to absorb moisture. Careful manipulation with the forceps and fingers will suffice to remove the skin on both sides as low down as convenient. Place the thumb and forefinger of your right hand upon the skin over the breast, press downward, and you will expose the whole breast to the neck. Now insert a hook in the neck near the body, the hook being suspended above. Take hold of the neck, pull upward, at the same time forcing your thumb and forefinger under the neck, bringing it clear of the skin sufficiently to insert your scissors, when you sever the neck. Lay hold at the wing, pushing down, at the same time opening a place under the wing-bone with your fingers, in which place your scissors and cut off at the shoulder. Having cut off both wings in this manner, you now carefully separate the skin from the back, using great care as you reach the loins, as here it adheres so closely that it is easily torn. Now take the leg at the lower joint with the left hand, and with the thumb and forefinger of the right on either side of the thigh press down the skin; insert the scissors at the joint, and sever. Then carefully force down the skin to the base of the tail, and cut off; remove the oil-sac and flesh adhering. Next strip the legs of all fat or flesh; take the wing-bone, draw out to the fore-arm, and with your fingers force the skin down sufficiently to expose the flesh, and with your knife remove it, *not* separating the shafts of the feathers from the bone. In large birds, especially geese, hawks, etc., the wings can be more easily cleaned from the outside; making an incision the whole length of the fore-arm on the under side, separate the skin and remove the flesh; the opening need not be sewn up. The neck is now reached. Take hold of it with your left hand, and with the right *strip* to the skull; here, carefully turning the skin, you reach the ears, which seize with your nails and *tear* out; then force down the skin, leaving bare the eyes; insert the point of your spring forceps in the socket and work around, loosening the eye; then lift out and tear loose from the lids. Next with the knife cut loose the tongue, and separate the neck at the base of the skull. Now with scissors cut down each side of the jaw and through into the skull, removing the roof of the mouth and exposing the brain, which may be scooped out with the forceps. Apply an abundance of arsenic to all parts of the skin, especially about the head and base of the tail; then fill the eye-sockets with cotton, turn back the head, being careful not to stretch the skin, adjust the feathers, and the bird is ready for mounting or to stuff as a "skin" for the cabinet. Ducks, geese, cranes, and some others have such large heads that it is necessary to cut the neck a little to let the parts through; this incision may be neatly sewn before mounting. In cases where the skin is much loaded with fat, plaster of Paris should be used freely; corn-meal is also a good absorbent. Before the arsenic is applied, the skin should be cleansed completely of fat, and all extraneous matter removed from it. Following the above directions, one may prepare skins for the cabinet or for exchange. To "set up" a skin requires some mechanical skill; with the facilities now at hand, from books and from operators, a knowledge of the art may be easily attained. For scientific purposes each bird should be mounted on a separate stand, and real or imitation foliage and moss should be avoided.

The best agent for preserving the skin is *pure* pulverized arsenic; it is not always found in drug-stores, but is sold by the reputable *wholesale* druggists of the large cities. This is important, as the learner will be puzzled to choose from a number of preparations, called "arsenical soaps," etc. It is well known that *pure* arsenic, in powder, is a perfect preservative, and is the most convenient form.

To preserve fishes, common table-salt is found the best when arsenic is not at hand or desirable. Corrosive sublimate (bichloride of mercury), in solution, is used by expert operators on the fur and extremities of animals, but this is often attended by a chemical action that is ruinous to the specimen; the bleaching properties of the chloride render it unsuitable in the hands of the learner. A strong solution of arsenic, applied freely and at intervals upon the bill and legs of birds, or, in the event of the actual presence of insects, on the fur of quadrupeds, is entirely efficient. Specimens of large quadrupeds are particularly liable to the attacks of *Anthrenus* and *Dermestes*; certain parts escape the arsenic dressing—the hoofs, around the horns, the nose, and the thicker parts of the skin. Very successful experiments were tried at the American Museum to resist this evil. In a pailful of hot water dissolve two pounds of carbonate of potash; *pure* pulverized arsenic may then be added as long as the liquid remains free from sediment; that amount of hot water will take up several pounds of arsenic. This solution may be applied *ad libitum* to the entire coat of the animal, leaving no trace of the mineral in sight.

J. B. Holder.

Taxonomy. See Botany, by Prof. Asa Gray, M. D., LL.D.

Tax Sales. This term denotes the public official sales of lands made in pursuance of law for the non-payment of the taxes which have been laid upon them. The whole subject is regulated by statute, and forms a very important head of American jurisprudence. The legislation of the various States differs very much in the provisions concerning the assessment of taxes, the mode of selling lands when they are unpaid, the effects of such sales, and the right of redemption given to the owners; but notwithstanding this diversity, certain general principles have been settled which apply to all or nearly all the statutes and regulate the proceedings thereon. The land must be liable for the tax, it must not be exempt, and the tax must remain unpaid or undischarged. Payment or even tender by the owner, or by any other person whose interests in the land would be damnified, destroys the right to sell. In order that a sale may be valid all the statutory requirements which prescribe the prior official proceedings, down to and including the sale itself, must be substantially and accurately complied with. This is the fundamental doctrine established in all the States, although there is a considerable difference in the means and methods by which this regularity may be judicially determined in any subsequent controversy between the purchaser and the original owner. The principle thus stated applies to and includes all the preliminary steps, whatever they may be, for the assessment and laying the tax, the preparation of the assessment roll, and its delivery to the proper officer for collection, and also all the subsequent steps connected with the non-payment of the tax and the proceedings thereafter preparatory to the sale. The sale itself must be properly advertised and noticed, must be held at the designated time and place, must be public, and must be conducted in all respects pursuant to the statutory mandate. The land having been sold to the highest bidder for cash, a certificate is issued to him in most of the States which entitles him to a deed at the expiration of the time fixed by statute. At the termination of this period, during which the owner is generally permitted to redeem, a deed is executed on behalf of the State which recites the prior proceedings with more or less fulness, and conveys, or purports to convey, the title to the purchaser. There is a marked difference in the legislation of the States in respect to the effect of this tax-deed. At the common law the burden of proof lies wholly upon the purchaser, and he must show by affirmative evidence that all the prior steps necessary to the validity of his title were regularly taken. A class of statutes have modified this common-law doctrine, and made the deed *prima-facie* evidence that all the proceedings on the sale itself were properly performed; but the purchaser is still obliged under them to prove that the tax was duly assessed and laid, and that the assessor and collector have performed their respective duties. More recent statutes in many of the States—and this is now the general rule—have made the deed *prima-facie* evidence that all the proceedings, from the first step in laying the tax to the last one on the sale, were regular, and that the purchaser's title is valid. This, it is plain, wholly shifts the burden of proof from the purchaser on to the owner, but still permits him, if possible, to contest and avoid the conveyance. In one State at least, Iowa, the statute goes much farther, and makes the deed conclusive proof that the land was regularly listed and assessed, and properly advertised and sold. Very little is thus left for the owner to allege in opposition to the validity of the sale. In a few States a judicial determination that the taxes are unpaid is made a pre-requisite to any sale of lands on account of the delinquency. An opportunity is always given for a redemption by the owners or other persons having interest in the land. There is great diversity among the statutes on this subject, some being much more liberal than others in respect to the period of time during which the right lasts, the amount to be paid, and the conditions to be performed. Although these statutes are construed so as to guard the rights of redemptioners, their requirements must be followed; the courts have no power to open a valid tax-sale and permit a redemption which is not authorized by the legislature. (For more particular and detailed information the reader may consult Cooley on *Taxation* and Blackwell on *Tax-Titles*.)

John Norton Pomeroy.

Tay, a river of Scotland, flows from Loch Tay, at an elevation of 355 feet above the level of the sea, to the German Ocean, which it enters through a large estuary, the Frith of Tay, from 1 to 3 miles broad. Its entire course is about 120 miles, and it is navigable for vessels of 500 tons burden up to Newburgh, 15 miles from its mouth.

Taya'bas, town of the Philippines, the capital of a district of the same name, on the southern shore of the island of Luzon, in an unhealthy region. It is a clean, well-built, and handsome town, carrying on quite a considerable trade. P. about 18,000, most of whom are Chinese mestizoes.

Taychee'dah, tp., Fond du Lac co., Wis. P. 1522.

Tayler (John James), D. D., b. at Nottingham, England, in 1798, son of a Unitarian minister; educated at the dissenting college at York; graduated at the University of Glasgow 1818; studied theology; became minister of a Unitarian congregation at Manchester 1820; was secretary to the college at York from 1822 to 1840, when it was removed to Manchester; became at that time professor of ecclesiastical history, and subsequently of doctrinal theology; was secretary and vice-president of the Manchester Literary and Philosophical Society; removed to London 1853, along with the college, of which, under the name of Manchester New College, he became principal; was for some years pastor, along with his friend, Rev. James Martineau, of the Unitarian congregation in Little Portland street, and represented the English Unitarians at the tercentenary festival of the denomination at Forda, Hungary, 1868. D. at Hampstead, near London, May 28, 1869. Author of *A Retrospect of the Religious Life of England* (1845), *Christian Aspects of Faith and Duty* (1851), *An Attempt to ascertain the Character of the Fourth Gospel* (1867), *A Catholic Christian Church the Want of our Time* (1867), *Christianity, What is it? and What has it done?* (1868), and other works on religious subjects, some of them posthumously published under the editorship of Mr. Martineau. His *Life and Letters* (1872) were published by Rev. John Hamilton Thom.

Tay'lor, county of N. Florida, lying on the Gulf of Mexico and drained by Ocilla River; surface level, soil sandy. Staples, live-stock, wheat, and a little cotton and sugar. Cap. Perry. Area, about 1100 sq. m. P. 1453.

Taylor, county of W. Georgia, drained by Flint River, and intersected by South-western R. R.; surface undulating, soil generally fertile. Staples, cotton, Indian corn, live-stock. Cap. Butler. Area, about 400 sq. m. P. 7143.

Taylor, county of S. W. Iowa, bordering on Missouri, and drained by East Nodaway, Platte, and other rivers; surface generally level, soil fertile. Staples, Indian corn, wheat, oats, wool, live-stock, flouring products, and lumber. Cap. Bedford. Area, 560 sq. m. P. 6989.

Taylor, county of Central Kentucky, drained by affluents of Green River; surface hilly, soil fertile. Staples, tobacco, Indian corn, distilled spirits, wool, and live-stock. Cap. Campbellsville. Area, 275 sq. m. P. 8226.

Taylor, county of Nebraska, recently formed, and not included in the census of 1870.

Taylor, county of N. W. Texas, drained by Clear fork of Brazos River. Area, about 900 sq. m. P. not returned in the census of 1870.

Taylor, county of N. West Virginia, intersected by Tygart's Valley River; surface very hilly, with some fertile valleys. Iron ore and bituminous coal abound, and there are tanneries, iron-foundries, flour-mills, and saw-mills. Staples, Indian corn, oats, wool, flouring products, and lumber. Cap. Pruntytown. Area, 130 sq. m. P. 9367.

Taylor, tp., Columbus co., Ark. P. 830.

Taylor, tp., Ogle co., Ill. P. 402.

Taylor, tp., Greene co., Ind. P. 1677.

Taylor, tp., Harrison co., Ind. P. 1259.

Taylor, tp., Owen co., Ind. P. 757.

Taylor, tp., Allamakee co., Ia. P. 863.

Taylor, tp., Appanoose co., Ia. P. 1059.

Taylor, tp., Benton co., Ia. P. 3331.

Taylor, tp., Dubuque co., Ia. P. 1742.

Taylor, tp., Harrison co., Ia. P. 525.

Taylor, tp., Wayne co., Mich. P. 867.

Taylor, tp., Greene co., Mo. P. 998.

Taylor, tp., Shelby co., Mo. P. 920.

Taylor, tp., Sullivan co., Mo. P. 628.

Taylor, tp., Cortland co., N. Y. P. 1016.

Taylor, tp., Union co., O. P. 1141.

Taylor, tp., Blair co., Pa. P. 1368.

Taylor, tp., Cambria co., Pa. P. 1670.

Taylor, tp., Centre co., Pa. P. 512.

Taylor, tp., Fulton co., Pa. P. 868.

Taylor, tp., Lawrence co., Pa. P. 736.

Taylor, tp., Orange co., Va. P. 3957.

Taylor, tp., Scott co., Va. P. 1783.

Taylor (Alexander S.), b. in Charleston, S. C., in 1817; travelled extensively for several years, residing at different periods in the West Indies, China, India, and Ceylon, and

in 1848–60 at Monterey, and subsequently at Santa Barbara, Cal. He has contributed to various periodicals articles upon ethnology, natural history, and the history of California, among which are *History of Grasshoppers and Locusts of America* (in the *Smithsonian Reports* of 1858) and *The Indianology of California* (150 numbers in the *California Farmer*, 1860–64).

Taylor (Alfred Swaine), M. D., F. R. S., b. at Northfleet, Kent, England, in Dec., 1806; educated at a private school; studied surgery under Sir Astley Cooper at Guy's Hospital and in the chief medical schools of France, Germany, and Italy; became professor of chemistry at Guy's Hospital, and first professor of medical jurisprudence in the same institution. Author of *A Manual of Medical Jurisprudence* (1843), for which in 1859 he received the Swiney prize of £200; *Photogenic Drawing* (1840), *On Poisons in Relation to Medical Jurisprudence and Medicine* (1848), *On Poisoning by Strychnia* (1856), and *The Principles and Practice of Medical Jurisprudence* (1865); joint author with Dr. W. T. Brande of a standard *Manual of Chemistry*, and editor for many years of the *Medical Gazette*.

Taylor (Ann Hinton), wife of Isaac Taylor of Ongar, and mother of the second Isaac Taylor and of two daughters, Jane and Ann, all of whom acquired literary repute; d. in 1830. She published—*Advice to Mothers* (1814), *Maternal Solicitude for a Daughter's Best Interests* (1814), *Practical Hints to Young Females* (1815), *Present of a Mistress to a Young Servant* (1822), *Reciprocal Duties of Parents and Children*, and the tales *The Family Mansion* and *Retrospection*; also, in conjunction with her daughter, Jane Taylor, *Correspondence between a Mother and her Daughter at School* (1817).—Her second daughter, Ann Taylor (d. in 1866), widow of the Rev. Joseph Gilbert, prepared a memoir of her husband, and in conjunction with her sister, Jane Taylor (which see), wrote *Original Poems for Infant Minds*, *Hymns for Infant Minds*, *Original Hymns for Sunday Schools*, and *Rhymes for the Nursery*, of all of which numerous editions have been published. The *Autobiography and other Memorials of Mrs. Gilbert, formerly Ann Taylor*, edited by Josiah Gilbert, appeared in 1874.

Taylor (Archibald A. E.), D. D., b. at Springfield, O., Aug. 27, 1834; graduated at Princeton College in 1854, and at Princeton Theological Seminary in 1857; became successively pastor of Presbyterian churches in Dubuque, Ia., Georgetown, D. C., and Cincinnati; and in 1873 was elected president of Wooster University. He has contributed largely to religious periodicals, and was for a time one of the editors of *Our Monthly*, a literary magazine.

Taylor (Bayard), b. at Kennett Square, Pa., Jan. 11, 1825; in 1842 became apprentice to a printer; in 1844–45 made a pedestrian tour in Europe at an expense of not more than $500, and after his return published *Views Afoot, or Europe seen with Knapsack and Staff*; in 1847 became one of the editorial staff of the New York *Tribune*, with which he has been connected ever since, though often travelling, and publishing in that journal originally the substance of most of his works of travel. In 1849 he visited California; in 1851 set out upon a long tour in the East, ascending the Nile and going over much of Asia Minor, Syria, and Europe; in 1852 set out from England; crossed Asia to Calcutta, where he joined Perry's expedition to Japan, and made several other journeys. In 1862–63 he was secretary of legation, and for a while chargé d'affaires at St. Petersburg; in 1874 went to Egypt, and thence to the millennial celebration in Iceland. He has resided at intervals several years in Germany, where he married, and since 1872 has been engaged upon a biography of Goethe and Schiller. Several of his works have been translated into German, French, and Russian. His books of travel are—*Views Afoot*, etc. (1846), *El Dorado, or Adventures in the Path of Empire* (1850), *Journey to Central Africa* (1854), *The Lands of the Saracen* (1854), *Visit to India, China, and Japan* (1855), *Northern Travel—Summer and Winter Pictures of Sweden, Denmark, and Lapland* (1857), *Travels in Greece and Russia* (1859), *At Home and Abroad, a Sketch-Book of Life, Scenery, and Men* (1859; 2d series, 1862), *Colorado, a Summer Trip* (1867), *Byways of Europe* (1869), and *Egypt and Iceland* (1874). He has written four novels—*Hannah Thurston* (1863), *John Godfrey's Fortunes* (1864), *The Story of Kennett* (1866), and *Joseph and his Friend* (1870). He has published the following volumes of poems: *Ximena, or the Battle of the Sierra Morena, and other Poems* (1844), *Rhymes of Travel, Ballads, and other Poems* (1848), *The American Legend*, delivered before the Phi Beta Kappa Society of Harvard University (1850), *Book of Romances, Lyrics, and Songs* (1851), *Poems and Ballads* (1854), *Poems of the Orient* (1855), *Poems of Home and Travel*, selected from his earlier productions (1855), *The Poet's Journal* (1862), *The Picture of St. John* (1866), *The Ballad of Abraham Lincoln* (1869), *The Masque of the Gods* (1872), *Lars, a Pastoral of Norway* (1873), *The Prophet, a Tragedy* (1874), *Home Pastorals and Lyrics* (1875), and a *Centennial Ode* (1876). He has edited a *Hand-Book of Literature and the Fine Arts*, in conjunction with George Ripley (1852), *Cyclopædia of Modern Travel* (1856), *Frithiof's Saga*, translated from the Swedish of Tegnér by W. L. Blackley (1867), Auerbach's *Villa on the Rhine* (1869), and the *Illustrated Library of Travel, Exploration, and Adventure* (1872 *seq.*), and has translated into the original metres both parts of Goethe's *Faust* (1870–71). Besides the foregoing he has written largely in prose and verse for many periodicals; contributed notes on Loo-Choo and Japan to the *Narrative of Perry's Expedition*, and an introduction to R. H. Stoddard's *Life, Travels, and Books of Alexander von Humboldt*, and has lectured extensively in nearly every part of the U. S. In 1876 he published *The Echo Club and other Literary Diversions*, and delivered the poem at the Centennial celebration of the anniversary of the Declaration of Independence, at Philadelphia, July 4, 1876. U. S. minister at Berlin, and died in office there Dec. 19, 1878. A. H. Guernsey.

Taylor (Benjamin Franklin), b. at Lowville, N. Y., in 1822; was educated at what is now Madison University, Hamilton, N. Y., where his father, Stephen W. Taylor, was professor; became literary editor of the Chicago *Evening Journal*, of which during the civil war he was military correspondent with the armies in the West, and after the war became a resident at La Porte, Ind. He has published—*The Attractions of Language* (1845), *January and June* (1853), *Pictures in Camp and Field* (1867), *The World on Wheels* (1873), *Old-Time Pictures and Sheaves of Rhyme* (1874), and *Songs of Yesterday* (1875).

Taylor (Brook), b. at Edmonton, near London, Aug. 18, 1685; entered St. John's College, Cambridge, in 1701; distinguished himself in music, painting, and mathematics; in 1708 wrote his treatise on *The Centre of Oscillation*, which was published in the *Philosophical Transactions* for 1713; in 1712 was chosen a fellow of the Royal Society, of which he became secretary two years later, and put forth several papers on magnetism and mathematics; and in 1715 he had a controversial correspondence with Count Raymond de Montmort upon the philosophical theories of Malebranche. He published *Methodus Incrementorum*, etc. (1715), which contains the first announcement of the famous "Taylor's theorem," which was almost unnoticed by mathematicians until 1772, when Lagrange adopted it as the basis of the differential calculus; and *New Principles of Linear Perspective* (1719). He left several works in MS., of which the *Contemplatio Philosophica* was published, with a memoir, by his grandson, Sir William Young (1793). D. in London Dec. 29, 1731.

Taylor (Rev. Charles), D. D., M. D., b. in Boston, Mass., Sept. 15, 1819; was prepared for college in an academy taught by his father, the Rev. Dr. Oliver Swaine Taylor, in the State of New York; entered the University of New York, and supported himself throughout the whole course, and graduated with the highest honors of his class in 1840; taught the ancient languages in the South Carolina Conference High School at Cokesbury 1842–44; joined the conference Dec., 1844; graduated in medicine in Philadelphia in 1848, and forthwith went as a missionary to Shanghai, China; while there published a *Harmony of the Gospels* and several tracts in Chinese. During the great rebellion in China ran the blockade of the imperial fleet, and carried books and tracts into the camp of the insurgents. His wife's health failing, he returned to the U. S. in 1854. He was professor (1855–57) and president (1857–58) of the Spartanburg Female College, and (1858–62) was general Sunday-school secretary of the M. E. Church, South. He was four years presiding elder of Wadesboro' district, and four years president of the Wesleyan University at Millersburg, Ky. He resigned that position to re-enter the pastoral work. The degree of D. D. was conferred on him by the University of New York. He is the author of an excellent work, *Five Years in China*, and *Baptism in a Nutshell*. He has contributed largely to the periodical press. He is now stationed in Maysville, Ky. T. O. Summers.

Taylor (Christopher), b. at Skipton, Yorkshire, about 1640; was a Puritan preacher, but became a proselyte of George Fox, and joined the Society of Friends, in which he became an eminent minister, and was several times arrested, fined, and imprisoned. He was an excellent scholar; taught classical schools in several places, the last being at Edmonton, near London, whence he emigrated to Pennsylvania in 1682, and immediately upon his arrival was chosen a representative in the assembly; was made a member of the first provincial council, retaining the office until his death, and was also register general and a justice of the Chester court. He published a *Compendium Trium Linguarum* (1679). D. in Philadelphia in 1688.

Taylor (Edgar), b. in 1793; was a solicitor in London, and an elegant and profound scholar. He published several legal and other pamphlets; contributed to periodicals; was one of the founders of the Camden Society; edited an edition of Griesbach's Greek Testament, of which he also made a translation—*The New Testament, Revised from the Authorized Version, with the Aid of other Translations, and made conformable to the text of J. J. Griesbach, Revised by a Layman* (1840); translated from the German and edited *German Popular Stories, collected by the Brothers Grimm* (1823), and *Gammer Grethel's Fairy-Tales and Popular Stories* (1839), both illustrated by George Cruikshank, and *Lays of the Minnesingers* (1825). He also published *The Book of Rights, a Collection of Acts of Parliament relative to Civil and Religious Liberty* (1833); translated into English prose *Master Wace, his Chronicle of the Norman Conquest* (1837), and edited *The Suffolk Bartholomian, or, The Domestic History of Rev. John Meadows* (1841). D. Aug. 9, 1839.

Taylor (Edward T.), b. in Richmond, Va., Dec. 25, 1794; was originally a sailor; united with the Methodist society, and was ordained as a preacher in 1819; about 1830 became preacher at the Seamen's Bethel in Boston, continuing in the position nearly forty years, and being universally designated as "Father Taylor." He went as chaplain to the U. S. frigate sent to Ireland with relief during the famine in 1846, and delivered public addresses in several places. D. in Boston Apr. 5, 1871.

Taylor (Emily), b. and residing in England, has within the last forty years put forth many works, mostly for the young, several of which have been republished in America. Among these are—*Pictorial Illustrations of Scripture; Sabbath Recreations*, a volume of poetical selections, republished in Boston under the title *Lays for the Sabbath*, with an introduction by John Pierpont (1860); *Tales of the Saxons; Vision of Las Casas and other Poems; England and its People* (1839; 7th ed. 1866), *Irish Tourist* (1843), *Norah Toole* (1844), *Van Ti, Chinese Tales* (1844), *Ball I Live on* (1846), *Historical Prints of English History, Historical Prints of Greece, Boy and Birds* (1848), *Chronicles of an Old English Oak* (1859), *The Knevets* (1862), *Flowers and Fruits from Old English Gardens* (1864), *Dear Charlotte's Boys, and other Stories* (1864), and *Contemporary Poets, with Selections from their Writings* (1868).

Taylor (Fitch Waterman), b. at Middle Haddam, Conn., Aug. 3, 1803; graduated at Yale College in 1828; studied divinity; received orders in the Episcopal Church, and was for a time settled over a parish in Maryland. In 1841 he was appointed chaplain in the navy, and continued such, either at sea or on land, until his death. He published *The Flag Ship*, a narrative of a voyage around the world in the U. S. frigate Columbia (1840), and *The Broad Pennant*, an account of a cruise in the Gulf of Mexico, and including a history of the Mexican war (1848). D. in Brooklyn, N. Y., July 24, 1865.

Taylor (George), b. in Ireland in 1716; came to America as a "redemptioner" in 1736; was engaged as a common laborer in an iron-foundry at Durham, Pa., the proprietor of which paid his passage over; became clerk in the foundry, and, the proprietor dying, married his widow; established large ironworks on the Lehigh River, and acquired a considerable fortune. In 1764 he was elected to the colonial assembly, in 1770 became a judge of the county court, and in 1775 was elected to the provincial assembly, and was earnest in the advocacy of Revolutionary measures. He was elected to fill a vacancy in the Continental Congress July 20, 1776, and so was not a member when the Declaration of Independence was passed, but was one of those who signed the document. He retired from Congress in Mar., 1777, and took up his residence in Delaware. D. at Easton, Pa., Feb. 23, 1781.

Taylor (George), b. in Wheeling, Va., Oct. 19, 1820; studied medicine, and afterward law; was admitted to the bar in 1840, and commenced practice in Indiana; removed to Alabama in 1844, thence to New York in 1848, and in 1856 was elected a Representative in Congress. He has written and lectured in behalf of popular education, and has published *Indications of the Creator* (1851).

Taylor (George W.), b. at Clinton, N. J., in 1808; at nineteen entered the navy as a midshipman, and after serving three years became a farmer in New Jersey; entered the army during the Mexican war as lieutenant, and rose to be captain; resided three years in California; then returned to New Jersey, and engaged in mining and manufacturing. At the outbreak of the civil war he became colonel of a New Jersey regiment in the Army of the Potomac; was made brigadier-general May, 1862, and engaged under McClellan in the battles on the Peninsula, and under Pope near Manassas. D. at Alexandria, Va., Sept. 1, 1862, from wounds received in the second battle of Bull Run.

Taylor (Rev. Gilbert), M. D., b. at Hare Forest on the Rapidan, Va., Nov. 18, 1791, in the same house in which his relative, Pres. Taylor, was born. He received his medical education in Philadelphia, and served as a surgeon under Gen. Jackson through the whole campaign in the war of 1812; was promoted to the general's staff; gave up a lucrative practice in Pulaski and entered the ministry in the Tennessee conference. D. in Pulaski, Tenn., Aug. 6, 1870. T. O. Summers.

Taylor (Sir Henry), D. C. L., b. in 1800; entered the colonial office in 1824, in which he has for many years been one of the five senior clerks. He has contributed to periodicals, and has published—*Isaac Comnenus*, a drama (1827); *Philip van Artevelde*, a tragedy (1834); *The Statesman*, a series of essays (1836); *Edwin the Fair*, an historical drama (1842); *The Eve of Conquest, and other Poems* (1847); *Notes from Life*, a series of essays (1847); *Notes from Books*, containing essays on the poems of Wordsworth and Sir Aubrey de Vere (1849); *The Virgin Widow*, a comedy (1850); *St. Clement's Eve*, a play (1862); and *A Sicilian Summer, and Minor Poems* (1868). A collective edition of his plays and poems was issued in 3 vols. in 1863.

Taylor (Isaac), known as "Taylor of Ongar," b. in London in 1759; was a successful engraver in London; removed to Lavenham, Suffolkshire, in 1786; was minister of an Independent congregation at Colchester 1796–1810, and subsequently of one at Ongar until his death. He superintended the education of his children, and, besides a number of sermons, published, mainly for the young—*Advice to the Teens, Beginnings of British Biography, Beginnings of European Biography, Biography of a Brown Loaf, Book of Martyrs for the Young, Bunyan explained to a Child, Character Essential to Success in Life, Child's Birthday, Child's Life of Christ, The Little Library*, comprising, in separate volumes, *The Mine, The Ship*, and *The Forest; Mirabilia, or the Wonders of Nature and Art; Scenes in America, in Asia, in England, in Europe, in Foreign Lands*, all separate works; *Scenes of Commerce, Scenes of British Wealth, Self-Cultivation Recommended*, and *Twelve Addresses to Youth, with Hymns*. Nearly all of his works have been frequently republished. He was the father of Ann, Jane, Jeffreys, and Isaac Taylor, Jr. (which see). D. at Ongar, Essexshire, Dec. 11, 1829.—His elder brother, Charles Taylor (b. 1756, d. 1821), was the editor of *Calmet's Dictionary of the Holy Bible*.

Taylor (Isaac), LL.D., son of Isaac "of Ongar," b. at Lavenham, Suffolkshire, Aug. 17, 1787; was designed by his father for an artist; began to study for a dissenting minister, but, having become a member of the Established Church, turned his attention to the bar, and finally devoted himself to the study of mechanical inventions, especially to the production of a machine for engraving upon copper the rollers used in calico-printing, and to literary labor. Besides numerous contributions to the *Eclectic Review*, he published the following works: *Elements of Thought* (1823), *History of the Transmission of Ancient Books to Modern Times* (1827), *The Process of Historical Proof Exemplified and Explained* (1828), *Balance of Criminality, or Mental Error compared with Immoral Conduct* (1828), a translation of *Herodotus*, with notes (1829), *Natural History of Enthusiasm*, one of his best works (1829), *New Model of Christian Missions* (1829), *Saturday Evening* (1832), *Fanaticism*, a continuation of the *Natural History of Enthusiasm* (1834), *Spiritual Despotism* (1835), *Physical Theory of Another Life*, the first work published under his own name, and which greatly enhanced his reputation (1836); *Home Education* (1838), *Ancient Christianity and the Doctrines of the Oxford Tracts for the Times* (1839; with supplement and indexes, 1844), *Man Responsible for his Dispositions, Opinions, and Conduct* (1840), *Loyola, and Jesuitism in its Rudiments* (1849), *Wesley and Methodism* (1851); *The Restoration of Belief* (1855), *The World of Mind* (1857), *Logic in Theology* (1859), *The Liturgy and the Dissenters* (1860), *Ultimate Civilization* (1860), *The Spirit of Hebrew Poetry* (1861), and *Considerations on the Pentateuch*, a reply to the work of Bishop Colenso (1863). In addition to these he edited *Edwards on the Will*, prefixing an essay on the *Application of Abstract Reasoning to the Christian Doctrine*, which was afterward published separately in 1832; translated from the German Pfizer's *Life of Christ*, with an introductory essay, and contributed to the *Edinburgh Review*, the *North British Review*, and the *Encyclopædia Britannica*, for the last of which he furnished the elaborate article on "Jesuitism." In 1836 he was a candidate for the chair of logic and metaphysics in the University of Edinburgh, but was unsuccessful, receiving 14 votes, while 18 were cast for Sir William Hamilton. In 1862 a pension of £100 was bestowed upon him from the civil service fund, "in public acknowledgment of his eminent services to literature, especially in

the departments of history and philosophy, during a period of more than forty years." D. at Stanford Rivers, Essexshire, June 28, 1865.—His son, ISAAC TAYLOR, a clergyman of the Church of England, has published—*Words and Places*, an explanation of the local names in Great Britain (1865); *The Family Pen, Memorials, Biographical and Literary, of the Taylor Family of Ongar* (1867); and *Etruscan Researches* (1874). A. H. GUERNSEY.

Taylor (ISIDORE SÉVERIN JUSTIN), b. at Brussels Aug. 15, 1789; studied art at Paris; served for several years in the army; travelled much; was appointed royal commissary of the Comédie française, where he introduced the dramas of Victor Hugo; induced by his petitions the Legislative Assembly (1818–30) to vote the restoration of the mediæval monuments in France; was sent to Egypt to negotiate the transfer to France of the obelisk of Luxor, and was made a senator in 1869. He wrote *Voyages pittoresques et romantiques dans l'Ancienne France* (1820–54), *Voyages pittoresques en Espagne*, etc. (1826 *seq.*), *La Syrie, l'Egypte*, etc. (1837), *Voyages en Suisse, Italie, Angleterre*, etc. (1843). D. Sept., 1879.

Taylor (JAMES), b. at Midway, Va., Apr. 19, 1769; emigrated to Kentucky in 1792; during the war of 1812 served as quartermaster of the army of the North-west under Gen. Hull, and became subsequently one of the largest landed proprietors in the West. D. at Newport, Ky., Nov. 7, 1848.

Taylor (JANE), daughter of Isaac Taylor of Ongar, b. in London Sept. 23, 1783. Her first poem, *The Beggar Boy*, appeared in a periodical in 1804; she afterward united with her sister, ANN TAYLOR (which see), in the preparation of several volumes of poems and hymns for young persons and for Sunday-schools; and with her mother was the author of *Correspondence between a Mother and her Daughter at School* (1817). To the *Youth's Magazine* she furnished the *Correspondence of Q. Q.* (1816–22; collected and published, with some additions, in 1826). She published *Display*, a tale (1815), and *Essays in Rhyme on Morals and Manners* (1816). After her death appeared *Memoirs, Correspondence, and Poetical Remains of the late Jane Taylor*, edited by her brother, Isaac Taylor (1825). D. at Ongar, Essexshire, Apr. 12, 1824.

Taylor (JANET), long a teacher in a nautical and mathematical academy in London, and noted for her scientific attainments. Has published—*Luni-Solar and Horary Tables, with their Application in Nautical Astronomy* (1833), *Lunar Tables* (1834), *Epitome of Navigation and Nautical Astronomy, with Improved Lunar Tables* (2d ed. 1851), *Diurnal Register for Barometer, Sympiesometer, Thermometer, and Hygrometer* (1844), *Planisphere of the Fixed Stars* (1846), *Handbook to the Local Marine Board Examinations*, and *Guide to the Use of Maury's Charts*. In 1859 her great services to science were acknowledged by a pension of £50 on the civil list.

Taylor (JEFFERYS), b. in 1792; wrote chiefly for the young. His works are—*Description of the Earth, Harry's Holiday, Little Historians, Month in London, Old English Sayings in Prose and Verse* (1827), *Parlor Commentaries on the Constitution, Ralph Richards the Miser, Tales and Dialogues in Prose and Verse, The Farm* (1834), *The Forest* (1834), *Young Islanders* (1841), *Cottage Traditions* (1842), *Incidents of the Apostolic Age in Britain* (1844), *Æsop in Rhyme* (1846), *Glance at the World around us* (1848), *The Family Bible newly opened*, which he was unable to finish on account of illness, and it was completed, with a preface, by his brother, Isaac Taylor. D. at Broadstairs, Kent, Aug. 8, 1853.

Taylor (JEREMY), D. D., b. in Cambridge, England, in 1613, where his father was a barber, although descended in a direct line from the famous Rowland Taylor; in 1626 entered Caius College as a sizar, or a student who in his time waited at the public tables, and after the fellows had finished their meal ate from what was left without payment; took his degree; gained the friendship of Bishop Laud, and in 1636 obtained a fellowship at Oxford, and in 1638 was presented to the rectory of Uppingham. In the civil wars he adhered to the cause of Charles I., who made him his chaplain, and in 1642 commanded that the degree of D. D. should be conferred upon him on account of a treatise which he had written in defence of episcopacy. But in that year his rectory was sequestered by Parliament, and he was forced to take refuge in Wales, where he supported himself by teaching a school; wrote some of his noblest works; preached occasionally in London; was several times imprisoned for giving utterance to royalist sentiments, and in 1658 took up his residence in Ireland upon the invitation of the earl of Conway. In 1660 he went to London to publish his *Ductor Dubitantium*, and was one of the signers of the royalist declaration of Apr. 24, which paved the way for the restoration of Charles II. He had married for his second wife Joanna Bridges, an illegitimate daughter of Charles I., and soon after the Restoration was made by Charles II. bishop of Down and Connor, to which the small see of Dromore was added, and was also made a member of the Irish privy council and vice-chancellor of the University of Dublin. He labored earnestly, but with indifferent success, for the firm establishment of the English Church in Ireland. As a preacher, and in certain respects as a writer, he occupies a foremost rank in our literature. Coleridge pronounced him "the most eloquent of divines," adding, "had I said of men, Cicero would forgive me and Demosthenes nod assent." Besides his *Sermons*, his principal works are—*The Sacred Order and Offices of the Episcopacy* (1642), *Discourse on the Liberty of Prophesying*, setting forth the iniquity of persecution for differences in opinions, by some held to be the ablest of all his works (1647); *The Great Exemplar of Sanctity and Holy Life* (1649), *The Rule and Exercise of Holy Living* (1650), *The Rule and Exercise of Holy Dying* (1651), *Ductor Dubitantium*, which Hallam pronounces to be "the most extensive and learned work on casuistry which has appeared in the English language," and *Dissuasives from Popery, addressed to the People of Ireland* (1664). Many of his separate works have been frequently republished. His *Whole Works*, with a *Life* of the author and a critical examination of his writings by Bishop Heber, in 15 vols., appeared in 1820–22; his *Life* has also been written by R. A. Willmott (1847). D. at Lisburne, Ireland, Aug. 13, 1667. A. H. GUERNSEY.

Taylor (JOHN), b. in Gloucestershire in 1580; was educated at a free school in Gloucester; went to London, where he was apprenticed to a waterman, and followed this occupation during the greater part of his life, whence he is styled "the water-poet." In 1596 he served on board the fleet under the earl of Essex, and was present at the attack upon Cadiz; upon his return plied his boat upon the Thames; was made collector of the dues of the lieutenant of the Tower upon imported wines, and subsequently kept a public-house near the waterside in London. His productions in prose and verse, of which about 140 are known to collectors, have some interest in showing the manners and customs of the times. The following are the titles of a few of them—*Greate Britaine all in Blacke for the incomparable Loss of Henry, our late worthy Prince* (1612); *Taylor's Urania, or his Heavenly Muse*, containing a versified account of all the sieges and sackings of Jerusalem (1615); *Taylor's Revenge, or the Rimer, William Fennor, firkt, ferrited, and finely fetcht over the Coals* (1615); *Taylor's Travels in Germanie, or three Weekes, three Daies, and three Houres Observations and Travel from London to Hamburgh* (1617); *The pennyles Pilgrimage, or the moneylesse Perambulation of John Taylor, alias the King's Majestie's Water-Poet, from London to Edenborough on Foot* (1618); *The Scourge of Baseness, a Kicksey Winsic, or a Lerry come Twang, wherein J. T. hath satyrically suted 750 of his bad Debtors who will not pay him for his Returne of his Journey from Scotland* (1619); *Taylor's Motto: Et Habeo, et Careo, et Curo: I have, I want, I care* (1621); *Wit and Mirth, chargeably collected out of Taverns, Alehouses, Tobacco-Shops*, etc.; *A Shilling, or the Travailes of 12 Pence* (1622); *Taylor's Farewell to the Tower-Bottles* (1622); *Sir Gregory Nonsence, his Newes from No Place* (1622); *The Life and Death of the most blessed amongst all Women, the Virgin Mary* (1622); *Taylor's Travels and Circular Perambulation through and by more than thirty times twelve Signes of the Zodiack of the famous Cities of London and Westminster* (1626); *The Praise of Cleane Linen, with the commendable Use of the Laundresse*; *Verbum Sempiternum*, an epitome of the Old Testament, and *Salvator Mundi*, an epitome of the New Testament, both in verse; *Drinke and Welcome*, an account of the various beverages in use in Great Britain and Ireland (1637); *Taylor's Physicke has purged the Divil, or the Divell has got a Squirt* (1641); *The Essence, Quintessence, Insence, Innocence, Lifesence, and Magnificence of Nonsence upon Sence* (1653); and *The Suddaine Turne of Fortunes Wheele*, an imaginary conversation between the pope, the emperor, and the king of Spain (1631). In 1630, Taylor made a collection, in a single volume, of the 63 pieces which he had at that time put forth in brochures and broadsheets, which was in 1869 republished in facsimile by the Spencer Society, which proposed to reprint those subsequently written, of many of which only single copies were known to exist. D. in London in 1654.

Taylor (JOHN), D. D., b. near Lancaster, England, in 1694; taught an academy, and was for many years pastor of a Unitarian society at Norwich; in 1757 became professor of divinity in the dissenting seminary at Warrington. His principal works are—*The Scripture Doctrine of Original Sin* (1738), *The Scripture Doctrine of Atonement* (1750), *Hebrew Concordance to the English Bible* (1754), and *Scheme of Scripture Divinity* (1762). D. Mar. 5, 1761.

Taylor (John), LL.D., b. at Shrewsbury about 1703; was educated at St. John's College, Cambridge, of which he became a fellow in 1730, librarian to the university in 1732, advocate in Doctors' Commons in 1741, and chancellor of Lincoln in 1744. He afterward entered holy orders; became rector of Lawford in 1751, archdeacon of Buckingham in 1753, and canon residentiary of St. Paul's in 1757. He published several orations and essays, but his principal works are—an edition of the Greek text, with a Latin translation and notes, of *The Orations and Fragments of Lysias* (1739), and of some of the *Orations of Demosthenes, Æschines, Dinarchus, and Demades*, intended to comprise five volumes, but only three were completed (1743–57), and *Elements of the Civil Law* (1755). D. in 1766.

Taylor (John), b. in Orange co., Va., about 1750; graduated at William and Mary College in 1770; was U. S. Senator in 1792–94, again in 1803, and a third time in 1822–24; in the interval was a member of the Virginia house of delegates and the mover of the celebrated Virginia resolutions of 1798–99. He was especially devoted to agriculture and political theories, and published—*Inquiry into the Principles and Policy of the Government of the United States* (1814); *Arator*, a series of essays upon agriculture and politics (1818); *Construction Construed, and Constitution Vindicated* (1820); *Tyranny Unmasked* (1822); *New Views of the Constitution of the United States* (1823). D. in Caroline co., Va., Aug. 20, 1824.

Taylor (John), b. in South Carolina in 1770; graduated at Princeton College in 1790; was admitted to the bar in 1793, but, having large estates, devoted himself to planting, and was prominent in politics, being several times elected to both branches of the State legislature: a Presidential elector in 1797; Representative in Congress 1807–09 and 1817–21; U. S. Senator 1810–16; governor of South Carolina 1826–28, and was receiver of public moneys in Mississippi Territory. D. in 1832.

Taylor (John), b. in 1781; was an eminent publisher and bookseller in London; wrote several essays on financial topics, among which are—*Money, its Origin and Use* (1831), *The Standard and Measure of Value, Catechisms of the Currency and Exchanges* (1835), and *Currency Investigated* (1845). Also, *The Great Pyramid, why was it Built? and who Built it?* in which he argues that it was built by the sons of Joktan as a standard of measurement. He is best known by his *Identity of Junius with a distinguished Living Character*, in which he endeavors to prove that Sir Philip Francis was the author of the *Letters of Junius* (1816; with a supplement, consisting of fac-similes and other illustrations, 1817). D. in 1864.

Taylor (John Louis), b. in London Mar. 1, 1769; was brought to America by his brother in 1781; studied law, and settled at Fayetteville, N. C.; was several times elected to the legislature; became one of the judges of the supreme court of the State in 1798, and was chief-justice from 1810 until his death. A volume of his decisions, containing cases decided from 1799 to 1802, was published in 1802, and another volume, of cases from 1816 to 1818, appeared in 1818. He also published a *Charge to the Grand Jury of Edgecombe Superior Court, exhibiting a View of the Criminal Law of North Carolina* (1817). D. Jan. 29, 1829.

Taylor (John W.), b. in Saratoga co., N. Y.; graduated at Union College in 1803; studied law in Albany, and was elected to the legislature in 1811; in 1813 he was chosen a Representative in Congress, and retained his seat until 1833; was Speaker of the House in the sixteenth Congress 1819–20, by which the Missouri Compromise bill was passed, in opposition to which he made an eloquent speech; and also Speaker of the nineteenth Congress 1825–26. He was State senator in 1841–43, and in 1843 removed to Cleveland, O. D. at Cleveland Sept. 8, 1854.

Taylor (Joseph P.), brother of Zachary, b. in Kentucky; entered the U. S. army in 1813 as third lieutenant of the 28th Infantry; first lieutenant 1814; retained in the 3d Artillery in the peace organization of the army, and became captain in 1825; in Mar., 1829, was appointed an assistant commissary of subsistence, in which department he had been acting for the greater part of the time since entering the service; in 1838 became major, and in 1841 assistant commissary-general with rank of lieutenant-colonel; during the war with Mexico his able administrative ability was displayed in the conduct of his department, and in 1848 was brevetted colonel; upon the death of Gen. Gibson (Sept., 1861), Taylor succeeded that officer as commissary-general with rank of colonel, which by act of Feb. 9, 1863, was increased to that of brigadier-general. D. at Washington, D. C., June 29, 1864.

Taylor (Joseph W.), b. about 1820 in Cumberland co., Ky.; graduated at Princeton College, Ky., and in 1838 removed to Alabama; became a prominent Whig lawyer and legislator and an active promoter of the cause of education; was elected in 1865 to Congress, but not allowed a seat; afterward editor of the Tuscaloosa *Times* and president of the trustees of the Southern University.

Taylor (Meadows), b. in Ireland about 1810; early entered the military service of the East India Company, in which he obtained high distinction, having risen to the rank of colonel and been decorated with the knighthood of the Star of India; was president or administrator at several native courts; was a learned archæologist, and married a princess of Southern India. D. in May, 1876. Author of *Confessions of a Thug* (3 vols., 1839; new ed. 1858), *Tippoo Sultaun, a Tale of the Mysore War* (3 vols., 1840), *Notices of Cromlechs, Cairns, and other Ancient Scytho-Druidical Remains in the Principality of Sorapur* (London, 1853), *Tara, a Mahratta Tale* (3 vols., 1863), *Ralph Darnell, a Tale* (3 vols., 1865), and *The Student's Manual of the History of India, from the Earliest Period to the Present* (1870), the latter work being the only popular history of India in which adequate attention is given to the dynasties of the Dekkan. Col. Taylor contributed the Indian materials to Cassell's *Biographical Dictionary* (London, vol. i., 1869).

Taylor (Nathaniel William), D. D., b. at New Milford, Conn., June 23, 1786; graduated at Yale College in 1807; studied theology, and in 1812 became pastor of the Centre Congregational church in New Haven, where he rose to eminence as a preacher. In 1822 he was chosen Dwight professor of didactic theology in Yale College, and occupied the chair until his death. In 1828 he delivered the *concio ad clerum* discourse at New Haven, in which he put forth views upon the subject of the nature and extent of human depravity and kindred dogmas which were widely denounced as unscriptural and heretical, but which he continued to maintain and to uphold through the *Christian Spectator*, and which were vehemently opposed by other divines in various discourses and periodicals. After his death 4 vols. of his works, edited by Rev. Noah Porter, D. D., were published: *Practical Sermons*, preached while pastor of the Centre church (1858); *Lectures on the Moral Government of God* (2 vols., 1859); and *Essays, Lectures, etc., upon Select Topics in Revealed Theology* (1859). D. in New Haven Mar. 10, 1858.

Taylor (Oliver Alden), b. at Yarmouth, Mass., Aug. 18, 1801; graduated at Union College in 1825, and at Andover Theological Seminary in 1829, where he subsequently was instructor in sacred literature; in 1839 became pastor of a church in Manchester, Mass. He contributed to various religious periodicals; prepared in 1838 a catalogue of the library of Andover Seminary, and besides several poems published *Brief Views of the Saviour* (1835), *Piety in Humble Life, a Memoir of Andrew Lee* (1844), and translated Reinhard's *Plan of the Founder of Christianity* (1831), Reinhard's *Memoirs and Confessions* (1832), and *The Music of the Hebrews*. A memoir of him, by his brother, Rev. T. A. Taylor, was published in 1853. D. at Manchester, Mass., Dec. 18, 1851.

Taylor (Richard), grandson of John Taylor of Norwich (which see), b. at Norwich May 18, 1781; learned the trade of a printer in London, at the same time studying language and literature, and in 1803 established himself in business in London, devoting himself especially to the publication of works upon natural history. In 1822 he became joint editor, with Dr. Tilloch, of the long-established *Philosophical Magazine*, with which in 1827 was incorporated Thomson's *Annals of Philosophy*; in 1837 commenced the publication of the *Scientific Memoirs*, selected from the transactions of foreign academies and learned societies, and in 1838 established the *Annals of Natural History*. During nearly half a century he was under-secretary of the Linnæan Society, and was a prominent member of the British Association for the Advancement of Science. He prepared annotated editions of Horne Tooke's *Diversions of Purley* (1829 and 1840) and of Warton's *History of English Poetry* (1840). D. at Richmond, near London, Dec. 1, 1858.

Taylor (Richard), son of Zachary Taylor, b. in Florida; was a resident of Louisiana at the breaking out of the civil war, when he entered the Confederate army, and was made colonel of a Louisiana regiment, which fought under his command at the battle of Bull Run; was made brigadier-general in Oct., 1861; served under Stonewall Jackson in Virginia; became major-general; in 1863–64 commanded in the department W. of the Mississippi, especially against Gen. Banks in his unsuccessful Red River campaign; in Sept., 1864, was placed in command of the department of East Louisiana, with his head-quarters at Mobile, and on May 4, 1865, surrendered to Gen. Canby, his force being the last which remained to the

Confederacy. After the war he resided on his plantation in Louisiana. D. at New York City Apr. 12, 1879.

Taylor (RICHARD COWLING), b. at Hinton, Staffordshire, Jan. 18, 1789; became eminent as a geologist and antiquary, publishing many papers and several books on these subjects; emigrated to America in 1830, making Philadelphia his residence, and devoted himself to the development of the mineral resources of the country. Before leaving England he published—*Index Monasticus, or the Abbeys, Monasteries, etc. formerly established in the City of Norwich and the Ancient Kingdom of East Anglia* (1821), *The Geology of East Anglia* (1827), and an elaborate *Index to Dugdale's Monasticon Anglicanum* (1830). After coming to America he published, among others—*History and Description of Fossil Fuel* (1841), *Statistics of Coal* (1848; 2d ed., revised by S. S. Haldeman, 1855), and many reports of his various surveys, some of which were issued in England and others in America. Among his publications are treatises on *The Geology and Natural History of the North-east extremity of the Alleghany Mountains, and a Supplement to the Natural History of the Birds of the Alleghany Range*. D. at Philadelphia Nov. 26, 1851.

Taylor (ROBERT), originally a clergyman, but subsequently the author of several books of an irreligious tendency. Among these are—*The Devil's Pulpit*, for which the author was imprisoned (1831); *The Diegesis, being a Discovery of the Origin and Early History of Christianity* (1833); *Astro-Theological Lectures on Freemasonry* (1856); *Astronomico-Theological Lectures* (1857); *Belief not the Safe Side* (1857).

Taylor (SAMUEL HARVEY), LL.D., b. in that part of Londonderry now called Derry, N. H., Oct. 3, 1807; graduated at Dartmouth College 1832; entered Andover Theological Seminary 1832; was assistant teacher in Phillips Andover Academy 1833–35; tutor in Dartmouth College 1836–37; graduated from the seminary 1837, and in the autumn of that same year became principal of Phillips Andover Academy, holding the office till he died suddenly of heart disease Jan. 29, 1871. His scholarship was exact and solid, his moral tone lofty, and the drill of his class-room terribly severe. From 1852 (when Bela B. Edwards died) he was one of the editors of the *Bibliotheca Sacra*. In 1851 he assisted in editing the *History of Londonderry*. He also published—Krebs's *Guide for Writing Latin* (1843), Kühner's *Grammar of the Greek Language*, in connection with Prof. Edwards (1844), *Elementary Greek Grammar* (1846), *Method of Classical Study* (1861), *Classical Study* (1870). (See *Congregational Quarterly*, Jan., 1872.)

R. D. HITCHCOCK.

Taylor (STEPHEN WILLIAM), LL.D., b. at Adams, Mass., Oct. 23, 1791; graduated at Hamilton College in 1817; was for fourteen years principal of the Black River Academy at Lowville, N. Y.; subsequently, for three years, teacher in a family school, and in 1834 became head of the preparatory department of Hamilton Institution, in which from 1838 to 1845 he was professor of mathematics and natural philosophy; the institution having been reorganized as Madison University, he became its president in 1851. He was eminent as a practical educator, and published an historical sketch of Madison University, several inaugural and baccalaureate addresses, and a series of essays on the theory of education. D. at Hamilton, N. Y., Jan. 7, 1856.

Taylor (THOMAS), styled "the Platonist," b. in London May 15, 1758; studied for a while at St. Paul's School with the design of becoming a dissenting minister, but afterward entered a banking-house; devoted his spare moments to the study of Greek, mathematics, and chemistry; taught the languages and mathematics; was appointed assistant secretary of the Society for the Encouragement of Arts and Manufactures; read in the occult sciences, and set about making a translation of the works of Plato and the remains of the so-called Platonists. His works comprise 63 volumes, of which 23 are large quartos; among them are treatises on arithmetic and geometry, on the Eleusinian and Bacchic mysteries; an edition, with large additions, of the *Greek Lexicon* of Hedericus; an essay on the *Rights of Brutes*, in ridicule of Paine's *Rights of Man*; a *History of the Restoration of the Platonic Theology*; and a volume of *Miscellanies in Prose and Verse*. His main labor, however, was the translating of little-known Greek and Latin works. Besides the *Plato* and *Aristotle*, his translations include the remains of Apuleius, Celsus, Demophilus, Hierocles, Iamblichus, Julian, Maximus Tyrius, Ocellus Lucanus, Olympiodorus, Pausanias, Plotinus, Porphyry, Proclus, Sallust *On the Gods and the World*, the *Orphic Hymns*, and the *Chaldæan Oracles*. His translation of Plato (5 vols. 4to, 1804) was printed at the cost of the duke of Norfolk, who from some whim locked up nearly the whole edition in his house, where the copies remained until 1848. Of his translation of Aristotle (10 vols. 4to, 1806–12) only 50 complete copies were struck off, the expense being defrayed by W. Meredith, a retired tradesman, who gave Taylor an annuity of £100, which constituted fully half his income for the rest of his life, during which he sank into almost absolute obscurity. His latest works were translations of Proclus *On Providence and Evil* (1833) and Plotinus *On Suicide* (1834). D. at Walworth Nov. 1, 1835.

Taylor (THOMAS HOUSE), D. D., b. at Georgetown, S. C., Oct. 18, 1799; received his collegiate and theological education in his native State; entered holy orders in the Episcopal Church, and in 1834 succeeded Dr. (afterward Bishop) J. M. Wainwright as rector of Grace church, New York. He took a high rank in his profession, and was identified with the "Low Church" side of the denomination. In 1866 he went to Europe for the benefit of his health, and after his return passed the greater part of his time at his country residence at West Park, on the Hudson. About two years before his death he was severely injured by being thrown from his carriage. After his death was published a volume of his *Sermons preached in Grace Church, 1846–67* (1869). D. at West Park, N. Y., Sept. 9, 1867.

Taylor (TOM), b. at Sunderland, Durhamshire, in 1817; passed two terms at the University of Glasgow, where he won three gold medals and other prizes; then went to Trinity College, Cambridge, where he graduated with high honors, and became a fellow; was appointed to the chair of English literature in University College, London, which he held for two years; wrote for periodicals, especially for *Punch*; studied law; was called to the bar in 1845; was made secretary to the board of health in 1854, and in 1858 secretary to the local government act office. He has produced, either singly or in conjunction with others, more than 100 dramatic pieces, many of which have had a marked success; among them are—*Still Waters Run Deep*, *The Unequal Match*, *The Overland Route*, *The Contested Election*, *Our American Cousin*, *The Ticket-of-Leave Man*, and *'Twixt Axe and Crown*. He has also published—*Life of B. R. Haydon* (1853), *Autobiographical Recollections of C. R. Leslie* (1860), *Handbook to the Pictures of the National Exhibition of 1862* (1862), furnished the letter-press to accompany *Birket Foster's Pictures of English Landscape* (1862); translated from the French of Villemarque the *Ballads and Songs of Brittany* (1865), and in conjunction with C. W. Franks prepared a *Catalogue of the Works of Sir Joshua Reynolds* (1869).—His wife, better known by her maiden name of LAURA W. BARKER, has assisted her husband in several of his works, and is a musical composer of decided originality and power.

Taylor (VIRGIL CORYDON), b. at Barkhamstead, Conn., in 1817; author of *Taylor's Index-Staff*, a new method of musical notation, in which the keynote, whether major or minor, is indicated by a heavy line or a wide space. He has written for the newspapers articles on political topics, and has published the following musical works: *Sacred Minstrel* (1846), *The Lute, or Musical Instructor* (1847), *Choral Anthems* (1850), *The Golden Lyre* (1850), *The Concordia* (1851), *The Chime* (1854), *The Celestina* (1856), *The Song Festival* (1858), *The Enchanter* (1861), *The Concertina* (1864), and *The Praise Offering* (1868).

Taylor (WALTER), b. probably in Virginia; emigrated to the Territory of Indiana, where he held several official stations, and in 1811 was aide-de-camp to Gen. Harrison at the battle of Tippecanoe. When Indiana was admitted into the Union as a State, in 1816, he was chosen one of the Senators in Congress, and was re-elected for a second term. D. at Lunenburg, Va., Aug. 26, 1826.

Taylor (WILLIAM), b. at Norwich, England, in 1765, the son of a wealthy merchant; was sent to Germany to complete his mercantile education, but having mastered the language, he became charmed with its literature, and returning to England devoted himself to letters, and for a time partially to politics. He was a very voluminous contributor to the *Monthly Review*, for which he wrote the critiques during many years. He was the first Englishman to introduce to English readers a knowledge of the literature of Germany, and is best known by his vigorous translation of Bürger's *Lenore*. He published a translation of Lessing's *Nathan the Wise* (1805), *English Synonyms Discriminated* (1813), and *Historic Survey of German Poetry*, with many translations (1828). His *Life and Writings*, containing correspondence with Robert Southey and original letters from Walter Scott, was published by J. W. Robberds (2 vols. 8vo, 1843). D. in Mar., 1836.

Taylor (WILLIAM COOKE), LL.D., b. at Youghal, Ireland, Apr. 16, 1800; was educated at the University of Dublin; went to London, where he entered upon a literary career; paid especial attention to the subject of education, and in 1846 was sent by government to examine the edu-

cational systems in use on the continent of Europe—a commission which he executed with marked ability—and had been sent to Ireland to carry out his educational views when he was cut off by cholera. His principal works are—*Historical Miscellany* (1829), *History of France and Normandy* (1830), *History of the Civil Wars in Ireland* (1831), *History of Mohammedanism and its Sects* (1834), *History of Popery* (1837), *The Bible Illustrated from Egyptian Monuments* (1838), *Manual of Modern History* (1838), *Manual of Ancient History* (1836), *Natural History of Society* (1839), *Romantic Biography of the Age of Elizabeth* (1842), *History of British India* (1842), *Revolutions, Insurrections, and Conspiracies of Europe* (1843), and *Memoirs of the House of Orleans* (1849). D. in Dublin Sept. 12, 1849.

Taylor (William Mackergo), D. D., b. at Kilmarnock, Ayrshire, Scotland, Oct. 23, 1829; educated at Kilmarnock Academy; graduated M. A. at the University of Glasgow 1849; studied theology at the Divinity Hall of the United Presbyterian Church in Edinburgh; was licensed to preach by the presbytery of Kilmarnock Dec. 14, 1852; ordained pastor of the U. P. congregation at Kilmarnock June 28, 1853; settled over the U. P. Church, Derby road, Liverpool, England, Oct. 23, 1855; in the spring of 1871 came to the U. S. as delegate from the U. P. Church in Scotland to the General Assembly of the Presbyterian Church at Chicago; was called to the pastorate of the Broadway Tabernacle (Congregational) church in New York City Nov. 22, 1871, and entered upon his labors there Mar. 10, 1872. In 1872 he received the degree of D. D. from both Yale and Amherst on the same day. In addition to many articles in the *Scottish Review* and many separate sermons, he has published *Life Truths* (1862), *The Miracles Helps to Faith, not Hindrances* (1865), *The Lost Found, and the Wanderer Welcomed* (1870), *Memoirs and Remains of Rev. M. Dickie, Bristol* (1872), *David, King of Israel* (1874), *Elijah the Prophet* (1875), *The Ministry of the Word* (1876). R. D. Hitchcock.

Taylor (William Rogers), U. S. N., b. Nov. 7, 1811, in Rhode Island; entered the navy as a midshipman Apr. 1, 1828; became a lieutenant in 1840, a commander in 1855, a captain in 1862, a commodore in 1866, a rear-admiral in 1871; retired in 1873. Served on the W. coast of Mexico during our war with that country, and as fleet-captain to Rear-Admiral Dahlgren was on board the monitors Catskill and Montauk in the fights of the 10th and 18th of July, 1863, with Forts Wagner and Sumter. Commanded the Juniata in the first Fort Fisher fight. Foxhall A. Parker.

Taylor (William Vigneron), b. at Newport, R. I., in 1781; went to sea before the mast, and rose to be a captain in the merchant service; entered the navy as sailing-master in 1813; effectually aided Perry in equipping his fleet on Lake Ontario and in the naval victory of Sept. 13, sailing the Lawrence, Perry's flag-ship, into and during the action, and for his services was made lieutenant; was made master commander in 1831, captain in 1841, and in 1847 commanded the Ohio, 74 guns, on a cruise to the Pacific, which was his last service. He was the father of Rear-Admiral William R. Taylor, U. S. N., and of Capt. O. H. P. Taylor, U. S. A., who was killed by the Indians in Washington Territory in May, 1858. D. at Newport, R. I., Feb. 11, 1858.

Taylor (Zachary), twelfth President of the U. S., b. in Orange co., Va., Sept. 24, 1784. His father, Richard Taylor (b. 1746), was colonel of a Virginia regiment in the Revolutionary war; removed to Kentucky in 1785; purchased a large plantation near Louisville, and became an influential citizen; was a member of the convention which framed the constitution of Kentucky; served in both branches of the legislature, and was collector of the port at Louisville under Pres. Washington; as a Presidential elector he voted for Jefferson, Madison, Monroe, and Clay. D. Jan. 19, 1829. Zachary remained on his father's plantation until 1808, in which year (May 3) he was appointed first lieutenant in the 7th Infantry to fill a vacancy occasioned by the death of his elder brother, Hancock. Up to this period he had received but a limited education. Joining his regiment at New Orleans, he was attacked with the yellow fever, with nearly fatal termination. Promoted to be captain in Nov., 1810, in the summer of 1812 he was in command of Fort Harrison, on the left bank of the Wabash River, near the present site of Terre Haute, his successful defence of which (Sept. 4–5, 1812), with but a handful of men against a large force of Indians which here attacked him, was one of the first marked military achievements of the war of 1812; was brevetted major, and in 1814 promoted to the full rank. During the remainder of the war Taylor was actively employed on the Western frontier. In the peace organization of the army in 1815 he was retained as captain, but soon after resigned and settled near Louisville. In May, 1816, however, he re-entered the army as major of the 3d Infantry, became lieutenant-colonel 8th Infantry in 1819, and in 1832 attained the colonelcy of the 1st Infantry, of which he had been lieutenant-colonel since 1821. On different occasions he had been called to Washington, as member of a military board for organizing the militia of the Union, and to aid the government with his knowledge in the organization of the Indian bureau, having for many years discharged the duties of Indian agent over large tracts of Western country. He served through the Black Hawk war (1832), and in 1837 was ordered to take command in Florida, then the scene of war with the Indians. As hitherto, the Indians after their attacks would retreat to their hiding-places in the swamps, beyond pursuit of the army; but Taylor determined to attack them in their strongholds. Accordingly, the battle of Okee-cho-bee was fought Dec. 25, 1837, resulting in the decisive defeat of the savages, and virtually ending the war. Taylor's loss was 112 wounded and 26 killed. For this Taylor was brevetted brigadier general and made commander-in-chief in Florida; was transferred to command of the army of the South-west in 1840, from which command he was relieved the same year at his own request. Subsequently, he was stationed on the Arkansas frontier at Forts Gibson, Smith, and Jesup, which latter work had been built under his direction in 1822. On May 28, 1845, he received a despatch from the secretary of war informing him of the receipt of information by the President "that Texas would shortly accede to the terms of annexation," in which event he was instructed to defend and protect her from "foreign invasion and Indian incursions." He proceeded, upon the annexation of Texas, with about 1500 men, to Corpus Christi, where his force was increased to some 4000. In Mar., 1846, he was ordered to advance to the banks of the Rio Grande, opposite Matamoras, where a camp was constructed (named Fort Brown after its gallant defence by Major Brown), and established his dépôt of supplies at Point Isabel, 25 miles to the E. He was ordered by Gen. Ampudia to retire beyond the Nueces, to which he replied that under instructions of his government he should maintain his position. Apprehending an attempt to cut him off from his base of supplies, he started for that point (May 1) with the main body of his troops. On May 3 the sound of heavy cannonading warned him of an attack on his camp, guarded only by a weak garrison, and he departed to its relief May 7. The battle of Palo Alto (which see) was fought next day, and that of Resaca de la Palma (which see) May 9; Matamoras was occupied without resistance May 18, where he remained until September. Taylor was brevetted major-general May 28, and a month later (June 29, 1846) his full commission to that grade was issued. After needed rest and reinforcement, he advanced in September on Monterey (which see), which city capitulated after three days' stubborn resistance. Here he took up his winter quarters. The plan for the invasion of Mexico by way of Vera Cruz, with Gen. Scott in command, was now determined upon by the government, and at the moment Taylor was about to resume active operations he received orders to send the larger part of his force (Worth and Quitman's divisions and most of Gen. Wool's volunteers) to reinforce the army of Gen. Scott at Vera Cruz. Though subsequently reinforced by raw recruits, yet after providing a garrison for Monterey and Saltillo he had but about 5300 effective troops, of whom but 500 or 600 were regulars. In this weakened condition, however, he was destined to achieve his greatest victory. Confidently relying upon the strength of Vera Cruz to resist the enemy for a long time, Santa Anna directed his entire army against Taylor to overwhelm him, and then return to oppose the advance of Scott's more formidable invasion. The battle of Buena Vista (which see) was fought Feb. 22–23, 1847. He received the thanks of Congress and a gold medal, and "Old Rough and Ready," the sobriquet given him in the army, became a household word. He remained in quiet possession of the Rio Grande valley until November, when he returned to the U. S. In the Whig convention which met at Philadelphia June 7, 1848, Taylor was nominated on the fourth ballot (June 8) as the candidate of the Whig party for President over Henry Clay, Gen. Scott, and Daniel Webster. In November, Taylor received a majority of the electoral votes and a popular vote of 1,360,752 against 1,219,962 for Cass and Butler and 291,342 for Van Buren and Adams. Gen. Taylor was inaugurated President Mar. 4, 1849. Among the questions requiring the prompt attention of the President was the organization of the large territories newly acquired by conquest and treaty, the question of the admission of California, the formation of new Territories, and the settlement of the boundary-line between Texas and New Mexico. The free and slave States being then equal in number, the struggle for supremacy on the part of the leaders in Congress was violent and bitter.

California adopted in convention, in the summer of 1849, a constitution prohibiting slavery within its borders. Taylor advocated the immediate admission of California with her constitution, and the postponement of the question as to the other Territories until they could hold conventions and decide for themselves whether slavery should exist within their borders. This policy ultimately prevailed through the celebrated "Compromise measures" of Henry Clay, but not during the life of the brave soldier and patriot statesman. On July 5 he was taken suddenly ill with a bilious fever, which proved fatal, his death occurring July 9, 1850. One of his daughters was married to Col. W. W. S. Bliss, his adjutant-general and chief of staff in Florida and Mexico, and private secretary during his Presidency; another was married to Jefferson Davis.—His son, RICHARD TAYLOR, is noticed above. G. C. SIMMONS.

Taylor Creek, tp., Hardin co., O. P. 891.

Taylor, Fort. See FORT TAYLOR.

Taylor's, tp., Wilson co., N. C. P. 555.

Taylor's Bridge, tp., Sampson co., N. C. P. 1521.

Taylor's Falls, p.-v. and tp., Chisago co., Minn., on St. Croix River, has a lumber-trade, manufactures, and a weekly newspaper. P. 1003.

Taylor's Port, v., Boone co., Ky. P. 120.

Taylor's Theorem, in mathematics, a theorem first demonstrated by Dr. Brook Taylor, and published by him in his *Methodus Incrementorum* in 1715. The object of the theorem is to show how to develop a function of the sum of two variables into a series arranged according to the ascending powers of one with coefficients that are functions of the other. The formula for making the development may be written—

$$f(x+y) = u + \frac{du}{dx}y + \frac{d^2u}{dx^2}\frac{y^2}{1.2} + \frac{d^3u}{dx^3}\frac{y^3}{1.2.3} +, \text{ etc.}$$

The first member of this formula denotes any function of the sum of x and y, and u is what that function becomes when x is made equal to 0. The formula is always applicable, but it sometimes happens that u or one of its successive differential coefficients reduces to ∞ for a particular value of x. This is called the *failing case* of Taylor's theorem. It is more proper to say that the function fails to be developable for the value in question. W. G. PECK.

Tay'lorstown, v., Washington co., Pa. P. 98.

Tay'lorsville, v., Bartholomew co., Ind. P. 350.

Taylorsville, p.-v., cap. of Spencer co., Ky., on the E. fork of Salt River, has water-power, manufactories, and a newspaper.

Taylorsville, p.-v. and tp., cap. of Alexander co., N. C. P. of v. 169; of tp. 1078.

Taylorsville, v., Highland co., O. P. 52.

Taylorsville, v., Muskingum co., O. P. 544.

Taylorsville, v., Indiana co., Pa. P. 169.

Taylorsville, p.-v., cap. of Johnson co., Tenn. P. 236.

Taylorville, p.-v. and tp., cap. of Christian co., Ill., at the junction of the Springfield division of Ohio and Mississippi and the St. Louis division of Toledo Wabash and Western R. Rs., 25 miles from Springfield, contains excellent schools, 3 newspapers, and does an extensive business in grain. P. 2180. G. W. WEBER, ED. "DEMOCRAT."

Tay'mouth, tp., Saginaw co., Mich. P. 638.

Taze'well, county of Central Illinois, bounded N. by Illinois River, intersected by the Mackinaw, and traversed by several railroads; surface mostly level prairie, soil fertile; bituminous coal is found. There are manufactories of agricultural implements, carriages, furniture, saddlery, iron castings, flour-mills, and distilleries. Staples, Indian corn, wheat, oats, wool, and live-stock. Cap. Pekin. Area, 550 sq. m. P. 27,903.

Tazewell, county of S. W. Virginia, bordering on West Virginia, traversed by Clinch Mountain and other ranges, and drained by the head-waters of Clinch and Holston rivers. Surface generally hilly, but with fertile valleys. There are tanneries and cloth dressing establishments. Staples, Indian corn, oats, a little tobacco, wool, and live stock. Cap. Tazewell Court-house. Area, about 600 sq. m. P. 10,791.

Tazewell, p.-v., cap. of Claiborne co., Tenn., on East Tennessee and Virginia R. R. P. 345.

Tazewell (HENRY), b. in Brunswick co., Va., in 1753; educated at William and Mary College; became a lawyer; was a member of the Virginia house of burgesses 1775–85, and of the committee which reported the Declaration of Rights and the State constitution of June, 1776; was chosen to a seat on the supreme bench 1785; was a member *ex-officio* of the first court of appeals, to which position he was again elevated by election 1793, and was U. S. Senator from 1794 to his death, at Philadelphia Jan. 24, 1799, having presided over the Senate 1795. Liberal in his political views, he favored the abolition of primogeniture and entail and the separation of Church and State in Virginia, took an active part in the discussions on the Jay treaty, and was considered a leader of the Republican party.

Tazewell (LITTLETON WALKER), son of Henry, b. at Williamsburg, Va., Dec. 17, 1774; graduated at William and Mary College 1791; began the practice of law at Williamsburg 1796; was chosen to the State legislature 1798; settled at Norfolk 1801; was a member of Congress 1800–01; was a commissioner under the Florida treaty 1820; U. S. Senator 1824–33; declined the mission to England 1829; was a prominent sympathizer with the nullification measures 1831–32, and governor of Virginia 1834–36. D. at Norfolk May 6, 1860. Author of a *Review of the Negotiations between the U. S. and Great Britain respecting the Commerce of the Two Countries*, etc. (London, 1829), reprinted from the columns of the Norfolk *Herald* of 1827.

Tazewell Court-house, p.-v., cap. of Tazewell co., Va.

Tchad, or **Tsád,** a large lake in Soudan, Central Africa, extends between lat. 12° 30′ and 14° 30′ N., and between lon. 13° and 15° 30′ E., and is about 200 miles long and 150 miles broad. Its elevation above the level of the sea is 800 feet; its depth varies from 8 to 15 feet. Its shores are low and overgrown with high reeds. It is studded with islands, densely peopled by a finely-built race, jet black, and with some civilization. It swarms with hippopotami, crocodiles, turtles, fish, and fowl.

Tcha'o-Nai'man-Soo'me, or **Dolou-Noor,** a town of Mongolia, in lat. 42° 25′ N., lon. 116° 18′ E., 165 miles N. of Peking. It is a large but dirty and miserable place, without streets, the houses or huts being huddled together without regularity. But its trade is very extensive, and its foundries of bells, idols, and sacred vessels celebrated wherever Booddhism is professed.

Tcherka'si, town of Russia, government of Kiev, on the Dnieper, has manufactures of beetroot-sugar. P. 8684.

Tchernigov', or **Tschernigow,** government of Southern Russia, bordering W. on the Dnieper, comprises an area of 20,231 sq. m., with 1,659,600 inhabitants. The ground is low and well watered, the surface level, the soil fertile, and the climate mild and healthy. Rye, barley, oats, potatoes, flax, hemp, tobacco, and hops are extensively cultivated, and numerous cattle, horses, sheep, and hogs are reared. Some manufactures of leather, linen fabrics, tallow, and spirits are carried on.

Tchernigov, or **Tschernigow,** an old town of European Russia, capital of the government of the same name, on the Desna, has 18 churches, among which one is from the eleventh century, and several educational institutions. P. 17,096.

Tches'me, the ancient *Cissos*, town of Asiatic Turkey, in Asia Minor, opposite the island of Scio, is fortified and has a good harbor. P. about 6000.

Tchihatcheff' (PETER), b. at Gatchina, government of St. Petersburg, Russia, in 1812; devoted himself to the study of geology; received an appointment in the department of foreign affairs; served for some time as attaché to the Russian embassy at Constantinople; was sent by the government to explore the Altai Mountains, and wrote *Voyage scientifique dans l'Altaï et dans les Contrées adjacentes* (1845), *L'Asie mineure, Description physique, statistique et archéologique* (8 vols., 1853–69), and *Le Bosphore et Constantinople* (1864).

Tchisto'pol, town of Russia, government of Kasan, on the Kama, has valuable fisheries, celebrated mineral springs, and a trade in cattle and agricultural produce. P. 9212.

Tchoogooev, or **Tchugujev,** town of Russia, government of Kharkow, is beautifully situated on the Donets, is fortified, and is a military station. P. 9000.

Tchook'tchees, a tribe inhabiting the north-eastern corner of Siberia from the 160th meridian to Behring Strait, consists of two divisions—one settled along the coast, and occupied in the hunting of the whale, the seal, and the walrus; and another wandering across the bleak, barren plateaus with their herds of reindeer. The Tchooktchees, whose number is variously estimated at from 6000 to 13,000, are a well-grown, vigorous people, hospitable and bold, but almost entirely destitute of civilization. They are dependents of the Russian government. Ethnologically, they belong to the same family as the Esquimaux of North America, and the Tchooktchee builds his house and his boat exactly like the Greenlander.

Tchooroom', or **Tchorum,** town of Asiatic Turkey, in Asia Minor, manufactures earthenware and leather, and has 16 mosques and 7600 inhabitants.

Tea. The history of tea is intimately bound up with the history of China, so far as the Western World is concerned. In very late times tea has been procured in considerable quantity from Japan, and the plant can be grown on many soils, but all its Western traditions are associated with China only. It was not known to the Greeks or Romans, nor can it have been known in very early times in India, for there is no word for tea in Sanskrit. (De Candolle, *Géog. Bot.*) Even in China no mention of the plant can be found earlier than about A. D. 350. (Williams, *Middle Kingdom.*) By the ninth century, however, tea was in general use among the Chinese, and the tax upon it was a source of revenue to the emperor, as stated by the Arabian traveller, Abuzeid el Hazen of Siraf, cited in Renaudot. Marco Polo, though for three years governor of a province in China in the thirteenth century, strangely enough, does not mention tea; but, as Humboldt has pointed out, he makes the equally strange omissions of failing to mention either the Great Wall of China or the existence of printing among the Chinese. Probably the earliest European notice of tea was in the second volume of Ramusio, first printed in 1559, though written several years earlier, where in his "Declaration," preceding Marco Polo's narrative, Ramusio quotes Chaggi Memet (Hajji Mahomed) to this effect: "And these people of Cathay do say that if in our parts of the world, in Persia and the country of the Franks, people only knew of it (tea), there is no doubt that the merchants would cease altogether to buy Ravend Cini, as they call rhubarb in those parts." (Yule, *Cathay, and the Way thither.*) The plant grows probably in every one of the eighteen provinces of China, and indeed in all the neighboring regions. It is spoken of by William Adams so early as 1598 as in general use in Japan. It is interesting to note, as showing the Chinese origin of tea, that there is still standing at Oojee, not far from Osaka, a temple sacred in the traditions of the Japanese to the Chinamen who brought the tea-plant to the island empire. The plant has been found wild in the mountainous regions of Assam and Yunnan, and it seems probable, though perhaps not certain, that this mountainous district is its native soil.

The Chinese name for tea is *tcha* or *chia*, but the inhabitants of Fuh-Kien, from whom the first cargoes were probably obtained, so pronounced the word as to give rise to the European name, *thé* or *tea*. (Williams, *Mid. King.*; Haussmann, *Voy. en Chine.*) The Chinese take neither sugar nor milk in their tea; they simply make a drawing with boiling water. The Abbé Huc speaks of tea being taken with milk among the Mongols. In Central Asia a kind of bouillon is made from brick-tea, which is mixed, in boiling, with salt and milk, and sometimes with flour fried in oil. (Timkovski, *Voy. à Peking.*) Pumpelly, in his journey from China to Russia, overland, partook of a Tartar mixture of tallow, tea, fat, salt, and cheese. In Russia the usual mode of drinking tea is with lemon; in Switzerland it is sometimes mixed with cinnamon in drawing; in England, as with ourselves, it is generally taken with milk and sugar. Among some of the peoples of Central Asia, as the Mongols and Kalmuks, bricks of tea serve as currency. (Timkovski, *Voy. à Peking.*) In China tea takes the place at once of beer and of wine. It is the ordinary beverage of all classes in the empire, while it also administers to the luxury of the epicure. The product of noted gardens is said upon native authority to sell at from \$15 to \$100 per pound. (*The Middle Kingdom.*) The supply for export is obtained mainly from the coast-provinces of Fuh-Kien, Cheh-Kiang, and Kiang-Su; these provinces extend from about 23° to 35° N. in the order named, and it is within these latitudes throughout the empire that the plant flourishes most. In Fuh-Kien are the important tea-centres of Amoy and Foo-Chow. Shanghai, the principal dépôt for all the northern black teas and for greens, is in Kiang-Su, close to the borders of Cheh-Kiang.

Tea is usually raised by small proprietors, each family producing what it can, as in the case of silk. There are but few large growers who cultivate extensive gardens. The men that grow the plants sometimes cure the leaves themselves; sometimes they sell them uncured, simply sorting them as to quality. The plants are raised from seeds, gathered generally in October, and kept fresh in sand and earth through the winter till they are planted in the spring. The shrub bears at the age of two or three years, and lasts for a period of ten to twelve years. The average product of a single plant seems to be about 6 ounces in weight, gleaned in three gatherings, the first of which, of the young and tender leaves, made when the leaf-buds begin to open, occurs about the middle of April; the second, of the full-sized leaves, occurs about the first of May; and the third is made about the middle of July. There is sometimes even a fourth gathering in August, but the last two pickings make only the inferior kinds. The method of curing the leaf, as might be expected of an interest existing in so wide an extent of territory, differs in detail in the different portions of the empire. (For particulars of some of the methods employed the reader is referred to the elaborate work on China by Hon. S. Wells Williams, LL.D., entitled *The Middle Kingdom*, and to Fortune's *Two Visits to the Tea-Countries of China.*) It is enough to indicate here the general features of the process, which are common to all methods. The leaves are first carefully sorted. The aim in curing is to get rid of more or less of the natural moisture of the leaf, and to preserve by thorough drying; the first point is mainly effected by pressure in rolling the leaf when it is in a flaccid state, and the latter point is attained by the careful firing to which the leaves are subjected. For export the leaves are much more highly fired than for native consumption. This is necessary in order to preserve the flavor of the leaf through the long voyage. The fact that teas sent overland through the cold climate of Siberia are less fired than those exported by sea may account in part for the reputation for quality attaching to the teas sent to Russia. Teas coming to the U. S. across the Pacific, and thus remaining in nearly the same latitude, are noticeably better in flavor than similar teas received around the Cape or *viâ* the Suez Canal. For black tea the leaves are exposed to the air a considerable time before firing. They are then tossed about till they are soft and moist, and after remaining an hour or more in heaps, they are roasted for about five minutes in iron firing-pans. Immediately afterward they are rolled upon rattan tables, and then exposed again to the air for some hours. The final process is to dry them slowly over charcoal fires, alternately firing and rolling. This frequent exposure to the air and to heat gives their dark color, and the rubbing and tossing explain their somewhat generic name of *congou*—that is to say "worked" tea. For green tea the leaves, instead of being first exposed to the air, are fired for a short time almost as soon as gathered. They are then rolled into the different forms in which they come upon the market, and immediately afterward are dried over hot fires. This process retains more of the essential oil of the leaf, and imparts a greenish hue that improves somewhat after a little time. The green tea of commerce is artificially colored, but that used by the natives is not. The coloring-matter is turmeric-powder and a mixture of gypsum and Prussian blue, or of gypsum and indigo, finely combined, the harmful elements entering in very minute proportions. It used to be supposed that black and the uncolored green teas were the product of different species of the tea-plant; it is now generally admitted that the color is the result of the manner in which the leaf is cured, both kinds being made from the same species of plant. The black color being the result of longer exposure to air and to heat, it is possible to transform green tea into black, but black tea cannot be turned into green. The Canton teas are generally scented by the infusion of the blossoms of certain aromatic plants. The names given to tea refer almost always to some peculiarity of make or the like. Thus, *souchong* means "little plant" or sort; *powchong*, "folded sort;" the former name denoting the character of the leaf, the latter the manner of packing. *Oolong* means "black dragon," and would thus appear to be an exception.

It seems certain that neither the very choicest nor the very poorest grades of tea enter into the export. The question of long transportation probably explains both facts, it being not worth while to transport the one, and impossible to preserve the delicate qualities of the other. The finest qualities exported go overland to Russia. Large quantities of what is called "brick-tea" go also to that country. Brick-tea is made by taking the common dried leaves and mixing them with some glutinous substance. They are then enclosed in square, oblong moulds, like bricks, and dried in the oven. Tea, as exported to other parts, is packed loose in wooden chests lined with sheet lead. Fortune calculated in 1848 that it took from six weeks to two months to transport the cured tea from the country districts where it was grown to the port of Canton, and about twenty-eight days to Shanghai. The time of transportation to Shanghai has been shortened eight or ten days by the use on the Yang-tse-Kiang of steamboats, which were introduced in 1860, and Shanghai is now the chief centre for the receipt and export of tea. The first steamer to take a cargo up the river was called the Scotland. (Lindsay, *Hist. of Merchant Shipping and Ancient Commerce.*)

European trade in tea commenced about 1602. (Haussmann, *Voy. en Chine.*) There seems to be little doubt that tea was introduced into Europe by the Dutch, although Portuguese intercourse with China began in 1518. The following account of the manner in which tea was first obtained is given in the history of the earl of Macartney's embassy to China: "Early in the seventeenth century some Dutch adventurers, seeking for such objects as might fetch a price in China, and hearing of the general usage there of

a beverage from a plant of the country, bethought themselves of trying how far a European plant of supposed great virtues might also be relished by the Chinese, and thereby become a salable commodity amongst them; and accordingly introduced to them the herb *sage*, so much once extolled by the Salernian school of physic as a powerful preservative of health; the Dutch accepting in return the Chinese *tea*, which they brought to Europe." The English East India Company was chartered A. D. 1600; their first order for tea was given in 1667. The first direct shipment, about 100 pounds in weight, reached London in 1669, and whatever tea was received in England previous to that year was probably brought over from Holland. From that date the direct trade increased rapidly. Up to 1834 the East India Company enjoyed a monopoly of the trade with England in tea, as in all China produce. Since then the trade has been open to all. Russian trade with China began toward the end of the seventeenth century, being conducted overland *viâ* Siberia. From the first, tea has been the staple of Chinese exports to Russia, and that mainly in the form of bricks. To this day the trade over the borders is conducted chiefly by barter, though this method has long ceased at the coast-ports. The first American ship sailed for China in 1784; the following year two vessels were despatched, and brought back 880,000 pounds of tea. In 1786–87 five vessels brought home 1,181,860 pounds. (Haussmann, *Voy. en Chine.*) The statistics at the end of this article will show the growth of the export to America and its present proportions. Up to 1845 the trade in tea was transacted almost entirely at Canton. In 1842, Shanghai, Ningpo, Foo-Chow, and Amoy were opened to foreigners by the Treaty of Nanking, and the China tea-trade now is mainly done at Shanghai, Foo-Chow, and Amoy. At Canton scented teas are still bought for England, but almost none come here. The principal kinds of scented teas are pekoes and capers. Powchong is the only tea of this class used in the U. S. In 1859 the first shipment of tea from Japan was made to England. The Japanese leaf was first brought to this country in 1860. The first direct cargo of tea from Japan *viâ* San Francisco and the Pacific R. R. was brought from Yokohama in 1868 in the American barque Benefactress in the remarkably short time of twenty-three days. In 1866 the export of tea from Formosa began; the export of this season (1875–76) was about 5,000,000 pounds. Since about 1850, Assam teas have been going to London. The English have made considerable and somewhat successful efforts to introduce the culture of tea into India, and their now rapidly-growing trade in Assam kinds is the result. The Assam tea is too heavy and powerful to be pleasant alone, and it is used altogether for mixing with the lighter Chinese teas. The export for 1875–76 will reach about 25,000,000 pounds. Tea is also grown in Brazil to a small extent, but wholly for native consumption.

So late as 1850 all vessels trading in tea carried considerable armaments, a necessary precaution because of the pirates which swarmed in the China seas during the first half of this century. In 1844 the Howqua and Montauk were built, the first of a class of vessels known as "clippers," in which speed was sought even at the expense of carrying capacity. By the clipper ships the average passage from China was shortened twenty to thirty days. In 1867 the first Pacific mail steamer, the Colorado, sailed from San Francisco for Yokohama and Hong-Kong, and steam entered the field then for the first time in the carrying-trade of tea to the U. S. In Nov., 1869, the Suez Canal was opened, and the route *viâ* Europe by steam was also thrown open to the shipper of tea. Small parcels of tea had gone to Europe across the Isthmus of Suez before the canal was opened, but steam communication practically began with the completion of the canal. By this date (1876) one-half or more of all shipments of tea to England and the U. S. are made in steam vessels, and the sailing ship is fast falling out of the China trade. Steam has even invaded the precincts of the caravan-trade to Russia by taking tea direct to Odessa through the Suez Canal. Tea reaches New York now, *viâ* San Francisco and railroad, in thirty to forty days from Japan, and forty to fifty days from Shanghai. The route *viâ* the Suez Canal takes sixty to seventy days. This is, again, a shortening of the tea-voyage by thirty to forty, or even fifty days.

At this time tea is on the free list in the U. S., the war-duty of 25 cents per pound having been reduced Jan. 1, 1871, to 15 cents, and removed entirely July 1, 1872. There is, however, a differential duty of 10 per cent. ad valorem on all teas imported from places W. of the Cape of Good Hope, if the tea has been grown E. of the Cape.

The teas used in the U. S. are principally greens, oolongs, congous, and souchongs from China, and the Japan leaf. Green teas are sold chiefly in the West and South. A standard invoice of greens should contain a number of lines, named as follows:

No. 1 gunpowder, " 2 "	Small, tightly-rolled, shot-like balls.
" 1 imperial, " 2 "	Like gunpowder, only larger and coarser.
" 1 young hyson, " 2 " " 3 " " 4 "	Small, tightly-rolled, long leaf. The No. 4 is often omitted.
" 1 hyson, " 2 " " 3 "	Like the young hyson, only larger and coarser. The No. 3 is often omitted.
Twankay,	Broken and mixed leaf, very common.

Oolongs, comprising Amoy, Foo-Chow, and Formosa kinds, are sold chiefly in the New England and Middle States. The Formosa oolongs are mainly shipped from Amoy, but somewhat from Tamsui on the island itself. They differ from the other sorts in possessing what is known as a jessamine flavor, said to be due to iron in the soil, which mineral seems to be absorbed by the plant. It is certain that in order to preserve the characteristic quality of the leaf the plant has to be cultivated continually in new places, the old ones failing to produce the characteristic flavor after one or two years. Congou and souchong are the staple of shipments to England, going from almost every one of the Chinese ports, but they meet with comparatively small sale here. The souchong leaf is longer than the congou, and draws lighter; otherwise, there is little difference between them. They find their outlet in this country in the Middle States and New England. Japans are more widely sold than any other sort, finding a market both in the East and the West. They resemble an uncolored green tea more than any other. The export of Japans to the U. S. has grown from about 17,000,000 pounds in 1873–74 to 25,000,000 pounds in 1875–76. An export trade of fair dimensions exists between the U. S. and Canada in greens, congous, and Japans, and there is an occasional call for greens to be shipped to South America.

Appended are tabular statements showing importations into the U. S. from 1801, by decades, down to the present time; also, the export from all China and Japan for 1874–75, thus displaying the present magnitude of the world's trade in tea. The former figures have been kindly furnished from the official returns by Dr. Edward Young, chief of bureau of statistics, Washington. The latter figures are from the circular of Olyphant & Co. of China. Dr. Young, in his work on *Labor in Europe and America*, computes the average consumption of tea in England at 4 pounds, against $1\frac{1}{2}$ pounds per capita in the U. S.:

Imports into U. S.	Pounds.	Imports into U. S.	Pounds.
1801	3,823,709	1850	29 872,654
1810	7,708,208	1860	31 696,657
1821	4,975,646	1870	47,408,481
1830	8,669,415	1875	64,856,899
1840	20,006,595		

The import into the U. S. for 1875–76 will be made up about as follows:

	Pounds.
Greens (estimated)	16,000,000
Oolongs	9,500,000
Congous, souchongs	2,750,000
Japans	24,250,000
Say	52,500,000

Season 1874–75.—Export of Tea from China and Japan to Great Britain and the Continent.

From Swatow and Amoy.	From Shanghai and Yang-tse ports.	From Foo-Chow.	From Canton, Hong-Kong, and Macao.	From Japan direct.	To London.	To out-ports.	To Russia.	Total exports
937,982	81,918,791	61,647,643	20,062,849	3,108	158,488,092	1,706,270	4,376.011	164,570,373

Season 1874–75.—Export of Tea from China and Japan to the U. S. Atlantic and Pacific Ports.

Congou and souchong.	Powchong.	Oolong.	Sorts.	Total black.	Greens.	Japans.	Total exports.
4,225,697	334,136	13,290,770	33,906	17,884,509	19.218,652	21,969,308	59,072,469

Total shipments of tea, as above, to Europe, 1874–75	pounds,	164,570,373
" " " " " America "	"	59,072,469
Add shipment from India, say	"	22,000,000
Grand total	pounds,	245,642,842

(See TEA, ADULTERATIONS OF, TEA, PHYSIOLOGICAL RELATIONS OF, and TEA-PLANT.)

SETH LOW.

Tea, Adulterations of, and their Detection. The sophistications to which tea is subjected have received the careful attention of chemists, but not to a greater extent than the importance of the subject merits. The greater part of the adulteration undoubtedly occurs in China, but there are strong reasons for the belief that both the English and the Americans have become in this respect expert imitators of the Chinese. The chief adulterants employed are—mineral and organic substances, for the purpose of giving an increased weight and bulk; substances used to bestow artificial strength; and coloring-matters or "facings," employed to impart a suitable color and gloss to inferior grades. The first heading includes such substances as silica, metallic iron, exhausted tea-leaves, and the leaves of other plants. The presence of metallic iron is easily detected by applying a magnet to the finely-powdered sample. Silica is most readily discovered by the increased amount of the insoluble portion of the ash obtained upon calcining the tea. In genuine teas this never exceeds 0.8 per cent., while in some adulterated samples 8 to 10 per cent. has been found. The addition of exhausted tea-leaves is detected by determining the tannin, the insoluble matter, and the ash. The first estimation is best made by means of a standardized solution of plumbic acetate. Genuine black tea (which is the kind most exposed to adulteration with exhausted leaves) contains from 10 to 11 per cent. of tannin, whereas not more than 2 per cent. is present in the exhausted tea-leaf; the extent of this species of adulteration is therefore indicated by the lessened proportion of this principle contained in the sample examined. Of pure green tea about 50 per cent. of matter remains insoluble in hot water, black tea containing 60 per cent.; but in case exhausted leaves have been added the insoluble residue often reaches the proportion of 75 to 85 per cent. In genuine teas the total ash amounts to 5 or 6 per cent., 3 per cent. being soluble in water; an increase, especially of the soluble portion, being an indication of the presence of exhausted tea-leaves, as well as of foreign leaves. In order to detect the presence of the latter, however, an intimate acquaintance with the tea-plant leaf and the use of the microscope are usually necessary. Upon treating the suspected sample with hot water, separating its leaves, and comparing them with those of the tea-plant, especially in respect to their venations and serrations, foreign leaves are easily recognized. The presence of exhausted and foreign leaves is often disguised by the addition of substances which impart artificial strength and coloring power to the tea, such as tannin (catechu), "lie tea," and soluble iron salts. Catechu is frequently detected in the microscopic examination, and by the abnormally large proportion of tannic acid present in the suspected tea. The infusion of tea to which catechu has been added becomes turbid when cold, and upon adding neutral plumbic acetate, separating the precipitate formed, and adding a small quantity of argentic nitrate to the filtrate, a brownish precipitate is produced, the fluid acquiring a distinctly yellow color; under the same conditions an infusion of pure tea is merely rendered turbid by the addition of argentic nitrate. If much catechu be present, a clear green color is produced upon adding a very dilute solution of ferric chloride to the filtrate from the lead precipitate. *Lie tea* consists of the dust of tea and other leaves, mixed with mineral substances, and agglutinated into little masses resembling genuine tea by means of starch and gum; it is used in the adulteration of gunpowder teas. By the action of hot water the gum and starch are dissolved and the grains become disintegrated. The presence of starch can be detected by the iodine test. As a rule, "lie tea" gives 30 to 40 per cent. of ash. *Caper tea* is a similar preparation, and is recognized by the same methods. Soluble salts of iron, employed to impart a dark color to the tea decoction, are detected by heating the powdered sample with acetic acid, and testing the solution with potassic ferrocyanide. The artificial coloring or "facing" of teas is perhaps the most extensive species of adulteration that is carried on. In regard to the extent of this practice, it is safe to assert that nearly every green tea imported into this country has been artificially colored; in fact, if this were not the case, there would be little difference in appearance between green and black tea. The glossy and deep-green color so often noticed in so-called "green tea" is entirely different from the natural color of the leaf, and its artificial production is for the purpose of concealing the presence of foreign leaves and meeting the demand of foreign dealers. It is a very significant fact that the Chinese themselves never use these colored teas. The restoration of a poor grade of tea and the conversion of a black into a green tea (or *vice versâ*) are constant practices in England and the U. S., and have given rise to a special branch of industry. A great variety of substances are used in the coloring of tea. Those chiefly employed are prussian blue, indigo, turmeric, and kaolin, which are mixed in the proportions necessary to give the desired shades of color; and steatite, graphite, etc., which impart a glossy appearance to the tea. The detection of these substances is easily accomplished, the microscopic examination alone being frequently sufficient. Upon treating a "faced" tea with hot water, the coloring-matter often becomes detached, and is deposited as a sediment. Prussian blue is detected by warming the tea with caustic soda, acidulating the filtrate with hydrochloric acid, and adding ferric chloride, when a deep-blue color will be produced. Indigo and turmeric are often recognized in the microscopic examination of the suspected sample. Graphite is sometimes visible to the naked eye, owing to its characteristic glossy appearance, and can be separated by treating the tea with water and evaporating the infusion, when it will be deposited on the bottom of the vessel as a dark shiny coating. Pure tea should not turn black when digested with an aqueous solution of sulphuretted hydrogen, nor impart a blue color to a solution of ammonia. If the addition of a few drops of sulphuric acid produces a red coloration in the infusion of the tea, logwood is probably present. The presence of such mineral compounds as steatite, kaolin, gypsum, chalk, etc., is detected by the analysis of the ash left upon incinerating the tea. J. P. BATTERSHALL.

Teach'ers' Institute, an official gathering of the teachers of the public schools of a certain district for the purpose of receiving instruction in the best methods of teaching and discipline, and the hearing of practical oral lessons from eminent instructors. Teachers' institutes have been held in most of the Northern States for many years. The first was held by Mr. Henry Barnard at Hartford, Conn., in 1839. When ably conducted, these meetings have proved extremely useful means of awakening the enthusiasm and giving a wise direction to the labor of teachers in the public schools.

Teak, the *Tectona grandis*, of the order Verbenaceæ, a noble forest tree of India and Farther India. It is the best timber known for shipbuilding. It is more durable than oak, more easily seasoned, equally strong, considerably lighter, and far more easily worked. It is used for making decks and planking, for the keel, timbers, and even masts and spars. Many all-teak built ships are reported to be over 100 years old, and still seaworthy. The wood somewhat resembles mahogany. Its flowers and leaves have medicinal qualities, and are used in dyeing. African teak, the wood of *Oldfieldia africana* an euphorbiaceous tree, resembles true teak, but is much inferior to it.

Teal, the English name given to certain ducks of small size, distinguished by the following characters: The bill is but little longer than the foot, its sides nearly parallel, and the lamellæ little or moderately developed; the tail is about two-fifths as long as the wing, and subtruncate; the wings have each a bright-colored green or blue speculum. The species thus distinguished present, however, considerable differences in other respects, and have been differentiated into two genera, which have been distinguished, so far as the North American species are concerned, by Prof. Baird (*The Birds of North America*, pp. 772, 777, 779) as follows: "(1) The blue-winged teals (*Querquedula*) have a rather broad or moderately narrow bill (the width equalling about a third or more of the lower edge); the nail is proportionately broad (about one-third of the width of the bill); the upper angle of the bill extends rather farther back than the lower edge; and the colors are characteristic in that the wing-coverts and the outer webs of some scapulars are bright blue; the greater coverts tipped with white; a grass-green speculum is just below the white of the coverts; the scapulars are streaked with yellowish buff; the top of head and chin are dusky; and the crissum is blackish. (2) The green-winged teals (*Nettion*) have a very narrow bill (the width being scarcely more than one-fourth of the lower edge); the nail proportionately still more narrow (only about one-fifth as wide as the bill); the upper angle of the bill does not reach as far back as the beginning of its lower edge; and the colors are distinctive in that the head and neck are chestnut, with a broad patch of green on the side of the head; the breast has rounded black spots; the upper part and sides are finely waved transversely with black and grayish white; the crissum is black, edged with creamy yellow; the wing-coverts are plain olive gray, the greater with a terminal band of fulvous; the speculum is green, edged externally and internally with black." The species frequent inland lakes and streams, and are among the most edible of the family. Representatives are found in almost every country, and are almost alike at home in the cold North and the heated tropical countries. The North American species are (1) the blue-winged teal (*Querquedula discors*), (2) red-breasted teal (*Querquedula cyanoptera*), (3)

green-winged teal (*Nettion carolinensis*), and (4) European teal (*Nettion crecca*), which last is, however, only a straggler within our limits. Eighteen species are recognized as inhabitants of various regions by G. R. Gray.

THEODORE GILL.

Teall (FRANCIS AUGUSTUS), b. in New York in 1822; a practical printer, he mastered several languages, and acted as one of the associate editors of the *American Cyclopædia*, his labors being chiefly directed to the revision of the copy and the correction of the press. He has occasionally written for journals, and has in preparation a general *Dictionary of Proper Names*.

Tea'no, town of Italy, province of Caserta, about 30 miles N. N. W. of the city of Naples. It is of ancient origin, and the medals found here (the workmanship of the *Sidicini*, an Oscan race) are greatly prized by antiquarians. The first Christian bishop was established here in 333 A. D. P. 12,943.

Tea, Paraguay. See MATÈ.

Tea, Physiological Relations of. The active ingredients of tea-leaves are an alkaloid called *theine*, identical with the alkaloid *caffeine* found in coffee, guarana, etc. (see CAFFEINE); an astringent principle of the character of tannic acid, which gives tea its bitter styptic taste; and a small percentage of a volatile oil, to which is due the peculiar aroma. The proportion of these ingredients varies considerably in different analyses of different samples of tea. Thus, the percentage of theine is variously stated from .43 to 1.27, 2.34, 3, and even in one case 6.21, per cent. The tannin ranges from 12 to 18 per cent., and the volatile oil from .50 to .80 per cent. Besides the above, tea contains chlorophyl, wax, resin, gum, coloring matter, albumen, extractive, fibre, and mineral substances. The effects of tea-infusion upon the human system are the resultant of the several effects of the alkaloid, the oil, the tannin, and the hot water; and of these elements the theine probably plays the most important part. Like all the potent alkaloids, theine or caffeine is a powerful modifier of nerve-function, and numerous experiments have been made upon animals to determine how the various parts of the nervous and muscular apparatus are affected by it. Cerebral irritation, muscular rigidity, convulsions of central origin, followed by paralysis and death from failure of respiration, are the prominent toxic effects. In man, experiments with large doses of caffeine, as 8 or 12 grains, show increased cerebral irritability, as manifested by persistent wakefulness, unnatural mental activity, with uneasiness of mind, and also great physical restlessness, tremulousness of the muscles, increased frequency of the pulse, and frequent micturition. An important effect of the alkaloid, which seems now abundantly proved, is to lessen the amount of nitrogenous excreta, notably of urea; which means, to diminish the rate at which nitrogenous substances are oxidized within the body. It is probable that the volatile oil of tea may also have the same effect, since Lehmann found the volatile oil of roasted coffee to possess this property. Infusion of tea-leaves taken as a beverage is found to have the effects just described, and in cases of mental exhaustion acts, as is well known, as an agreeable restorative, dispelling fatigue and drowsiness and disposing to increased mental activity. Tea is also one of many substances, such as coffee, coca-leaves, tobacco, opium, and alcohol, which in case of deficiency of food tend to remove hunger and the distress and sinking arising from the inanition. But in considering the vivifying effects of a cup of tea, there must not be forgotten the powerful reviving influence of the *heat* contained in the steaming draught, and the true nourishment of the sugar and milk commonly added to the same. In excess, tea produces restlessness, tremulousness, wakefulness, and has a strong tendency to cause dyspepsia, with the special symptoms of gastric flatulence and a most distressing sinking at the stomach. This latter property is one perhaps not generally known, but the writer has seen many cases of dyspepsia of the above character, which had long resisted treatment, disappear immediately upon the abandonment of tea as a beverage. There is no doubt that, especially among women, and particularly with the Irish, tea is largely consumed in improper excess. In irritable stomachs, also, tea often aggravates nausea, and may even promptly determine vomiting. Medicinally, tea is not often prescribed, as in the circumstance where it would be principally useful—namely, in opium poisoning—the stronger infusion of coffee is preferred. In making an infusion of tea, the water should be neither particularly hard nor soft, and should be poured upon the leaves when actually boiling, and allowed to steep but for a short time. Both by boiling, and by too long soaking in hot water, the tea loses much of its aroma, and by solution of an excess of the extractive matters acquires a rough and bitter flavor.

EDWARD CURTIS.

Tea-Plant, a shrub with bright green and smooth evergreen leaves, bearing white flowers (an inch or more broad) in their axils, resembling those of a small camellia, belonging, indeed, not only to the same natural order (*Camelliaceæ* or *Ternstræmiaceæ*), but in the opinion of most recent botanists to the same genus. Dr. Seemann, however, pointed out a character which might distinguish them—viz. that camellias have numerous unconnected stamens within the ring of outer ones, the united filaments of which form a short tube, cohering with the base of the petals, and falling with them; while in the tea-plants there are only five or six of these inner and separate stamens. In both the blossom is succeeded by a globular, thick-walled, woody capsule, internally divided into three or four cells, tardily splitting open; each cell ripening one, or rarely a pair, of large and oily seeds, with a hard and smooth seed-coat.

As to nomenclature, Linnæus established the genus *Thea* (Latinizing the Chinese name), and, following the opinion of the time, indicated two species—*T. Bohea*, from which black tea was supposed to be prepared, and *T. viridis*, for green tea. It is known, however, that these are mere varieties, of no botanical importance, and that the difference between green and black teas results from the mode of preparation; whereupon the tea-plant generally took the name of *T. chinensis* or *T. sinensis* (of which the latter is the preferable form). But at length it appears that the tea plant is unknown in a wild state in China; that it was probably introduced into China from some part of Upper India adjacent to the Chinese empire; and that the tea-plant indigenous in Upper Assam, which was discovered there by the English in the year 1834, and published under the name of *Thea assamica*, is specifically identical with the long-cultivated plant of China. Wherefore, the latest authorities, referring the tea-plant to the camellia genus, name it *Camellia Thea*. They might have taken the alternative course of referring *Camellia* to *Thea*, but this would have involved more extensive changes of specific names.

ASA GRAY.

Tears [Ang.-Sax. *tæher*], the slightly saline watery secretion of the LACHRYMAL GLAND (which see). The ordinary function of this secretion is to assist in the work of moistening and lubricating the eyeball; but in the human species, at least, the exercise of certain strong emotions acts as a powerful stimulus upon this secretion. To certain of the lower animals, as the crocodile and the hyæna, folk-lore ascribes the power of shedding voluntary tears for the deception of the beholder; and observers old and recent testify that certain species of deer and of the seal family express grief by the shedding of tears. There are certain strong-smelling plants, such as the onion, whose exhalations sometimes provoke a copious and even painful discharge of tears. Most of the lower animals do not secrete in any circumstances a noteworthy flow of tears, except after injury of the eye or in some diseases of the gland or of some adjacent part.

Tea'sel [Ang.-Sax. *tæsel*], the *Dipsacus fullonum* (order Dipsaceæ), a biennial plant of the S. of Europe, naturalized to some extent in the U. S. It is cultivated in Europe, as formerly in the U. S. to some extent, on account of its burs or heads, covered with hooked bracts. These heads are fastened to a revolving cylinder, and used by woollen manufacturers to raise a nap on cloth. No artificial contrivance has been found to equal the teasel for this purpose. "Male" and "female" teasels are merely varieties in size and stiffness, each adapted to the dressing of special cloths.

Tebeau'ville, p.-v., Ware co., Ga.

Tebes'sa, town of Algeria, province of Constantine, in a beautiful and exceedingly fertile district, carries on a very important trade. It contains many and interesting Roman remains. P. about 15,000.

Te'bo, tp., Henry co., Mo. P. 3308.

Teche, Bayou. See APPENDIX.

Technol'ogy [Gr. τέχνη, "art," and λόγος, "discourse"] is a general name for industrial science. Strictly, there is no such science, but all the sciences contribute much which is of the greatest value to the various industries; and technology is the teaching of those parts of science which are of direct industrial importance.

Teck was, in the Middle Ages, the name of a small duchy situated in Suabia, and called so after the castle of Teck, of which ruins still exist. In the eleventh century it came into the possession of the house of Hapsburg, which in the fourteenth century sold it to the dukes of Würtemberg.

Tectibranchia'ta [from *tectus*, "covered," and *branchiæ*, "gills"], an order of gasteropod mollusks belonging to the sub-class Opisthobranchiata. The sexes are combined together in one individual; the heart has but one auricle; the branchiæ generally are in a tuft on the side of the back and under a fold of the mantle; the otocysts lie

on or over the pedal ganglia; the shell is developed in the embryo, and mostly persistent through life, generally spiral and moderately well developed, sometimes scale-like or rudimentary, rarely entirely wanting. The order is quite comprehensive, and very considerable modifications of the superficial parts of the body, as well as of the teeth, are exemplified in forms which appear to be otherwise closely allied. The relations of the sexual organs also differ, and their differences have been used by J. E. Gray (perhaps incorrectly) to differentiate the order into two primary groups: in the one the organs of generation are far apart and connected by a groove, and in the other they are close together and situate in a tubercle; the former includes the bulliform and aplysiiform families, the latter the other families. The order is represented by numerous species and in every sea. About fourteen families are generally recognized; the most prominent of these are the Bullidæ, Cylichnidæ, Aplysiidæ, and Pleurobranchiidæ. THEODORE GILL.

Tecum'seh, tp., Shawnee co., Kan. P. 854.

Tecumseh, p.-v. and tp., Lenawee co., Mich., on Lake Shore and Michigan Southern R. R., 60 miles S. W. of Detroit, contains 6 churches, 4 fine school buildings, 2 banks, 2 newspapers, 2 hotels, 4 flouring-mills, 1 foundry, an agricultural implement manufactory, 2 planing-mills, 3 machine-shops, 2 carriage-factories, a paper-mill, and stove-factory. Principal business, farming, fruit-growing, and manufacturing. P. of v. 2039; of tp. 2583.

S. C. STACY, ED. "HERALD."

Tecumseh, p.-v. and tp., cap. of Johnson co., Neb., on Atchison and Nebraska R. R., 50 miles S. E. of Lincoln, has 3 churches, 1 high school, a public hall, 1 bank, 2 newspapers, 2 grist-mills, and 2 hotels. P. 722.

M. C. BARROW, ED. "CHIEFTAIN."

Tecumseh, or **Tecumtha,** a celebrated chief of the Shawnee Indians, b. near Springfield, O., about 1770; took part in the war with the Kentucky forces about 1791; was engaged in the battle of Mad River and in the attack on Fort Recovery, 1794; joined his brother, Elskwatawa (called "the Prophet"), about 1805 in the attempt to organize all the Western Indians in a confederacy against the whites; visited all the tribes on the upper lakes and in the Mississippi Valley down to the Gulf of Mexico; collected a considerable force on the upper Wabash in the autumn of 1811, which under command of the Prophet attacked Gen. Harrison, and was defeated at Tippecanoe Nov. 7, during Tecumseh's absence among the Southern tribes; went to Canada with a band of Shawnees in the following year on the outbreak of hostilities with Great Britain; was a useful ally to the British in the battles of Raisin River and of Maguaga, where he was wounded; made a brigadier-general in the British service; joint commander with Gen. Proctor at the siege of Fort Meigs, and protected the American prisoners from massacre: wounded at the battle of Lake Erie, and commanded the right wing at the battle near the Moravian towns on the Thames. Having, it is said, a presentiment of his approaching death, he laid aside his sword and uniform, put on his hunting-costume, and plunged into the hottest of the fight, in which he was killed Oct. 5, 1813. It was asserted for many years that he fell by the hand of Col. Richard M. Johnson, afterward Vice-President of the U. S. during Van Buren's administration (1837-41), and several other persons claimed the same honor, but on insufficient grounds. A *Life of Tecumseh and his Brother the Prophet, with an Historical Sketch of the Shawnee Indians* (1841), based chiefly upon the statements of numerous persons who had known Tecumseh, was prepared by Benjamin Drake of Cincinnati, and still constitutes the best source of information on an interesting episode of American history.

Te De'um. This most venerable hymn, commencing *Te Deum laudamus, Te Dominum confitemur*, or, in the English version, "We praise thee, O God; we acknowledge thee to be the Lord," has been sung by the whole Western Church, "day by day," on all her feasts from time immemorial. It is Morning Service of the English Church as far back as the Conquest (Blunt's *Annotated Book of Common Prayer*); very ancient ecclesiastical traditions represent the Te Deum as a hymn antiphonally extemporized by St. Ambrose and St. Augustine at the baptism of the latter (A. D. 356), and the title anciently given to it in the Psalter of the English Church was "Canticum Ambrosii et Augustini." The authorship has also been attributed to St. Hilary (A. D. 355) and Nicetius, bishop of Treves (A. D. 535), but there is reason to think it is much older, and that the first two names are connected with it merely through their introducing it into their respective churches. (*Ibid.*) It has always constituted a portion of the Morning Service (as one of its supplications, "Keep us *this day* without sin," implies) in the English and American church services between the first and second lessons for the morning, the rubric prescribing that it shall be "said or sung."

Besides the use in the Morning Service, this triumphal hymn is used, arranged to elaborate music, as a special service of thanksgiving. The sovereigns of England have been accustomed to go in state to the singing of the Te Deum after great victories, Handel's "Dettingen Te Deum" having been composed for one of these occasions. At the conclusion of coronations it has been used from time immemorial throughout Europe. When, in the ordinary Morning Service, it is "said," its verses are antiphonally recited by minister and congregation, but it is now very generally *sung* by choir and congregation. The most ancient Christian music known, the "Ambrosian Te Deum," found in a work by Boëtius (A. D. 457), has come down in connection with this hymn, but it is probably an adaptation of the temple psalmody of the Jews. No hymn or form of words has been the subject of so many musical renderings by composers of all grades, of all ages, and of all nations. Among the elaborate works are those of Handel (just cited), Romberg, Meyerbeer, etc. For ordinary purposes, that of Jackson of Exeter is the most universally in use. To the "goodly fellowship" the writer, aided by Rev. Dr. Staunton, who has himself composed a noble *Te Deum*, has added one. J. G. BARNARD.

Ted'la, town of Morocco, Northern Africa, at the foot of the Atlas Mountains, manufactures fine woollen cloths and shawls, which are exported to Europe. P. 11,000.

Ted'si, town of Morocco, province of Soos, among fertile surroundings, has a lively trade. P. about 12,000.

Tees'water, p.-v., Bruce co., Ontario, Canada, on Toronto Grey and Bruce Railway, 16 miles from Walkerton, has a weekly newspaper. P. about 450.

Teeth. See APPENDIX.

Teeth, Chemistry of. See APPENDIX.

Teff, the *Poa abyssinica*, a cereal grass of the interior of Africa, where the grain is employed extensively in making bread and beer, while the straw is a forage material.

Tefft (BENJAMIN FRANKLIN), D. D., LL.D., b. at Floyd, N. Y., Aug. 20, 1813, and graduated at the Wesleyan University, Middletown, Conn., 1835; was pastor of a Methodist church at Bangor, Me., and has been professor in Asbury University, Indiana, and president of the Genesee College, N. Y. In 1862 he was U. S. consul and acting U. S. minister at Stockholm, Sweden; since 1866 has been pastor at Portland, Me. He has published *The Shoulder-Knot, Hungary and Kossuth, Webster and his Masterpieces, Methodism successful, and the Internal Causes of its Success*, etc.

Tefft (THOMAS ALEXANDER), b. at Richmond, R. I., Aug. 3, 1826; graduated at Brown University 1851; studied architecture at Providence; made designs for many public and private edifices; published *Our Deficiency in Art Education* (1852); wrote on architecture and art in the New York *Crayon;* went to Europe 1856; presented to the British Institute of Social Science a plan for a uniform currency for all nations. D. at Florence, Italy, Dec. 12, 1859.

Te'gea, ancient town of Greece, in the Tegeatis, which formed the south-eastern part of Arcadia, was brought under the supremacy of Sparta in 560 B. C., and was an important town under the Roman authority, but was utterly destroyed by Alaric in 400 A. D. Remains of it are found near the village of *Piali*, 4 miles from Tripolitza.

Teggia'no [formerly *Diano*], town of Southern Italy, province of Salerno, about 9 miles from Sala Consilina. Of the ancient town little remains except old inscriptions, etc., that prove its former existence. The present inhabitants are chiefly engaged in agriculture, and are not wanting in industry. P. 7018.

Te'glio, town of Italy, province of Sondrio, on the slope of the mountains which flank the right bank of the Adda. This town is remembered as the place where was assembled (1524) a congress to regulate the political difficulties between the Grisons and the Valtellines. P. 5973.

Tegnér' (ESAIAS), b. at Kirkerud, in Wermland, Nov. 13, 1782. His father, who was a poor country minister, died early, and the son had to fight his way through life with his own weapons. He contrived, however, to go to Lund in 1799, and in 1802 he graduated from the university with great honor. In 1815 he became professor of æsthetics at the same university on account of a fine treatise he wrote in Latin on the fables of Æsop, and in 1812 he exchanged this professorship for that of Greek literature, having in the mean time acquired a great fame as a poet by his *Axel, Svea*, and a great number of lyrical poems, and having been elected a member of the Swedish Academy in 1811. In 1824 he was made bishop of Wexiö, and in this position he exercised a great and beneficial influence by his powerful eloquence, his energy in school matters, and his lofty piety. D. Nov. 2, 1846. His talent as a poet was

essentially lyrical, with a tendency toward the didactic. His best poems are those which have an epic under-structure, not so prominent as to require an objective characterization—which he was not able to give—but strong enough to lift his lyrical enthusiasm and hold the rich tracework of his imagination. *Frithiof's Saga*, which is his most celebrated work, and which has been translated into all European languages, and sixteen times into German, is a combination of ballads; and whenever the discrepancy between the rough and stern sublimity of the Northern subject, and the soft sentimentality and almost Oriental fancifulness of the poet, does not become too loud, the poem is very charming. His influence on the Swedish people was decisive. He was—and acknowledged himself to be—a disciple of the Danish poet Œhlenshläger, but Œhlenshläger's influence was only the knock at the door which awakened Tegnér's genius; he was perfectly original and thoroughly national. In opposition to the French school, which with its pompous and pedantic or superficial and frivolous elegance predominated in the Swedish literature at the beginning of this century, Tegnér unveiled the ideal of the romantic school, with its new relations between nature and art, and between art and religion; and in a very short time his powerful enthusiasm and rich imagination altered the taste of the Swedish public. He can hardly be said, however, to be more than the founder of the school: he lacked power of objective characterization in too high a degree to become its master. CLEMENS PETERSEN.

Teha'ma, county of California, lying between the Sierra Nevada and the Coast Range, intersected by Sacramento River, and traversed by the Oregon division of Central Pacific R. R. The E. portion is rocky, with many pine forests. Some gold is found in the Sierra Nevada, and in the S. part are medicinal and salt springs. Staples, wheat, barley, wine, wool, mill products, and live-stock. Cap. Red Bluff. Area, 2800 sq. m. P. 3587.

Tehama, p.-v. and tp., Tehama co., Cal. P. 881.

Teheran', capital of Persia, in lat. 35° 41′ N., lon. 51° 23′ E., province of Irak-Ajemi, 70 miles S. of the Caspian Sea, in a sandy and stony plain at the southern foot of the Elburz Mountains, which rise here, in Mount Demavend, 22,000 feet above the level of the sea. It is surrounded with a mud wall 4 miles in circumference, 20 feet high, and pierced with six gates. The streets are narrow, crooked, ill-paved, and filthy, and the houses low and insignificant, generally built of mud. Some mosques, bazaars, and caravanserais look well, however, and the palace of the shah, forming a city by itself adjoining the northern part of the wall, is a vast and elegant structure. Teheran became the residence of the shah in 1796, and has increased considerably since that time. It has some manufactures of carpets, cotton and linen goods, shoes and hats, and carries on a brisk trade. Its population varies much from winter to summer, as the shah and all the wealthier citizens leave it early in spring on account of the intolerable heat and unhealthy atmosphere; during winter its population is estimated at about 100,000. In the vicinity are the ruins of Rei, the *Rhages* of Scripture, the ancient capital of Parthia and the birthplace of Haroun-al-Raschid.

Tehri', Teeree, or **Garwhal,** a small hill-state under English control in the Himalayas, E. of Simla, with an area of 5465 sq. m., inhabited by 200,000 hill-men, famous with the Hindoos for its sacred places of pilgrimage at the sources of the Jumna and the tributaries of the Ganges, and with the Europeans for its magnificent forests consisting of sal (*Shorea robusta*), cedar, and pine trees; extended formerly in the S. to the foot of the Himalaya Mountains, and bordered to the E. the kingdom of Nepal; became reduced to its present size in 1816, when the English acquired it from Nepal, forming its southern and eastern provinces into the British district of Garwhal, of 5500 sq. m., with a population of 310,218 inhabitants, with Srinagar, a small town of 700 inhabitants on the shore of Alaknanda River, as head-quarters. E. SCHLAGINTWEIT.

Tehuaca'na, p.-v., Limestone co., Tex.

Tehuacan de las Granadas, town of the Mexican confederation, state of La Puebla, is well built and contains many handsome edifices, but is in a sandy and little-productive region. P. 5000 to 6000.

Tehuantepec'. The name is common to the *isthmus*, the *gulf*, the *river*, and the *city*, but, as the geographical expression for the most northern portion of the American isthmus connecting North and South America, it has its primary signification. The isthmus derives an especial interest from being one of the available interoceanic routes. Columbus, who sought to "reach the East by sailing W.," and whose objective point was probably Zipangu (Japan), believed that he had found it near where his calculations had placed it. It was many years before the conviction came that *another* continent was discovered—a conviction which served to prompt fresh efforts to find a passage in this barrier, or at least those points where it might be surmounted. New Granada, Darien, and Panama, at the other end of the American isthmus, were discovered by Bastides in 1501, and Columbus himself explored the coasts of Central America from Truxillo in Honduras to Darien. The expeditions of Cordova (1517), of Grijalva (1518), and the memorable one of Cortez (1519) established the outlines of the Gulf of Mexico. The river Cocuqualquo (Coatzacoalcos) was surveyed for several miles by Cortez *with the hope of finding an opening to the South Sea*. These successive discoveries pretty well defined what is now called the "American isthmus," which extends from the Gulf of Darien, where it connects with South America, to Tehuantepec, where North America may be said to commence. With Cortez—who, as we have seen, explored the Coatzacoalcos with that view—is said to have originated the idea of a communication by this isthmus between the two oceans; and as his hope of finding a water-communication waned, that of substituting a *portage* or road over the isthmus by which to transport to Spain the spices of India and the products of new regions he should discover, took its place. Dampier and Don Augustus Cramer, toward the close of the seventeenth and eighteenth centuries respectively, allude to the Coatzacoalcos, and describe it as an available route to the "South Sea;" in reference to which Humboldt mentions Tehuantepec as claiming attention for an interoceanic route. In 1814 the Spanish Cortes issued a decree authorizing the opening of a canal. Wars at home and in Mexico made this decree futile, and nothing further was done for nearly thirty years. In 1842 the Mexican government conferred on Don José de Garay the right of executing the work, with concession of land-grants and important exclusive privileges. A survey (or rather a reconnaissance) was made for Garay by Gaetano Moro in 1842, and attempts were made without success to raise funds in Europe for the work. After the termination of the war of the U. S. with Mexico and the acquisition of California, the rights of M. Garay were transferred to Mr. P. A. Hargous of New York, and by him to the Tehuantepec R. R. Co. of New Orleans, and during the year 1851 an elaborate survey of the isthmus for a railroad, with a view to a route to California, was made by a commission under Major J. G. Barnard, U. S. engineers, a report of which was published, containing the first full account of the isthmus ever furnished the public. (See *The Isthmus of Tehuantepec*, 1855.) The work was interrupted by a decree of the Mexican Congress annulling the Garay grant. Since that date there have been three grants issued to various parties, under which in 1857–58 the railroad surveys were resumed, and the work perfected by examining various alternative lines. An attempt was made at the same time to open a travelling route to California by a stage-road. These grants failed and were annulled, and a fourth made in 1867 to "Don Emilio la Sere," which is now held by the Tehuantepec Railway Co. (Mr. Simon Stevens president) of the U. S. The U. S. government having undertaken in 1870 to make a thorough exploration of the American isthmus with a view to deciding the question of practicability of an interoceanic canal, a survey was made in 1870–71 under Captain R. W. Shufeldt, U. S. navy, a report of which, with maps, is published by the government. (For further account of these surveys, and the questions they are intended to elucidate, consult article SHIP-CANALS, in APPENDIX.)

The *Isthmus of Tehuantepec* is that portion of the Mexican territory which lies between the Gulf of Mexico and the Pacific Ocean, where the two seas approach the nearest to each other, and comprises the eastern portion of the states of Vera Cruz and Oaxaca. From the mouth of the Coatzacoalcos, which discharges itself into the Gulf in 18° 8′ 20″ N. lat. and 94° 32′ 50″ W. lon. (from Greenwich) to the harbor of Ventosa on the Pacific, situated in 16° 11′ 45″ N. lat. and 95° 15′ 40″ W. lon., the distance in a direct line is 143½ miles. The coast-lines on either side have a general direction nearly E. and W. The isthmus may properly be said to comprise three main divisions, more or less distinct in their general characteristics—the first embracing that portion extending from the Gulf to the base of the Cordillera, and which may be called the *Atlantic plains*; the second comprising the more elevated or *mountainous districts* in the central parts; and the third including the level country bordering the ocean on the S., and known as the *Pacific plains*. The first division comprises a belt of country of some 40 or 50 miles in breadth, lying contiguous to the Gulf coast, and made up of extensive alluvial basins of exceeding richness and fertility. The principal of these hydrographic basins is that of the Coatzacoalcos, which occupies the central portion of this division.

and has a general direction of N. N. E. by S. S. W. The second or middle division may be said to extend from the Jaltepec River (tributary to the above) on the N. to within 20 or 25 miles of the Pacific coast, comprising a strip of country through the central portions of the isthmus. This division presents a great diversity of feature. The immense chain of the Cordillera, which, under different denominations, extends almost without interruption the entire length of the two Americas, traverses the country from E. to W.; but there is a sudden depression of the range in its passage across this isthmus, the continuity of the chain being nearly broken at a point directly in the line of shortest communication between the two oceans. The Cordillera here approaches very near the Pacific coast. By a narrow opening or gap in these mountains we descend suddenly from the elevated table-lands to the Pacific plains, which form the third or southern division. These plains average about 20 miles in breadth, and form, as it were, an immense inclined plane, with its side next the mountains about 250 feet above the Pacific.

Of the streams watering the northern slope of the isthmus, the most important by far is the Coatzacoalcos, by reason both of the comparatively large extent of country for the drainage of which it is the outlet, and also as furnishing the natural channel through which the projected communication between the two oceans may, in part, be effected. The river takes its rise in the unexplored part of the Sierra. It is entered over a bar having 14 feet of water on it, and affords a ship navigation with 20 feet depth above Mina-Titlan, or 30 miles inland.

The total population is about 61,000 or 62,000, mostly Indians and half-breeds. The productions are mainly sugar, tobacco, cotton, coffee, cocoa, indigo, maize. The vast forests of the Gulf slopes yield valuable timbers—mahogany, cedar, the india-rubber tree, and gums—while those of the mountains abound in pine and oak. Numerous herds of cattle are found on the table-lands of the central region and plains of the Pacific coast.

The Tehuantepec River, emptying into the Pacific, and on which is the city of that name, has a short course, and is but little more than a mountain-torrent, of copious volume during the rainy season. The city of Tehuantepec, 11 miles from the Pacific shores of the "Ventosa" Bay, the second town in the state of Oaxaca (see Mexico), has a population of 13,000, mostly Indians or half-breeds, with a few Castilians. It has 16 churches, among which is the *parroquia*, built by the last cacique of the Zapotecos in 1530, dedicated to church-worship by the Dominican friars. There are manufactures of leather, cotton, shoes, hats, saddlery, pottery, etc. By the Gulf of Tehuantepec is meant that portion of the Pacific waters comprised in an indentation of the coast of Guatemala and Mexico, between meridians 92 and 97 W. If a straight line be drawn across, the versed sine or sagitta of the segment thus formed is about 70 miles. The bays of Salina-Cruz, of the Ventosa, mere indentations of the coast-line, the inlet of "Boca Barra," and the "lagoons," are important features of the shores of the Gulf in its relations to a ship-canal or to a railroad transit route. J. G. Barnard.

Te'idæ [from *Teius*—the Latinized form of a South American name of one of the forms—the typical genus], a family of lizards (saurians) of the group Leptoglossa, distinguished, according to Cope, by the single premaxillary bones and squamous tongue. In form the species essentially resemble the typical lizards (Lacertidæ), to which they are most nearly allied; the head is pyramidal, and its upper surface is covered with regular polygonal plates; the supraorbital plates are horny; the teeth are solid and rooted; the tongue elongate and flat; the throat is generally provided with a distinct fold or "collar;" the scales of the back and sides are usually small; the members are all well developed. The family is peculiar to America (especially the tropical portions), and is quite rich in genera and species. The most noteworthy species is the *Teius teguexim* (the monitor and sauvegarde of some writers) of Brazil. This animal sometimes attains the length of six feet and more, and is quite active and strong. When pursued and brought to bay, it fights with its tail, with which it can inflict violent blows, as well as with its teeth. It is a rather indiscriminate feeder, taking almost any such small animals (mammals, frogs, and birds) as it can get, and frequently robbing bees of their honey after driving them from their nests. Its flesh is esteemed, and is somewhat like that of a chicken. Theodore Gill.

Teign'mouth, town of England, county of Devon, at the mouth of the Teign in the English Channel, is much frequented for its sea-bathing. P. 6975.

Teignmouth (John **Shore**), first Baron, b. in Devonshire, England, Oct. 8, 1751; went to India as a cadet 1769; became Persian translator at Moorshedabad 1773; passed through all the subordinate stages of the civil service; accompanied Warren Hastings to England 1785; became a member of the supreme council at Calcutta 1786; took a prominent part in the formation of the revenue and judicial systems of India, especially the measure of zemindar proprietorship of the soil, which took effect under Lord Cornwallis's administration; was made a baronet 1792; was governor-general of India from Aug., 1793, to 1797; was an intimate friend of Sir William Jones, whom he succeeded as president of the Asiatic Society of Bengal Apr., 1794; was a chief author of the code of laws for Bengal published in 1793; was created Baron Teignmouth at the expiration of his term of office 1797; returned shortly after to England; was the first president of the British and Foreign Bible Society 1804–34; became a member of the board of control and of the privy council Apr., 1807, and was a prominent member of the religio-philanthropic circle known as the "Clapham Sect." D. in London Feb. 14, 1834. He edited the *Works* of Sir William Jones (13 vols.), to which he prefixed a *Memoir*; and his own *Life and Correspondence* (2 vols., 1842) were published by his son, the second baron.

Teinds (in the Scotch law) are similar to the "tithes" of the English law, and are the certain portion of the annual rents, increase, and profits of the land, payable by the owner or occupant thereof, and appropriated toward the support of the clergy of the Established Church of Scotland. Although teinds and tithes are somewhat analogous in their general objects, the differences between them are radical. (1) Many products tithable in England are not subject to teind in Scotland. (2) The teinds are not directly held by, nor payable to, the clergy. The ministers of the Established Church, so far as the state interferes, receive regular stipends or salaries, determined upon and paid by certain state officials. This official commission or court, therefore, holds the teinds, oversees and enforces their collection, and distributes them in making up the ministerial stipends. (3) The proprietors of land can buy in the teinds imposed thereon by paying a fixed sum, calculated upon their annual amount. The Free Church of Scotland, and all other ecclesiastical bodies legally regarded as sectarian, are wholly voluntary and self-supporting. Recent legislation concerning the Established Church has simplified the administration of teinds, and has provided more easy and equitable measures for their being funded. John Norton Pomeroy.

Tejada. See Lerdo de Tejada.

Tejucigal'pa, town of Central America, in Honduras, on the Rio Grande, which here is crossed by a fine bridge of ten arches. Although it has lost much, partly by the emigration of many old Spanish families after the emancipation, partly by the exhaustion of the adjacent gold and silver mines, it is still the finest and most lively place in the state, and contains several handsome buildings, among which the cathedral is noteworthy, both on account of its fine architecture, and because it contains the only public clock in the state. P. 12,000.

Teka'mah, p.-v., cap. of Burt co., Neb., on Tekamah Creek, 6 miles from Missouri River, has 2 churches, a high school, 1 bank, 1 newspaper, a safe manufactory, and 3 hotels. P. 498. Geo. P. Hall, Ed. "Burtonian."

Tekon'sha, p.-v. and tp., Calhoun co., Mich., on St. Joseph River and Michigan Central Air-line R. R., 119 miles W. of Detroit, has 3 churches, a fine school-house, 1 newspaper, 2 hotels, 1 flouring and 2 saw mills, and 1 blind, sash, and door factory. It is in a rich farming section. P. 1333. Wallace W. Switzer, Ed. "Reporter."

Tel'de, town of the Canaries, on the island of Grand Canary, is well built and surrounded with palm-groves. It exports quantities of grain and cochineal. P. 12,027.

Tel'edu, or **Stinkard,** the *Mydaus meliceps*, a small mammal of the family Mustelidæ and sub-family Melinæ, found in the mountainous parts of Java and Sumatra. It is said rarely if ever to descend much below the level of 7000 feet above the level of the sea, and therefore its areas of distribution are quite isolated. It secretes, like the skunks of America, a most intolerably offensive fluid. It is rather nearer the badgers than the skunks in its structure and habits, as well as appearance. The chief distinctive characters are the nearly square form of the tubercular grinders, and the moderate flesh teeth, which are trigonal, with the outer edge compressed and the inner with a ridge studded by two unequal tubercles; it is of a blackish-brown color, with a broad white mark along its back and head. Its motions are slow. Its flesh is eaten by the natives.

Tel'egraph [from Gr. τῆλε, "afar off," and γράφειν, to "write"]. The etymology of this word implies a means of writing at a distance, but it has come to signify any

system of conveying intelligence other than by voice or writing. The idea of speed is also implied, the telegraph being seldom if ever employed when it cannot transmit intelligence more quickly than can be done by ordinary means. Sound, light, and electricity, owing to the rapidity with which they are propagated, form the most convenient means of telegraphing. Sounds, like those of bells, guns, etc., are often employed in sending a single message through short distances. For long distances, however, light and electricity are immeasurably superior to sound.

The necessity of transmitting intelligence to a distance without the employment of a carrier, and with greater rapidity and certainty, was felt by the ancients, and many expedients were resorted to under various circumstances. These were usually very simple, and exhibited little mechanical contrivance. The semaphore was the first really efficient telegraph. It was invented by Claude Chappé, and adopted by the French government in 1794. Subsequently, under various modifications, it came into use in nearly every civilized country. It consisted of an upright

FIG. 1.

The Semaphore.

post supporting a horizontal bar, which, turning upon a pivot, could be placed at various inclinations. This had two smaller arms pivoted to its extremities, and capable of being turned at various angles with them. By independent movements of the parts the apparatus was susceptible of 98 distinct positions, and of exhibiting the same number of different signals, which could be made to represent either letters, numbers, words, or sentences. The speed of transmission under the most favorable circumstances was about three signals per minute. The semaphores were placed upon high towers, usually about four or five miles apart. Much ingenuity was expended by Chappé and others in arranging a system of lights to enable the semaphore to be used at night, but with only partial success. In fogs and snowstorms, moreover, this system was entirely useless. Until the introduction of the electric telegraph almost every country in Europe maintained lines of semaphores between its capital and the most important ports upon its seaboard. Perhaps the most important and costly undertaking of this kind was the great line constructed by Nicholas I. of Russia from the Austrian frontier through Warsaw to St. Petersburg, and which was composed of 220 stations. The semaphores were erected upon the summits of substantial and lofty towers, and the whole work cost several millions of dollars.

Another system of optical telegraphy consists of alternately exposing and cutting off a continuous beam of light directed from the sending to the receiving station, the characters being formed on the same principle as those of the Morse telegraphic alphabet, by the breaking of a continuous line into sections of varying length. In 1861, Moses G. Farmer made a series of successful experiments with his method between Hull and Nantasket on the coast of Massachusetts, and it also appears to have been employed about the same time by the officers of the U. S. Coast Survey on Lake Superior, where by means of mirrors equatorially mounted, telegraphic messages were exchanged between stations 90 miles apart with ease and rapidity. In 1862 this system was taken up by Capt. Colomb and Major Bolton and introduced into the British navy, where it is now universally used, the electric and calcium lights being employed at night and a collapsing drum closing upon its central hoop by day. During the siege of Paris messages were often sent 20 or 30 miles in this way from one elevated point to another by the use of a calcium light concentrated and directed by lenses. More recently it has been proposed to employ a similar alphabet of short and long sounds for signalling between vessels at sea, which is of course entirely feasible.

As soon as it became known that electricity could be conducted by wires to a distance, it began to be regarded as a possible means of conveying intelligence. The earliest suggestion of this kind seems to have been contained in a letter to the *Scots Magazine* dated Feb. 1, 1753, and which Sir David Brewster thinks was written by Charles Marshall of Paisley. He proposed to employ insulated wires equal in number to the letters of the alphabet, the signals being given by means of frictional electricity. In 1774, Lesage of Geneva constructed the first electric telegraph, which was almost a realization of Marshall's idea. It had twenty-four wires, each connected with a pith-ball electroscope, the signals being given by frictional electricity. From this time forward many ingenious attempts were made to employ frictional electricity for telegraphic purposes, most of which it is unnecessary to notice in detail, as they were attended with only partial success. In 1816, Ronalds constructed a telegraph, making use of frictional electricity and a single wire, and exhibited signals by the divergence of pith balls combined with dials revolving synchronously. He fully perceived the value of his idea, and strove to bring it before the British government, but was informed that "telegraphs of any kind are now wholly unnecessary, and no other than the one now in use will be adopted." In 1828, Harrison Gray Dyar of New York invented a telegraph, the principle of which consisted in sending discharges of frictional electricity through a wire, which should be recorded by being caused to pass through a sheet of moistened litmus-paper moving at a uniform rate. The relative distances apart of the discharges were to indicate the letters of the alphabet. There is evidence that this invention was experimentally tried on Long Island the same year in which it was invented, but little is definitely known respecting the results. In 1820, Ampère suggested that the deflection of a needle by the galvanic current might be used for telegraphic purposes. In 1830, Baron Schilling constructed a telegraph having five vertical needles, and in 1835 he exhibited his invention, simplified to a single needle, at Bonn. This was shown by Moncke at Heidelberg in 1836 to W. Fothergill Cooke, who immediately set to work to devise and construct a telegraph for practical use, consisting of a pair of three-needle instruments, with keys and reciprocal system. He also invented the electro-mechanical alarm and the detector for discovering the position of faults in the lines. In Feb., 1867, he became associated with Wheatstone, and took out a patent with him the same year. In 1855 the first *actual electric telegraph* was constructed, extending from Paddington to Drayton, a distance of 13 miles. It had six wires and five needles. The wires were wound with hemp and laid in a pipe on the surface of the ground. In 1839, Dr. W. O'Shaughnessy at Calcutta, India, built the first overground line of iron wire on bamboo poles. It was 21 miles long, and worked by Cooke's single-needle instrument.

Samuel F. B. Morse of New York, during a voyage home from France in 1832, conceived the idea of making signs at a distance by means of a pencil moved by an electro-magnet and a single conducting circuit, the paper being moved under the pencil by clockwork. He constructed a working model of his invention in 1835, and exhibited it to several persons the same year, but not publicly until 1837. Several years were devoted to improving the invention and endeavoring to interest the public in the project. It was not until 1844 that the first public line was completed between Washington and Baltimore (40 miles), and the first message transmitted May 27 of that year. Within a few years, however, lines were extended to the principal cities of the U. S. The Morse telegraph was introduced into Germany in 1847, whence it has spread all over the Eastern hemisphere, and may now be said to be the universal telegraph of the world. Gauss and Weber of Göttingen, Germany, constructed a telegraph in 1833 consisting of a magnetic needle acted upon by magneto-electric currents. Their invention was taken up by Steinheil in 1836-37, and practically worked out to a high degree of perfection. The discovery that the earth may be employed as part of a telegraphic circuit was made by him. Steinheil's telegraph never went into extensive use, owing to the introduction of the Morse system in Germany.

The earliest experiment on record in submarine telegraphy was made by Dr. W. O'Shaughnessy at Calcutta in 1839. He laid a copper wire, insulated with a coating of cotton thread saturated with pitch and tar, across the river Hoogly, and transmitted signals through it. In 1847, J. J. Craven of Newark, N. J., insulated an iron wire with

gutta-percha and placed it in the circuit of the New York and Washington telegraph line, submerging it in the waters of a small creek. The success of this experiment led to the laying of a gutta-percha cable between New York and Jersey City in 1848. In 1850 an experimental line was laid across the English Channel, followed in 1851 by a permanent cable, which is still in use. The success of this undertaking at once revived the suggestion of laying a cable across the Atlantic Ocean from Ireland to Newfoundland. In 1854 the attention of Mr. Cyrus W. Field of New York was directed to the subject, and mainly through his efforts a company was formed, principally of English capitalists, to undertake the enterprise. The first attempt was made in Aug., 1857, but it was unsuccessful, the cable parting 300 miles from shore. The following year the attempt was renewed, and the enterprise successfully completed Aug. 5, 1858. The electrical condition of the cable was faulty from the first, but signals and communications were exchanged with more or less facility until Sept. 1, when the cable failed altogether. During this time 366 messages, containing 3942 words, were interchanged between Europe and America. Several attempts to pick up and repair the cable were made without success, and this disastrous result discouraged further enterprise in the same direction for a number of years. The experience gained, however, was of the highest value, and the success of the Malta and Alexandria (1861), Persian Gulf (1864), and other deep-sea cables led to a renewal of the attempt to cross the Atlantic in 1865, which again resulted in the breaking of the cable after 1186 miles had been paid out. The following year, however, a new cable was successfully submerged, being landed at Newfoundland in perfect working order July 27, 1866, and the great problem was thus at last definitely solved. In September following the lost cable of 1865 was picked up and completed. From that date such rapid progress has been made in the extension of telegraphic cables that at the present time the only isolated system of telegraphs in the world is that of South Africa.

All electric telegraphs may be said to consist of three parts: first, an apparatus for generating or producing the electric current; second, a conductor for conveying the electricity from one point to another as required; and, third, apparatus for transmitting and receiving the signals. It will be convenient to treat of the telegraphs now in use under this general classification.

I. Sources of Electricity.—The electricity used in telegraphy may be derived either from the voltaic battery, from the magneto-electric machine, or from the thermo-electric battery. Of these, the voltaic battery is the most commonly used, though latterly much has been done in developing the capacity of the magneto-electric machine, and it now seems probable that it will to some extent replace the voltaic combinations now in use. The employment of the thermo-battery has thus far been merely experimental.

A. *Voltaic Batteries.*—Of these, the sulphate-of-copper battery, invented by Daniell in 1836, is most generally employed. It is constructed in various forms, the most useful of which are (1) the gravity battery, invented by Fuller in 1853, which is now almost exclusively used in the U. S., and (2) the trough battery, another form of the same, used in England; (3) the manganese battery, invented by Leclanche in 1867, is extensively used in France and England; (4) the nitric-acid battery of Grove; and (5) the chromic-acid battery of Bunsen and Poggendorff are now but little used.

B. *Magneto-Electric Machines.*—The earliest form of this apparatus was (1) Pixii's, which is employed in Wheatstone's dial telegraph; (2) Siemens's (1855), a much more efficient apparatus, is now largely used in dial and other special telegraphs. Within a few years (3) Gramme's apparatus, which is arranged to give a continuous current, has given very promising results as a substitute for the voltaic battery in general telegraphing.

C. *Thermo-Electric Batteries.*—(1) Farmer's and (2) Clamond's have been used experimentally to some extent, the latter especially with very good results.

D. *Circuits.*—In applying electricity from any source to the production of telegraphic signals, it is generally done in one of three ways: (1) by completing the circuit of a battery or other generator, and giving signals by causing currents of a certain polarity to traverse a line normally free from electricity; or (2) by connecting the battery and line, so that a constant current will traverse the latter, the signal being given by interrupting this current; or (3) by arranging the battery and line as in the last case, and giving signals by reversing the polarity of the current instead of interrupting it.

II. Telegraphic Conductors.—Conductors are usually carried through the air, but when required may be placed under ground or under water. In either case they must be well insulated.

A. *Over-ground.*—Galvanized iron wire weighing from 320 to 600 pounds per mile is used in the U. S. The largest wire is used for the longest lines, and still larger wires are used in some of the European countries. The wires are supported on wooden poles placed along the railways or highways from 8 to 10 rods apart. From 1 to 40 wires may be conveniently placed on one line of poles, the lowest being 20 feet from the ground. Iron poles are seldom used except in desert and tropical countries. The wires are attached to the poles by insulators of a bell or inverted cup shape. In the U. S. they are usually of glass, in Europe and Asia of white porcelain, and supported by brackets of wood or iron attached to the poles. In large cities the wires are frequently carried on standards fixed upon the highest buildings. A steel wire electro-plated with copper, invented by Farmer (1867), is of late years coming into use. Copper being five times as good a conductor as iron, this compound wire combines lightness and strength in a high degree.

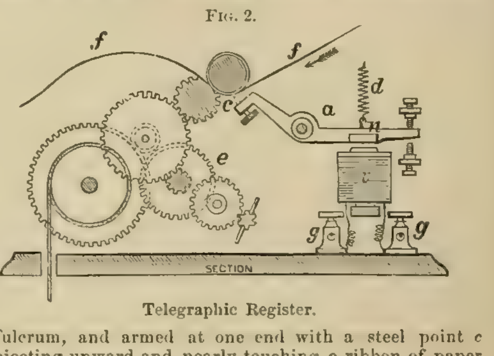
B. *Under-ground.*—Wires are at present seldom laid under ground except in the large cities of Europe, but this must eventually become necessary in New York and other cities of the U. S. An experimental line of this kind has already been laid in New York by the Western Union Telegraph Co. In London, No. 13 copper wires, coated with gutta-percha to a diameter of $\frac{3}{16}$ths of an inch, are used. The required number of these are laid in a cable served with tarred tape. The cables are made in lengths of 400 yards, and drawn into iron pipes laid 2 or 3 feet below the surface of the ground. Boxes with trap-covers are placed every 400 yards for convenience in testing wires and drawing them in and out. The same system has been adopted in other cities of Great Britain, and also in New York. In Paris the cables are placed in the sewers. The plan of stretching naked wires in a trench, and filling around them with bitumen or asphalt in a plastic state, which afterward becomes hard, has been tried in France and the Netherlands with indifferent results.

C. *Submarine.*—The first submarine lines were simply ordinary iron wires coated with gutta-percha to a diameter of half an inch. In the cable laid between Dover and Calais in 1851 four gutta-percha coated conducting wires were wrapped with hemp and enclosed in a wire rope for protection. This general plan has been followed in all cables since constructed. The Atlantic cables are composed of a copper strand of seven wires, forming the conductor, surrounded by four layers of gutta-percha and covered by a serving of jute; outside of this is a protecting armor of ten wires of homogeneous iron, each enveloped in fine strands of manila hemp. In shallow waters, where cables are exposed to injury from anchors, the armor is often made enormously thick and heavy, sometimes weighing as much as 20 tons per mile.

III. Telegraphic Apparatus.—The apparatus used in telegraphy may be conveniently divided into recording and non-recording. Of each of these there are several varieties, which will be described in order.

A. *Recording Telegraphs.*—These are of two classes, one recording arbitrary signs, and the other ordinary printed letters. (1) *Marking Telegraphs.*—(*a*) Morse's is by far the best known and the most extensively used of this class. Its most important feature is the *register*, which is constructed in many forms, but upon the general principle shown in Fig. 2. A horizontal lever *a* is mounted upon

Fig. 2.



Telegraphic Register.

a fulcrum, and armed at one end with a steel point *c* projecting upward and nearly touching a ribbon of paper *f*, which is carried along at a uniform rate by a grooved roller just above it, the roller being impelled by a system of clockwork *e*. The opposite end of the lever carries a soft iron armature *n* suspended just above the poles of an electro-magnet *t*. The end of the wire helix surrounding this magnet terminates in binding-screws *g g*, to which the

conducting wires are attached. A current of electricity traversing the helix of the electro-magnet causes it to become powerfully magnetic, attracting the armature *a* to its poles, and thus pressing the steel point *c* against the paper ribbon moving above it upon the grooved roller. A continuous line will in this manner be embossed upon the paper as long as the armature remains attached to the poles of the magnet. When the current is interrupted, the magnetism disappears, and the spring *d* draws the marking-point away from the paper. Thus, the length of the line embossed upon the paper corresponds to the greater or less length of time that the electric current is allowed to traverse the helix of the electro-magnet *t*. This is governed by the transmitting instrument termed the key, which is simply a small horizontal lever with a finger-knob at one end and a spring beneath. The wire leading from the line is connected to this lever, and when the latter is depressed by the finger of the operator, it comes in contact with a metallic stud, known as the anvil, to which the battery wire is attached; thus the circuit is completed and the current permitted to flow into the line. When the latter is but a few miles long, the battery and key are connected directly by a wire with the electro-magnet of the register; but when the distance is greater, an instrument called the *relay* is employed. This consists of an electro-magnet with a lever mounted like that of a *register*, except that the marking-point is replaced by a contact-point, which opens and closes the circuit of a local battery, and this in turn operates the register. A considerable number of relays with their registers may be placed at as many different points upon the same line, and all operated simultaneously by a key at any point; and, in fact, this is the arrangement usually adopted in the U. S. The greatest length of line usually worked in one circuit is about 500 miles, and the number of relays at different points varies from 2 to 30, and even 40. The line or main batteries are usually placed at the two ends of the route, though each station has of course its local battery of one or two cells. The alphabet devised by Morse consists of arbitrary characters composed of combinations of short lines termed dots and longer ones termed dashes, separated by varying spaces. This alphabet, it will be seen, is capable of being written with facility by means of the key and register above described. The following is the alphabet used in the U. S. and Canada.

The American Morse Telegraph Alphabet.

A - —	J — - — -	S - - -
B — - - -	K — - —	T —
C - - -	L ———	U - - —
D — - -	M — —	V - - - —
E -	N — -	W - — —
F - — -	O - -	X - — - -
G — — -	P - - - - -	Y - - - -
H - - - -	Q - - — -	Z - - - -
I - -	R - - -	& - - - -
1 - — — -	4 - - - - —	8 — - - - -
2 - - — - -	5 — — —	9 — - - —
3 - - - — -	6 - - - - - -	0 ———
	7 — — - -	

Period (.) - - — — - -
Comma (,) - — - —
Interrogation (?) — - - — -
Exclamation (!) — — — -

In all other parts of the world the *international Morse telegraph alphabet* is used, as follows:

A - —	J - — — —	S - - -
B — - - -	K — - —	T —
C — - — -	L - — - -	U - - —
D — - -	M — —	V - - - —
E -	N — -	W - — —
F - - — -	O — — —	X — - - —
G — — -	P - — — -	Y — - — —
H - - - -	Q — — - —	Z — — - -
I - -	R - — -	

1 - — — — —	6 — - - - -
2 - - — — —	7 — — - - -
3 - - - — —	8 — — — - -
4 - - - - —	9 — — — — -
5 - - - - -	0 — — — — —

Period (.) - - - - - -
Comma (,) - — - — - —
Interrogation (?) - - — — - -
Exclamation (!) — — - - — —

The international alphabet is preferable, as it contains no spaced letters; these sometimes give rise to errors in reading communications. In Europe and Asia an improved register called the "ink-writer" is much used. A sharp-edged wheel is kept constantly revolving in a dish of colored fluid. The slightest pressure of this against the paper suffices to make a distinct mark, and thus the relay may be in most cases dispensed with, as a very feeble current is sufficient to make a perfect record. Electro-magnets intended for use in the main circuit, whether for relays or ink-writers, usually have helices composed of several thousand convolutions of very fine insulated wire, but for local circuits a small number of convolutions of coarse wire is sufficient. In order to transmit direct between points more than 500 or 600 miles apart, two or more circuits are coupled together by means of an automatic repeater, which was first accomplished by C. S. Bulkley in 1848. By this means each circuit operates the succeeding one upon the principle of the relay. In this way direct communication has been had between points several thousand miles apart.

(*b*) Bain's electro-chemical telegraph was invented in 1846, and extensively used in the U. S., Great Britain, and Germany from 1849 to 1860, but is now superseded by Morse's. The system of signs and the transmitting key are similar to those of Morse. The record is made by passing the current from the line over an iron style and thence directly through a moving strip or disk of paper. The paper is saturated with a mixture of 10 parts of saturated solution of yellow prussiate of potash, 2 parts each of nitric and muriatic acid, and 1 part of chloride of lime. The electric current causes the solution to chemically unite with the iron of the style, forming Prussian blue. A very weak current suffices to give a distinct mark. No electro-magnet is required in this system except to operate an alarm.

(2) *Printing Telegraphs.*—The idea of a telegraph which should record messages in printed Roman letters is due to Alfred Vail of New Jersey (1837). The first model of such an instrument was made by Wheatstone (1841). (*a*) *House's Telegraph.*—This was the earliest practical printing instrument. It was introduced in 1847, and largely used in the U. S. until about 1860. It is simple in principle, though somewhat complicated in construction. The twenty-six letters of the alphabet, a period, and a blank space are engraved on the edge of a type-wheel, upon the shaft of which is a scape-wheel of fourteen teeth. The type-wheel revolves by manual power, but is held in check by a double-acting anchor escapement. The latter vibrates by the alternate action of an axial electro-magnet and a retracting spring. When at rest, the blank space on the type-wheel is in front, the circuit being complete. If it is interrupted the scape-wheel advances half a tooth, presenting the letter *A*, and when restored it again advances, presenting *B*. If the circuit is opened fourteen times and closed fourteen times alternately, the type-wheel will make a complete revolution. It is obvious that any particular letter may be presented by breaking and closing the circuit the proper number of times. This is effected in practice by a metallic contact-wheel at the transmitting station. This wheel has fourteen teeth and fourteen equal spaces; its axis is connected to the line. A flat spring connected with the battery touches each tooth as it revolves, and transmits the electric pulsations. The revolution of this contact-wheel is stopped at the proper place for each letter by a piano keyboard having twenty-eight keys. A cylinder fixed upon the axis of the contact wheel carries twenty-eight pins arranged in a spiral, each pin turning with the cylinder underneath its own key. Each key is provided with a stop, which falls into the path of the pin and arrests the cylinder when the key is depressed. Thus, when the cylinder is turned from one letter to another, just so many contacts and interruptions are given as will advance the type-wheel the same distance. The printing is effected at the receiving station by the action of an eccentric which is automatically released when the wheel pauses at any letter. It makes a single revolution, forcing the paper against the letter presented by the type-wheel, and then advances the paper, which is in the form of a continuous ribbon, so as to leave a clear space for the impression of the succeeding letter. Thus, it will be seen that the instrument is operated wholly by manual power, the only office of the electric current being to secure a corresponding movement between the type wheel of the receiving and the contact-wheel of the transmitting instrument. The apparatus requires a powerful battery, and it seldom operates satisfactorily on a line more than 250 miles in length. (*b*) *Hughes's Telegraph.*—This was invented by D. E. Hughes in 1855, and has been extensively used in Europe since 1860. The essential principle of the apparatus is the synchronous movement of two constantly-revolving shafts at two stations. This is effected by means of a governor consisting of a recoil escapement and a vibrating bar. The shaft at the transmitting station carries a revolving contact-maker, and the corresponding one at the receiving station a type-wheel similar to that of House. The contact maker travels over a circular row of twenty-eight vertical pins, which are connected with the same number of piano keys. Each pin represents a letter, and is raised by the depression of the corresponding key when a letter is to be transmitted. The contact-maker, which travels round the circle of pins

with a motion uniform with that of the type-wheel at the receiving station, comes in contact with the raised pin at the same instant that the corresponding type upon the type-wheel is passing the platen, and closes the circuit. An electro-magnet at the receiving station releases a cam which throws the platen carrying the paper against the type as it is passing, thus printing the letter. Only one pulsation is thus required for the printing of each letter, and by the use of a peculiar form of electro-magnet a very weak current suffices to do the work. (c) The *combination instrument* is a modification of Hughes's. It retains the principle of synchronous mechanism at the sending and receiving stations, but it differs much in details. It has an electro-magnetic governor instead of a vibrating spring, and is more simple and durable in its construction than the Hughes apparatus. It was invented in 1859 by G. M. Phelps, and has been used on many of the principal lines in the eastern part of the U. S. since that date. (d) ***Phelps's Electro-Motor Telegraph.*** This is the most effective printing instrument which has yet been produced. It was invented in 1869, but has only recently (1875) been practically used. It now seems likely to supersede all the other type-printing instruments both of the U. S. and Europe. The mechanism is driven by a small electro-motor, which is connected with a special battery. This is more convenient and economical than the manual power required by the House machine or the heavy weight and clockwork of the Hughes apparatus. The synchronous movements of the transmitting mechanism at one station and the type-wheel at the other are maintained by means of a centrifugal governor attached to the motor, which instantly reduces the strength of the local current by which the latter is propelled whenever the speed of revolution tends, however slightly, to exceed the prescribed limit. The movement of the Hughes apparatus is retained, except that both the type-wheel and the revolving contact-maker are simultaneously arrested for a given integral portion of a revolution during the transmission and printing of each letter. An improved form of the automatic unison for bringing the two instruments into correspondence whenever transmission is suspended for a few moments (invented by Farmer, 1858) has also been applied to this instrument. (e) *Telegraphs for Financial and Commercial Reporting.*—The method of reporting the fluctuations of the prices of stocks, gold, merchandise, etc., by means of automatic-printing telegraph instruments placed in the offices of merchants, brokers, and other interested persons, and of which several hundred are often simultaneously operated by a single person located in the central exchange, originated in New York in 1867, and has since extended to the principal cities of the U. S. and of Europe. The instruments now in use are those of Calahan, Edison, Phelps, and Smith, though many other inventors have aided in the perfection of the apparatus. The general principle is the step-by-step movement of the House apparatus, but two type-wheels are made use of—one for letters and the other for numerals and fractions—which print in parallel lines on the same strip of paper. By an ingenious device invented by Dujardin in 1867 the platen is automatically shifted from one type-wheel to the other by the operator at the central station according as he wishes to print letters or numerals. These instruments also have an automatic unison invented by Foote (1869). The printing is in most cases effected by a special electro-magnet. (f) *Printing Telegraphs for Private Use.*—These are constructed upon a plan similar to the instrument described in the last paragraph, and although introduced as lately as 1870, thousands of them are already in use by manufacturers and others in the U. S. The most successful are those of Gray, Phelps, Edison, Chester, and Anders. Any intelligent person after a few minutes' instruction can print a communication at any distance, even in the absence of an attendant, by depressing the proper keys upon a lettered keyboard. The speed of transmission is from 10 to 30 words per minute, depending upon the instrument used and the skill of the operator.

B. *Non-Recording Telegraphs.*—These may be divided into two classes—visual and acoustic: they give only evanescent signals, and are sometimes termed semaphores.

(1) *Visual Telegraphs.*—(a) *Cooke's Needle Instrument.*—This is simply an upright galvanometer needle surrounded by a coil of fine insulated wire, and is operated from the sending station by two keys, one of which sends a positive current, deflecting the needle to the right, and the other a negative current, deflecting it to the left. The alphabetical code is the same as the Morse, a deflection to the left signifying a dot, and to the right a dash. Owing to its simplicity and convenience, this apparatus was almost universally used in England from 1840 until within a few years, since which time it has been superseded on all the important lines by the Morse system. It still retains its supremacy for railway use. (b) The dial instrument, invented by Wheatstone in 1840, is arranged on the same plan as a type-printer, but is much more simple, as an index-hand and dial carrying the alphabet replaces the somewhat complex type-wheel and printing apparatus. These are largely used for private and police telegraphs, and in Europe for railway purposes, as they are easily operated by unskilled persons. The best known are those of Wheatstone, Siemens, Anders, Breguet, and Chester. The three first mentioned are operated by magneto-generators, and require no battery. (c) The gold-indicator, invented by S. S. Laws (1866), is a species of dial telegraph largely employed in New York City to exhibit the current rate of premium on gold in the offices of brokers and dealers in exchange. It is operated from the Exchange in the same manner as the stock telegraph.

(2) *Acoustic Telegraphs.*—Of these, the best known and most important is (a) the sounder, which is simply a Morse register stripped of all its parts except the electro-magnet, writing lever, and retracting spring. The operator interprets the sounds made by the motion of the lever up and down between its stops. This method was taken up by the American operators about 1850, and the sounder has now almost entirely superseded the recording apparatus in the U. S. and Canada, as experience proves that the speed of transmission is practically doubled, while, somewhat paradoxically, the proportion of errors is largely diminished. The same method is employed in India, and to a limited but increasing extent in England and other parts of Europe. The operator reads from the instrument, and copies the message simultaneously. For military purposes the sounder, together with a manipulating key, is often reduced in size, so as to be contained in a pocket-case not larger than a tobacco-box and weighing but a few ounces, and yet forming a completely-equipped Morse telegraph station, which may be connected with a line at any required point. (b) The fire-alarm telegraph, invented by W. F. Channing and M. G. Farmer of Boston (1851), is a most ingenious and useful application of the telegraph, now in use in seventy-five of the principal cities and towns of the U. S., and in some other countries. It consists of a series of locked signal-boxes placed at convenient intervals throughout a city or town (in New York City, for example, there are 600); each of these contains mechanism which, when wound up by simply pulling a hook, will instantly transmit through the connecting telegraph wires a determinate numerical signal representing that individual box, and no other. The signal thus transmitted is instantly sounded, by means of mechanism controlled by electro-magnets in the circuit, upon the church and tower bells and upon large gongs placed in all the fire-engine houses. So effective is this system in practice that frequently in less than 30 seconds after the discovery of a fire a number of engines will be on their way to the very spot. This invention has been the means of saving millions of dollars' worth of property and thousands of lives since its first introduction. By recent improvements of W. B. Watkins (1871) the fire itself is made to transmit a numerical alarm-signal automatically. Thermostats are placed in the various rooms of a building, which when heated above the normal temperature close a circuit and trip the clockwork of an automatic transmitter. The rest of the apparatus resembles Channing & Farmer's. (c) The district telegraph (1870) is a recent application of the above system: Signal-boxes are placed in the houses of persons desiring them, and connected telegraphically with a central station. By simply turning a crank at any hour of the day or night a messenger or policeman may be instantly summoned or a fire-alarm transmitted. More than 3000 of these signal-boxes are in daily use in the city of New York, and the system has been introduced in many other cities of the U. S.

IV. Special Methods of Telegraphy.—A. *The Automatic Process.*—At an early period in the history of telegraphy attempts were made to devise methods of transmission, by which means the capacity of each individual wire might be largely increased, and the evils which necessarily arise from a multiplication of wires in a great measure avoided. In 1846, Alexander Bain of Scotland patented an automatic telegraph, in which the messages, instead of being transmitted by a key or manipulator, were first prepared by punching out the telegraphic characters in a ribbon of paper, the dots and dashes being represented by perforations of different lengths. In order to transmit the prepared message the strip was caused to pass rapidly over a metallic roller driven by clockwork or otherwise, and a light spring or brush of metal, resting upon the paper over the roller, made contact with the latter through each of the perforations as they successively passed under it, and thus completed the electric circuit between the battery and the line. By this means several operators could be employed simultaneously in preparing messages, which could be run through the machine and recorded on chemical paper at

the receiving station at a high rate of speed. The system was tried in England and America in 1849 and 1850, but no practical advantage over hand-labor resulted in practice, perhaps largely owing to the fact that no convenient means of perforating the paper had been devised. In 1856, Dr. W. Siemens of Berlin invented a perforating-machine with three keys, by which the time required to prepare a despatch was much lessened. He applied this method in conjunction with Morse's receiving apparatus on many Russian lines in 1853–55, but the automatic feature was soon abandoned. In 1856, J. P. Humaston of Connecticut invented a keyboard perforator, which produced a complete character by the touch of a single key. The same year Siemens introduced the polarized relay, operated by alternate positive and negative currents. In 1858, Wheatstone in England modified Siemens's apparatus, and in its subsequently improved form it is now largely used on the government lines in Great Britain, especially for sending large quantities of press news in duplicate to various parts of the kingdom. In the U. S. an improved modification of Bain's method and of Humaston's perforator has been operated since 1871. The speed of transmission obtained by the Wheatstone process is 120 words per minute; by the American process 800 words have been sent in the same time a distance of 100 miles; but it is still an unsettled question, owing to the rapid improvement of other methods, whether the automatic process will succeed in permanently establishing itself.

B. *The Autographic Process.*—In 1848, F. C. Bakewell of London patented a modification of Bain's automatic process by which a fac-simile of the transmitted despatch is produced at the receiving station. The original is written on tin-foil with insulating ink, and wrapped round a metallic cylinder rotated by clockwork at a uniform rate. A style rests upon the cylinder as it turns, and also receives a slight lateral motion by a screw as the cylinder revolves; it thus describes a spiral path, passing successively over the whole surface of the tin-foil on the cylinder. The battery-current passes through the style to the tin foil, thence to the cylinder and over the line, but is necessarily interrupted when passing over the insulating lines of the writing. The cylinder at the receiving station is covered with Bain's chemical paper, and revolves synchronously with that of the transmitter. The iron style traces a continuous blue line on the paper, except when the current is interrupted by the style passing over the lines of writing upon the tin foil. The chemical paper therefore appears covered with fine parallel blue lines, forming a ground-tint upon which a fac simile of the writing appears in white. This apparatus, though practically unsuccessful on account of the difficulty in maintaining sufficiently accurate synchronism, illustrates the principle of all its successors. Abbé Caselli of Florence in 1856 greatly improved this process by employing a pendulum to control the synchronous movements of the two corresponding instruments, and by so arranging his electrical connections that the fac-simile appeared in blue on a white ground. In 1865 this process was put in actual service on some of the French and Russian telegraphs, and has given very good results. The more recent inventions of Lenoir and Meyer in France record in ink by means of electro-magnets. W. E. Sawyer of Washington, D. C., has recently (1874) made some improvements in the autographic process, one of which consists in transferring the original message, written upon ordinary paper, to a metal plate for transmission. As the process of autographic transmission and reception dispenses entirely with specially skilled labor, it is not unlikely that it may yet prove to be of considerable economic value.

C. *The Multiple Process.*—The idea of increasing the capacity of a line by transmitting two or more communications through it simultaneously appears to have been first suggested by Farmer, who in 1852 made a successful experiment on one of the municipal lines in Boston. He employed two rapidly-revolving synchronous commutators, one at each end of the line, which served to bring the latter successively and simultaneously into connection with two or more short branches at each terminus, in each of which ordinary telegraphic instruments were inserted. Thus, the current in the corresponding branches at each terminus, though apparently continuous, actually consisted of rapidly recurring pulsations. From the difficulty of maintaining synchronism, and other causes, nothing practical resulted from the experiment at that time. In 1873, Meyer of France exhibited at Vienna an apparatus on this principle capable of transmitting four simultaneous communications. It is employed in actual service between Lyons and Paris, and is said to have a capacity of 110 messages per hour. In 1853, Dr. W. Gintl of Austria invented a method of simultaneous transmission in opposite directions by connecting an auxiliary local circuit with the Morse key, which passed through a separate but opposing helix upon the instrument at the home station, and thus neutralized the effect of the current transmitted over the line upon the home instrument, while at the same time it was left free to respond to the increased current in the line caused by the depression of the distant key. Practically, it was found impossible to adjust the local current so as to perfectly compensate that of the main line. The following year Carl Frischen of Hanover substituted a branch of the main current for the local current of Gintl, and the method thus improved was used to a limited extent for many years in Austria and Holland. In 1855, Stark of Austria proposed a method of simultaneous transmission in the same direction, and suggested that it might be combined with Frischen's plan, thus enabling four simultaneous despatches to be sent over one wire, but nothing practical resulted at that time. In 1858–59, Farmer made successful experiments with a modification of Frischen's method on several American lines. J. B. Stearns of Massachusetts revived Frischen's method in 1868, and in 1872 vastly improved it by adding a condenser to compensate the effects of induction in long lines. He introduced the improved method now known as the "duplex" into general use, first in America and afterward in Europe. In 1874, T. A. Edison invented a new method of simultaneous transmission in the same direction, which has been combined with Stearns's method, forming a "quadruplex." Subsequent improvements by G. Smith and others have vastly increased the effectiveness of this method. It is now in extensive use, and is regarded as an improvement of the highest value. Since 1872 the working capacity of the lines of the Western Union Telegraph Co. alone has been, by the use of these methods, increased 25 per cent., which is equivalent to the addition of nearly 50,000 miles of wire at a comparatively trifling expense.

D. *The Harmonic Process.*—This method of telegraphy, invented by Elisha Gray of Chicago, is of recent origin, and is based on discoveries made by him in 1873 in reference to the telegraphic transmission of musical tones. By Gray's process at least eight communications may be simultaneously transmitted over one wire, and this is probably much below its actual capacity. The transmitting apparatus consists of a number of steel reeds, each tuned to vibrate at a definite rate, corresponding to some one note of the musical scale. One end of each reed is rigidly fixed, while the other is left free to vibrate by the alternate action of two electro magnets, a local battery, and an automatic device for alternating the current of the battery between the two magnets at each vibration, so that the movement of the reed is rendered continuous as long as the current passes; but the rate of vibration of each individual reed must always correspond rigidly with the note to which it is tuned. If a line is to be equipped for eight simultaneous transmissions, the main battery is divided into eight equal sections, which are so arranged as to be thrown alternately on and off the line at each vibration of the reed connected with that section. If, then, the first reed be tuned on fundamental C, it will make 128 vibrations per second, and by depressing the corresponding transmitting key the particular section of the battery will be thrown in and out of the main circuit 128 times per second, and a corresponding number of electric waves will pass through the line. The next reed may be tuned on D, which in like manner will produce 144 waves per second; and so of the remaining six. At the receiving station a series of eight analyzers are placed in the circuit, the current passing through them all in succession. Each analyzer consists of an electro-magnet whose armature is fixed at one end and free at the other, and so arranged as to form a vibrating tongue or reed, which is tuned to the same note as the transmitting reed to which it is intended that it shall respond. When the transmitted vibrations pass through the series of analyzers, each armature takes up its own set of vibrations, rejecting all the others, and consequently gives forth its own musical note. The sound is greatly increased and intensified by mounting each analyzer upon a sounding box or resonator adjusted to its own note. The several transmitting keys at the sending stations break up the continuous tone into the dots and dashes of the telegraphic alphabet, which may be read from the sound of the analyzer as readily as from an ordinary sounder. Indeed, by the addition of a secondary spring attached to the analyzer, having a slower rate of vibration, it may be readily made to operate the usual Morse sounder by opening and closing a local circuit. No difficulty is found in transmitting eight simultaneous communications over one wire to a distance of several hundred miles, each pair of operators sending and receiving at the same rate of speed as in the ordinary single transmission. It is obvious that musical tones may be perfectly reproduced at any distance by this method, and in fact this has often been accomplished with remarkable success. The inventor has recently brought out a type printing instru-

ment which is operated upon the principle already described.

E. *Telegraphic Transmission of Articulate Sounds.*—The most recent improvement in telegraphic methods is an apparatus invented by Prof. Alex. Graham Bell, of Salem, Mass., by which spoken words transmitted through an electric wire are made audible at the distant station. This apparatus was first publicly exhibited by Prof. Bell at the Centennial Exhibition of 1876 in Philadelphia, where it was examined and reported on by Sir William Thomson of Glasgow, chairman of the board of judges on instruments of precision. From this report we are permitted to make the following brief extracts. Sir William Thomson, after pronouncing this invention "an achievement of transcendent scientific interest," goes on to say: "Mr. Bell perceived that he must produce a variation of strength of current in the telegraph wire as nearly as may be in exact proportion to the velocity of a particle of air moved by the sound; and he invented a method of doing so—a piece of iron attached to a membrane, and thus moved to and fro in the neighborhood of an electro-magnet—which has proved perfectly successful. The battery and wire of this electro-magnet are in circuit with the telegraph wire and the wire from another electro-magnet at the receiving station. This second electro-magnet has a solid bar of iron for core, which is connected at one end by a thick disk of iron to an iron tube surrounding the coil and the bar. The free circular end of this tube constitutes one pole of the magnet, and the adjacent free end of the iron core the other. A thin circular iron disk held pressed against the end of the tube by the electro-magnetic attraction, and free to vibrate through a very small space without touching the central pole, constitutes the sounder by which the electric effect is converted into sound." This disk, pressed against the ear, conveys distinctly to the receiver the words of the sender of the message which agitate the membrane with its iron armature at the other end of the line. The reporter adds: "This, perhaps the greatest marvel hitherto achieved by the electric telegraph, has been obtained by appliances of quite a homespun and rudimentary character. With somewhat more advanced plans and more powerful apparatus we may confidently expect that Mr. Bell will give us the means of making voice and spoken words audible through the electric wire to an ear hundreds of miles distant."

F. *Submarine or Cable Telegraphy.*—Owing to the embarrassment arising from electro-static induction in long submarine cables, special arrangements have been devised by Prof. Sir William Thomson, C. F. Varley, and others without which it would scarcely be possible to transmit through them at a sufficient rate of speed to render them commercially valuable. The method employed on the Atlantic cables is a modification of Cooke's single-needle method, and is arranged as follows: Two keys, which when depressed transmit respectively positive and negative currents, are employed at the sending station in connection with a battery of a few elements only. The current of the battery does not pass directly into the cable, but into a condenser of considerable capacity composed of tin-foil plates interleaved with paraffined paper (see ELECTRICITY), the opposite side of which is attached to the cable, and the condenser transmits a wave of electricity through the cable. As there is no actual circuit from one terminus to the other, this arrangement serves to cut off the earth-currents, which would otherwise be troublesome. The receiving instrument employed is Thomson's reflecting galvanometer, which is described in ELECTRICITY, the message being read by the right and left deflections of a spot of light upon a screen, which moves to and fro as in the ordinary needle telegraph. The recording or syphon galvanometer of the same inventor writes down the deflections by means of ink spurted from a fine glass syphon-tube attached to a coil suspended between powerful fixed magnets, and which swings to the right or left as the positive or negative pulsations pass through it. The record appears upon a ribbon of paper in the form of a straight line when no signal is passing, but with waves to the right or left when pulsations pass through the coil.

G. *Pneumatic Telegraph.* This system has been employed for many years in Europe, but has only recently been introduced in New York. Brass tubes $2\frac{1}{2}$ inches in diameter are laid in trenches under the streets. The messages are rolled up and placed in a cylindrical carrier of leather or felt about 8 inches in length, closed at the front, and provided with a flange loosely fitting the inside of the tube, while the rear end is left open. The carriers are driven in one direction by compressed air, and in the other by an exhaust, both operated by a powerful air-pump at the central station. Packages of ten or twelve messages are sent a distance of half a mile in a few seconds. This method is destined to be extensively used in the larger cities, in connection with the telegraphic system, as it is more rapid, convenient, and economical for short distances than the electric telegraph. (See PNEUMATIC TRANSMISSION.)

The Telegraphs of the Principal Countries of the World.

COUNTRIES.	Year.	Line, miles.	Wire, miles.	Stations.
Argentine Republic	1873	4,146	8,059	60
Australia	1875	21,989	27,408	658
Austro-Hungary	1875	22,482	67,051	3,099
Bavaria	1875	4,711	17,329	874
Belgium	1875	3,078	13,962	586
Brazil	1875	3,193	5,284	87
British India	1875	17,203	36,215	925
British Indo-European	1873	3,378	3,414	10
Canada	1876	15,518	27,191	1,859
Chili	1873	2,090	3,143	52
Dutch East Indies	1873	2,843	3,458	51
Denmark	1875	1,724	4,745	203
France	1875	31,001	84,285	4,266
German Empire	1875	22,139	81,846	4,338
Great Britain	1876	24,091	119,338	5,337
Greece	1875	1,590	1,962	60
Holland	1875	2,133	7,646	330
Italy	1875	13,408	46,819	1,726
Luxembourg	1874	180	276	37
Mexico	1874	5,735	5,735	194
New Zealand	1875	3,154	7,247	142
Norway	1875	4,449	7,691	172
Portugal	1875	2,190	4,747	144
Roumania	1875	2,369	4,243	167
Russian Empire	1874	50,670	101,569	1,091
Servia	1874	906	1,330	37
Spain	1874	7,452	16,810	225
Sweden	1875	4,935	12,014	521
Switzerland	1875	3,927	9,575	1,002
Turkey	1875	15,644	30,163	444
United States	1875	88,821	214,085	8,498
Würtemberg	1875	1,538	3,867	338
Totals	......	388,687	978,507	37,533

The number of ocean cables laid between 1850 and the close of 1875 was 206, representing a total length of 50,716 miles. Of these, 61 have been discontinued and 145 are now in operation. The longest cable is from Brest to St. Pierre, 2584 miles. Eleven other cables are projected, the total length of which will be 17,144 miles. Nearly all these lines have been laid by English companies.

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Telegraph, Pneumatic. See PNEUMATIC TRANSMISSION.

Telem'achus, son of Odysseus and Penelope, was an infant when his father joined in the war against Troy. After the termination of the war, he sailed out, accompanied by Athena in the shape of Mentor, and visited Pylos, Sparta, and other places, where he expected to gather some information concerning the fate of his father; and on his return to Ithaca he found Odysseus living there in disguise with the swineherd Eumæus. A recognition took place, and he then aided Odysseus in slaying the suitors and clearing the house of its many burdensome guests, who ate up its wealth without bringing it any honor. His voyage forms the subject of Fénelon's epic, *Télémaque*, once so celebrated.

Teleoceph'ali [τέλειος, "perfect," and κεφαλή, "head"], the principal order of fishes. The diagnostic common characters are as follows: The skeleton is more or less ossified; the skull well developed, and its elements numerous; the cranial bones are as follows: of cartilage bones, basioccipital, exoccipital, supraoccipital, basisphenoid, alisphenoid, opisthotic, proötic, postfrontal, and prefrontal; of membrane bones, parietals, frontals, nasals, vomer, parasphenoid, supraorbitals, intermaxillaries, and supramaxillaries; the suspensory arch of the lower jaw has a well-developed quadrate bone, with which, on the one hand, is articulated the pterygo-palatine arch, consisting, generally, of the ectopterygoid, entopterygoid, mesopterygoid, and palatine bones, and, on the other, the hyomandibular and symplectic; the branchihyal apparatus consists of a median series of bones (glossohyal, basihyal, ceratohyal, epihyal, and stylohyal), with the posterior of which are connected four branchial arches and a modified pharyngeal arch, and with the anterior the branchiostegal arches, bearing, generally, three or more (most generally six or seven) rays on each side; the lower jaw is composed of a dentary, and, behind, of an articular, angular, and surangular; the scapular arch has an undivided proscapula (to the inner side of which are apposed at least a hypercoracoid and hypocoracoid), and is connected with the cranium by postero-temporal and post-temporal bones; the brain is differentiated, according to the current nomenclature, into (1) a cerebral part, consisting of cerebral hemispheres and optic lobes, and, in front, small olfactory lobes; and (2) a cerebellar part, cerebellum, which is moderately developed, covered, and simple. The sub-orders are Gymnonoti, Eventognathi, Isospondyli, Haplomi, Synentognathi, Percesoces, Acanthopterygii, Jugulares, and Heterosomata. THEODORE GILL.

Teleol'ogy [Gr. τέλος, "an end as far as accomplished"], the doctrine of final ends involved in and revealed by the phenomena of nature and history. On this doctrine is based the teleological or physico-theological argument on the existence of God. (See GOD.)

Teleos'tomi [Gr. τέλειος, "perfect," and στόμα, "mouth"], the name applied to the combination of teleostean and ganoid fishes, and which is equivalent to the class of fishes as here understood. It was originated by R. Owen in 1866, and refers to the fact that the upper arch of the mouth is formed by maxillary (intermaxillary, as well as, generally, supramaxillary) bones, or, in the words of Owen, "the mouth [is] formed by upper and lower jaws opening at the fore part of the head, and admitting the respiratory currents." (Owen, *Anatomy of Vertebrates*, vol. i. p. 8.) (See FISH.) THEODORE GILL.

Te'leosts [from τέλειος, "perfect," and ὀστέον, "bone"], the name of that sub-class of fishes which embraces the great majority of living species, and so designated (by Johannes Müller) on account of the ossified condition of the skeleton in all the representatives of the group. (See FISH and FOSSIL FISHES.) THEODORE GILL.

Telescope. See APPENDIX.

Tel'fair, county of S. Georgia, between Ockmulgee and Little Ockmulgee rivers, and intersected in its northern part by Macon and Brunswick R. R.; surface level, soil sandy, with extensive pine forests. Staples, sawed lumber, live-stock, wool, Indian corn, sweet potatoes, and a little cotton. Cap. McRae. Area, 925 sq. m. P. 3245.

Telfair (EDWARD), b. in Scotland in 1735; educated at Kirkcudbright grammar school; settled in Virginia in mercantile pursuits 1758; subsequently removed to Halifax, N. C., and to Savannah, Ga.; was prominent in the political struggles before and during the Revolution; sat in the Continental Congress 1778 and 1780–83; was a commissioner to negotiate a treaty of peace with the Cherokees 1783, and governor of Georgia 1786 and 1790–93. D. at Savannah Sept. 17, 1807.—His son THOMAS, b. about 1780, graduated at Princeton 1805; was member of Congress 1813–17. D. at Savannah in Apr., 1818.

Tel'ford (THOMAS), b. at Westerkirk, Dumfriesshire, Scotland, Aug. 9, 1757; became a stone-mason, studying architecture and drawing; went to London 1783, and was architect in the Portsmouth dockyard; in 1787 removed to Shrewsbury, where he was engaged upon the alterations in the old castle and in the construction of several bridges, and was appointed surveyor of the county of Salop, a position which he held until his death. His first great engineering work was the construction of the Ellesmere Canal, 103 miles long, which was commenced in 1793 and completed in ten years. In 1803 he was entrusted with the construction of the Caledonian ship-canal, connecting the Atlantic Ocean with the North Sea, a distance of 61½ miles, of which 23 is artificial navigation; it is 120 feet broad at the top, 50 at the bottom, and 17 deep, the highest part being 94 feet above the sea-level, the ascent and descent being accomplished by locks of a size surpassing any heretofore attempted. This was completed in 1823. Besides other works, as engineer to the commissioners of Highland roads and bridges he built about 1000 miles of road in Scotland, upon which are more than 1200 bridges; he constructed eight canals in Great Britain, the Gotha Canal in Sweden, and, above all, the beautiful suspension railway bridge over the Menai Strait. He had a turn for literature; before he left his native district wrote several very creditable poems in the Scottish dialect, taught himself Latin, Italian, French, and German, contributed valuable papers to the *Edinburgh Encyclopædia*, and left *The Life of Thomas Telford, Civil Engineer, written by himself*, published in 1838. D. at Westminster Sept. 2, 1834.

Tell, tp., Huntingdon co., Pa. P. 1024.

Tell (WILLIAM), according to Swiss legends, a celebrated marksman with the bow, living as a hunter at Bürgelen in the canton of Uri, and a member of the conspiracy which was formed against Austria at Grütli Nov. 7, 1307, by Walter Fürst of Uri, his father-in-law, Werner Stauffacher of Schwytz, and Arnold von Melchthal of Unterwalden, and which finally succeeded in freeing the country from the foreign yoke. At this time Gessler, the Austrian bailiff in Küssnacht, raised a cap on a pole in the market-place of Altorf, and ordered all passers-by to bow to the cap in token of submission. Tell refused, and was condemned to death, but pardoned on condition that he should shoot an apple from the head of his son. He ventured the shot, and succeeded, but Gessler noticed that he had put two arrows in his quiver, and asked why he had done so; and when Tell answered that if he had hit his son with the one he would have hit the bailiff with the other, he was again put in chains and taken on board the bailiff's boat to be brought to Küssnacht. While crossing the lake, the boat was overtaken by a fearful storm, and Tell was unchained in order to steer it, but at a certain point, known as "Tell's Leap," he jumped ashore, lay in ambush in a defile through which Gessler had to pass on his way to Küssnacht, and shot him; which deed became the occasion of a general rising in the cantons. Of this story about Gessler, Tell, Stauffacher, etc., the oldest Swiss chroniclers, Johannes of Winterthur, Justinger of Berne, and Hemmerlin of Zurich, know nothing. The first mention of these names and incidents is made in the latter part of the fifteenth century by *Das weisse Buch*, and a complete narrative does not occur until the middle of the sixteenth century in the *Chronicon Helveticum* by Ægidias Tschudi. The monuments erected in various places in honor of Tell are of a much later date. These circumstances early made the story of William Tell somewhat suspected, though as a general rule it was considered as real history; even Johannes von Müller accepted it. Later critics, however, have proved that the whole story is nothing but a legend, common among the nations of the Aryan race, found with all its principal features in the Persian poet Ferid ed-Din Attar, the Icelandic *Vilkinasaga*, the Danish historian Saxo Grammaticus, the English popular song on William of Cloudesly, etc., and only modified to suit Swiss circumstances. (See Ideler, *Die Sage vom Schusse des Tells* (1836); Haüsser, *Die Sage vom Tell* (1840); Hisely, *Recherches critiques sur l'Histoire de Guillaume Tell* (1843); Huber, *Die Waldstädte Uri, Schwyz und Unterwalden bis zur festen Begründung ihrer Eidgenossenschaft* (1861); Vischer, *Die Sage von der Befreiung der Waldstädte* (1867).

Tell City, p.-v., Perry co., Ind., on Ohio River, 75 miles above Evansville, was settled by a Swiss colonization society in 1858, and contains 3 churches, excellent public schools, 2 newspapers, 1 national and 1 private bank, 2 flouring-mills, 4 large furniture-factories, 1 chair and plough manufactory, foundry and machine-shop, 2 breweries, 1 woollen-mill, 2 distilleries, saw and shingle mills, 4 hotels, Masonic, Odd Fellow, and Druid lodges, and cigar-factories. Principal business, manufacturing. P. 1660. WM. P. KNIGHT, ED. "COMMERCIAL."

Tellez' (BALTHAZAR), b. at Lisbon, Portugal, in 1595; entered the order of Jesuits 1610; pursued for ten years a critical study of literature, philosophy, and theology, of which branches he was for forty years a professor in the Jesuit colleges at Braga, Evora, Coimbra, and Lisbon; became master of the house of professed Jesuits at Lisbon, and ultimately provincial of his order in Portugal. D. at Lisbon Apr. 19, 1675. Author of *Summa Universa Philosophiæ, cum Quæstionibus quæ inter Philosophos agitantur* (1642), *Chronica da Companhia de Jesus da Provincia de Portugal* (2 vols., Lisbon, 1645–48), and *Historia Geral de Ethiopia a Alta* (Coimbra, 1660), the latter work being still the most copious and exact description of Abyssinia.

Tellez (GABRIEL), better known by his *nom-de-plume* of TIRSO DE MOLINA, b. at Madrid, Spain, about 1585; was educated at the University of Alcalá de Henares; took orders in the Church 1613; became a monk of the order of

Nuestra Señora de la Merced 1620; was chosen chronicler of his order, inspector of the convents in Old Castile, and prior of the convent of Soria, where he d. in 1648. Next to Lope de Vega and Calderon, he was the most prolific and successful Spanish dramatist. He stated that he had written over 300 comedies, but only 51 remain, many having been destroyed by the author and some suppressed by the Inquisition on account of their indelicacy. Among his comedies are *Prudencia en la Mujer*, *La Mujer que manda en Casa*, *Escarmientos para el cuerdo*, *El condenado por desconfiado*, *No hay peor sordo que el que no quiere oir*, and *El Burlador de Sevilla, ó el Convidado de Piedra*. The latter piece was imitated by Molière, and is the original of the numerous *Don Juans* of modern literature. A selection of 36 of his best comedies was edited by J. E. Hartzenbusch (12 vols., 1839-42; new ed., 1 vol., 1850).

Tellicher'ry, town of British India, presidency of Madras, is picturesquely situated on the open sea in a beautiful, fertile, and well-cultivated district, rich in spices, rice, and cocoanut palms. It enjoys a healthy climate, has a good harbor and a fort, and carries on a considerable trade, exporting spices and sandal-wood. P. 20,000.

Tel'lurides [Lat. *tellus*, "earth"], compounds of the amphigen element tellurium with other metals. They constitute chiefly the native mineral compounds of tellurium.

Telluride of bismuth is the mineral *tetradymite*, which, as found in gold-mines in Virginia and Georgia, has the composition, according to Genth, of pure telluride of bismuth, Bi_2Te_3, while that from the Uncle Sam lode in Montana is Bi_4Te_5S. Other Montana tetradymites, however, from placer gold, were found by Genth to be free from sulphur. Genth discovered with these latter tetradymites, and also in Davidson co., N. C., a new mineral which he called *montanite*, a *tellurate of bismuth*, $Bi_2O_3.TeO_3.2H_2O$. Tetradymite is a steel-gray mineral, inflexible folia or laminæ like graphite, soft and marking paper like the latter, hexagonal in form. It may be distinguished from graphite by roasting in a glass tube open at both ends, when a white sublimate of tellurous oxide will appear, fusible to transparent, colorless droplets. It is also fusible and combustible before the blowpipe, tinging the flame bluish-green. For tetradymite free from sulphur the writer's geometric law of volumes (*Am. Chemist*, Mar., 1876) indicates the zero densities for different modifications, 7.641 (Balch, from Dahlonega, Ga., 7.642) and 7.877 (Jackson, from Dahlonega, 7.868), with others not yet definitely identified in nature.

Telluride of Lead.—This constitutes the rare mineral *altaite*, a white metallic sectile mineral, sometimes in cubical crystals, like galena, the corresponding sulphide. It is PbTe. It is found in the Altai Mountains, and Genth discovered two years since two American localities—one in Colorado, at the Red Cloud mine, and the other in North Carolina, at the King's Mountain gold-mine in Gaston co.

Telluride of Silver.—The rare mineral *hessite*, Ag_2Te. Metallic, iron-gray, and sectile; in crystallization right rhombic. Usually contains some gold in its composition. Found in the Altai Mountains, also at several Hungarian localities, and at the Stanislaus mine in Calaveras co., Cal. Genth has also recognized it in small quantity from the Red Cloud mine, Col.

Telluride of Gold and Silver—Petzite.—Found at Nagy-Ag in Transylvania, and also by Genth among the ores of the Red Cloud mine. Genth's analyses indicated 24 and 25 per cent. of gold in the composition of the Colorado petzite. It is scarcely to be distinguished in appearance or character from hessite without analysis. The auriferous mineral is, however, somewhat lighter in color and more brittle. It is right rhombic, like hessite.

Tellurides of Gold—Sylvanite—which, however, always contains also some silver (12 to 13 per cent. at the Red Cloud mine).—It is monoclinic, steel-gray or silver-white, and varies in composition and density within quite wide limits, containing from 23 to 30 per cent. of gold. It was found only at two Transylvanian localities in Europe, Nagy-Ag and Offenbanya, and Genth states that it was unknown in America until Prof. Silliman found it at the Red Cloud mine; but Dana gives also the Melones and Stanislaus mines in Calaveras co., Cal., as localities. Genth, however, has announced a *new* telluride of gold, *calaverite*, from the Stanislaus mine, having the composition $AuTe_4$, with about 41 per cent. of gold. Its color is bronze yellow, and its streak yellowish-gray. It is brittle, and not crystalline. HENRY WURTZ.

Tellu'rium [Lat. *tellus*, "earth"], an element of matter belonging to the rarer elements, though contained in certain minerals which are of rather abundant occurrence in some very limited districts of the earth. Von Reichenstein proved its existence in such minerals in 1782. Klaproth confirmed this in 1798, and gave the element its name. Berzelius and Wöhler have been the most eminent investigators of tellurium and its compounds. It occurs native in elementary form, generally associated with native gold or telluride of gold, the *sylvanite* of Kirwan, named from Transylvania (in which, at the Maria Loretto mine, was the first known locality). Within a few years our eminent American chemist and mineralogist, Prof. B. Silliman, discovered tellurium minerals, including native tellurium, in Boulder co., Col., notably at the Red Cloud mine, near Gold Hill. (*American Journal of Science* [3], viii. 25.) Tellurium minerals have long been known to occur at several points throughout the auriferous region of Virginia, North and South Carolina, and Georgia. A very notable new locality is the Uncle Sam lode, in Highland district, Mont. It has also been found with gold at the Montgomery mine, Hassayampa district, Ara. The occurrence of tellurium in considerable abundance at so many new localities on this continent has given this element an American interest, and our eminent chemist, Dr. Genth of Philadelphia, has given much time and labor to the investigation of these American tellurium minerals. (See TELLURIDES.) Tellurium exists in the star Aldebaran and in others.

Preparation.—Tellurium is obtained in elemental form from any of the native tellurides by first fusing with black flux at a white heat, then boiling in water, which gives a port-wine-colored solution of telluride of the alkali-metal; which solution on exposure to the air, or more quickly by passing air through it, precipitates tellurium in metallic scales. The mineral *nagyagite*, which is telluride of gold, may also be made to yield pure tellurium by first boiling with muriatic acid till all lead and antimony are removed, and then dissolving in hot nitric acid, which gives a solution of tellurous acid, O_3H_2Te, which is then readily decomposed by a current of sulphurous oxide gas, SO_2.

Nature, Properties, and Relations.—Tellurium is a white, brittle, lustrous metal, highly crystalline in structure, the crystals being hexagonal. Though so metallic in appearance, it does not conduct electricity or heat very readily. Its fusing-point is placed at 932° F., about a red heat, and above this temperature it volatilizes to a vapor which has the greenish-yellow color of chlorine gas, and has a density about nine times that of air. When tellurium is strongly heated, it takes fire and burns with a strong flame of a blue color with green edges, and a smoke of tellurous oxide. Tellurium belongs to what Berzelius called the amphigen group of elements, including SELENIUM (which see) and sulphur. Most chemists also include oxygen, but this exceptional element certainly presents relations ranging it with the amphigens much fewer in number than those which separate it widely therefrom. The parallelism of tellurium with sulphur in its compounds is very complete. For the atomic weight of tellurium the number 128, four times that of sulphur, is accepted, as determined by Berzelius. The *densities* of the element on record indicate at least three allotropic modifications. The new geometric law of volumic condensation (*Am. Chemist*, Mar., 1876) of the writer indicates for two of these the densities at zero 6.149 (Klaproth found 6.115) and 6.262 (Berzelius found about 6.25). A denser one, = 6.339, was approached by Von Reichenstein. The allotropic changes of tellurium, however, unlike those of SULPHUR and SELENIUM (which see), have not yet been looked into at all by chemists.

Tellurium itself and tellurium compounds, when heated before the blowpipe, burn with an odor which is likened by some to that of rotten horseradish, and which is so characteristic as to be readily recognized by those familiar with it. Its soluble compounds are regarded as very poisonous, particularly those obtained by substitution in organic compounds. When it has been taken into the system, even in the minutest quantity, it remains there for a long time, and communicates to the breath and perspiration a peculiar fetid odor very disagreeable to others. This has happened to chemists who have attempted to investigate the tellurium compounds, and the effect found to endure for many weeks, and to impose upon them an isolation from mankind.

Tellurium forms many classes of compounds—two *oxides*, TeO_2 and TeO_3, each of which forms an acid with water and salts with bases; two chlorides, $TeCl_2$ and $TeCl_4$, the first black, amorphous, and fusible, the last liquid, transparent, and yellow when hot, but solidifying to a white mass; a gaseous compound with hydrogen, H_2Te, similar to sulphuretted hydrogen, H_2S; and others, for which the chemical textbooks must be consulted. HENRY WURTZ.

Temacula, p.-v. and tp., San Diego co., Cal. P. 140.

Temascaltepec', town of the Mexican confederation, state of Mexico, is beautifully situated, and has 500 inhabitants, mostly engaged in the manufacture of coarse cotton stuffs. Its former rich mines are now exhausted.

Temesvar', town of Southern Hungary, is surrounded with walls and strongly fortified. It is well built, with

broad and straight streets lined with substantial houses; has some manufactures of leather, silks, and linen fabrics, and an extensive transit trade in corn and wine. P. 32,754.

Temis'caming Lake is on the boundary between the provinces of Ottawa and Quebec, Canada. It is 30 miles long and 15 broad, and is in lat. 47° 30′ N., lon. 80° W. Its waters flow into Ottawa River.

Temiscoua'ta, county of Quebec, Canada, bounded N. W. by the river St. Lawrence and S. E. by Maine and New Brunswick. It contains much fertile soil, but is in large part a wilderness, resorted to for its fine scenery and excellent fishing. It is traversed by Grand Trunk Railway. Cap. Isle Verte. P. 22,491.

Temiscouata Lake, in Temiscouata co., province of Quebec, Canada, is 130 miles E. N. E. of Quebec. It is very beautiful. Length, 22 miles; breadth, from 1 to 2½ miles. Its waters are discharged by Madawaska River.

Tem'pe, a valley, or rather a gorge, in North-eastern Thessaly, Greece, 5 miles long, and in some places so narrow that between the high cliffs which rise almost perpendicularly on both sides there is space only for the river Peneus, which traverses the valley, and a carriage-road. In antiquity it was very celebrated for the beauty of its scenery. It was strongly fortified at several points, and ruins are still visible of these fortifications.

Tem'perament [Lat. *temperamentum*]. In music, this term relates to a certain adjustment or regulation of the sounds or intervals of the scale, with the view of removing an apparent imperfection, and fitting the scale for use in all keys without offence to the ear. The musical scale now in use is a compromise, or a scale in which most of the intervals are not mathematically correct, or true to the scale of nature as deduced from the MONOCHORD (which see), but are slightly modified by elevation or depression, a process absolutely necessary to meet the various exigencies of modern music. This modifying or nice adjustment of the sounds of the scale is the office of *temperament;* and in tuning an organ or pianoforte the first thing done is the "fixing of the temperament" by adjusting with great care a single octave in the middle of the keyboard as a pattern from which all the other pipes or strings, above or below, are to be tuned by octaves, double octaves, etc. On this subject of temperament many entire works have been written by learned musicians; and it will be obvious that in this article we shall only have space to show very briefly why temperament is necessary, and how it is effected.

It has been found by those who are conversant with the accurate measurement of intervals that though the perfect octave *seems* to be divisible into six major tones, as C—D, D—E, E—F♯, F♯—G♯, A♭—B♭, and B♭—C, yet these, when added together, are really somewhat *more* than an octave. And again, though the octave seems divisible into three major thirds, as C—E, E—G♯, and A♭—C, yet by strict measurement these three thirds prove to be *less* than the octave in extent. This is illustrated in the following manner by E. J. Hopkins, Esq., of the Temple church, London, in his work on *The Organ:* "Supposing the perfect octave to be divided into 3010 equal parts, the interval of a major tone would contain 511 of those parts. But if we multiply 511 by 6, we have 3066, instead of 3010, plus 56 parts; so that the octave contains *less* than 6 major tones by 56 parts. A major third also would contain 969 parts, which multiplied by 3 would make 2907, instead of 3010, minus 103 parts; the octave in this case containing 103 parts *more* than the three major thirds." Now, to distribute or get rid of this excess or shortcoming we have no resource but temperament—*i. e.* the modifying of several of the intervals by very slightly raising or lowering them, so as to extend or contract their whole sum to the exact limits of the octave. In the practice of tuning, this apparent irregularity or imperfection of the scale is usually treated as an *overplus*, which must be disposed of by some method which shall not so affect any interval of the scale as to make it offensive to the ear. Hence, several modes of doing this have been devised, and these are commonly classed under the heads of *equal* and *unequal* temperament, of which we shall speak presently. To set the case in a very simple light, let us undertake to tune, *without* temperament, the following series of fifths, and then observe the result: At 1, in the example below, tune F to its proper pitch by tuning fork or otherwise; at 2, tune C a perfect fifth above the F; at 3, tune the lower C a perfect octave (simply to keep the exercise within bounds); at 4, tune G a perfect fifth above C, and also tune the E between as a major third from C, thus forming the major triad; at 5, tune D a perfect fifth above G; at 6, tune the lower D for convenience; at 7, tune A a perfect fifth above D, and at 8, tune E a perfect fifth above A:

Let this upper E, at 9, now be tried as octave of the E previously tuned at 4, and it will be found entirely *too sharp* to be endured even by the ordinary ear. Though we have tuned no more than five successive fifths, yet we discover that an overplus has been accumulating which makes the upper term of the last of these fifths quite unfit for use as octave of the first E. The only remedy for this lies in temperament. We therefore begin again, and make every fifth a little flatter than perfect, repeating the process, if necessary, till the difficulty is removed. In this manner the superfluity is distributed among the five fifths, and the upper E is so reduced as to be now the perfect octave of the E at 4. The same thing will occur if we commence another series of fifths on A, or by the reverse process of tuning *downward*, as from F to E♭, etc. And it is by pursuing this course till every degree of the chromatic scale has come under treatment that the temperament is said to be "fixed," or the aberrations of the several intervals corrected. In regard to the apportionment of temperament among the different intervals of the scale, it is to be observed that the unison and octave, on account of the simplicity of their ratios, 1—1 and 1—2, cannot bear to be tempered at all, as the slightest change would render them offensive to the ear. The fifth and fourth, being less simple (2—3 and 3—4), may be slightly tempered without producing any disagreeable effect; and the major or minor third may admit of a change quite equal to a comma, or 1—80th of a tone, sharper or flatter, which is as large an extent of temperament as is commonly required.

In the above example and its explanation we have proceeded on the ground that all the fifths were tempered in *like degree*. But the excess spoken of may also be distributed among them *unequally*, or one or two of the fifths may remain perfect, and the whole burden of the temperament be laid on the others. In the former case the temperament is called *equal*, and in the latter *unequal*. From this it will be readily understood that on an instrument *unequally* tempered some of the intervals will be smooth and agreeable, while others will be harsh and almost intolerable. In old church organs this temperament was in general use. Music formerly was written in very few keys, and modulations were seldom carried into remote scales. It was customary, therefore, in tuning instruments, to make the keys that were in common use as perfect as possible, at the expense of the other keys, on which all the roughness of the temperament was concentrated. Under the requirements of modern music, with the whole circle of the keys in common use, this unequal temperament has become obsolete, except in such cases as the accompaniment of oratorios, etc., by the organ in combination with orchestral instruments. The advantages of unequal temperament are the greater brilliance imparted to certain keys, and the better preservation of those qualities which distinguish one key from another. The disadvantage is, that keys with more than three sharps or flats are too harsh and discordant to be of practical service. The *equal* temperament now in general use is a necessity of modern music. In this temperament the excess or deficiency above noted is distributed among *all* the keys, thereby rendering them all available for use, and enabling the composer to present harmonious combinations in the remotest keys without any disagreeable effect. There are, however, several shades or degrees of equal temperament, from the strictest uniformity to any amount of inequality which is still bearable. If all keys were made exactly *alike*, there would be an undesirable loss of their individual character, and no difference perceptible except in their degree of acuteness. To avoid this, some discrimination is commonly used in favor of certain popular keys, yet not to such an extent as sensibly to injure the effect of keys less favored. A difference is recognized at once between the major keys of D and A♭, even though the instrument in use is said to be equally tempered. Some discrimination, therefore, has been exercised by the tuner; and sometimes the key which bears the greatest stress of imperfection is that which most attracts us by its beauty. It will be apparent, from what has now been stated, that by temperament all fifths on the keyboard of the organ and pianoforte are reduced below the perfect standard. There are no *absolutely perfect* fifths on such instruments; and yet the ear so readily accustoms itself to these slight changes that they are not even suspected, much less distinctly felt, by the ordinary hearer. The perfect fifths made by two open violin strings have no counterpart on the instruments just named, but the discrepancy is so small that it invariably escapes notice except by the critical ear. In musical theory and in treatises

on harmony a tempered interval does not differ by name from an untempered one. Thus, the fifth C—G, though reduced by temperament, is still called and assumed to be a "perfect fifth:" and all terms indicating chords, combinations, and progressions remain unaffected by any influence from temperament. WILLIAM STAUNTON.

Temperament, Physical, once a most important consideration in physiology and symptomatology. Temperament, or crasis, denotes a mixture or tempering of essential elements of the body, whose excess or variable quantity determines the chief characteristics of mind and physique. In remote ages these elements were heat, cold, dryness, and moisture, viewed as entities. Later, Hippocrates regarded the circulating fluids of the body as constituted of four subordinate fluids—blood, phlegm, yellow bile, and atrabilis or black bile. Upon this basis a hypothetical division of temperaments arose. Persons of full habit, muscular, vigorous, plethoric, and florid, with active circulation and high body heat, were classed as of sanguineous temperament. Persons less developed, cool-blooded, light-complexioned, and less vigorous were assumed to have an excess of phlegm, and classed as of the phlegmatic temperament. Dark complexion, sluggish circulation, stolidity, or irascibility were classed as of choleric temperament; the melancholic temperament was ascribed to black bile. It is true that whole races have a prevailing temperament quite opposite to that predominating among other and even adjacent races. The English are sanguineous, the Scotch phlegmatic. With corrected views of physiology we have a corrected division of the temperaments, no longer an arbitrary classification, but indicative of the fulness of habit and relative activity of the nutritive functions and cerebro-spinal activity. Thus, sanguineous, nervous, nervo-sanguineous, and sanguineo-nervous, lymphatic, and phlegmatic are the terms now employed. The English are peculiarly sanguineous as compared with the French and Italians, who are of nervous temperament. The American is regarded as sanguineo-nervous. The lymphatic temperament includes the large mass of light-haired, light-complexioned, thin-skinned persons, among whom derangements of the lymphatics are frequent, and scrofula, struma, and tuberculosis are most liable to develop. Temperament may thus be an entity in the individual, the inheritance of his nationality or ancestry. But many so-called temperaments, as the bilious, melancholic, and lymphatic, are merely departures from health, the result of imperfect growth, bad nutrition, incorrect habits, and inactive functions of the body, and may be modified or removed by corrected habits, regimen, or medical treatment.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Temperaments, Human. See APPENDIX.

Tem'perance [Lat. *temperantia*]. There cannot be a doubt that temperance in the use of all alcoholic drinks is more common now, among the more educated and refined classes in the community, than it was a century ago. At that time all classes indulged often to excess, and without a thought of the impropriety of so doing. The disgusting stories of what happened without rebuke from public opinion in Europe or America are not myths. Some of the worst of them, which would not now be tolerated in any decent society, were then generally considered as mere practical jokes. But such facts could not long occur in any reasonable community without exciting decided opposition from the more thoughtful members of it. The evils arising therefrom were too patent. Hence arose temperance societies, so called—societies of men and women pledged to promote *temperance* in the use of intoxicating drinks, *not total abstinence*, as now inculcated by many. After some years their efforts seemed weak and success impossible to the more earnest advocates. Hence have arisen various movements, all having the same general object, but some of these measures border upon, if they do not reach, the limits of fanaticism and intolerance. Between thirty and forty years ago the so-called Washingtonian movement began in Baltimore. This for a season aroused the whole people, and was the means of exciting a deep interest in the subject. It may be styled the confessional phase of the temperance movement. The pioneers and chief workers in it pleaded the cause of temperance by minutely detailing at public meetings their own erratic courses. Every drunkard became for the time being a most effective apostle, not only of temperance, but of total abstinence. But this movement did not last long, because (1) some of these apostles became backsliders; and (2) because after a time the community became nauseated with the disgusting revelations made by some of the speakers. Total abstinence was an essential article of faith for every Washingtonian. For him, certainly, that rule was supreme, and admitted by all to be absolutely necessary. Following these, have arisen societies which declare that the taking of stimulants in any amount, by *any* person, is unnecessary, and virtually a crime against society, a sin *per se*. Everybody should forego the use of all liquors because some become drunkards. This result was quite a logical and practical one for the Washingtonians. It was vital to them; a drop of liquor, if allowed to touch any of their lips, aroused all the old fires, and they were lost. But it was by no means an equally logical conclusion when applied to the whole public, as the "Prohibitionists" for many years have been trying to do. The old temperance societies opposed this idea, but either failed of meeting it or were finally subdued by it. Licenses, which had been previously given by the state, were deemed wrong in principle as licensing a crime. Hence, for thirty years or more the questions of *prohibition* and *license* have been the watchwords of bitterly-opposing partisans. Moral suasion nowadays is voted weak; Washingtonianism is not to be found. At the risk of being sustained by neither of these contending parties, but in the hope of, in some degree, meeting the views of the large body of spectators of this conflict, we propose to examine these two systems of promoting temperance.

Alcohol has been proved to be at times a food of immense value to man; without it, men and women would at times die. In order, however, to be thus valuable to mankind, it must be used legitimately and under proper safeguards. On the contrary, if used on improper occasions or too frequently or too freely, it ruins man and injures society to its very depths. These two propositions are strictly, scientifically, true. It would seem as if none but bigots of either of the contending parties could deny them. Hence it follows that we ought, under the varying circumstances of life, to take one or the other position of favoring or of opposing either license or prohibition in our dealings, practically, with the question of temperance. It has been proved by correspondents living in various and widely-separated portions of the earth's surface that a tendency to use stimulants exists among all people. From the savage to the most highly-civilized race of men there is no one of them that has not this instinct; and with the instinct naturally arises the tendency to excess in the indulgence of it. But the desire for this gratification appears to vary much according to a cosmic law of heat and climate. The isothermal lines which limit the growth of the grape N. and S. of the equator seem to divide the northern and southern hemispheres into three tolerably well-marked zones—namely, (1) the tropical, (2) the temperate or grape-growing, and (3) the northern or colder. In the first drunkenness is almost unknown, and it is deemed disgraceful, while lusts of other kinds, which are rare at the N., have full sway, unopposed by public opinion. In the second region milder drinks, such as native grape wines, mild beers, and ales, are used, perhaps in very large quantities, producing, when drunkenness follows, a milder and more jovial, less offensive, less destructive type of it than is observed in the more northern regions. In the third zone man drinks less in amount, perhaps, but it is of a more potent, fiery liquor. It makes him brutal and beastly, and frequently he becomes destructive of persons and of property. If this be so—and such seems to be the fact—it is plain that prohibition in the first zone would scarcely be thought of; in the second some enthusiast might possibly suggest it; in the third it is a most natural occurrence. Parties there would inevitably arise prepared to stop the whole traffic in liquor, because of its vile influence on man; and the violence of these parties would be just in proportion to the enormity of the evil sought to be eradicated. Surely, any reasonable plan which proposes to prevent a man from degrading and making a tiger of himself in his intercourse with others should be sustained.

Another great influence—viz. that of race, with its centuries perhaps of education, of certain habits—should always be taken into consideration in judging of this question. Undoubtedly, the Englishman carries his gross habits of drinking everywhere, even into the warmest region, but he soon finds, to his cost, that habits which were not obviously pernicious in England cannot be carried out with impunity in his more tropical abode. So other races carry their peculiar habits.

From these various considerations it seems to many people that the state, as a guardian of the public health, is bound to use its great powers to restrain its citizens by actual prohibition from the use of every alcoholic stimulus, or to allow the use of them under more or less restriction to all, provided that in so doing it does not interfere with the inherent right of the individual to use any food or drink he may prefer without injury to himself or others. In deciding these delicate questions the community may be divided into childhood and manhood. This is already done on the subject of voting and on many others. Only at certain ages does the male in the eyes of the law become a man, and the female a woman. For the former of these

classes—*i. e.* for all persons under the age of legal manhood—the prohibition of the use of liquors or a most restricted license should be inaugurated, and as far as possible thoroughly carried out. For the very young, statute law would be rarely needed if the parental authority were duly exercised. The strict rule in all families should be—no liquid stronger than milk should be allowed the youngest, and weak tea and coffee only for the elder children. The custom in some families, more common formerly than now, of allowing children to sip wine at their father's table is fraught with dangers of the most deadly kind for the future well-being of the man and of society. Statute law should provide still further for the correct guidance of the youthful years of the future citizen, and the giving or selling of liquor to a minor should be prohibited under the severest penalties. When the state appreciates its high prerogative of contributing to the best education of every citizen, then the selling or giving of liquor to a minor will be deemed one of the most heinous of crimes. After the youth arrives at manhood or womanhood—viz. at the age at which even by statute law he or she has the fullest privileges in the choice of good or evil—we cannot proceed in this arbitrary way. But in consequence of the inherent infirmity of human nature, some will then be induced to drink inordinately, and behave in a manner contrary not only to their own interests, but to the peace of the commonwealth. All such persons will need the watchful care of the state, and it must assume the parental relation or that of a stern judge. Several methods have been pursued by the state in this capacity of guardian of the public weal. Fines and imprisonment of drunkards have been tried without any permanent effect in restraining the inebriate or in doing good to the state. The fines are usually promptly paid; the individual feels that he has lost caste in the community in consequence of his public trial; but they rarely prevent a repetition of his drunkenness. If the drunkard be the head of a family, another evil results in case of his confinement—viz. that the innocent family suffers in consequence of his being taken from his work for its support. There is one method more effectual than either of the preceding. But, unfortunately, under a high sense of the essential dignity of man, it is believed that all the States except Delaware have abolished the use of it. The *whipping-post* has disappeared from all the States except Delaware, yet it may reasonably be asked whether a smart whipping, inflicted in the presence of a public officer, and which should not physically injure the culprit, would not be far more efficient to prevent a repetition of drunkenness than either fines or imprisonment. Moreover, it would not injure the family of the offender. Let it be once understood that an appearance in public in a state of intoxication should be followed by this physical suffering, with its social disgrace, it is believed that intoxication public and unblushing, such as we daily see in our streets, would become less frequent than at present. But if no one of the punishments should be sufficient to restrain the drunkard, then the state should seclude him as an insane man in an inebriate asylum. This would be appropriate when we remember that not a few drunkards are really suffering from the sins of their forefathers, who have transmitted evil habits and tendencies to their progeny. Fiery cognac, and perhaps the rich old port, sipped inordinately by aristocratic lips in one generation, have often been the prophets and moulders of the sots of a subsequent one.

Again, it has been most justly urged that the state should not only prohibit the sale of liquor to an habitual drunkard, but that the dealer who for the sake of gain violates such a law should be held responsible, not only for that violation, but for all the damages the victim may commit while intoxicated; and, moreover, that the family of the latter, which is bereft of its natural guardian, should be allowed a weekly stipend from the vender during the illness or imprisonment of the father.

Finally, the state, for its own safety and on the sacred principle of *salus populi ultima lex*, should deprive the incorrigible drunkard of his civil rights, as the state treats the felon. Virtually, the drunkard throws his recklessly away in the very act of becoming intoxicated. But shall we have prohibition or a limited license for the community at large? This question divides itself when applied to the practical customs of life. The system of open bars for the sale of the coarser liquors and the custom of "*treating*," as allowed by the English-speaking race, and especially in this country, are unmitigated evils, and should be forthwith given up or should be crushed by state power. Although they would undoubtedly exist in secret places, it would nevertheless be the greatest boon to the community to have them, at least like the felons they make, obliged to keep out of sight. But should the same prompt measures be applied to the sellers of milder beers, ales, and wines? Undoubtedly, these too should be under state and municipal surveillance. Moreover, some of the stronger English and Northern beers or ales should be classed with the coarser liquors, as they steal away the senses almost as quickly and quite as powerfully as absinthe, Bourbon whisky, or Medford rum. But the question still arises: Should the same rigid rule be applied to native light wines and German lager beer, both of which may be used more freely and with comparatively little danger if taken with caution and temperately? It is, however, argued that though these may be indulged in much more freely than stronger drinks, there is a danger, if we may believe the statement of many persons in England and Sweden, that this use of milder liquors will lead to the use of grosser ones. It is possible that this may be the case in the northern zone, where intoxication is more common and more furious in its bearings; but it has been proved by large data—*e. g.* those of the soldiery of Austria—that these milder beers do not deteriorate the race as the more potent liquors do. Doubtless, it would be wrong to allow any one having strong tendencies to intoxication, either from hereditary descent or previous bad habits, to use even these milder liquors. With all such, total abstinence is absolutely essential; but it does not follow that this rigid rule should be established for all, nor do we believe, nor have we any proof, that in Germany, situated in the middle zone above named, beer tends to develop the love of stronger drinks.

One excellent result has followed from these various and often heated discussions in our community on this all-important topic of temperance—viz. that temperance among the more educated classes has become more widely spread. No one now feels obliged to take wine in company; many habitually refuse to do so, and are not regarded as singular. Liquors are now never placed on the buffet or sideboard in the parlor, always at hand, and always to be offered to a friend as an act of hospitality, and as such rarely refused. At our dinner-parties for a man to be drunk is very uncommon. To be excited, and evidently so by liquor, is considered an unpleasant sight, and no longer a joke. In other words, temperance is honored, intemperance discountenanced, by the educated classes more than formerly. We regret we cannot say the same of the laboring classes. Perhaps among them intemperance was never more rampant than at present.

The final conclusion is this—viz. education and a cultivation of all the amenities of life should be promoted for the sake of temperance. In the school, and above all in the family, no opportunity should be lost of impressing on the tender consciences of the young the utter beastliness of drunkenness. A child should be taught to reverence the mind within him, and to shrink with horror from the thought of ever once depriving himself of its perfect control.

As it has been in the past, so it will be in the future—temperance will never prevail save with the constant labor of all in their various spheres. HENRY I. BOWDITCH.

Temperance, tp., Amherst co., Va. P. 3417.

Tem'peranceville, p.-v., Somerton tp., Belmont co., O. P. 120.

Temperanceville, b., Allegheny co., Pa., on Ohio River, 3 miles below Pittsburg, has extensive manufactures of iron and glass. P. 2069.

Tem'perature, Nature of. The term "temperature" relates to the degree or intensity of the heat of a body. In popular language, the expressions "high temperature" and "low temperature" are often employed instead of the terms "hot" and "cold" or "warm" and "cool;" but the use of the word temperature implies usually a measure of the intensity of heat. In this respect it is analogous to the word "velocity" in connection with motion. The motion of a body may be described as fast or slow, or the body may be said to have a high velocity or a low velocity. In the latter case there is implied a reference of the rate of motion to some standard or unit of velocity, which may be more expressly defined if necessary. In the same way, when it is said that a body has a certain temperature—a high or low temperature—it is implied that the condition of heat in the body may be compared with some standard. It is well known that the means of such comparison is the thermometer, and the standard condition is usually that of a body at the melting-point of ice. The thermometer applied to melting ice indicates zero; when applied to a body hotter or colder than melting ice, it indicates by a scale the degree of heat of the body as compared with one at the temperature of melting ice.

In connection with the dynamic theory of heat the measure of temperature has an important signification. Supposing the scale of numbers of any ordinary thermometer to begin at what is termed the absolute zero of heat, the temperature, or the number of such a scale which indicates the heat of a body, is proportional to the actual energy or

living force due to the molecular vibrations of the particles of the body. This assumption gives rise to one of the important axioms on which the dynamic theory of heat is founded—viz. that the capacity of a body for exerting heat influences, or its actual heat-energy, is proportional to its absolute temperature. At the absolute zero of heat (– 273° C.) all bodies cease to have the power or capacity of exerting any of the influences which arise from heat, dynamically considered, whatever be the state of aggregation of the body.

Temperature is thus considered to be a measure of the energy which arises from molecular motion and apart from atomic or chemical energy—that is, energy of chemical constitution. To illustrate: suppose a man to lift with tongs a lump of red-hot quicklime from a limekiln, and hold it over a basin of water. He has converted his muscular energy into potential energy of position. If he drop the red hot lump, this potential will again become actual energy, and will splash a portion of the water out of the basin. Then the energy of temperature, which here, from the difference of temperature between the lime and the water, is working energy, will be transferred from the lime to the water, part of which will be transformed into steam, containing potential energy again as latent heat of steam. So far, no *chemical* change has taken place. The lime is still quicklime, and the remaining water is still water. But when these bodies have both reached the same temperature, a new class of changes begins. The temperature will again begin to rise rapidly, the water will be absorbed by the quicklime and disappear, the latter will crumble to a white powder, which will be a *new chemical compound*, slaked lime. If the proportion of water be not too large, sufficient *mobile energy* of temperature will appear to raise the mass again to nearly a red heat. It is usual to attribute this heat, developed in the familiar but wondrous phenomenon of the slaking of quicklime, vaguely to "molecular condensation." In fact, however, though it is not generally known, *there is here little or no change of volume.* The latest and best determinations of densities show that the volumes of the water and quicklime are together slightly less, if anything, than that of the resulting slaked lime. Whence, then, is this actual working energy of temperature, here so largely developed? Evidently, from conversion of some latent or potential energy into actual energy, such latent energy being what the writer proposes to call *potential energy of chemical constitution.*

This is only one of the innumerable cases of the transmutation of such potential energy of chemical constitution into actual working energy of temperature. All chemical reactions causing rise of temperature of the bodies reacting —*combustion* being one example—indicate the loss from these bodies of something which passes off as energy of temperature, and is lost for ever by diffusion throughout the universe. This loss represents *chemical energy*, and the writer believes, as he has elsewhere demonstrated (*American Chemist*, vol. vi. pp. 341, 342), that it is in reality energy of the chemical *atoms.* His view is that temperature measures energy of the chemical *molecule*, representing motion thereof as a whole, and independent of the atoms that make up the molecule, whose intra-molecular intestinal motion—upon which the occupation of space by the molecule depends, that is, the molecular volume—is the atomic energy, or energy of chemical constitution, of the body. This chemical energy is therefore mainly independent of temperature or molecular energy, within such limits as do not alter the chemical nature of the body, by dissociation or otherwise.

From this view it will follow that what is known as the (hypothetical) *absolute zero of heat*, so called, deduced from the result of the exhaustive application of the Boyle-Mariotte law to *gases*, can only be, at most, even if it applies to solids and liquids at all, the *absolute zero of temperature*, or of molecular motion, and that there would yet be in matter, even at that supposed absolute zero, an enormous, possibly inexhaustible, store of potential energy which could be converted into actual energy, at least in cases, if such there be, of bodies capable of reacting chemically at that low temperature. That there may still be such bodies at that temperature (or rather, absence of temperature) is probable from the consideration that although the incondensable class of gases would, according to the Boyle-Mariotte law, necessarily all become liquids at that point, it by no means follows that they would further become *solids*; and there would therefore be no necessary conflict with the hypothesis embodied in the aphorism, *Corpora non agunt nisi soluta.*

It may then be imagined, without unreason, that even in a universe at the absolute zero of heat, so called—or, as the writer prefers to state it, altogether destitute of temperature or molecular motion—nuclei of temperature-development could happen through conversion of potential atomic energy into molecular energy; and such conversion could extend cumulatively throughout such a universe until the present known point of heat and light development, sufficient to sustain the known present forms of vitality, might result. HENRY WURTZ.

Temperature of Space. The phrase "temperature of space," derived from the illustrious Fourier, although in quite general use among physicists, is not a very accurate designation of the idea intended. Properly speaking, space itself can no more have temperature than it can have illumination. But a body situated in space must attain the temperature due to the combined effect of all the radiations received from the heavenly bodies at that particular position; and, to adopt Fourier's definition, "the temperature of planetary space, exactly defined, is that which would be indicated by a thermometer placed therein were the sun and its attendants blotted from existence." (*Annales Chim. et Phys.*, 1824, xxvii. 148.) Perhaps the least objectionable designation of this residual temperature (as the nearest analogue to star-light) would be "star-heat." Fourier supposed that this temperature could not be much less than the lowest degree of cold observed in polar regions, and estimated it at – 58° F. (– 50° C.). Following in his track, Poisson adopted essentially the same views, and the same estimate of the "temperature of space;" but he supposed that the polar system might pass in 1,000,000 years from an external temperature of + 100° C. to that of – 100° C. (*Comptes rendus*, 1837, iv. 151.) This fanciful suggestion is demonstrably impossible in fact. (See article REFRIGERATION OF THE EARTH.) When, in 1836, Arago announced to the Academy that Capt. Black's observation in his northern voyage of a temperature at Fort Reliance as low as – 70° F. (– 56.7° C.) must modify our conclusions derived from Fourier as to the "temperature of space" (it being actually 12° lower), Poisson controverted the inference, maintaining that the upper layers of the atmosphere were necessarily colder than the external "temperature of space." (*Comptes rendus*, ii. 575.) Pouillet in an elaborate and valuable *Memoir on the Solar Heat, the Radiant and Absorbent Power of the Atmosphere, and on the Temperature of Space*, presented to the Academy July 9, 1838, arrived at the value of – 224° F. (– 142° C.) for the latter. (*Comptes rendus*, 1838, vii. 64.)

Turning to English authorities, Mr. Hopkins in a communication to the Cambridge Philosophical Society, May 21, 1855, placed this star-heat as high as – 39° F. (– 39.5° C.); and he estimated from the data of Dove that the whole effect of solar heat (under our atmosphere) is nearly double that of the direct solar radiation. (*L. E. D. Phil. Mag.*, 1856, xi. 401.) Mr. Hopkins argues, from the lack of atmospheric transparency to obscure heat, that in order to allow the stellar heat to escape from our planet at as rapid a rate as it is received (or, in other words, that it may not be accumulating, and increasing the surface temperature), the exterior portions of our atmosphere must be colder than the surrounding space, with a still colder stratum below this, the minimum of temperature being "at some point within the earth's atmosphere." (*Loc. cit.*, p. 400.) When we reflect, however, that the air, even when dry, is not absolutely diathermanous, and that there is a constant tendency by conduction and convection to equalization, it would appear that the extreme limit of the atmosphere must in indefinite time attain to at least the temperature of star-heat. Sir John Herschel, in his *Treatise on Meteorology* (1857), from considerations based on the law of decreasing temperature in the atmosphere as the radiating surface of the earth is departed from, assigns – 239° F. (– 151° C.) as the probable "temperature of space." (*Meteor.*, sec. 36, *Encycl. Brit.*, 8th ed., xiv. 643.)

We have, then, as the estimates of these distinguished mathematicians, the following:

Fourier (1824),	star-heat	– 58° F.	– 50° C.
Pouillet (1838),	"	– 224	– 142
Hopkins (1855),	"	– 39	– 39.5
Herschel (1857),	"	– 239	– 151

While these values are very discordant, they all involve elements of great improbability. Assuming the absolute zero to be in round numbers about 500 Fahrenheit degrees below freezing water (– 278° C.), we have the startling result from Fourier's estimate that while we derive from the sun and stars a mean temperature of about 518 absolute degrees F. (289° C.), we derive from the celestial sphere (exclusive of the sun) 442 absolute degrees F. (245° C.); that is, of all the heat received by the globe, about five-sixths are due to the stars! It would appear that the mere statement should suffice to expose the fallacy of the assumptions.

Fourier appears to have quite underrated the blanketing effect of our atmosphere. The subaërial surface of our globe is practically that of an enclosed greenhouse; and if, as Hopkins allows, the actual surface temperature from

sun-heat is nearly double that due to the free solar radiation, then it follows that the "temperature of our space," under the full and unobstructed *blaze of the sun*, is as low as the lowest of the estimates above given for star-heat, or is more than 200° below the Fahrenheit zero. It is indeed wholly improbable that at our distance from the sun (92,000,000 miles) its radiant heat has sufficient energy to melt mercury (−39°), which is Mr. Hopkins's estimate of star-heat. We know that within our tropics, under a vertical sun, the line of perpetual snow is only about 3 miles above the sea-level; that is to say, with a barometric column of 15 inches, or one-half the atmosphere above it, ice is not melted by the direct rays of the sun. The same fact is even more strikingly illustrated by the well-known circumstance that the delicate spicules of ice in the frozen cirrus clouds remain untouched by an equatorial sun, with a considerable earth-radiation on their under sides.

We have really no reason for supposing that the aggregate proportion of heat to light radiated by the stars differs materially from that radiated by our sun. The whole amount of light received from the stellar vault on either hemisphere does not probably exceed the ten millionth of that received from the sun; and if the heat received be in the same proportion, even Herschel's estimate (the lowest on the list) must be pronounced enormously too high, and the star-heat commonly called the "temperature of space," cannot be much above the absolute zero. W. B. TAYLOR.

Temperature of the Body. The temperature of the human adult in a state of health averages from 98.4° to 98.6° F., the fractionally higher temperature existing in the warmer-blooded races, as those of Southern Europe, the lower average being found in northern nations and the Anglo-Saxon race. The fluctuations of temperature in health are exceedingly small—fractions of a degree, rarely more—dependent on physical activity or inactivity in sleep or wakefulness, or functional activity, as digestion. The extremities and surfaces may show a lowered temperature in winter, but the temperature taken by a thermometer in the mouth, rectum, armpit, or fold of the groin reveals a nearly uniform heat of the blood and internal organs. Animal heat is generated, and its uniform degree maintained, by the equal balance of nutritive supply and assimilation with destructive tissue-waste and excretion. Hence, the generation of heat in the body is a chemico-vital phenomenon. In so far as the sympathetic nervous system presides over the functions of the large organs, the secretory and excretory glands, and the capillary circulation, it may be said to regulate the temperature. As well-known examples of its office, "shock" or nervous depression causes reduced temperature, while excitement, pleasure, anger accelerate the circulation and elevate temperature. The temperature of children and infants is one to two degrees higher than that of adults. The temperature of aged persons is half a degree or more behind the adult average.

"Medical thermometry," the use of the thermometer to register and study temperature in disease, is now extensively practised in Europe and America. De Haen (during the fever at Breslau a century and more ago), John Hunter, and Currie employed the thermometer, but the German school—and notably Wunderlich—has popularized its use by the profession within the past fifteen years. The self-registering thermometer is employed, rendering observations useful to the physician taken by the nurse or attendant. Observations should be taken twice daily, morning and evening, as the uniformity of health is lost in disease, being replaced by marked increase of temperature toward and during night, and decrease or descent in the morning. In most diseases there is elevation of temperature. Exceptions to this rule are in various paralyses, gradual death by exhaustion, and stages of collapse after hæmorrhage or copious alvine evacuations. The essential fevers and all febrile disorders, local inflammations with sympathetic fever, have a period of invasion more or less abrupt and extreme. The temperature ascends from the normal 98.4° to 100°, 102°, 104° F., etc. The temperature reaches these higher points in children often from slight and temporary ailments, as indigestion or fatigue. In adults a temperature of 102°, 103°, 104° F., especially when initiated by a chill, indicates serious fever. Even during the period of chill, which is a tremor accompanying the subjective sensation of cold, the skin only is cool; the blood has been driven from the chilled, contracted skin to the internal parts, which are congested and hot. Thus, death by "congestive chill" often occurs in extremely malarial districts. Different diseases have peculiar and characteristic methods of onset. This period of access of fever is termed "effervescence." Thus, in intermittent fever in a half hour or hour the body-heat ascends from 98.4° to 104° or 106° F., while in typhoid fever it ascends 2° each day, falls 1° each morning for four or five successive days, and remains nearly stationary thereafter for several days. Typhus has a higher temperature than typhoid; the latter's average is 104°–105° F., the former 105°–107° F. A temperature of 106° or 107° F. is cause for solicitude and unfavorable prognosis, although it may go higher in rare cases, and recovery follow. Relapsing fever has a temperature ranging from 107° to 109° F., yet rarely is fatal. In many fatal cases the temperature during life has reached 110°, and 112° F. has been recorded. When in a fever patient the morning temperature is found slightly below that of the previous evening, recovery will probably ensue. The decline of temperature, approaching recovery, is termed *defervescence*. In some cases the temperature falls many degrees suddenly, coincident with the appearance of perspiration or the free secretion of urine. Then the fever is said to terminate by crisis. Thus, in typhus within a few hours it descends from 106° F. to near the normal. More often the defervescence is gradual, as in typhoid, by *lysis*, a gliding or gradual descent. After death, as a rule, the body cools as *rigor mortis* takes place. A remarkable exception exists in the body following death from Asiatic cholera. The temperature, which may have descended during "collapse" and at the time of death to 93° or 94° F., rises to 100° or 110° F., becoming hot; this is due to chemical changes in the tissues of the body, accompanied by evolution of heat. Such return of heat is often interpreted as a return of life to the dead, especially when automatic movements of the corpse coexist. The latter are induced by the irritation of the chemical changes upon the ganglionic cells of the spinal cord, which seem to retain their vitality later than the brain and medulla.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Temperature of the Earth. See EARTH, by PROF. A. GUYOT, PH. D., LL.D.

Tempered or Toughened Glass. See GLASS, by C. G. LELAND, A. M.

Tem'pio Pausa'nia, town of Sardinia, province of Sassari, on the slope of the Limbara chain, and almost surrounded by mountains in every direction. The climate is cold in winter, while the heat in summer is excessive, owing to the smallness of the basin in which the town lies. The buildings are of polygonal blocks of granite, and very little lime is used on account of its cost. The public edifices are respectable, and the houses of the better class are not without comfort, but those of the poor are very wretched. They have no floors but the earth; the walls, as was said above, are without mortar or plaster, and consequently allow free passage to the sharp mountain-winds; the roofs are of reeds, covered very imperfectly with clay and tiles, and admitting not only the little light which enters the hut, but the rain, the snow, and the hail as well. In winter the cows or horses, or both if the family possess them, share the one room, for generally there is but one, with their owners. Even here, however, the new order of things is beginning to be felt, and it is said that a decided advance in decency, and even in comfort, is perceptible during the last few years. The inhabitants are laborious, and export cheese, honey, wool, cork, hides, and even cattle. P. 10,096.

Tem'plar, Knights, or **Poor Soldiers of the Temple of Solomon,** a military and religious order founded in 1118 or 1119 by nine French gentlemen at Jerusalem for the defence of the Holy Sepulchre and of pilgrims. Their rule was prepared in the Council of Troyes, and confirmed by the pope in 1128. They were at first all noble laymen, but in 1172 secular priests were admitted as chaplains. In 1146 the red cross banner became their distinction. They were at first bound by vows of poverty, chastity, and severe religious exercises. On the loss of the Holy Land (1192) they occupied Cyprus. They had some time previously organized chapters in most European countries, and their fame for valor and piety was great. Their wealth and luxury rapidly increased also, and were the occasion of their final overthrow. This was accomplished by the conjoined efforts of Philip IV. of France and Pope Clement V. They were accused of abominable and unheard of crimes, and of Ophitic, Gnostic, and even Mohammedan practices, and of the worship of the Baphomet. In 1308 the pope demanded the aid of all princes and prelates in suppressing the order, and their dissolution was proclaimed in 1312 by the Council of Vienne. Their grand master, De Molay, was burned alive in 1314, and considerable numbers suffered the same fate both before and after that date. In most countries their property was in part seized by the sovereign, and in part turned over to the Hospitallers and other orders. In Portugal the order never was suppressed, but in 1317 took the name of the Order of Christ, which name it still bears; but the vows of poverty and chastity have been long since relinquished, so that it is now a strictly military order. It has a branch in Italy dependent upon the Apostolic See.

Tem'ple, tp., Franklin co., Me. P. 640.

Temple, p.-v. and tp., Hillsborough co., N. H. P. 421.

Temple (DANIEL), b. at Reading, Mass., in 1790; graduated at Dartmouth College 1817 and at Andover Seminary 1820; went as a missionary of the American Board to the East 1822, taking a printing-press; was stationed at Malta 1822-32, and at Smyrna 1833-44; printed many volumes in modern Greek, Italian, and Armenian; edited a magazine in Greek; wrote several religious books in that language; returned to the U. S. 1844; was for two years a travelling agent of the board, and was settled at Phelps, N. Y., 1847-49. D. at Reading, Mass., Aug. 9, 1851. His *Life and Letters* (1855) were published by his son, with an introduction by R. S. Storrs, Sr., D. D.

Temple (FREDERICK), D. D., b. in England Nov. 30, 1821; educated in the grammar school at Tiverton; obtained a scholarship at Baliol College, Oxford, where he graduated with the highest honors 1842; became fellow and mathematical tutor there; took orders in the Church of England 1846; was principal of the training college at Kneller Hall, near Twickenham, 1848-55; one of the government inspectors of schools 1855-58, and master of Rugby School from 1858 to 1869, when he was appointed by Lord Palmerston bishop of Exeter. He is a chaplain to the queen; was one of the authors of the famous *Essays and Reviews* (1860), and his confirmation to a bishopric was ineffectually opposed by the conservative party in the Church. He wrote 3 vols. of *Sermons preached in Rugby Chapel* (1861-71).

Temple (HENRY JOHN). See PALMERSTON, VISCOUNT.

Temple (Sir RICHARD), b. in Worcestershire, England, about 1825; passed through a distinguished career in the India civil service; was knighted 1867, and has been for several years (1876) lieutenant-governor and actual ruler of Bengal, in which capacity he has accomplished immense results for good, especially during the famine of 1874.

Temple (RICHARD **Grenville**), K. G., EARL, brother of George Grenville, b. in England Sept. 26, 1711; entered Parliament for Buckingham 1734; succeeded to the earldom on the death of his mother, Hester, Countess Temple, Oct. 6, 1752; advanced in political life by William Pitt, who married his sister Hester; lord of the admiralty 1756-57, lord privy seal 1757-61, and made a knight of the Garter 1760. D. at Stowe Sept. 11, 1779. His correspondence, and that of his brother George, with Pitt, was edited as *The Grenville Papers* (4 vols., 1852-53), by W. J. Smith.

Temple (Sir WILLIAM), BART., b. in London, England, in 1628; educated at Emmanuel College, Cambridge; travelled on the Continent for six years 1647-54; married 1654; resided several years with his father in Ireland; was a member of the Irish convention 1660; a joint commissioner of the Irish Parliament to Charles II. 1662; settled in England 1663; was sent on a secret mission to the bishop of Münster 1665; was made a baronet and minister resident at the court of Brussels 1666; visited Holland to urge the formation of a league against Louis XIV. 1667; negotiated the triple alliance between England, Holland, and Sweden Jan., 1688; assisted in perfecting the Peace of Aix-la-Chapelle, and was commissioned ambassador to the Hague 1668; returned to England Sept., 1670; was dismissed from office June, 1671, in consequence of the change of policy which had already (1670) led to a secret treaty with France, but was again appointed to negotiate a peace with the States General 1674; assisted at the Congress of Nymwegen 1675-79; devised for Charles II. the plan of his new privy council of thirty members Apr., 1679; declined the secretaryship of state in the same year; was stricken from the roll of privy councillors 1680; served in Parliament as member for the University of Cambridge for a single session; lived in retirement at Sheen or Moor Park during his later years, having as secretary and literary assistant Jonathan Swift; was visited and consulted by William III., but declined to return to political life. D. at Moor Park, Surrey, Jan. 27, 1699. Author of *Observations upon the United Provinces* (1672), *The Origin and Nature of Government*, *Essay upon Ancient and Modern Learning*, and other publications, collectively issued as his *Works* (2 vols., 1720), edited with a *Memoir* by Dr. Swift.

Temple (WILLIAM G.), U. S. N., b. Mar. 3, 1824, in Vermont; entered the navy as a midshipman May 21, 1840; became lieutenant in 1855, commander in 1865, captain in 1870; served on the W. coast of Mexico during our war with that country, and in 1864 commanded the steamer Pontoosuc in both the Fort Fisher fights. Commended for gallantry and recommended for promotion by Rear-Admiral Porter in his official despatch of Jan. 28, 1865.

FOXHALL A. PARKER.

Temple, The. See JERUSALEM, by REV. HOWARD CROSBY, S. T. D., LL.D.

Tem'pleton, p.-v. and tp., Worcester co., Mass. P. 2802.

Templeton, tp., Atchison co., Mo. P. 974.

Templeton, p.-v. and tp., Prince George co., Va. P. 1326.

Tem'poral Bones [Lat. *tempora*, the "temples" of the head], a pair of irregular bones which in man constitute a portion of the sides and base of the skull. Each consists of (1) a *squamous* portion, perhaps a part of the expanded neural spine of the second cephalic vertebra; (2) a *mastoid* portion; and (3) a *petrous* portion. Some regard these two last as parts of the splanchno skeleton rather than of the vertebral skeleton, considering them as structurally parts of the auditory apparatus, although they are functionally, at least in part, identified with the rest of the temporal bones. But others regard the mastoid as belonging to the neural arch of the second vertebra. The zygomatic process reaches forward from the outer surface of the squamous portion, and joins the malar bone, forming the zygomatic arch; while attached to the petrous portion are a long *styloid* process and a nearly circular auditory process, the pleurapophyses, or *ribs*, of the third and second vertebræ of the skull. Attached to the mastoid portion is the *mastoid* (teat-shaped) *process*, which after puberty becomes hollowed into a number of *mastoid cells*.

Temporal Power. See PAPAL STATES and ROMAN CATHOLIC CHURCH.

Tenacity of Metals, etc. See STRENGTH OF MATERIALS, by W. A. NORTON.

Tenancy from Year to Year. See TENANT FOR YEARS.

Ten'ancy in Common (in law) is a particular mode of owning the same parcel of land in undivided shares by two or more persons, so that while neither is entitled to the exclusive possession of any particular portion, each is entitled to an equal possession of the whole, and the possession of one is that of all. The statutes of the various States have so radically changed the common-law doctrines that, as the general rule, whatever in England would have been a joint-tenancy is in the U. S. a tenancy in common; *e. g.* when land is conveyed to two or more by the same deed, or is devised to them by will, or is inherited in undivided parts by a number of heirs. On the other hand, the undivided shares need not be acquired by all the holders at the same time nor from the same source, nor be of an equal amount nor of the same estate. Every owner in common has a complete power of disposal over his undivided share; it is liable for his debts; it may be mortgaged, conveyed, devised, inherited; is subject to dower or curtesy. Finally, in every case of an ownership in common, one or more of the owners may always enforce against the others a partition of the land; that is, a judicial separation of the hitherto undivided shares, and a distribution of these ascertained portions, so that the common ownership will be thereby ended, and in place thereof each person will become entitled to his own individual allotment. (See articles JOINT TENANCY and PARTITION.)

JOHN NORTON POMEROY.

Ten'ant for Years, at Will, and by Sufferance. Estates or tenancies for years are interests in land granted for some definite period of time, and embrace those for a single year or less, as well as those for any fixed number of years, however great. At the common law these interests, no matter for how long a time they are to last, even for 1000 years, are inferior to estates for life or in fee; but in some of the States leases for 100 years or more have been partially assimilated by statute to inheritances. The estate for years, with the exceptions just mentioned, possesses the quality of personal rather than of real property, for on the death of the lessee his remaining interest in the land goes not to his heirs, but to his executors or administrators. In modern law the tenancy is created by a contract called a lease, whereby one party, the lessor, and generally the owner, lets to another, the lessee or tenant, the possession of the specified land, building, or part of a building for a definite period of time agreed upon by the parties. The word "term"—from *terminus*, a "boundary"—is often used to designate both the period during which the tenant's interest is to last, and also the interest itself. By the statute of frauds leases for more than a certain designated time must be in writing in order to be fully binding according to their provisions. In England and in several of the American States this maximum period for an oral lease is three years; in New York and many other States it is one year. Verbal lettings for these terms, or for less, are in every way valid, and even a verbal contract for a longer term is not absolutely void. In addition to the letting of

the premises, leases may, and usually do, contain various stipulations, of which there are two generic classes, covenants and conditions. A covenant is simply an agreement to do or not to do some act in reference to the premises, and may be made either by the lessor or the lessee; as, for example, the latter may agree to pay rent, not to assign or underlet, not to use the premises in a certain manner, and the like, while the former may agree to repair, to rebuild in case of fire, to pay the taxes, etc. A condition is an agreement necessarily by the tenant, with a further provision that if he fails to perform, the lease is to become void at the option of the landlord, who may thereupon enter and resume the possession. Any and all agreements of the lessee may be thus fortified and enforced by conditions, but the sole remedy for the breach of a mere covenant is an action for damages. The rights of the tenant may be summed up as follows: Complete possession during the continuance of the estate, and reasonable use in all modes and for all purposes to which the premises are adapted, unless such use is restricted and regulated by the contract. As long as no condition has been broken, he has the exclusive right of possession, and neither the landlord nor a stranger can enter except by his license. If not prohibited by the contract, he may assign the lease or sublet the premises or any part thereof. An assignment consists in a transfer of the entire interest the whole remainder of the term, and the assignee then becomes liable for all the rent accruing while he continues to hold the lease, but if he in turn transfers it, his liability for any subsequent rent ceases. The duties of the tenant may be summed up by saying that he is bound to perform all his conditions and covenants contained in the instrument. The most important of these is his covenant to pay rent. His liability for the rent continues during the entire term; he does not free himself from it by assigning, since it arises out of his express contract to pay, as well as out of his possession and interest, while the assignee's liability results solely from his interest. In the technical language of the law, between the lessor and lessee there is privity both of contract and of estate, while between the lessor and assignee there is only a privity of estate. In New York and many other States the statutes provide summary proceedings by which the landlord may dispossess a tenant who fails to pay his rent, even though the lease contains no condition in reference to the matter. The tenant's liability for the rent ceases if he is evicted from the whole of the premises by a person holding a title paramount to that of the landlord (that is, by the true owner), or if he is evicted from a portion of the premises by the landlord himself. As a general rule, however, the tenant is not permitted to deny his landlord's title, and on that ground refuse to pay the rent, as long as there has been no eviction by a true owner or a change in the relations of the parties equivalent to an eviction. Unless he agrees to do so, the landlord is not bound to keep the premises in repair during the continuance of the lease. In the absence of express stipulations to the contrary, it is the tenant's duty to make all necessary repairs, and he is responsible for waste caused or suffered by himself. Even the destruction of the buildings by fire or by the elements did not, at the common law, affect the tenant's liability for rent. This hard rule has been altered by statute in New York and other States, which permits the tenant to surrender the lease if the buildings are destroyed by fire or rendered untenantable by storms, floods, or other agencies without his fault, neglect, or procurement.

A *tenant at will* is one who holds possession of lands during the will of the landlord or of himself, so that either may terminate the holding at any time by his own act. Anciently, whenever a person held possession of land under an agreement to pay rent, but without any stipulation as to time, he was a tenant at will; but in modern times such facts, and especially the rent, constitute a "tenancy from year to year," which requires a notice of six months for its termination. Tenancies purely at will now arise when the landlord permits the premises to be occupied without rent and with no agreement as to time, and also when the parties expressly agree that the occupation shall be at will, although rent is paid. At the common law no notice to quit is required to end a tenancy purely at will; any act by the landlord in assertion of his right to the possession is sufficient to produce that result. In several of the States a notice to quit is made necessary by statute; in New York it must be given thirty days before the time designated.

A *tenant by sufferance* is a person who, having been rightfully in possession of land by permission of the owner, continues to hold the same after the time to which he was entitled has expired. He has no estate, interest, or right to the possession, but simply the possession. He holds merely by the sufferance of the owner, and his only semblance of legal interest or advantage is, that he is not liable as a trespasser until the owner has entered and put an end to his occupation. JOHN NORTON POMEROY.

Tenas'serim, a division of the British province of Burmah, forming part of the British empire in India, contains an area of 46,730 sq. m., with 576,765 inhabitants, and is that tract of country lying between 10° to 17° N. lat., along the eastern side of the Bay of Bengal, and between it and a high chain of hills about 40 miles inland. It includes the Mergui Archipelago—that is, the chain of islands along the coast, and 15 to 20 miles distant from it. The surface of the country is mountainous, thinly populated, and much intersected by streams. The great boundary range is 5000 feet high; in the latitude of Tavoy it is 40 miles wide, whence it gradually narrows to 10 miles near Mergui. The whole range is covered with pathless jungle, and may be said to be without a human habitation. The coast is very irregular and low for some miles inland, consisting of uncultivated mangrove islands. The principal river is the Tenasserim; it gives its name to the division, rises in about 15° N. lat., and empties itself into the sea by two mouths, the northern of which is the more easily navigable for large ships. The soil is clayey, mixed with a good deal of sand. Rice is the staple product; the cultivation of sesamum and fruit trees is very productive. Coal has been discovered, and found to be well adapted for steamers, having a low specific gravity; ores of excellent tin, copper, magnesia, and iron are opened in abundance. The climate is moist and depressing for a part of the year, but cooler, and on the whole better adapted to the European constitution, than any other part of India; the mean annual temperature at Tavoy is 79.5° F. The division comprises five districts; the head-quarters are at Maulmain, a large town with 53,653 inhabitants, to which the post-steamers from Rangoon run twice a month. The gross revenue receipts of the division amount to £211,240 a year; the trade in merchandise is improving, and had risen in 1873 to £1,241,815; the principal export is rice, of which from 200,000 to 300,000 tons are shipped to China and other Eastern markets. Tavoy and Mergui were taken by the British as early as 1757; the island was ceded by Burmah in 1826. E. SCHLAGINTWEIT.

Tench [Fr. *tenche*], the English name of the *Tinca vulgaris*, a fish belonging to the family Cyprinidæ, abundant in European streams and lakes, and the only member of its genus. It has a compressed, fusiform shape, the trunk covered with small scales, the lateral line little decurved, the head conic in profile, the mouth small, and with a small barbel at each corner, the dorsal above the pectorals, and short, the anal also short, and the caudal little emarginated; the pharyngeal teeth are compressed, club-shaped, and in one row, generally five on the left and four on the right side; the rays are D. 11, A. 10, P. 17, V. 10; the color is generally dark greenish-olive above and on the sides, lighter below; the fins dark-brownish. It occasionally attains a length of nearly three feet and a weight of twelve pounds, but does not often weigh more than three pounds. It prefers rather deep and weedy, and apparently even foul water. It is very tenacious of life. The female spawns in the spring "when wheat is in blossom." The fish is popularly supposed to possess healing properties. It is by some rather esteemed as a table-fish. THEODORE GILL.

Tencin', de (CLAUDINE ALEXANDRINE GUÉRIN), MARQUISE, b. at Grenoble, France, in 1681; was compelled by her parents to enter a nunnery in her native city, much against her own will, and was subsequently removed to another monastery near Lyons of a less rigorous discipline, but fled in 1714 to Paris, and was released from her vows by the pope through the influence of her powerful friends, especially through that of Fontenelle. She was the mistress of D'Argenson, Bolingbroke, Marshal Uxelles, the duke of Orleans, Cardinal Dubois, Law (by whose aid she made a considerable fortune), Destouches-Canon (who is said to be the father of D'Alembert, the most celebrated of her children), and many others. In 1726 she was for a short time confined in the Bastile on account of a duel in which one of her lovers had been killed. But at the same time she was one of the stars of Parisian society, and is said to have exercised considerable influence on its tone. Her salon was frequented by the most celebrated littérateurs, and she herself was an authoress of repute; she wrote *Mémoires du Comte de Comminges*, *Le Siège de Calais*, *Les Malheurs de l'Amour*, *Anecdotes de la Cour et du Règne d'Édouard II., Roi d'Angleterre*. D. at Paris Dec. 4, 1749. Her son, D'Alembert, was rescued from the foundling hospital and educated by his father. Her works have been edited in 5 vols. (1825) by Jay and Étienne; they were formerly published with those of Madame La Fayette.

Ten'der [Lat. *tendere*, to "stretch" or "extend"], in law, is an offer to deliver either money or chattels due in

pursuance of some contract or obligation, in such form and manner that if accepted by the creditor the transfer will thereby be complete and the liability will be discharged. It may be made by the debtor or his agent, and to the creditor or to a person authorized to receive payment for him. In order that a tender of money may be available, it must be of such coin or other circulating medium as the law has made a "legal tender" in payment of debts, or else the creditor may refuse to accept it; but if he does not put his refusal upon that ground at the time, he cannot afterward raise the objection. The full amount due must be offered, and some cases hold that if more than that sum is tendered there must be no intention of demanding a return of the surplus. The offer must also be absolute, and without any condition annexed to its acceptance. A mere ability, readiness, willingness, or verbal proposal to pay is not sufficient; as the word itself indicates, the offer must be accompanied by an actual production of the money in the presence of the creditor, so that the power and wish to deliver it may be openly shown, unless the peremptory nature of his refusal or other conduct on his part amount to a waiver of this condition. If any specific place of payment has been agreed upon, the tender must be made there; but if no such place has been designated, it may be made wherever the creditor is found. A valid tender of money does not discharge the debt; it simply cuts off all interest from that date and all costs of suit; and even to produce this effect it must at all times be kept good—that is, the debtor must be ready and willing to pay whenever a demand is subsequently made upon him. Although a tender does not discharge the debt, it may operate to destroy a lien—for example of a mortgage—held by the creditor as security for the payment. JOHN NORTON POMEROY.

Tendon, in anatomy, the name of a white fibrous tissue connecting the end of a muscle with the bone which it is intended to move. It has sometimes the form of a cylindrical cord, sometimes of a broad ribbon, and in a few cases of a wide, thin sheet, but it is always inextensible and inelastic, and transfers at once the motion imparted by the contraction of the muscle to the bone into which it is inserted.

Tendon, Achilles'. See ACHILLES' TENDON.

Ten'drac, the French name conferred on the genus *Ericulus*, a member of the family Centetidæ. It is closely related to the TANREC (which see), but the teeth are larger, especially those of the lower jaw, and the premolars follow closely after the canines; there are four (2 × 2) incisors in the lower as well as upper jaw. It is about a third smaller than the hedgehog of Europe, which it considerably resembles in general appearance. It is peculiar to the island of Madagascar. THEODORE GILL.

Tene'brio [Lat. *tenebræ*, "darkness"], (*Tenebrio molitor*), a coleopterous insect allied to the *Blaps*, of a dark-brown color, smooth, about half an inch long, with wings and wing-covers, short antennæ and stout legs; is common in granaries, mills, and other places where meal or flour is kept, and is most active during night. Its larva, about an inch long, thin, smooth, of an ochreous color with rusty bands, with six small feet and two short antennæ, is the so-called meal-worm, which often does considerable injury.

Ten'edos, a small island in the Ægean Sea, 17 miles S. of the entrance of the Strait of the Dardanelles, belonging to Turkey, and has a pop. of about 7000, partly Greeks and partly Turks. It is celebrated for its exquisite wine.

Ten'ement [Lat. *tenementum*, from *tenere*, to "hold"]. In the common law this word denotes anything of a permanent nature—that is, not a movable or chattel—which may be holden from a superior lord or of which tenure may be predicated. An ancient phrase of the English law describes real property as consisting in "lands, tenements, and hereditaments." "Tenement" is a word of broader meaning than "land," for it applies to a large class of incorporeal rights which are regarded by the law as a kind of property that may be holden, as well as to corporeal things. It includes not only land, and the buildings and other fixtures forming a part thereof, but also rights issuing out of or connected with land, such as rents, commons, easements or servitudes, profits *à prendre*, and the like. The term had its origin in the system of feudal tenures, by virtue of which all lands were held from superior lords in consideration of some feudal service, either military or having a pecuniary value. The person thus holding an estate was therefore termed a "tenant," and the property held, whether it was land or a rent in fee or for life issuing out of land, or an easement annexed to the land, was called a "tenement," a holding or thing held. If the estate in fee or for life was thus held by a "free-man," in contradistinction to a vilain or serf, it was anciently denominated a "frank tenement," and the English equivalent "freehold" came to be the generic name given to these higher grades of ownership—estates in fee or for life—in order to distinguish them from the lower grades, or estates for years. In modern and popular nomenclature the word "tenement" is often used in wills, deeds, and other instruments to designate any building for habitation or occupation, such as a dwelling-house or messuage, shop, warehouse, and the like. This use of the term probably arose from the fact that in England such buildings are generally occupied by tenants or lessees, rather than by their owners in fee. (The reader may further consult the articles on the FEUDAL SYSTEM and on the various kinds and incidents of real property.) JOHN NORTON POMEROY.

Tenera'ni (PIETRO), b. at Torano, near Carrara, Nov. 11, 1789; was a pupil in sculpture of Canova, and also of Thorwaldsen. His principal works are—a *Psyche with the Vase of Pandora*, a group of *Venus and Psyche*, a *Venus reclining, with Cupid drawing a Thorn from her Foot*, a *Piping Faun*, a *Crucifix*, a statue of *Bolivar* for Colombia, a bas-relief representing the *Deposition from the Cross*, the *Angel of the Last Judgment*, a statue of great power; busts of Thorwaldsen, of Pius IX., etc., and many other works for churches and cemeteries. D. at Rome Dec. 14, 1869.

Teneriffe', the largest of the Canary Islands (see CANARIES), comprises an area of about 900 sq. m., with about 90,000 inhabitants. The coasts are rocky and wild, and afford only one good harbor, that of Santa Cruz de Santiago. The interior is mountainous, and in the centre the ground rises in the mighty volcano of Pico de Teyde to a height of 12,182 feet. The upper half of this peak is rugged and barren, covered with pumice-stone and lava blocks, always emitting sulphurous vapors through its crevices, and generally enveloped with a girdle of clouds, through which its top pierces like a spear. The middle region is clad with beautiful forests of chestnut and oak, and the foot, as well as the hills and valleys around it, is covered with vineyards, olive and almond groves, wheatfields, and orchards in which oranges and figs ripen to perfection. Principal town, Santa Cruz de Santiago.

Teneriffe Wine, a white wine from the Canaries, bears a close resemblance to madeira. It is somewhat acid, and has when good a nutty and aromatic bouquet. Its percentage, by measure, of alcohol varies from 16.61 to 19.79, and it is somewhat stronger than the average sherry.

Tenhas'sen, p.-v. and tp., Martin co., Minn. P. 314.

Teniers' (DAVID), called THE ELDER, b. at Antwerp in 1582; studied painting; visited Rome; settled in his native city, and d. there in 1649. He painted genre pieces, mostly scenes of the every-day life of the lower classes of the Flemish population, picnics, fairs, alehouse scenes, charlatans, etc., and acquired a great reputation, but was, nevertheless, entirely outshone by his son, DAVID TENIERS, called THE YOUNGER, who was born at Antwerp in 1610; educated partly in his father's studio, partly in that of Rubens, and appointed court-painter to the archduke Leopold William of Austria, governor of the Flemish provinces, and afterward superintendent and director of his picture-gallery. He painted both biblical and historical subjects and landscapes, but his masterpieces are genre pictures. He resided first in Brussels, afterward at Lerck, where he built a splendid mansion, Dry Toren, and where he d. Feb. 11, 1685. He was a rapid worker, and produced more than 1000 pictures, but his fame was so great that he could hardly satisfy the demand and fill the incoming orders. Philip IV. of Spain had a separate gallery arranged in his palace for Teniers's pictures. Excellent specimens of his art are also in Vienna and at the Louvre, although Louis XIV. felt very little sympathy for him, and ordered his pictures to be removed out of his way.

Ten Mile, p.-v. and tp., Macon co., Mo. P. 1518.

Ten Mile, tp., Harrison co., West Va. P. 1736.

Ten Mile River, tp., Mendocino co., Cal. P. 80.

Ten'nant (SMITHSON), M. D., F. R. S., b. at Selby, Yorkshire, England, Nov. 30, 1761; was distinguished in childhood for his fondness for chemistry and physics; studied medicine at Edinburgh under Dr. Black 1781–82; was a resident member of Christ's College, Cambridge, 1782–86, and of Emanuel College 1786–89; travelled in Denmark and Sweden 1784, visiting the mines and becoming acquainted with the celebrated chemist Scheele, whose recent discoveries he much admired; resided for some time in Paris and the Netherlands engaged in chemical studies; became a member of the Royal Society 1785, and resided in London from 1789 until 1813, when he was elected professor of chemistry at Cambridge. D. by a fall from his horse at Boulogne Feb. 22, 1815. Author of eight papers on chemistry and mineralogy in the *Philosophical Transactions*; was the discoverer of the purely carbonic character of the diamond, of the identity of emery and corundum, and of the minerals osmium and iridium.

Tennant (William), LL.D., b. at Easter Anstruther, Fifeshire, Scotland, May 15, 1784; became a cripple in childhood; studied at the University of St. Andrew's 1799-1801; was for some years clerk to his brother, a corn-factor at Glasgow, and afterward in his native town; published *The Anster Concert* (1811), a poem in the Scottish dialect, and *Anster Fair, a Poem in Six Cantos* (1812), in *ottava rima*, both descriptive of rural Scottish life, which gradually acquired popularity; was parish schoolmaster of Dunino 1812-16, and at Lasswade 1816-19; acquired the Arabic, Syriac, and Persian languages; taught Oriental and classical languages in the academy of Dollar, Clackmannanshire, 1819-34; became in 1834 professor of Oriental languages in St. Mary's College, St. Andrew's, and subsequently was also professor of Hebrew in Edinburgh College. D. near Dollar Feb. 15, 1848. Author of several later poems and dramas which were not successful, of a *Syriac and Chaldee Grammar* (1840), a *Life of Allan Ramsay* (1808), and of numerous contributions to periodicals, including some translations from Oriental poets.

Ten'nemann (Wilhelm Gottlieb), b. at Brembach, near Erfurt, Prussian Saxony, Dec. 7, 1761; studied theology, afterward philosophy, at Erfurt and Jena, and was appointed professor of philosophy in 1798 at Jena, and in 1804 at Marburg, where he d. Sept. 30, 1819. His principal work is his *Geschichte der Philosophie* (11 vols., 1798-1819). Of this work he gave in 1812 an abridgment, *Grundriss der Geschichte der Philosophie*, which has been often republished, and translated into English by Arthur Johnson (Oxford, 1832). Among his other works is a *System der Platonischen Philosophie* (4 vols., 1792-94).

Ten'nent (Gilbert), b. in county Armagh, Ireland, Feb. 5, 1703; came to Philadelphia in 1718 with his father, a Presbyterian minister, whom he aided in the management of an academy; studied medicine and theology; was ordained pastor of a church at New Brunswick, N. J., 1726, where he remained until 1743; travelled in New England 1740-41, preaching with great success as a coadjutor of Whitefield in his revival labors; founded at Philadelphia in 1743 a Presbyterian church composed of followers of Whitefield; visited various parts of the colonies as a revivalist; published an account of the revival of 1744, several volumes of sermons, and many single addresses, and visited England 1753 to solicit contributions for Princeton College. D. at Philadelphia July 23, 1764.

Tennent (Sir James **Emerson**), Bart., LL.D., b. in Belfast, Ireland, Apr. 7, 1794, son of William Emerson, a wealthy merchant; was educated at Trinity College, Dublin; travelled after graduation (1824-25) through Europe and the Levant, also in Greece, where he met Lord Byron and became an enthusiast for Grecian independence; published *A Picture of Greece in 1825* (1826), *Letters from the Ægean or Grecian Islands* (2 vols., 1829), and a *History of Modern Greece* (2 vols., 1830); was called to the bar 1831, but never practised; married (June, 1831) the only daughter and heiress of William Tennent, a wealthy banker of Belfast, whose name and arms he assumed by royal license in the following year; was chosen for Belfast as a Whig to the first Reformed Parliament 1832, and several times subsequently; withdrew from the Whigs, along with Lord Stanley and Sir James Graham, in what was called the "Derby dilly;" was subsequently an efficient supporter of Sir Robert Peel; was secretary to the Indian board 1841-45; published a work on *Belgium* (2 vols., 1841) and a *Treatise on Copyright of Designs for Printed Fabrics* (1841); procured the passage of an act establishing copyright in designs 1843; was knighted and appointed civil secretary to the colonial government of Ceylon July, 1845; filled that post until Dec., 1850; was chosen to Parliament for Lisburn 1851; was secretary to the poor-law board under the Conservative administration of 1852; was subsequently (1852-67) one of the joint secretaries to the board of trade, and retired from office with a baronetcy Feb. 5, 1867. D. at London Mar. 6, 1869. Author of *Christianity in Ceylon* (1850), *Wine, its Use and Taxation* (1855), *The Story of the Guns* (1864), and *The Wild Elephant* (1867), besides his chief work, *Ceylon, an Account of the Island, Physical, Historical, and Topographical*, etc. (2 vols., 1859). He also contributed largely to *Notes and Queries* and *Land and Water*; wrote the articles "Tarshish," "Trincomalie," and "Wine-making" in the 8th ed. of the *Encyclopædia Britannica*, and republished a portion of his larger work, with additions, under the title *Sketches of the Natural History of Ceylon* (1861), with illustrations from original drawings.

Tennent (William), D. D., brother of Gilbert, b. in county Antrim, Ireland, Jan. 3, 1705; came to America with his family 1718; studied theology under his brother at New Brunswick; had a remarkable catalepsy or trance which continued three days, during which he had every appearance of being dead, and so completely lost all memory of his past life that he had to be taught to read anew; recovered his memory by a sudden shock in the head, and related extraordinary visions of heaven as seen during the state of trance, and of being sent back to earth by a heavenly messenger; was ordained pastor of the Presbyterian church at Freehold, N. J., Oct. 25, 1733, as successor to his brother John, and filled that post forty-four years until his death, Mar. 8, 1777. He published a few occasional sermons, some of which were included in a volume entitled *Sermons and Essays by the Tennents and their Contemporaries* (1855). A *Life of Rev. William Tennent, with an Account of his being Three Days in a Trance* (New York, 1847), was prepared by Judge Elias Boudinot. Some "statements" of his on the subject of the famous trance may be found in Prince's *Christian History*. (See Sprague's *Annals*, vol. iii., and Storrs's *Constitution of the Human Soul*, 1857.)

Ten'nents, tp., Franklin co., Ala. P. 68.

Tennessee', one of the central States of the Union, lying mostly in the lower Mississippi Valley, between the parallels of 35° and 36° 30' N. lat., and between the meridians of 81° 37' and 90° 28' W. lon. from Greenwich. It is bounded on the N. by Kentucky and Virginia, on the S. E. by North Carolina, on the S. by Georgia, Alabama, and Mississippi, and on the W. by the Mississippi River,

The Seal of Tennessee.

which separates it from Arkansas and Missouri. Its greatest length from E. to W. is 432 miles, and its extreme width 109 miles. The State is rhomboidal in shape. The area is stated in the ninth census report as 45,600 sq. m., or 29,184,000 acres, but Col. J. B. Killebrew, the secretary of the Tennessee Bureau of agriculture, and author of the *Resources of Tennessee* (Nashville, 1874), gives the area as only 42,000 sq. m., or 26,880,000 acres.

Face of the Country and Topography.—The State comprises eight great natural divisions: (1) The mountain-ridges of the Appalachian chain, forming the eastern border of the State. This portion of the Appalachian chain is called the Unaka Mountains. Its average elevation is 5000 feet above the sea, and its area about 2000 sq. m. Its climate is similar to that of the Catskill region in New York. The valleys among the mountains are arable, but the region generally is barren, and of little agricultural value. (2) Adjoining this on the W., and lying between the Unakas and the Cumberland Table-land, is the valley of East Tennessee. This valley, bordered by much higher lands, stretches from N. E. to S. W. in a succession of ridges and minor valleys, its average elevation being about 1000 feet above the sea, and its area 9200 sq. m. A large proportion of it is arable and fertile. (3) Next comes the Cumberland Table-land, a rocky plateau 2000 feet above the sea, its eastern face a gray, abrupt, cliff-lined rampart, rising almost perpendicularly from the valley; its western face jagged and broken, less abrupt, and having numerous finger-like spurs penetrating and separating the valleys. Its area is 5100 sq. m. (4) From the western edge of this Cumberland Table-land, the Highlands, Rim lands, or Terrace lands extend to the Tennessee River. The[illegible] average elevation of about 1000 feet above the [illegible] is a region of great agricultural importance [illegible] 9300 sq. m. (5) In the centre of these Highlands [illegible] the great Central Basin, elliptical and resembling [illegible] drained lake. This basin has an average [illegible] feet below the Highlands, and an area [illegible] Its soil is fertile and highly productive. [illegible] of the Rim lands and of the basin is less [illegible] N. W. side than on any other. (6) Beyond the western edge of the Highlands, and penetrated by [illegible] from these, [illegible] narrow W. valley of the lower Tennessee and its smaller affluents. This valley has an average breadth of 10 or 12 miles,

and extends across the State. Its area is 1200 sq. m., and its elevation about 350 feet above the sea. It is fertile, but in some places marshy, with cypress swamps. (7) The plateau or slope of West Tennessee, a broad, rolling plain about 84 miles wide, and sloping toward the Mississippi River, terminating a short distance E. of the river in a long, steep bluff. This plateau is furrowed with river-valleys. The soil is light, porous, silicious, and for the most part abundantly fertile. The area is about 8850 sq. m., and the elevation averages 500 feet. (8) The bottoms of the Mississippi, forming a flat alluvial plain, with frequent lakes and morasses, often overflowed, and having an average elevation of 295 feet above the Gulf. The soil is of exuberant fertility, and the vegetation tropical in its rank luxuriance. Its area is about 900 sq. m.

For civil purposes, the State is divided into East Tennessee, extending from the eastern boundary to the middle of the Cumberland Table-land; Middle Tennessee, from the dividing-line on the Cumberland Table-land to the lower Tennessee River; and West Tennessee, from the Tennessee River to the Mississippi. Though there are hills and bluffs in Middle Tennessee, yet East Tennessee is the only portion of the State which can be called mountainous. The Unaka Mountains have many elevated summits, of which the most noteworthy are Roan Mountain in Carter co. (6306 feet high), in the Stone Mountain Range: Buffalo Mountain and Rich Mountain, both about 5550 feet, peaks of the Bald Mountains in Washington co.; the Big Butte Range and Paint Mountain, both in Greene co., and terminating on French Broad River, have summits of about the same height as those of Washington co. The Great Smoky Mountain, in Cocke co., is one of the highest in the State, and the Chilhowee, in the same county, has elevated peaks. Frog Mountain, in Polk co., and Starr Mountain, forming the outlying ridge in McMinn and Polk cos., have also lofty summits. The highest portions of these mountains, usually destitute of trees, and hence called "Balds," have usually a thin soil, but furnish excellent pasturage. There are a few considerable elevations in the East Tennessee Valley, such as Powell Mountain, in Hancock and Claiborne cos., the Bays Mountain Group in Hawkins and Greene cos., and Clinch Mountain, in Hawkins and Grainger cos. The almost perpendicular escarpment of the eastern face of the Cumberland Plateau gives the impression of a lofty mountain-chain. It is really only about 1000 feet above the valley, and perhaps 2000 above the sea.

Rivers.—The State is well watered. The Mississippi washes its western border, and often overflows its alluvial lands; and its affluents within the State, the Big Hatchie, N. and S. Forked Deer, and Obion rivers, are large streams, navigable for a considerable distance. Loosahatchie and Wolf rivers are smaller streams, discharging into the Mississippi. But the principal rivers are the Tennessee and the Cumberland, which, together with their affluents, drain more than three-fourths of the State. The tributaries of the Tennessee River on the N. shore are the Clinch, Sequatchie, Paint Rock, Flint, Elk, and Duck rivers, and Shoal and other creeks; on the S. shore, the Watauga, French Broad, Little Tennessee, Hiawassee, and Big Sandy. Most of these are navigable for considerable distances. The principal tributaries of the Cumberland River in the State are Caney Fork and Stone rivers. Reelfoot Lake is rather an expansion of a stream in the bottom-lands than a lake. There are several islands in the Mississippi opposite the State, and several in Tennessee River.

Geology.—The geology of Tennessee represents almost every system from the metamorphic rocks and the Lower Silurian to the most recent alluvial deposits of the Mississippi river-bottoms. Beginning with the extreme eastern border of the State, we have the metamorphic rocks of the Appalachian chain, occupying in Tennessee only small portions of Johnson, Carter, Washington, Cocke, Roe, and Polk cos. They are mostly gneiss, talcose slate, and mica slate, and furnish good grazing-grounds and orchard-lands. In the Lower Silurian proper, which has an enormous development in the State, the Potsdam, the Quebec, and the Trenton are represented: the first by the Ocoee group, having an estimated thickness of 10,000 feet, and making up the greater part of the Unaka Mountains, and the Chilhowee sandstones, a whitish sandstone, having a thickness of about 2000 feet. The rocks of this period include conglomerates, sandstones, clay-slates, semi talcose, and roofing slates, and dolomite, with veins of gold-bearing quartz. The second or Quebec period is represented by the Knox formation, ridge lands and valley-lands, the richest and best of East Tennessee, and suitable for all Tennessee crops and fruits. The third or Trenton period has the Trenton or Lebanon group proper and the Cincinnati, or Hudson River group. It is characteristic of many of the East Tennessee valleys, but has its largest development in the great Central Basin. The lands of this formation are very fertile, and are known as "blue-grass" lands. The Upper Silurian is represented by two groups: the Niagara, divided into four sub-groups—viz. the Clinch Mountain sandstone, found mainly on narrow ridges of the East Tennessee Valley: the White Mountain sandstone; the dyestone group, containing several layers of fossiliferous iron ore; and the Niagara limestone proper. In close proximity to this is the limestone of the Lower Helderberg group. The last two formations are confined almost entirely to the western valley. The only representative of the Devonian system is a black shale, attributed to the Helderberg period, found in a few long narrow valleys in East Tennessee. This shale is bituminous, and contains pyrites and enough hydrocarbon to make it burn with flame for a time. It yields a considerable quantity of viscid petroleum oil. We find the Lower Carboniferous period represented by three groups—the Barren or Protean group, constituting the barrens of the Rim-lands or Highlands, much of it in forest, and having a thin but arable soil—good grass lands: the coral or St. Louis limestone: the "hickory barrens" of the Rim-lands, and the base of the Cumberland Table-land, a strong and tolerably productive soil, adapted to cereals and tobacco; and the mountain limestone, which is the underlying rock of the Cumberland Table-land. It is very thick in the southern part of the State, but becomes thinner toward the N., having a thickness of about 400 feet at the Kentucky line. The soil is often very rich, and much of it covered with heavy timber. The coal-measures are coextensive with the Cumberland Table-land, of which they form the superficial covering, varying in thickness from 600 to 2000 feet. They form an irregular quadrilateral, 71 miles wide at the northern end and 50 at the southern, and have an area of 5100 sq. m., covering portions of twenty-one counties. This coal-field is a part of the great Appalachian coal-field extending from Western Pennsylvania and Ohio to Central Alabama. The veins of coal are of varying thickness—in some places from 4 to 9 feet, in others from 1 to 4 feet. There are in the southern part of the coal-field at least twenty-one distinct strata or layers of coal, but not a third of them capable of profitable working. The coal is bituminous, but generally contains very little sulphur, and is admirably adapted for smelting and other purposes. The supply is ample, not only for the furnaces and manufactories of that region, but for the steamboats, locomotives, and family use of that and the adjacent States for ages to come. Above the coal-measures come the Cretaceous, Tertiary, and Lower Quaternary systems, almost wholly laid over, superficially, by the orange sand or drift, a Quaternary deposit. The Cretaceous groups are: the coffee sand of rotten limestone or greensand, with numerous fossil oyster and other shells; and Ripley limestone and sandstone, with occasional veins of greensand. To these succeed two groups belonging to the Tertiary system—the Flatwoods group, sands and clays of later formation, and the La Grange group, mainly sands of varied colors, with occasional beds of white and variegated clays and beds of lignite. These two groups have a thickness of about 700 feet, the last much the thickest. The orange sand, a well-marked Quaternary deposit which contains also beds of gravel, not only forms the superficial layer over the greater part of the plateau or slope of that part of West Tennessee and the bluffs, but is in some places of considerable thickness. The Cretaceous groups succeed one another in regular order W. of the western valley of the Tennessee, the coffee sand, rotten limestone, and Ripley groups occupying Tennessee Ridge, but all overlaid by a thin layer of this orange sand; the Flatwoods group (similarly overlaid) occupying an adjacent narrow strip extending across the State: while the La Grange group, also overlaid with the orange sand, extends from the Flatwoods deposit to the bluff or loess of the Terrace formation. Nearly all these lands, Cretaceous, Tertiary, and Quaternary, have a good soil, a mellow silicious loam, and yielding excellent crops. A portion of them form the best tobacco-lands in the State. Along the Tennessee Ridge the surface is more broken, but generally fertile. The bluff or loess, now reckoned as constituting the Terrace formation, and more recent in its origin than the Quaternary, extends in a belt of nearly 20 miles (average width) from the Plateau slope of West Tennessee to the bluffs overlooking the Mississippi. The soil is light ashen-yellowish or buff color, contains large quantities of fossil land and water shells, and is generally very rich and fertile. It has a thickness ranging from a few feet to over a hundred. The alluvium is widest and richest in the bottom-lands of the Mississippi; but the beds of the immediate tributaries of that river in the State, and the bottom-lands of the Tennessee and Cumberland, are also alluvial. The soil has a great depth, and is marvellously productive.

Mineralogy.—We have already given some account of the coal-fields of the State. Next in value to coal, are the iron deposits. There are four distinct iron districts in Tennes-

see—viz. (1) The eastern iron belt, along the base and in front of the Unaka Mountains, the ore being mainly limonite, or, as it is frequently called, brown hematite, and occurring in irregular masses in banks of clay or sand. There are also magnetic ores, and at one or two points red hematites. (2) The dyestone belt, skirting the eastern base of the Cumberland Table land, and extending into the East Tennessee Valley and along Waldron's Ridge. The ore is very abundant in this belt. It is stratified, and belongs to the hematites. It yields from 50 to 60 per cent. of pure iron in the furnace. (3) The Cumberland Tableland belt, in which the ores are argillaceous, occur in nodules and layers, and yield but about 30 per cent. (4) The western iron belt, extending through the Rim-lands or Highlands on both sides of the central basin. The ore here is limonite, and occurs in immense masses in banks, and yields from 40 to 55 per cent., and the ore delivered to the furnace costs not over $2 per ton. The facilities for supplying both wood and coal for smelting, limestone for fluxes, and sandstone for hearths, are such that iron can be made more cheaply in Tennessee than anywhere else in the world, and its furnaces are increasing largely. Copper ores are found in great quantities in Polk co., varying in yield from 2 to 26 per cent. Gold is found in the State, but not in paying quantities. There is lead also at several points, but except in Union co. it is in pockets, and not in sufficient quantity to defray the cost of expensive machinery for its reduction. Zinc is also found in Union co., and mines have been worked there. The zinc ores are smithsonite and calamine, and both are very rich. The other principal minerals are black oxide of manganese, iron pyrites, sulphate of iron, barytes, gypsum, salt, nitrate of potassa, petroleum, lignite (in Western Tennessee), alum, sulphate of soda, sulphate of copper, a great variety of mineral waters. There are also marble, black, gray, red, and variegated, of great beauty and in immense quantities, in East and West Tennessee, breccia in the Little Tennessee River; roofing-slates in East Tennessee, millstone grit in Middle Tennessee, hydraulic rocks in East, Middle, and West Tennessee, limestones, sandstones, and granite for building, potter's clay and fire-clay.

Vegetation.—We have given with the geology a description of the soils of the State, but it remains to speak of the natural vegetation. Tennessee had 13,268,789 acres in timber or forest lands in 1870. The following are the most abundant of the forest trees of the State: white, blue, and water ash; beech, birch, buckeye, red cedar, chestnut, wild cherry, cottonwood, cypress, dogwood, white, slippery, and witch or cork elm; the balsam and black fir; the black gum and the liquidamber or sweet gum; six species of hickory, all very abundant; the linden or basswood; the black or yellow locust and the honey locust; three species of maple; the red mulberry; twelve or fifteen species of oak, including the white oak in great abundance and of excellent quality, the post, chestnut, black, scarlet, and other species; the yellow and white pine; the blue, white, and yellow poplar or tulip tree; the sassafras, both as a shrub and a forest tree; the sycamore or buttonwood; the tupelo; the black walnut and white walnut, or butternut; the yellow-wood; the cucumber tree; the laurel or bay; the holly, hop hornbeam, box elder, chinquapin, crab-apple, hackberry, a great number of species of willow, the persimmon, etc. Fruit trees and small fruits are abundant and of the best quality. Apples, pears, peaches, cherries, plums, apricots, nectarines, and, in Western Tennessee, the fig, papaw, the most luscious grapes, and all the smaller fruits and berries, grow in great profusion. The flora is of the most varied character. The State has several valuable indigenous grasses, and all the cultivated grasses succeed well there.

Zoology.—The wild animals of the State are those usually found on the Appalachian chain and in the adjacent valleys. In Eastern and Middle Tennessee bears are seen rarely in the mountain forests, while deer, raccoons, foxes, opossums, squirrels, and hares exist in great numbers. The serpent tribes include the rattlesnake and moccasin and a large number of harmless snakes. Lizards, horned frogs, etc., are common, and the alligator occasionally finds his way into the bayous of the Mississippi. The birds of prey, as well as those remarkable for beauty of plumage and song, abound.

Climate.—Along a line running E. and W. through the middle of the State the mean temperature of the year is 57° in East Tennessee, 58° in Middle, and 59° in West Tennessee; along the southern boundary of the State it is 58°, 59°, and 60° in these respective localities; and along the northern border, 56°, 57°, and 58°. In this statement we must except the valley of East Tennessee, which at the northern boundary has a mean not exceeding 55°, and perhaps, taking a series of years together, not 54°, while at the southern boundary it is not less than 58°. The following table gives the average mean temperature, etc., at several different points in the State, and other particulars as far as possible:

METEOROLOGICAL DATA.	Knoxville, lat. 35° 56', lon. 83° 58', elevation, 993 feet.	Lebanon, lat. 36° 17', lon. 86° 23', elevation, about 536 feet.	Nashville, lat. 36° 11', lon. 86° 53', elevation, 501 feet.	Glenwood (Montgomery co.), lat. 36° 20' 12", lon. 87° 07' 30", elevation, 500 feet.	Falls of Caney Fork, lat. [illegible] 47', lon. [illegible] 44', elevation 1002 feet.	Memphis, lat. [illegible] elevation, 29[illegible] feet.
	°	°	°	°		°
Average mean annual temperature........	57.03	57.76	58.47	57.26	58.48	61.60
Average maximum temp. of the year.....	92	97	95	92.90	94.50	101.50
" minimum " "	6	6	5	3.25	3	
Range of annual temperature...............	86	91	90	89.65	91.50	
Average mean temperature of spring....	56.3	58.64	58.93	56.71	58.86	60.13
Maximum temperature " " ...	90	91	91	84	90	87
Minimum " " " ...	6	12	11	31	10.50	30
Range of temperature in spring............	84	79	80	53	79.50	57
Average mean temperature of summer...	74.02	75.41	74.33	74.40	74.27	75.57
Maximum temperature " " ...	92	97	95	92.90	94.50	101.50
Minimum " " " ...	61	46	66	48	65	58.00
Range of temperature in summer.........	31	51	29	44.90	29.50	43
Average mean temperature of autumn...	55.40	57.61	58.81	57.54	58.56	59.40
Maximum temperature " " ...	91	94	95	86	90	90
Minimum " " " ...	15	19	20	15	21	28
Range of temperature in autumn..........	76	75	75	71	69	62
Average mean temperature of winter....	38.66	38	41.20	37.87	40.97	44.66
Maximum temperature " "	69	72.50	73	74	68	
Minimum " " "	6	6.50	5	3.25	3	
Range of temperature in winter............	63	66	68	70.75	65	
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Average annual rainfall.........................	59.25	43.61	54.74	53.48	58.47	49.39
Rainfall in spring	12.60	10.55	15.03	13.41	12.35	17.40
" " summer	13.15	9.57	14.37	13.32	14.02	7.29
" " autumn..................................	12.40	7.54	13.39	11.63	11.83	14.54
" " winter	21.10	15.95	11.95	15.12	20.27	6.93
Date of last frost in spring (average of from 3 to 23 years)................................	Apr. 10	....	....	Apr. 17		
First killing frost in autumn..................	Oct. 18	....	....	Oct. 20		
Number of days without frost..	166	....	....	173		
Number of days without killing frost.....	181	....	....	189		
Prevailing winds in order of frequency	S. W., N. E., N., S., W., E., calm, N. W., S. E.	....	Calm, N. W., S. W., N., S. E., E., S. W., N. E.	S., N.W., N.E., calm, S. E., N., S. W., E., W.	....	N. W., S. W., N. E., S. E., [illegible]

Agricultural Productions. According to the census of 1870, 72.6 per cent. of the inhabitants of the State are engaged in agricultural pursuits. The census of 1870 reports 19,581,214 acres of land in the State in farms. Of this amount, 6,843,278 acres are said to be improved. The value of the farms in 1870 was said to be $218,743,747, and of farming implements and machinery, $8,199,487. The value of all farm productions, etc., was stated at $86,472,847; of animals slaughtered or sold for slaughter, $15,806,880; of home manufactures, $2,77[illegible]; of forest products, $335,317; of market garden products, [illegible]; of orchard products, $571,520; of w[illegible] during the year, $7,118,003. Of the cereals, Te[illegible] 1869-70 produced 6,188,916 bushels of wheat [illegible] 1871, according to the Bureau of agriculture, 11,121,[illegible] bushels, valued at $11,788,260; in 1869-70, 2[illegible] bushels of rye, and in 1871, 238,000 bushels, valued at [illegible],900; in 1869-70, 41,343,614 bushels of Indian corn, and in 1874 but

31,953,000, worth $21,728,040; in 1869–70, of oats, 4,513,315 bushels, and in 1874, 3,816,000 bushels, worth $2,175,120; of barley, 75,068 bushels, and in 1874, 84,000 bushels, worth $91,080; of buckwheat, in 1869–70, 77,437 bushels, and in 1874, 76,000 bushels, worth $56,240; of cotton in 1869–70, 181,842 bales, worth $12,274,335. The cotton crop of 1873–74 was somewhat more than 300,000 bales, worth in round numbers about $13,000,000. Of flax, 80,930 pounds were grown in 1869–70, 1033 tons of hemp, 153 pounds of silk cocoons, and 1,389,762 pounds of wool. Of hay, Tennessee produced in 1870, 116,582 tons—in 1874 the estimated crop was 114,300 tons, worth $2,180,844. Tennessee ranks as the third State in the Union in the production of tobacco, the crop of 1869–70 having been 21,465,452 pounds. Mr. Killebrew states that the annual product ranges from 20,000,000 to 25,000,000 pounds, the first-named amount being the minimum. The estimated crop of 1875, according to the State Bureau of agriculture, was 35,000,000 pounds. Its average value is about 10 cents per pound. In 1870, Tennessee reported 1410 hogsheads (or 1,410,000 pounds) of cane-sugar and 3629 gallons of cane molasses; 134,968 pounds of maple-sugar, 4843 gallons of maple-molasses, and 1,254,701 gallons of sorghum-molasses. In 1870 the State produced 1,124,337 bushels of Irish potatoes and 1,205,683 bushels of sweet potatoes. This, Mr. Killebrew says, is about the usual crop. The agricultural department reports only Irish potatoes in 1874, and estimates the crop at 605,000 bushels. The amount of clover, flax, and grass seeds raised in the State is not large, being in 1870, 8564, 4612, and 11,153 bushels respectively. Peanuts are a large and generally profitable crop in Tennessee. In 1872, 680,000 bushels were raised in four counties, valued at about $1,200,000. The dairy products of the State were in 1870, 9,571,069 pounds of butter, 142,240 pounds of cheese, and 415,786 gallons of milk sold, the whole worth $3,071,545.70. There has been a large increase in these products since 1870. The live-stock of the State was valued in 1870 at $55,084,075, and consisted of 273,200 horses, 102,983 mules and asses, 682,318 neat cattle (of which 243,197 were milch cows), 826,783 sheep, and 1,828,690 swine. In Jan., 1875, the U. S. agricultural department reported 318,000 horses, 107,300 mules and asses, 242,700 milch cows, 340,800 oxen and other cattle, 325,500 sheep, and 1,193,500 swine.

Manufacturing and Mining Products.—In 1870 there were, according to the census, 5317 manufactories in the State, driven by 732 steam-engines and 1340 water-wheels, having an aggregate of 37,983 horse-power, employing 19,412 hands (17,663 men, 1089 women, and 660 children) and a capital of $15,595,295, paying $5,390,630 wages, using $19,657,027 of raw material, and producing goods valued at $34,362,636. Of specified industries, there were 216 flouring-mills, producing $5,666,698 of flour and meal; 349 saw and planing mills and sash-factories, producing together $3,768,976 worth of manufactured lumber; 65 furnaces, bloomeries, and foundries, producing $2,072,040 of iron; 395 establishments for tanning and currying leather, producing $1,844,138 of leather; 39 printing and publishing offices, producing books, pamphlets, periodicals, and printing to the amount of $1,022,600; 28 cotton-mills, producing cotton goods worth $941,542; 220 wheelwright-shops, making carriages and wagons to the value of $938,647; 161 saddlery and harness shops, producing harnesses and saddles valued at $650,071; 180 ready-made clothing establishments, producing clothing valued at $597,607; 2 copper milling and smelting works, producing copper to the value of $510,677; 133 wool-carding and dressing mills, producing $491,847 of woollen goods; 4 cotton-seed oil-mills, producing $490,000 worth of oil; 44 distilleries, producing $454,853 worth of liquors; 76 tin, copper, and sheet-iron ware shops, making up $437,551 of tinware, etc.; 89 cabinet-shops, producing $404,538 of furniture; 21 machine-shops, making $387,450 of machinery, and 4 car-shops, producing cars to the value of $293,624. Notwithstanding the great depression in business and manufactures, there has been a great increase in many branches of manufacture since 1870. In 1874, Mr. Killebrew stated that "in the manufacture of cotton goods and iron the establishments, if they had not doubled in number, had twice the capacity they had in 1870;" and later information makes it certain that for the present year (1876) the production is not less than three times that of 1870; the distilleries, carriage and wagon shops, and woollen-mills have doubled their product; the production of coal and iron ore has been trebled.

Railroads.—The railroads of Tennessee have all been built since 1850; between 1850 and 1860, 1253 miles were built; between 1860 and 1870, only 239 miles; and between 1870 and 1876, 316.80 miles, making in all 1808.80 miles, the cost of which, for road equipment, etc., was estimated in Poor's *Manual* at $58,319,555. Of these roads, the most important are the Mobile and Ohio, the Mississippi Central and New Orleans, the Memphis and Charleston, the Memphis and Ohio, the Mississippi and Tennessee, the Memphis and Paducah, the East Tennessee Virginia and Georgia, the Nashville and Chattanooga, the East Tennessee and Georgia, the Nashville and North-western, the Jackson and Birmingham, the St. Louis and South-eastern, the Jackson and Evansville, the Selma Montgomery and Memphis, the Memphis and Vicksburg, the Louisville Nashville and Great Southern, and the Cairo and Tennessee River. These are mostly trunk-roads, extending through other States and having but a part of their length in this; there are also 10 or 12 short roads, wholly within the State.

Finances.—The sessions of the legislature and the State reports being biennial, we have no reports later than those of about Jan. 1, 1875. At that time (or rather Dec. 20, 1874) the State funded and registered debt amounted to $22,908,400, of which all but $286,000 bore 6 per cent. interest. There was, besides, a contingent liability of the State as endorser on some railroad bonds of $1,802,000. The total receipts from all sources for the period from Jan. 1, 1873, to Dec. 19, 1874 (two years, less 12 days) were $3,618,703.52, and the total disbursements, $3,290,158.41, showing a balance in the treasury of $328,704.55.

Commerce.—Memphis and Nashville are both river-ports of entry, but the State has no direct foreign commerce, its large exports of cotton being made through New Orleans, Norfolk, Charleston, and New York, and exchange drawn upon the shipments either through New York or New Orleans. The internal and riverine commerce is of very large amount. The shipments of cotton from the State (two-thirds of it from Memphis) in 1873 were 613,750 bales, and in 1872, 548,913 bales; and the value of these shipments alone was from 35 to 45 millions of dollars. The tobacco shipped is worth from 2 to 2½ millions more. The wholesale trade of the State, from the data before us, cannot be estimated at less than 300 million dollars.

Banks.—In 1875, Tennessee had 26 national banks. These 26 banks had $3,360,000 paid capital, $3,116,500 bonds on deposit, $3,061,232 circulation outstanding. There were also 11 State banks, with a capital of $1,442,000, 8 savings banks, of which 4 reported a capital of $263,000, and 5 private banking-houses.

Insurance.—In 1875 there were 12 fire and marine insurance companies in Tennessee, having an aggregate capital of $2,775,750, and reported assets of $3,263,988. There were also 3 life insurance companies, with a capital of $668,300, and reported assets of $2,615,737.

Population.

Census year.	Total population.	Males.	Females.	White.	Free colored.	Slave.	Natives.	Foreigners.	Density of population.	Ratio of increase.	Number of families.	Number of dwellings.	Persons to a family.	Persons to a dwelling.	Illiterate.	Of school age, 5–20.	Of military age, 18–45, males.	Of voting age, 21 and upward, males.	Citizens, males.
1790	35,691	[illegible]	17,171	[illegible]	361	3,417	....	......	0.85	......	......	......	....	....	....	....	5,919	7,138	
1800	105,602	53,811	[illegible]	[illegible]	309	13,584	....	......	2.51	195.05	......	......	....	....	....	....	17,600	21,120	
1810	261,727	134,564	[illegible]	[illegible]	1,317	44,535	....	......	6.23	147.84	......	......	....	....	....	....	43,605	52,345	
1820	422,813	[illegible]	207,940	339,927	2,779	80,107	....	......	10.07	61.55	......	......	....	....	....	....	70,433	84,562	
1830	681,904	347,612	[illegible]	[illegible]	[illegible]	141,603	....	......	16.23	61.28	......	......	....	....	....	†217,804	113,622	136,381	
1840	829,210	419,707	[illegible]	640,627	[illegible]	183,059	....	......	19.74	21.60	......	......	....	....	....	†261,843	134,801	165,842	119,947
1850	1,002,717	504,132	[illegible]	[illegible]	6,422	[illegible]	995,478	7,239	21.99	20.92	130,004	121,419	5.87	5.90	*78,619	418,125	174,534	198,695	151,367
1860	1,109,801	562,718	[illegible]	[illegible]	[illegible]	[illegible]	1,088,575	21,226	24.34	10.68	149,335	147,947	5.59	5.61	*72,054	413,511	206,423	235,856	165,365
1870	1,258,520	623,347	635,173	936,119	[illegible]	.....	1,239,204	19,316	27.60	13.40	231,565	224,816	5.44	5.60	*364,697	484,513	222,903	263,200	259,016

Education.—Higher education has received a somewhat remarkable degree of attention in Tennessee. In the number of her colleges and collegiate schools, her universities and professional schools, as well as in the grade of scholarship in some of them, she is beyond any other of the South-western States. In the past twenty-five years her situation relatively to the other States of the South-west has attracted attention to her, and she has received large gifts from citizens of other States for the endowment of her universities. But while these institutions are in a prosperous condition, the public schools and primary education have been almost entirely neglected. There were, in the

*The illiterate in 1850 and 1860 are persons of 20 years and upward who cannot read and write; in 1870, 10 years old and upward.

† Whites only.

more populous districts, private schools and seminaries at which the children of the wealthy could receive the rudiments of education, but for the great mass of her people even the most elementary knowledge of books was almost unattainable. "Prior to the civil war," says the Commissioner of Education, "the interest upon the school fund, amounting annually to $90,000, was for many years ratably distributed among the several counties of the State for the maintenance of free schools, but the sums thus realized by the school districts were so inconsiderable, and the provisions made for the profitable use of the money so imperfect, that but little good was or could be accomplished. The schools, thus maintained for a few weeks in the year, and taught usually by incompetent persons, were not looked to by the people as sources of instruction for their children, but rather as temporary eleemosynary establishments, at which the children of poor people might enjoy a scanty charity in the shape of bad primary instruction." In 1867 a school law was passed which was not acceptable to the people, and was superseded by the law of 1870, which in turn proving objectionable, in that it virtually restored the old condition of things before the war, remitting the whole subject to the several counties, and providing for no responsible head or superintendent, was repealed, and the law of 1873 substituted for it. This law, though better than any which preceded it, is yet very imperfect. When this law was adopted, there were in the State (says Col. Killebrew) 93,651 voters unable to read or write, a considerable portion of them whites. The results so far are shown in the following summary of the report of the superintendent for the year 1874: Amount of available school fund, $2,512,500. Receipts: interest on permanent fund, $150,750; total from taxation, $750,290.88; from other sources, $97,418.23, making the total receipts $998,459.11. The expenditures were: for sites, buildings, and furniture, $101,875.98; for salaries of State and county superintendents, $37,023.64; for salaries of teachers, $769,459.75; miscellaneous or contingent, $69,017.09; total expenditures, $977,376.46. Expenditure per capita of school population, $2.09; per capita of school enrolment, $3.10; per capita of average attendance, $5.47. The population of school age (in Tennessee 6 to 18 years) in 1874 was 420,384 (boys 216,134, girls 204,250); number enrolled in the schools, 258,577; average daily attendance, 161,089. The number of teachers was 5551 (4227 men, 1324 women); the number necessary to supply the public schools, 6000; average salary of teachers (no distinction of sex made), $33 per month. The superintendent complains of the great difficulty of finding competent teachers, and of the wretched condition of the school-houses, most of them, outside of the cities and largest towns, being log structures. Forty-six of the private schools reported to the U. S. commissioner of education in 1874–'75. These had 289 instructors and 4866 scholars. There were 2022 students in the preparatory departments of the colleges. There were 4 business colleges, with 554 students, and high schools at Chattanooga, Nashville, and Memphis. In 1874 the Peabody fund aided 62 schools of the State in various amounts, the whole sum expended being about $34,000. The State University has arranged to have normal classes; and efforts are making to establish a State normal school, to which Dr. Sears, agent of the Peabody fund, offers to contribute $6000 a year if the State will appropriate a similar sum. Teachers' institutes have been held in several sections of the State with good results. There is a school for the blind at Nashville, which in 1874 had 6 instructors and teachers and 46 blind pupils; its annual expenditure was about $10,000, mostly from the State. The school for the deaf and dumb at Knoxville in 1874 had 7 professors and instructors and 136 pupils (81 males and 55 females). Its expenditures were $28,000; the value of buildings and grounds is $150,000. The following table gives as full particulars as can be obtained of the colleges, universities, female colleges, and professional schools of the State in 1874–'75:

Universities, Colleges, and Professional Schools.

Universities, Colleges, Female Colleges, and Professional Schools.	Location.	When organized.	Under what control.	Professors and instructors.	Students: In preparatory departments.	Students: In collegiate or professional departments.	Students: Male.	Students: Female.	Property, endowment, and income: Value of grounds, buildings, and apparatus.	Property, endowment, and income: Amount of endowment in productive funds.	Property, endowment, and income: Income from productive funds.	Property, endowment, and income: Income from all sources.	Property, endowment, and income: Aggregate amount of scholarships.	Volumes in library.
									$	$	$	$	$	
Beach Grove College	Beach Grove	1868	Non-sectarian	5	106	18	78	46	10,000	....	.	1,600		
Bethel College	McKenzie	1847	Cumb. Presb.	4	105	49	92	62	12,000	....	...	[illegible]		350
Central Tennessee College	Nashville	1866	Non-sectarian	14	262	.	139	123	[illegible]	....		[illegible]		800
Christian Brothers' College	Memphis	1872	Roman Catholic	19	90	61	151	.	10,000	.....	.	9,100		150
Cumberland University	Lebanon	1842	Cumb. Presb.	9	70	94	164	.	20,000	.	.	5,008	..	6,000
East Tennessee University	Knoxville	1807	Non-sectarian	17	87	47	134	..	150,000	90,000	2,000	[illegible]		3,989
East Tennessee Wesleyan University	Athens	1867	Meth. Episcopal	8	46	11	66	23	[illegible]	.	.	2,800		1,800
Fisk University	Nashville	1866	Cong. and non-sec.	6	53	12	[illegible]	26	100,000	[illegible]	.	7,[illegible]	.	1,[illegible]
Franklin Female College	Franklin	1857	Meth. Ch., South	7	...	145	.	145	25,000	....	..	6,500	.	600
Greeneville and Tusculum College	Greeneville	1794 / 1840	Independent	11	192	8	129	71	8,000	500	50	9,[illegible]		7,000
Hiwassee College	Near Sweetwater	1849	M. E. Ch., South	4	107	23	110	..	[illegible]	.		...		1,222
King College	Bristol	1868	Presbyterian	5	40	.	40	.	[illegible]	[illegible]	[illegible]	[illegible]		
Maryville College	Maryville	1819	Presbyterian	6	[illegible]	18	104	[illegible]	[illegible]	[illegible]	798	[illegible]		2,000
Mosheim Male and Female Institute	Mosheim	1869	Lutheran	4	[illegible]	19	63	[illegible]	[illegible]	.	.	900		200
Mossy Creek College	Mossy Creek	1851	Baptist	3	[illegible]	8	[illegible]	..	10,000	[illegible]				
South-western University	Jackson	1871	Baptist	4	[illegible]	.	[illegible]	.	[illegible]	4,[illegible]	[illegible]			
Stewart College	Clarksville	1856	Presbyterian	6	[illegible]	6	110	.	[illegible]	[illegible]	[illegible]	[illegible]	.	[illegible]
University of Nashville	Nashville	1785	State, in part	13	156	30	186	..	[illegible]	100,000	6,000	16,000		10,[illegible]
University of the South	Sewanee P. O.	1858	Prot. Episcopal	18	[illegible]	[illegible]	262	..	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Vanderbilt University	Nashville	1875	M. E. Ch., South	26	.	307	307	...	[illegible]	[illegible]	[illegible]			
West Tennessee College	Jackson	1844	.....	4	100	.	100	.	30,000					
Bellevue Female College	Collierville	1872	Non-sectarian	6	[illegible]	[illegible]	.	[illegible]	[illegible]	.	...	5,000		
La Grange Female College	La Grange	1855	Non-sectarian	8	.	141	.	141	[illegible]			6,000	..	400
Cumberland Female College	McMinnville	1851	Cumb. Presb.	4	[illegible]	[illegible]	.	[illegible]	[illegible]			[illegible]		500
State Female College	Memphis	1858	M. E. Ch., South	[illegible]	[illegible]	[illegible]	.	167	[illegible]		...	.		500
Soule Female College	Murfreesboro'	1852	M. E. Ch., South	6	...	.		...	[illegible]					
Savannah Female College	Savannah	1861	M. E. Ch., South	4	..	[illegible]	.	[illegible]	10,000			[illegible]		
Fairmount College for Young Ladies	Sewanee Mount	1873	Prot. Episcopal	6	.	[illegible]	.	40	[illegible]			[illegible]	.	200
Washington Female College	Washington co.	.	Presbyterian	[illegible]	[illegible]	[illegible]	.	[illegible]	[illegible]					[illegible]
Mary Sharp College	Winchester	1850	Baptist	10	[illegible]	[illegible]	.	190	20,000			[illegible]		1,[illegible]
Ward's Collegiate Seminary for Young Ladies	Nashville	1865	Non-sectarian	[illegible]	.	[illegible]	.	241	[illegible]			14,000	..	2,000
School of Science.														
Tennessee Agricultural College, E. Tenn. Univ.	Knoxville	1869	State		...	[illegible]	46	Endowment [illegible]						
Schools of Theology.														
Nashville Institute	Nashville	1866	Baptist	[illegible]	.	[illegible]	[illegible]	.	40,000			.	..	600
Theological department Central Tenn. College	Nashville	[illegible]	Meth. Epis.	[illegible]		[illegible]	[illegible]	.				.	..	800
Theological department Cumberland Univ.	Lebanon	[illegible]	Cumb. Presb.	4	.	[illegible]	[illegible]	.	1,[illegible]	[illegible]	1,[illegible]			
Theological department Vanderbilt University	Nashville	1875	M. E. Ch., South	4	.	...	[illegible]							
Schools of Law.														
Law department Cumberland University	Lebanon	1847	Trustees	.	..	[illegible]	[illegible]	...	..	.	.....	7,000		
Law department Vanderbilt University	Nashville	[illegible]	Trustees	.										
Schools of Medicine.														
Depart. of Med. and Surgery Vanderbilt Univ.	Nashville	1874	Trustees	[illegible]	.	[illegible]	[illegible]							
" " Univ. Nashville	Nashville	[illegible]	[illegible]	[illegible]	.	[illegible]	[illegible]	..	250,000	...	.	[illegible]		
Tennessee College of Pharmacy	Nashville	[illegible]	[illegible]	.	.	[illegible]	[illegible]	..	.	..		[illegible]		[illegible]

Charitable and Corrective Institutions.—The Tennessee hospital for the insane, established in 1848 through the persevering efforts of Miss D. L. Dix, is in Davidson co., about 6 miles from Nashville. It has about 350 patients. Nearer Nashville are several hospitals, 2 orphan asylums, etc. In Nashville is the State penitentiary, a massive structure, and enclosed by a stone wall 2[illegible] feet high and 4 feet thick at the base. There are numerous workshops in the enclosure in which a part of the convicts are employed, but under a new system a majority of them work in coal-mines, in the construction of railroads, and upon the capitol grounds. The whole number [illegible] somewhat more than 900, of whom the [illegible] are negroes. The county jail, the city work[illegible] house of industry for females are also in [illegible].

Newspapers.—In 1870 the whole [illegible] in the State was 91, issuing annually [illegible], and having a circulation of 22[illegible] [illegible] dailies, with 34,630 circulation; 2 [illegible] and 1 semi-weekly, with an aggregate [illegible] weeklies, circulation 117,022; 1 [illegible] monthlies, circulation 51,200; 1 quarterly, 1800; 1 annual,

12,000. At the beginning of 1875 the number had increased to 124, of which 11 were dailies, 1 semi-weekly, 1 tri-weekly, 97 weeklies, 12 monthlies, and 2 quarterlies. There was no report of annuals. Of these 124 papers, 80 were political (7 of them independent or neutral), 14 were religious, 3 agricultural, 3 commercial, 2 medical, 1 law, 1 temperance, 1 educational, and 5 miscellaneous. The circulation had materially increased.

Churches.

DENOMINATIONS.	Number of organizations, 1870.	Number of church edifices, 1870.	Church sittings, 1870.	Church property, 1870.	Church organizations, 1875.	Church edifices, 1875.	Clergymen or ministers, 1875.	Church members or communicants, 1875.	Adherent population, 1875.	Church property, 1875.
All denominations	3180	2842	878,524	$4,697,675	3622	3174	2319	287,070	1,243,750	$5,934,450
Baptists, regular	942	877	245,151	843,675	1179	1047	779	104,312	468,000	1,147,500
Baptists, Free-Will, Anti-Mission, etc.	45	41	10,225	16,400	53	46	32	4,240	20,000	21,500
Christian Connection and Disciples	203	167	55,455	244,625	239	186	81	21,120	80,000	321,850
Congregationalists	3	2	525	14,100	8	8	11	522	2,500	26,500
Protestant Episcopalians	33	31	12,940	269,573	33	32	31	3,699	18,000	290,000
Friends	5	4	1,900	4,800	5	5	......	507	2,500	6,100
Jews	4	4	1,100	21,000	5	5	5	480	2,800	31,000
Lutherans	22	22	9,875	27,664	30	29	17	3,600	16,000	43,500
Methodists of all kinds	1339	1155	336,433	1,506,153	1471	1253	1023	117,860	482,000	1,963,250
Presbyterians, regular	262	241	83,590	858,105	249	237	151	14,500	63,750	1,016,550
Presbyterians, Cumberland, etc.	294	271	105,380	400,230	309	287	147	15,120	68,300	528,000
Roman Catholics	21	21	13,850	486,250	29	29	31	....	15,000	549,500
United Brethren in Christ	7	5	1,600	4,100	12	9	10	960	4,000	8,500
Union	......	1	500	1,000	......	1	1	150	600	1,000

Constitution, Courts, Representatives in Congress, etc.—Under the new constitution, ratified in Mar., 1870, every male person of the age of 21 years, being a citizen of the U. S., and a resident of the State for 12 months, and in the county wherein he may offer his vote for 6 months next preceding an election, shall be entitled to vote for members of the general assembly and other civil officers. The supreme executive power is vested in a governor, who is chosen by the legal voters for a term of 2 years. He must be at least 30 years of age, and must have been a citizen of the State for 7 years next before his election. A secretary of state is appointed by joint vote of the general assembly for 4 years; a treasurer and controller of the treasury are appointed in the same manner for a term of 2 years. The State superintendent of schools is nominated by the governor and confirmed by the senate; his term of office is 2 years. The legislative authority is vested in a general assembly consisting of a senate and house of representatives, the former having 25 and the latter 75 members. They are elected for 2 years, and must have been citizens of the State for 3 years and of the county for 1 year next preceding their election. The senators must be at least 30 and the representatives 21 years of age. The judicial power is vested in a supreme court of 5 judges, elected for 8 years, having only appellate jurisdiction, and the concurrence of 3 judges being necessary to a decision—they choose for themselves one of their number as chief-justice; of circuit courts and chancery courts for the judicial districts, having original jurisdiction, and elected for 8 years. The attorney-general and reporter for the State are appointed by the judges of the supreme court for 8 years. Minor causes can be transferred from the justices' courts to the circuit courts or chancery courts on sufficient cause. The State is now entitled to 10 members of Congress.

Counties (93).*

COUNTIES.	Population, 1870.	Males, 1870.	Females, 1870.	Population, 1860.	Assessed valuation of real and personal estate, 1873-74.	COUNTIES.	Population, 1870.	Males, 1870.	Females, 1870.	Population, 1860.	Assessed valuation of real and personal estate, 1873-74.
					$						$
Anderson	8,704	4,357	4,347	7,068	1,266,591	Lake	2,428	1,291	1,137	....	908,386
Bedford	24,333	11,981	12,352	21,584	7,104,965	Lauderdale	10,838	5,552	5,286	7,559	2,829,185
Benton	8,234	4,119	4,115	8,463	1,012,619	Lawrence	7,601	3,682	3,919	9,320	1,265,580
Bledsoe	4,870	2,418	2,452	4,459	818,229	Lewis	1,986	961	1,025	2,241	230,888
Blount	14,237	7,077	7,160	13,270	2,310,357	Lincoln	28,050	13,936	14,114	22,828	5,178,933
Bradley	11,652	5,641	6,011	11,701	2,535,820	Loudon	new	county	....	....	1,972,252
Campbell	7,445	3,737	3,708	6,712	992,912	Macon	6,633	3,288	3,345	7,290	987,802
Cannon	10,502	5,151	5,351	9,509	1,669,240	Madison	23,480	11,877	11,603	21,535	6,248,727
Carroll	19,447	9,525	9,922	17,437	3,787,855	Marion	6,841	3,396	3,445	6,190	1,263,199
Carter	7,909	3,846	4,063	7,124	1,004,451	Marshall	16,207	8,017	8,190	14,592	4,625,106
Cheatham	6,678	3,339	3,339	7,258	1,154,108	Maury	36,289	17,833	18,456	32,498	11,109,144
Claiborne	9,321	4,554	4,767	9,643	907,093	McMinn	13,969	6,714	7,255	13,555	2,754,753
Clay	new	county	....	....	763,615	McNairy	12,726	6,348	6,378	14,732	2,161,269
Cocke	12,458	6,012	6,446	10,408	1,362,032	Meigs	4,511	2,241	2,270	4,667	1,148,930
Coffee	10,237	5,035	5,202	9,689	1,911,074	Monroe	12,589	6,118	6,471	12,607	2,304,291
Crockett	new	county	....	....	3,163,589	Montgomery	24,747	12,219	12,528	20,895	5,716,025
Cumberland	3,461	1,713	1,748	3,460	614,099	Moore	new	county	....	....	1,130,168
Davidson	62,897	30,996	31,901	47,055	26,683,765	Morgan	2,969	1,437	1,532	3,353	398,081
Decatur	7,772	3,792	3,980	6,276	1,054,846	Obion	15,584	7,824	7,760	12,817	4,525,800
De Kalb	11,425	5,642	5,783	10,573	1,960,031	Overton	11,297	5,424	5,873	12,637	828,466
Dickson	9,340	4,756	4,584	9,982	1,232,543	Perry	6,925	3,438	3,487	6,042	1,235,085
Dyer	13,706	6,814	6,892	10,536	4,072,081	Polk	7,369	3,606	3,763	8,726	1,220,470
Fayette	26,145	13,165	12,980	24,327	6,343,325	Putnam	8,698	4,269	4,429	8,558	1,235,085
Fentress	4,717	2,299	2,418	5,054	413,658	Rhea	5,538	2,722	2,816	4,991	1,123,570
Franklin	14,970	7,493	7,477	13,848	2,081,318	Roane	15,622	7,660	7,962	13,583	2,210,961
Gibson	25,666	13,163	12,503	21,777	7,471,389	Robertson	16,166	8,114	8,052	15,265	4,516,117
Giles	32,413	16,176	16,237	26,166	7,616,921	Rutherford	33,289	16,552	16,737	27,918	9,614,975
Grainger	12,421	6,093	6,328	10,932	1,531,807	Scott	4,054	2,028	2,026	3,519	266,943
Greene	21,668	10,569	11,099	19,004	3,413,336	Sequatchie	2,335	1,171	1,164	2,120	347,526
Grundy	3,250	1,569	1,681	3,093	741,498	Sevier	11,028	5,393	5,635	9,122	1,593,648
Hamblen	new	county	....	....	1,676,665	Shelby	76,378	38,663	37,715	48,092	38,553,951
Hamilton	17,241	8,655	8,583	13,258	7,012,903	Smith	15,994	7,902	8,092	16,357	2,841,259
Hancock	7,148	3,427	3,721	7,020	519,650	Stewart	12,019	6,130	5,889	9,896	1,524,379
Hardeman	18,074	8,929	9,145	17,769	4,449,059	Sullivan	13,136	6,361	6,775	13,552	2,394,472
Hardin	11,768	5,743	6,025	11,214	1,930,970	Sumner	23,711	11,768	11,943	22,030	5,185,727
Hawkins	15,837	7,578	8,259	16,162	2,316,675	Tipton	14,884	7,586	7,298	10,705	3,354,682
Haywood	25,094	12,532	12,562	19,232	5,697,559	Trousdale	new	county	....	....	1,152,904
Henderson	14,217	6,974	7,243	14,491	2,311,338	Union	7,605	3,721	3,884	6,117	843,015
Henry	20,380	10,082	10,298	19,133	3,656,340	Van Buren	2,725	1,327	1,398	2,581	259,493
Hickman	9,856	4,858	4,998	9,312	1,794,307	Warren	12,714	6,288	6,426	11,147	2,535,768
Houston	new	county	....	....	512,100	Washington	16,317	7,951	8,366	14,829	2,709,541
Humphreys	9,326	4,640	4,686	9,096	1,394,935	Wayne	10,209	5,081	5,128	9,115	1,664,494
Jackson	12,583	6,188	6,395	11,725	1,123,915	Weakley	20,755	10,416	10,339	18,216	4,100,065
James	new	county	....	....	754,372	White	9,375	4,581	4,794	9,381	1,320,610
Jefferson	19,476	9,479	9,997	16,043	2,459,205	Williamson	25,328	12,583	12,745	23,827	7,629,778
Johnson	5,852	2,855	2,997	5,018	613,326	Wilson	25,881	12,753	13,128	26,072	6,691,164
Knox	28,990	14,153	14,837	22,813	9,503,533						
						Totals	1,258,520	623,347	635,173	1,109,801	308,089,743

The true valuation, according to the census report in 1870, was $498,237,724, and this is admitted by the Bureau of agriculture in the State to be a very accurate valuation.

Principal Cities and Towns.—Nashville, the capital of

* Bell co., mentioned by some writers, had not been organized in 1876.

the State, had in 1870 a population of 25,865; its present population exceeds 35,000. Memphis, the largest city and principal river-port of the State, had 40,226 inhabitants in 1870, and about 45,000 now; Knoxville had 8682 then, and perhaps 13,000 now; Chattanooga 6093, and now probably 11,000. The other cities in 1870 were Jackson, 4119; Murfreesboro', 3502; Clarksville, 3200; and Columbia, 2500. Brownsville, Gallatin, Lebanon, Pulaski, Trenton, and Shelbyville have between 2000 and 3000 inhabitants, and Cleveland, Franklin, Fayetteville, McMinnville, and Greenville, between 1200 and 2000.

History.—When North Carolina was separated from South Carolina, she claimed what was afterward Tennessee as a part of her domain, and defined its boundaries as of equal width with her own and extending to the Mississippi River. In 1757, Fort Loudon was erected on Little Tennessee River, in what is now Blount co. This was attacked and captured by the Indians in 1760, and 200 persons killed. The Indians were severely punished for this massacre. The settlers soon began to enter the region of Holston River from North Carolina, and a few also from South Carolina and Virginia. Among the latter was Capt. William Bean, from Pittsylvania co., Va., who came with his family to what is now East Tennessee, and built a cabin on Boone Creek, an affluent of Watauga River, in 1769. The growth of the settlements on the Watauga was very rapid. At the beginning of the Revolutionary war these Watauga colonists were all patriots. They met in a mass convention in 1776, chose thirteen men as commissioners, and five others—of whom John Sevier was the first—to form a court for the settlement of all disputes. They named East Tennessee the Washington district, after Gen. Washington, who had just been appointed to the command of the patriot army, and sent a memorial to the North Carolina legislature explaining that they had no desire to withdraw from North Carolina, but were willing to bear their share in the hardships and sacrifices of the war, and desiring to have its authority and laws extended over them. The North Carolina legislature responded by naming all the settlements W. of the mountains as Washington co., and inviting them to send delegates to a State convention about to assemble at Halifax. They did so, and soon after raised a regiment known as the "Watauga regiment" for the war, which was commanded by Col. John Sevier. They, with some of the Virginia troops, defeated the Indians signally in June, 1776, and subsequently fought bravely at King's Mountain and elsewhere. The settlements in what is now East Tennessee increased rapidly during the war, but none of them penetrated far into Middle Tennessee, and for forty years more West Tennessee was the peaceable possession of the Chickasaw Indians. In 1784, North Carolina made a provisional cession of the territory W. of the mountains to the U. S., but repealed it the next year, and from that time to 1788 or 1789 opposed the independence of the colonists. Early in 1785 the settlers in East Tennessee resolved to form a State government of their own. They formed a constitution similar to that of North Carolina, submitted it to the people, and chose a governor (John Sevier being their unanimous choice), elected a legislature, appointed judges, organized courts, and held treaties with the Indians. They named their new State Franklin or Frankland, and held the first and only session of their legislature at Jonesborough in 1785. At this session Martin Academy was chartered. North Carolina looked upon all these proceedings as irregular, and exercised her own legislative authority over the settlements, incorporating the same year Davidson Academy at Nashville, then a small settlement which had sprung up since 1780. In 1789, the excitement having subsided, North Carolina ceded the "territory beyond the mountains" to the U. S., and the next year the Territorial government of Tennessee was organized by the appointment of William Blount of North Carolina governor. He was a judicious and able man, and soon all discord ceased. In June, 1796, Tennessee having adopted a constitution and otherwise complied with the requisitions of the U. S., was admitted into the Union. The first capital was Knoxville. At this time there were no settlements in West Tennessee, and only a few scattering ones in seven counties of Middle Tennessee. The westward tendency of the emigration led to the gradual encroachment on the Chickasaw lands of West Tennessee, and in 1819 the Indian title to these lands was extinguished by treaty, and the Indians removed to the Indian Territory. The growth of the State was rapid, and in 1860 of its 1,110,000 inhabitants one-fourth were slaves. These were mostly in Middle and West Tennessee, East Tennessee having never held a large number. An ordinance of secession was passed (it is said illegally) May 6, 1861. During the war the State was the scene of many bloody battles—Island No. 10; the conflicts around and in Memphis; the severe battle of Pittsburg Landing or Shiloh; the numerous skirmishes and slight actions during Buell's retreat to Louisville, and the heavier fighting of Rosecrans's march to Nashville, whence he expelled the Confederate State government; the battle of Stone River; the capture of Murfreesboro', Tullahoma, and Chattanooga; and, though the battle of Chickamauga was over the line in Georgia, the subsequent battles around Chattanooga; the siege and relief of Knoxville; the actions of Cumberland Gap and Bean's Station; the battles of Columbia, Franklin, and Nashville; the retreat and pursuit of Hood, were all in this State. Almost the whole State was a battle-ground, and probably more square miles of its territory were fought over than of any other State in the Union. For a part of the time there were two State governments in operation. But the war over, the citizens of the State hastened to acknowledge their allegiance to the Union. In Apr., 1865, the State legislature ratified the Thirteenth amendment to the Constitution, and July 12, 1866, the Fourteenth amendment. The same month the State was restored to the Union, and has manifested her hearty loyalty for the past ten years.

Governors of Tennessee.

1. *State of Franklin or Frankland.*

John Sevier..................1785–88

2. *Territory of Tennessee.*

William Blount..............1790–96

3. *State of Tennessee.*

John Sevier...............1796–1801
Archibald Roane.........1801–03
John Sevier..............1803–09
William Blount............1809–15
Joseph McMinn...........1815–21
William Carroll..........1821–27
Samuel Houston..........1827–29
William Carroll..........1829–35
Newton Cannon...........1835–39
James K. Polk..............1839–41
James C. Jones..............1841–45
Aaron V. Brown............1845–47
Neil S. Brown..............1847–49
William Trousdale.........1849–51
William B. Campbell ...1851–53
Andrew Johnson...........1853–57
Isham G. Harris...........1857–62
Andrew Johnson 1862–65
William G. Brownlow..1865–69
De Witt C. Senter 1869–71
John C. Brown.............1871–75
James D. Porter...........1875–

Electoral and Popular Vote for President and Vice-President.

Elect. year.	Candidates who received the electoral vote.	Elect. vote
1796	Thomas Jefferson P....... Aaron Burr V.-P..........	3
1800	Thomas Jefferson P....... Aaron Burr V.-P	3
1804	Thomas Jefferson P....... George Clinton V.-P	5
1808	James Madison P. .... George Clinton V.-P	5
1812	James Madison P... ..... Elbridge Gerry V.-P.	8
1816	James Monroe P .... D. D. Tompkins V.-P	8
1820	James Monroe P. .... D. D. Tompkins V.-P.....	7

Elect. year.	Candidates who received the electoral and popular vote.	Elect. vote.	Pop. vote.	Opposition candidates.	Pop. vote.	Third-party candidates.	Pop vote
1824	Andrew Jackson P........ John C. Calhoun V.-P....	11	20,197	William H. Crawford P. Martin Van Buren V.-P.	312	John Quincy Adams P.....	216
1828	Andrew Jackson P......... John C. Calhoun V.-P....	11	44,090	John Quincy Adams P. Richard Rush V.-P.	2,240		
1832	Andrew Jackson P .... Martin Van Buren V.-P..	15	28,740	Henry Clay P. .... John Sergeant V.-P......	1,436		
1836	Hugh L. White P .... John Tyler V.-P.	15	35,168	Martin Van Buren P...... Richard M. Johnson V.-P.	26,129		
1840	William H. Harrison P.. John Tyler V.-P.....	15	60,391	Martin Van Buren P...... Richard M. Johnson V.-P.	48,289		
1844	Henry Clay P..... T. Frelinghuysen V.-P.	13	60,030	James K. Polk P. .... George M. Dallas V.-P.	59,917		
1848	Zachary Taylor P. ...... Millard Fillmore V.-P....	13	64,705	Lewis Cass P. .... William O. Butler V.-P.	58,419		
1852	Winfield Scott P. .... William A. Graham V.-P.	12	58,898	Franklin Pierce P. William R. King V.-P.	57,018		
1856	James Buchanan P. J. C. Breckinridge V.-P. .	12	[illegible]	Millard Fillmore P....... A. J. Donelson V.-P......	66,178		
1860	John Bell P .... Edward Everett V.-P.....	12	69,274	John C. Breckinridge P. Joseph Lane V.-P........	64,709	Stephen A. Douglas P. H. V. Johnson V.-P. .	[illegible]
1864	No vote.						
1868	Ulysses S. Grant P. ..... Schuyler Colfax V.-P.	10	[illegible]	Horatio Seymour P..... Francis P. Blair Jr., V.-P.	26,129		
1872	Horace Greeley P. ..... B. Gratz Brown V.-P.....	12	94,391	Ulysses S. Grant P. Henry Wilson V.-P.	85,655		
1876	Samuel J. Tilden P. Thos. A. Hendricks V.-P.	12		Rutherford B. Hayes P. William A. Wheeler V.-P.			

(The writer acknowledges his indebtedness for many facts to Col. J. B. Killebrew, secretary of the Tennessee Bureau of agriculture; to His Excellency Gov. James D. Porter, for documents; and to W. W. Thacker, Esq., cashier of First National Bank of Memphis, Tenn., for much valuable information.)

L. P. BROCKETT.

Ten'nessee, tp., Grant co., Ark. P. 308.

Tennessee, tp., McDonough co., Ill. P. 2126.

Tennessee River, the chief affluent of the Ohio, originates in the confluence of Holston and Clinch rivers at Kingston, Tenn. It flows S. W. to Chattanooga, thence W., and again S. W. sweeping through Northern Alabama, it turns northward, traverses Tennessee and Kentucky, and joins the Ohio at Paducah, Ky. Its drainage-area is 41,000 sq. m. Total length to the head of the Holston, nearly 1200 miles; below the confluence, 800 miles. It is navigable without obstruction 280 miles to Florence, Ala., at the foot of the MUSCLE SHOALS (which see). The shoals (20 miles long) are navigable about three weeks in the year, during spring floods. Above this point the river is navigable throughout its course for the greater part of the year by light draught steamers. There are 925 miles of naturally navigable waters above the shoals upon this river and its tributaries for six months in the year. It might easily be increased to 1300 miles.

Tennessee University, East. See EAST TENNESSEE UNIVERSITY.

Ten'ney (SAMUEL), M. D., b. at Byfield, Mass., Nov. 27, 1748; graduated at Harvard 1772; taught school a year at Andover; studied medicine; commenced practice at Exeter, N. H., 1775; entered the military service as surgeon in the Massachusetts line June 17, 1775; served through the war, being at Saratoga and Yorktown; settled again at Exeter after the war, but did not resume practice; was an early member of the American Academy of Arts and Sciences, to whose *Memoirs* he contributed an account of the mineral waters at Saratoga and his *Theory of Prismatic Colors*; furnished the Massachusetts Historical Society an account of Exeter, N. H., and a notice of the "dark day," May 19, 1780, and wrote for the Massachusetts Agricultural Society a valued treatise on orchard-planting; wrote much on politics in the periodicals, especially in advocacy of the Federal Constitution; was a member of the New Hampshire constitutional convention 1788; judge of probate for Rockingham county 1793–1800; member of Congress 1800–07; and published in the New York *Medical Repository* for 1811 *An Explanation of Certain Curious Phenomena in the Heating of Water*. D. at Exeter Feb. 6, 1816.—His wife, TABITHA GILMAN (b. at Exeter, N. H., in 1762, d. there May 2, 1837), was author of *The Adventures of Dorcasina Sheldon* and other writings.

Tenney (SANBORN), b. at Stoddard, N. H., in 1827; graduated at Amherst College 1853, in which year he became instructor in natural history in the New England Naval Institution at Lancaster, Mass.; afterward studied under Agassiz at Cambridge; was lecturer on natural history in the Massachusetts Teachers' Institute 1856–65, also giving public lectures in Pennsylvania and other parts of the country; was for several years from its foundation a professor at Vassar College; became in 1868 professor at Williams College; lectured on *Physical Structure and Natural Resources* before the Lowell Institute at Boston 1873. Author of *Geology for Teachers, Classes, and Private Students* (1859), *A Manual of Zoology* (1865), *Natural History of Animals*, *Natural History Tablets*, *Elements of Zoology*, and other works. D. at Buchanan, Mich., July 9, 1877.—His wife, MRS. ABBY A. TENNEY, is author of *Pictures and Stories of Animals for the Little Ones at Home* (New York, 6 vols., 1868), and contributed to the *Natural History of Animals*.

Tenney (WILLIAM JEWETT), b. at Newport, R. I., in 1811; graduated at Yale College in 1832; became editorially connected with the New York *Journal of Commerce*, *Evening Post*, and other journals, and finally one of a literary corps connected with the New York publishing-house of D. Appleton & Co. Besides much general literary labor, he completed Benton's abridgment of the *Debates of Congress*, edited an illustrated edition of *The Queens of England*, prepared the *Military and Naval History of the Rebellion in the United States* (1865), and has been the principal compiler of *The American Annual Cyclopædia* since its commencement in 1861 down to the volume for 1876.

Ten'niel (JOHN), b. in London, England, in 1820; showed a decided taste for art in boyhood; pursued his studies in his own way, thus developing a very original style; was a successful competitor for painting cartoons in fresco in Westminster Palace 1845; has been since 1851 one of the principal artists on the staff of *Punch*, and has illustrated many elegant Christmas books, among which are Æsop's *Fables*, the *Ingoldsby Legends*, and *Lalla Rookh*.

Ten'nis, a game at ball in which the ball is thrown against a wall, and upon its rebound is struck by a racket and driven again to the wall, etc. Tennis is variously played. "Rackets" (see RACKET) in England is a modern modification of tennis, which is a very ancient game.

Ten'nyson (ALFRED), D. C. L., F. R. S., b. at Somersby, Lincolnshire, England, in 1809, being the third of the seven sons of Rev. George Clayton Tennyson, D. D., rector of Somersby, by his wife Elizabeth, daughter of Rev. Stephen Fytche, vicar of Louth. The poet's father (d. about 1830) was a man of genius and of energetic character, remarkable for great strength and stature, and gave a careful education to his children, nearly all of whom began to write tales and verses from the time they could use a pen. The three eldest sons, Frederick, Charles, and Alfred, who have all become known as poets, entered Trinity College, Cambridge, together about 1827, and were pupils of the celebrated Dr. William Whewell, then one of the tutors of that college. A small anonymous volume of *Poems by Two Brothers* (1827) contained the earliest published verses of Charles and Alfred, and in the opinion of Coleridge and Wordsworth the poems of the former possessed the greater merit. In 1828 the eldest brother, Frederick, gained the medal for a Greek poem, and in 1829, Alfred carried off the chancellor's medal for an English poem of 250 lines on *Timbuctoo*—a performance showing many of the characteristic features of his later style, though not included in his collected works. One of his chief competitors for this prize was his most intimate college friend, Arthur H. Hallam (d. 1833), whose memory received in later years a most splendid poetical commemoration. While still an undergraduate, Alfred published a small volume of *Poems chiefly Lyrical* (1830), containing the gallery of female portraits and the elegiac verse still reprinted at the head of his poems, but including nothing of decisive promise, and which accordingly made no great sensation, though kindly noticed by several critics. It was in his third volume of *Poems* (1832) that, discarding nearly all his verses of 1827, and reprinting with great improvements the best verses from the volume of 1830, he first stamped himself as a genuine poet by such classical pieces as *The Lady of Shalott*, *Œnone*, *The May Queen*, and *The Lotos-Eaters*. This volume received warm applause from the highest authorities, but for unexplained reasons the poet published nothing more for ten years, until he fairly took the literary world by storm, and established his permanent reputation as the first poet of the age, by the new edition of his *Poems* (2 vols., 1842), substantially in the form still familiar to all readers. The author of *Morte d'Arthur*, *Locksley Hall*, and *The Two Voices* had nearly reached the summit of his powers, and though his fame has been steadily widening and broadening ever since, it may be doubted whether he has surpassed the "high-water mark" of 1842 by any of his later productions. *The Princess, a Medley* (1847), his first long poem, was disappointing to those critics who insisted upon seeking comparisons with the author's lyrical masterpieces, but was quite satisfactory for those who chose to take it upon its own merits as "a brilliant serio-comic *jeu d'esprit* upon the noise about woman's rights;" and the songs, which first appeared as interludes in the second edition, commended themselves to all admirers of lyrical gems. *In Memoriam* (1850), a series of marvellously pathetic monodies, written at intervals through many years, is still to many minds the poet's masterpiece. In 1850, Tennyson succeeded Wordsworth as poet-laureate, in which capacity he produced on the day of the funeral of the duke of Wellington (Nov., 1852) his immortal *Ode*. The Crimean war, with its uncertain results, exerted a depressing effect upon the poet's sensitive genius, as evidenced by his poem *Maud* (1855). After a silence of several years, the first series of *Idylls of the King* (1859), embracing four stories in blank verse drawn from the Arthurian legends, restored the poet's waning popularity, and was generally accepted as his greatest poetical effort—a verdict confirmed and strengthened ten years later when the cycle was completed by the publication of *The Holy Grail, and other Poems* (1869). *The Idylls of the King* (1870), as reconstructed by arranging the eight idylls in their artistic sequence, constitute an epic to which English literature can produce few or no rivals since the time of Milton. In the interval between the publication of the two parts of his *Idylls*, Tennyson had issued *Enoch Arden, and other Poems* (1864), a volume which fell somewhat below the standard of public expectation. He has since published *The Window, or The Songs of the Wrens* (1870), consisting of twelve brief lyrics written for music, and *Queen Mary, a Drama* (1875), represented upon the stage with moderate success in 1876; and in 1877 another drama, *Harold*, also in five acts. Tennyson resided chiefly in London during the first twenty years of his poetic career; married late in life (1851) Miss Emily Sellwood, a lady of Lincolnshire; was settled at Farringford, Isle of Wight, 1851–69, having also a residence at Aldworth in Surrey, and in 1869 established himself near Petersfield, Hampshire. His poems have been issued in many editions, and in the U. S. by rival publishers. Two editions of 1871

(Boston and New York) contain the poems of his earlier volumes of 1830 and 1832, which were cancelled by himself, and also some never collected by him from the magazines where they originally appeared. The two early volumes above mentioned were also privately reprinted in one volume in Canada (1862). The *Idylls of the King* were magnificently illustrated by Doré, and most of the other poems have received similar honors from other artists, to which painting and statuary have also lent their aid. Translations of the principal poems have appeared in several languages. Several volumes of selections have been published, and more than one volume of critical analysis, but the most remarkable evidence of his popularity is D. Barron Brightwell's *Concordance to the Entire Works of Alfred Tennyson* (London, 1869). PORTER C. BLISS.

Tennyson (FREDERICK), brother of Alfred, b. at Somersby, Lincolnshire, England, about 1806; graduated at Trinity College, Cambridge, about 1830; is author of a volume of poems, *Days and Hours* (1854).

Ten-Pins. See NINE-PINS.

Tenrec. See TANREC.

Ten'sas, parish of N. E. Louisiana, bordering on Mississippi River, and drained by Tensas River, by means of which it has water communication with the interior; surface low and flat, soil fertile. Staples, cotton, Indian corn, live-stock. Cap. St. Joseph. Area, 680 sq. m. P. 12,419.

Tensas (or **Tensaw**) **River,** or **Bayou Tensas,** rises in Carroll parish, La., and after a devious southerly course of 250 miles joins the Washita at Trinity, La. It is navigable 150 miles during good stages of water.

Tensaw River, of Alabama, is a bayou which leaves Alabama River before its junction with the Tombigbee, and pursues a course parallel with that of Mobile River. Its waters flow into Mobile Bay.

Tension of Dissociation. See DISSOCIATION, by PROF. C. A. JOY, PH. D.

Tension of Electricity. See ELECTRICITY, by PRES. H. MORTON, PH. D.

Tension of Vapors. See HEAT, by PROF. W. P. TROWBRIDGE, A. M.; GAS, by PROF. J. P. COOKE; and VAPORS AND VAPORIZATION.

Tent [from the Lat. *tentus*, "stretched"]. Both sacred and profane history tells us that tents of some sort have been used by all nomadic tribes from the earliest ages. At the present day the poorer classes in Persia, China, and indeed in most Eastern countries, dwell in tents formed of frames of wood covered with thick cloth, felt, or matting. The early Greek and Roman soldiers appear to have used tents of skins or canvas. The history of all wars in the temperate zone proves that men cannot war without tents. All military tents are now made of canvas, generally of cotton duck, sometimes of linen, cotton being considered the more suitable material, being more impervious to water and cheaper than linen or hemp.

The tents used in the military service of the U. S. comprise the following: the *hospital tent*, which is made of heavy cotton duck, 15 feet square, 12 feet high to ridge, with wall 4½ feet high, and is provided with a heavy fly or double roof. These tents are made to open at both ends, so that two or more placed together form a continuous ward. Each tent holds from six to eight beds. The wall tent for officers, 9 feet square, 8 feet 6 inches in height to ridge, having a wall 3 feet 9 inches high, and is furnished with a fly. The common or wedge-shaped tent for enlisted men, 6 feet 10 inches in height, 8 feet 4 inches in width, and 6 feet 10 inches long; it holds six men. The shelter tent, being a modification of the French *tente d'abri*, made of two pieces of cotton duck, each 5 feet 6 inches by 5 feet 5 inches, arranged to button together and stretch over a ridge supported by poles. In active field-service experience shows that the best arrangement is for each soldier to carry a portion of a shelter tent, which may serve as a cloak on the march and a cover at night, and which, joined to two or three other pieces, makes a tent to hold from two to four men. During the late civil war in the U. S. shelter or poncho tents were adopted, and came to be used very generally before the close of the war. The poncho is a piece of oil-cloth or rubber-cloth about 6 feet square, with a slit in the centre through which the head is put. Two or three ponchos form a shelter tent.

Many different plans of tents for military purposes have been tried during the past few years in Europe and in this country. A few years prior to the late civil war in the U. S. the wedge-shaped tent and the wall tent for enlisted men were replaced by the Sibley tent, which is a conical tent supported by a central pole resting on an iron tripod, and is intended to hold fifteen infantry soldiers or thirteen mounted men. One chief advantage of the Sibley tent is that it admits of being warmed by an open fire or small stove, and is admirably ventilated, having a circular opening at the apex partially covered by a movable piece of canvas so arranged as to be easily shifted according to the direction of the wind. The Sibley tent is almost exactly like the Sioux lodge, the chief difference being that it is constructed of canvas and supported by the central pole and tripod, while the Indian lodge is made of rudely-tanned buffalo hides and stretched on several long wooden poles. The use of the Sibley tent for our army was discontinued during the war. C. G. SAWTELLE.

Ten'terden (CHARLES STUART AUBREY **Abbot**), THIRD BARON, b. in England Dec. 26, 1834; succeeded to the title Apr. 10, 1870; has been for some years assistant under-secretary of state, and won a high reputation for ability upon questions of international law by his services at Washington (1871) and Geneva (1872) as counsel for Great Britain in the Alabama claims question.

Tenterden, LORD. See ABBOTT (CHARLES).

Ten Thousand, Retreat of the. After the battle of Cunaxa (401 B. C.), in which Cyrus fell and all his barbarian troops were dispersed, the Greek soldiers who had served in the army of Cyrus, and who numbered about ten thousand, found themselves placed in a most critical position, especially after the assassination of Clearchus and their other leaders by the Persian satrap Tissaphernes. Under these circumstances, XENOPHON (which see) was chosen leader, and he conducted them through the plains of the Euphrates and the Tigris, across the table-land of Armenia, to Trapezus (now Trebizond), a Greek colony on the south-eastern coast of the Black Sea, and from Trapezus to Chrysopolis, opposite to Byzantium. This retreat, which was effected under extraordinary difficulties, but conducted with great success, has been described by Xenophon himself in his *Anabasis*.

Tenuiros'tres [Lat. *tenuis*, "slender," and *rostrum*, "bill"], the name given to a group ("tribe" or "family") of birds, and including forms whose only common characters consisted in the possession of a more or less slender bill, and feet with three toes directed forward and one backward. According to Cuvier, it included the Linnaean "genera" *Sitta*, *Certhia*, *Trochilus*, and *Upupa*. The group was a very heterogeneous one, and has not been retained in the ornithological system. THEODORE GILL.

Tenure. See FEUDAL SYSTEM, by PRES. T. D. WOOLSEY, S. T. D., LL.D.

Teocal'li [Aztec, *teotl*, "god," and *calli*, "house"—*i. e.* "house of God"], a name given to the aboriginal temples of Mexico, many remains of which are still in existence. Recent investigations have rendered it probable that many structures which, on Spanish authority, have been received as temples and palaces, were in reality but multiple houses, built on the plan of the *pueblo* structures or *casas grandes*, still inhabited.

Te'os, one of the most prominent of the Ionian cities in Asia Minor, was situated in Lydia, 25 miles S. W. of Smyrna, between the promontories of Coryceum and Myonnesus, and N. of the island of Samos. It had two good harbors, and carried on a considerable trade. In its vicinity was produced a celebrated wine, and its most prominent public building was a splendid temple of Bacchus. After the Persian conquest most of the inhabitants emigrated to Abdera in Thrace. Teos continued, nevertheless, to be a city of some importance until the time of the Romans, when it gradually fell into decay. Ruins of it, of its walls, theatre, and temple, are visible near the present village of *Sighajik*.

Tepic', town of the Mexican confederation, state of Jalisco, on an elevated plateau 2500 feet above the sea, encircled by high mountains and surrounded with orchards and gardens, has about 9000 inhabitants, mostly engaged in sugar cultivation, cotton manufacture, and agriculture.

Teplitz. See TOPLITZ.

Tequendama, Cataract of. See BOGOTÁ.

Ter'amo, town of Southern Italy, province of the same name, about 35 miles S. of Fermo. It is beautifully situated on an elevated plain between two streams, somewhat above the site of the old *Interamna*, of which the modern name is a corruption. Little is known of the origin or history of this ancient town, whose remains are still visible, but the Roman colony, a walled city [illegible] ence, was destroyed by the Goths, rose again under the Lombards, and afterward experienced many and great vicissitudes. It is now an industrious and thriving place, having manufactories of porcelain, of hats, tartar, and licorice, etc. Good and even elegant household furniture is also extensively made here. P. 19,721.

Ter'aphim [a Heb. plural of doubtful meaning], a name given to images or figures, probably used by the ancient Hebrews either as objects of household worship or as religious symbols of some kind. Nothing satisfactory is known of their character, origin, or use.

Terashima Múnenori, b. in the province of Satsuma in 1830; educated in the provincial schools until his thirteenth year, when, because of his superior talents, he was sent to Yedo (now Tokio) to study medicine; had for his instructor a famous physician; acquired a thorough knowledge of the Dutch language, and was noted for his scholarship when Commodore Perry visited Japan; also became a good English scholar; was attached to the Japanese embassy which visited America in 1861; in 1865 was sent by the prince of Satsuma to England as a commissioner to take charge of several students, where they all remained for about two years; was made one of the councillors in the new government in 1868; was appointed governor of Kanagawa in 1869, acting at the same time as assistant secretary of foreign affairs; held the governorship for two years, and became senior vice-minister of foreign affairs; in 1872 was sent as envoy extraordinary and minister plenipotentiary to Great Britain; on account of his health he resigned that position in 1873, when he was appointed a privy councillor, or *sangi*, and also minister for foreign affairs, in which position he still continues.

F. A. P. BARNARD.

Teratol'ogy [Gr. τέρας, τερατος, "monster," and λόγος, "discourse"]. In this article under the term *teratology* will be comprised all that is usually included in the several terms "malformation," "monster," "double monster," "parasitic monster," "fœtus-in-fœtu," etc., or a summary of the principal deviations from the normal type occurring in the vegetable and animal kingdoms. Elementary considerations only will be entered upon in this article. The reader must bear in mind the important distinction between *primitive* anomalies or congenital malformations, such as have been developed during intra-uterine life, and *acquired* deformities, such as have arisen *after* the birth of the fœtus. The former belong to the province of teratology, while the latter are embraced in the field of medical and surgical pathology.

General Considerations.—Teratology is a subject which to those who have bestowed but little thought upon it is likely to be regarded as affording a very limited field of research; it, however, embraces the consideration of so many facts pertaining to its history, literature, classification, and description, and the embryology of the multitudinous forms of simple and compound malformations, including the so-called single, double, and parasitic monsters, fœtus-in-fœtu, and supernumerary development, as to require the extended limits of one or more considerable volumes, with numerous and expensive pictorial illustrations, to treat it in a satisfactory or anything like an exhaustive manner.

History.—For many centuries the more remarkable deviations from the normal type of the human or animal body were called monsters, a term derived from the Latin *monstrum*, "anything strange," a derivation from *monstrare*, to "show:" as, for example, the box in which relics were anciently kept for display was called *monstrum*. They not only attracted the attention of philosophers, but excited the wonder and superstitious awe of the illiterate. The writings of most of the ancient naturalists and anatomists abound in frequent allusions to the subject, among whom Hippocrates, Aristotle, Pliny, and Galen may be cited, and even Empedocles and Democritus noticed the more remarkable malformations occurring in both men and brutes; they also attempted explanations of the causes which they believed to have operated in their production. All that can be found in any of the ancient authors who have attempted to discourse upon the subject—or, indeed, in any of the works written previous to the beginning of the eighteenth century—is of very little scientific value, and for the most part consists of a confused and perplexing mass of marvellous and apocryphal tales, inaccurate descriptions founded on fanciful resemblances, and absurd and superstitious notions regarding the origin and portentous signification of monsters. While remarkable malformations among the lower animals were regarded as monsters portending dire calamities, human monstrosities were considered as evidences of divine anger or as the direct result of demoniacal influence, and hence looked upon with apprehension and dread, being interpreted by the augurs of the times as prodigies entailed upon parents as punishments, and frequently as wonders of bad omen to the public, foreshadowing some general calamity. In a curious and rare work printed at Bâle a little more than three centuries ago (1557), the author, Conrad Lycosthenes, collected with more industry than discrimination all the prodigies which had been recorded, as he tells us, from the beginning of the world down to his own time. This curious folio is profusely illustrated with wood-engravings, affording good examples of the existing state of the art, as well as illustrating the absurd popular notions of that day. Accompanying the picture of a malformation, human or animal, single or double, follows a representation of the special calamity of which it was believed to be the immediate precursor, whether an earthquake, flood, fire, pestilence, or war. After narrating an instance of a monstrous child, calf, or lamb being born in a certain province, he follows it with an account of its correlative event, such as the death of a bishop or the destruction of a city, represented in flames or toppling down by earthquakes, or its houses and inhabitants floating off in floods of water. The general belief that monsters had a satanic origin gave rise to the horrid practice of destroying them, either by drowning, strangling, or casting them into the flames, with the hope of thus diminishing or entirely exterminating the progeny of the devil. Notwithstanding that the greater part of the cases reported in the old literature of teratology consisted of fabulous stories concerning supernatural prodigies, such as could have had no real existence, yet there are to be found a few genuine cases quite accurately described. Some of the cases which at first would appear to be fabulous are, when examined by the light of modern science and compared with recent examples, found to be identical with recognized forms. The result of a careful study of the older works on monsters, such as Lycosthenes, Licetus, and Androvandus, will diminish the number of cases heretofore regarded as spurious, and elevate our respect for the observation and veracity of our ancestors. It was not until the early part of the eighteenth century that painstaking observations of the anatomical structure of monsters were fairly instituted in place of the mere superficial examination and description of the external configuration which had previously constituted the ultimate limit of physical inquiry on this subject. Corresponding with an increased knowledge of the anatomical structure, theories concerning the genesis and embryological development of monstrosities, and systems of classification, partook of a more rational if not of a scientific character. It would, perhaps, interest many readers to follow the history of teratology through its traditional, transitional, and scientific periods; the limited space allotted to an article in a work of this character only admits of reference to works devoted to the subject as cited in the appended bibliography.

Classification.—Various systems have been proposed by the numerous writers on teratology, among whom may be mentioned Licetus, Buffon, Breschet, Blumenbach, Meckel, Geoffroy Saint-Hilaire and his son Isidore, Gurlt, Otto, and Bischoff. Some of these systems of classification have been very complex and elaborate, while others have been sufficiently simple. There are many obstacles in the way of a satisfactory and scientific classification. Vrolik ignored all attempts in this direction, and arranged analogous forms under mere general groups. It is true that the multiplicity of forms under which malformations occur will admit of an arrangement into an unbroken series, the inferior degrees of which are represented by the existence of a mere rudimentary fragment or minus proportional of the entire body, and thence through many intermediate forms approaching the plus quantity or normal type of the species, which now becomes the point of departure for the series of excessive or redundant developments whereby more than belongs to a single being is produced, and through another long chain of transitional links, ranging from the addition of an insignificant member or part of a member, as a finger or toe, to the complete duplication of the body, as seen in the famous Siamese Twins. In systematic treatises on teratology some sort of classification is absolutely required, and at least a provisional nomenclature adopted. In this article the two heads of *simple* and *compound* malformations, corresponding with single and double monsters, will serve the writer's purpose.

Causes of Malformation.—This inquiry has given rise to much fruitless speculation; and although a degree of obscurity still remains as to the essential cause of the several vices of conformation and more remarkable anomalies of organization which occur among all the divisions of the animal kingdom, in common with the human species, yet we are gradually approaching to a clearer understanding of the genesis of all the varieties of malformation. The superstitions and absurd explanations of a former age, which to some extent still hold in the minds of a few from whom more rational views should be expected, have chiefly vanished, in consequence of the light which modern embryological investigations have shed upon the subject. Certainly, nothing can be more irrational than an attempt to explain the anomalies of organization which occur in

man by maternal mental emotions, when corresponding malformations, in every respect identical in character, occur among the lower order of animals, viviparous or oviparous —among birds, reptiles, and fishes; indeed, we may go still farther, and find analogous malformations in the vegetable kingdom, where single and double monsters also abound—developments which apparently result from defective or excessive formative power. Such flimsy explanations would certainly fail to account for the fact that deep-seated organs, the existence of which is unknown to the pregnant woman, are frequently malformed, as in examples of congenital malformations of the heart, kidneys, intestinal canal, the abnormal distribution of blood-vessels, more or less than the typical number of vertebræ, ribs, etc. This subject has been somewhat exhaustively discussed by the writer in an article to be found in the *American Jour. of Insanity* for Jan., 1870. External mechanical influences, such as blows, falls, etc., may by shock or by affecting the general health of the mother have power to disturb the normal development of the fœtus in utero; it, however, remains to be proved that any form of malformation has ever resulted from such a cause.

Original malformation of the germ has been reckoned among the causes of anomalous development. The germ is now considered a product of ovarian secretion upon which the male sperm acts; hence we may suppose it possible for the germ to be malformed. (*Vrolik.*) This view of the embryogenesis of at least some of the primitive anomalies receives force from the fact that repetition of the same kind of malformation by the same parents has been observed in a number of cases. It may be ascribed to the mother when the malformation is repeated, and to the father where his children, by different wives, are malformed in the same manner. An additional evidence of original defect in the germ is the hereditary transmission of certain deformities through several generations, examples of which in an excessive number of digits, hare-lip, hypospadias, and other structural vices, are not very infrequent.

Diseases of the Ovum and of the Fœtus.—The late Prof. Simpson of Edinburgh wrote several elaborate essays upon intra-uterine pathology (*Ed. Med. and Surg. Jour.*, Apr., 1836, Oct., 1838, July, 1839); also Prof. Montgomery (*Dublin Jour. of Med. Sci.*, 1832, and in his work on *Pregnancy*, and article "Fœtus" in *Cyclop. of Anat. and Physiol.*). The late Dr. William C. Roberts of New York City, on *Diseases of the Fœtus*, etc. (*Amer. Jour. Med. Sci.*, Aug., 1840, Oct., 1841), as well as Vrolik, Otto, and many others, have greatly enlarged our knowledge of this interesting subject. Otto maintains that many malformations may be ascribed to diseases of the fœtus, while Vrolik contends that very few are attributable to this cause. Chronic inflammation of the brain may produce dropsy of the ventricles, and this the malformation called *acrania* (no cranium). Spontaneous amputation of the limbs *in utero* by constriction of the umbilical cord, and also some other congenital deformities, are described under this head.

We now come to the chief cause of malformation—viz. impeded or retarded development of the fœtus from whatever cause. The doctrine of Serres and others, that monstrosities result from defect of the vascular or nervous system, is untenable. Embryogenesis teaches that the several parts of the body are formed independently, and Vrolik, an eminent authority in embryology and teratology, and to whom the writer is so much indebted in the preparation of this article, concludes that no malformation whatever proceeds from a central system, but is occasioned merely by impeded development, the cause of which remains concealed. Retardation or arrest of development may be confined to one part or extended to others, as seen where several malformations coexist. Wolff, Tiedemann, and J. F. Meckel have elaborated the theory that "most malformations represent certain stages of the development of the embryo and of its organs, at which stages formation has stopped short, or from which ulterior development has ceased to follow the normal type." This is doubtless the most rational of all the views which have been proposed or entertained upon this subject, yet the various malformations which are known and have been so often repeated do not precisely represent the exact form at which the fœtus was arrested in its development, for the reason that important modifications result from the growth of the normal parts in the progressive nutrition of the fœtus. It has been observed by eminent embryologists that the transient forms of the human fœtus, in its several stages of development, bear a striking resemblance to the persistent types of the lower orders of animals; hence the human malformations which result from arrest of development often acquire the appearance of brutes, while those occurring in animals for the most part have the forms of those still lower in the scale, instead of the higher orders. The deviations from the normal type of a species are never so great as to destroy all semblance to it. There is a limit beyond which abnormalities never pass. In reaching her ultimate anomalies Nature observes the law of propriety (*lex proprietatis*, Fleischmann), and makes her approach through a series of transitional gradations. Dissimilar parts and organs are never found fused or united together, nor transpositions of viscera beyond the limits of their natural locality: as, *e. g.*, the brain in the abdomen, or intestinal tube in the cranial cavity.

There are several facts which have been observed in relation to monsters which are so constant that they can be considered as fixed organic laws: That they occur in definite number, the relation being about 1 to 3000 births; that in the greater part of malformations the sex is female; that certain species of animals are more liable to produce monsters than others—for example, cyclopia in swine, double monsters in man (*Vrolik*); in the constancy of form in monsters, even among animals of the most diverse orders (we find cyclopia, acrania, and double monsters occurring in birds, possessing the identical characters as in the Mammalia); and, lastly, the greater predisposition to monstrosity among certain animals, being greater among domestic than wild animals, 75 per cent. among mammals to 25 among birds.

We shall now proceed to the consideration of simple monsters, resulting from arrest of development: the merest abstract of the various forms is all that can be given here, in doing which Vrolik's article in the *Cyclopædia of Anatomy and Physiology* is quite closely followed.

Malformations of the Ovum.—(1) The so-called moles are the product of disease of the ovum. The vesicular masses which have been so often regarded as hydatids are but degenerations of the chorion, consisting of its enlarged villi filled with serous fluid. Occasionally the mass contains a small fœtus which has been blighted at an early stage of development. (2) The placenta and cord may undergo various alterations, the former divided into large lobes, the latter being abnormally long or thick, or vary in the number of its vessels or in the persistency of the umbilical vesicle.

Malformations of the Fœtus.—These are so numerous that only the more notable can be referred to here. First, simple malformations, or such as result from arrest or retardation of development, and lastly of compound monstrosities.

Cleft Malformations, or such as result from non-closure of those parts of the body which are open in an early stage of normal development, but which at a later period should become closed, furnish an explanation of many forms of fœtal anomaly.

Non-closure of the Anterior Parts of the Body. Fissure of the Thorax.—The cavities of the chest and abdomen are open in the earlier periods of embryonic development, and close in the later months of fœtal life. The sternum does not commence to ossify until the fourth or fifth month of pregnancy; the ossific centres in the broad cartilage are at first widely separated in the middle of the sternum, but subsequently fuse into one bone. This furnishes an explanation of some of the malformations of the sternum, as its abnormal breadth, the openings which are found in it, and its separation into two parts, which is generally seen in *ectopia* of the thoracic and abdominal viscera. In some cases the sternum is found separated, and the heart and part of the lungs enclosed and merely covered by the skin. In rare cases the breast-bone is absent, and no other defect. In still more rare instances the front walls of the chest and abdomen consist merely of the skin, the bony and fleshy parts being entirely wanting. The writer of this article has met with an instance of a child born with the entrails covered with what appeared to be merely the peritoneum; it was a thin, transparent membrane, which took on inflammation from exposure to the air, gave way on the third day after birth, and allowed the intestines, etc., to hang out of the child's abdomen, in which condition it survived to the end of the fifth day. Instances are on record where a persistence of the normal separation of the front walls of the body has resulted in the birth of a child with the heart protruding without even its own proper covering, the pericardium, [illegible] *extra cordis* (*Br. and For. Med. Rev.*, Oct., 18[illegible], p. [illegible]), and others in which the entire contents of the abdomen are uncovered and protruding at the [illegible] of birth. Congenital umbilical hernia, or rupture at the navel, as it is popularly called, is the result of a les[illegible] fissure of the anterior walls of the belly, the parts near the navel being the last to close.

Fissure of the Pubic Region. [illegible] happens that this region alone remains op[illegible] fissure of the urinary bladder, with or with[illegible] epispadiac abnormality occurs. The prolapsed or inverted [illegible], as it has been called, forms a red spongy tumor, [illegible] a little above the separated pubic bones. In male [illegible] then the openings

of the seminal vessels can be found in the lower part of the tumor. The tubes which convey the urine from the kidneys open into the interior of the bladder, and can be seen on its naked surface as two papillary eminences. The urine drops constantly from them, and is sometimes seen to flow in small streams. It has taxed the ingenuity of surgeons and instrument-makers to devise methods which would render the lives of those who are the subjects of this malformation endurable. In these cases the pubic bones are widely apart, as in the early stage of embryogenesis—in some cases four inches—without intermediate cartilage, but merely a ligament. The penis is split open along its upper surface (*epispadias*), the testes are small, even in adults, and often retained in the abdomen or in the inguinal or groin canals. Various other defects have been observed in both sexes associated with this malformation. It is evident that all of the cases of malformation above alluded to are the result of non-closure of parts which in the early embryo are formed in two bilateral parts, and later, when not arrested, unite at the middle line. Imperforate anus is the persistent condition of the early embryogenic state of the rectum.

Fissure of the Face.—In order to properly understand the various forms of fissure of the face, the several changes which occur during the development of the head must be briefly stated. Vrolik gives the following summary: Originally, there is a common oral and nasal cavity. The place of the nose is occupied by two fissures, which extend from the internal angles of the eyes to the upper margin of the cavity of the mouth. There is at this period not the least indication of a palate, so that the mouth and the nose form one cavity. The first rudiment of a palate is found in the fœtus when a little less than an inch in length. (*Meckel.*) This rudimentary palate is in the form of an arc, which is gradually completed on the sides, so as at first to be open at its back part, but subsequently closed, when it becomes a complete transverse septum between the mouth and nose. Arrest of development at these different stages results in the production of the various forms of facial fissure. In the greatest degree of cleavage of the face the fissures extend from the angles of the mouth to the internal angles of the eyes, the eyeballs, the nose, and the mouth forming but one cavity. (*Vrolik, Van Doeveren, J. S. Meckel.*) It may be confined to one side only, and in some cases it is merely a shallow groove. When the fissures are restricted to the upper jaw, double hare-lip, with cleft palate, results; if confined to one side, single hare-lip, with or without cleft palate; or cleft palate may occur without hare-lip. Fissure of the under lip and separation of the lower jaw have occurred, but very rarely.

Fissure of the Skull (Acrania).—This malformation has received various names—microcephalia (small head), anencephalia (no head), and hemicephalia (half head). In systematic treatises on teratology several types are described. In the first the brain is entirely wanting, and also the walls of the cranium; the whole base of the skull is exposed. In some cases not even the terminations of the cranial or cerebral nerves can be discovered. The absence of the cranium, the low forehead, and the protrusion of the eyeballs give to these distorted monsters a brute-like aspect, the cat's head or *Katzenkopfe* of the Germans. The bones of the face are also frequently malformed, and the vertebræ of the neck cleft. In the second type the base of the cranium is occupied by a rudimentary brain in the shape of a spongy substance, with which the nerves may or may not be connected. The spine may be perfect or cleft. Specimens of this form of malformation have been found among the Egyptian mummies. In the third type the back part of the skull may be closed, the spongy tumor occupies the place of the brain, all of the nerves are present, and the cranial bones partly developed. In the fourth and last type the skull is flat, with a large opening through which the brain protrudes (*cerebral hernia*). The brain is covered with the skin, and generally hangs like a bag resting on the back of the neck. Unlike the other types, the head is never turned with the face upward, and the ears do not rest on the shoulders. All of the forms referred to are the result of arrested and defective development of the skull and brain. Their origin cannot be accidental, since the cases are quite numerous, and bear a perfect resemblance and constancy of form in all anatomical museums and in the illustrations of reported cases. The bodies and limbs of these monsters are generally well formed and well nourished. They are mostly born living at the end of full term; they, however, rarely survive more than a few hours. In some cases of cerebral hernia life has been protracted twenty, thirty, and even sixty years. Among the causes of acrania, inflammation and dropsy of the brain probably are the chief agents. Rupture of the cerebral vesicle at an early period of embryonic life will explain some of the cases; also arrests of development.

Spina bifida, split or cleft spine, is doubtless generally caused by inflammation and dropsy of the sheath of the spinal cord. It is analogous to acrania, above described. In one case of spina bifida in the lower part of the back the subject lived twenty-eight years. In some cases there has been a complete want of the spinal cord, while in others the cord has been cleft in two right and left portions as if it were double. In the early life of the embryo the two lateral halves of the spinal cord are evolved separated, and subsequently, if not arrested, become united.

Acephalia, or headless monsters, occur under many forms and in different degrees of development. In some of the more imperfect forms there is only a rounded fleshy mass covered with skin, without any indications of extremities; it contains a fold of intestine, and receives blood through the vessels of the navel-string. In other cases there exists one or both of the lower limbs, and through a series of transitional forms we come to cases in which the chest and abdomen and all the extremities are present and seem to be more or less imperfectly formed. Even in these cases there is scarcely an indication of a head. To the spinal column are added the vertebræ of the neck, and sometimes confused rudiments of cranial bones. In these cases there is usually a diaphragm, but neither heart nor lungs; sometimes a liver. As this form approaches nearer to the normal type, cases are found in which an amorphous head is seen, with indications of eyes and nose, but neither ears nor mouth. In other cases the body and extremities are perfectly well developed, and having a neck, which is wanting in all the other types; which neck is merely surmounted and terminated by the ears. In the last type the headless monster consists of a body only, without the least indication of upper or lower limbs. Only one case is known. In this, which had reached the mature period of development, the chest contained a large heart, imperfect lungs, a malformed liver, a stomach and intestinal canal. It has been observed that nearly all the types of acephali are twins, being born with one or more perfect children. The question has been raised whether quantity affects quality in these cases. It is easy to reduce the external appearance of these monsters to the early periods of development, in which the head is not yet distinct from the trunk, and in which the limbs are not yet protruded.

Want and defective formation of the trunk have already been alluded to. In its extreme degrees neither body nor limbs are formed; several cases are described in which the head was the only part found. Vrolik mentions a case, which he saw, which was born with a well-formed calf, the tongue being the only well-developed part in this imperfect head. This case would seem to prove that each part of the body is evolved quite independently of the rest—vessels without the heart, nerves without brain or spinal cord, etc. In less degrees of malformation the upper part of the body is found without the lower limbs. In some examples only one of the lower limbs exists. In other cases there is apparently but one lower limb, which is composed of the elements of two, being fused and terminating in a caudal extremity, and hence *monstra sireniformia*. In this deformity the anus is closed, the genitals defective, and the navel-string has but one artery. The fused limb may terminate with a single or a double foot, or none at all.

Want of all of the extremities is an arrest of development at that period in which the limbs are not yet formed, and in which small tubercles occupy their places. The upper may alone be wanting. Adult examples of this defect are often exhibited in "side-shows" in whom the feet are made to act as skilful hands. Cases have been met with in which the intermediate parts of the limbs are wanting, so that the hands are attached to the shoulder and the feet to the hips. This may occur to one or all of the extremities. In less degrees the limbs are merely too short, all their elements being present. Another deformity is where one or more of the limbs terminate abruptly in a stump. Where the stump presents a cicatrix, it is due to amputation *in utero*, caused by constriction of the coil of the navel-string. In cases where the stump is terminated by one or more rudimentary fingers, the cause is from arrest of development. It is not infrequent that cases are met with in which the only malformation that exists in a well-formed child is the absence of one or more of the fingers or toes. Coalescence of fingers or toes to a greater or less degree is called web-fingered or web-toed. Congenital club-foot is a mere abnormal direction of the foot.

Cyclopia, or one-eyed monster, arises from defective development of the middle line of the face—cleft deformity—and fusion, more or less complete, of the two eyeballs, in which case the nose forms a sort of proboscis, and hangs from above the compound eye. Want of the under jaw often coexists with cyclopia; sometimes total defect of the opening of the mouth; in others a mere fissure represents the mouth. The under jaw may be merely too short. This

whole series consists, as Bischoff says, in an imperfect development of the first visceral arc.

Compound monsters include all cases in which more than belongs to a single being is developed; in its lower degrees the mere addition of an extra finger or toe, and in the highest complete duplication by the union of two well-formed fœtuses. That the genesis of double monsters is not a mere freak of nature, but the result of obedience to laws as invariable as those which govern normal development, will be seen by the following general considerations: (1) *The Law of Unity of Sex.*—Out of over 500 cases of human double monsters, as also of innumerable cases in the lower order of animals, in no instance has this law been violated. The account of a double monster of both sexes, given by a clergyman of Giessen, is very properly rejected by Virchow and all teratologists. The individuals of a double fœtus will always be found to have the same sex, either both males or both females. It is also a fact that in the vast majority of cases they have been found to be females, whether human or animal. (2) *The Law of Homologous Union.*—The union of the two fœtuses of a compound monster obeys the law of homologous union as uniformly as in the union of the two lateral halves of a single fœtus in normal embryogenesis. In other words, there is an equal balancing of parts and organs in each individual. The same muscle of one fœtus unites with the same muscle of the other; bone to bone; the same nerve or blood-vessel to the corresponding parts; and so on until all the parts and organs which are situated adjacent to each other are fused, heart to heart, stomach to stomach, etc. In cases of apparent exception to this law—such as a fœtus by inclusion or of a parasitic monster—it has been found that the union was homologous in the early embryonic periods, but that the growth of one fœtus being arrested or retarded, this blighted one was overlapped and included by its fellow. (3) *The Law of Right and Left Symmetry.*—On examination of the structure and relative position of the internal organs of a double fœtus there will be found a transposition of the viscera of each individual in order to dispose them symmetrically in relation to the common median axis of the compound body. If the double fœtus has two hearts, they will be right and left in position, and their apices will converge toward the line of fusion of the two bodies. This will be found true also of the livers and spleens and of the stomachs. The universality of this law is less positively proven than the two previously stated.

Several theories have been suggested to explain the production of double monsters: (1) The notion which attributes them to maternal impressions has already been referred to, and dismissed as untenable alike to double or single monsters. (2) The theory that they result from the fecundation of a double egg—*i. e.* of two distinct yolks enclosed in one capsule—has been proved by repeated experiments to be incorrect. (Prof. Panum of Kiel with eighty double eggs of the domestic fowl.) The product of hatching such eggs is twins, separate and of the same or of opposite sexes. (3) A more plausible hypothesis claimed that all double monsters were originally twin conceptions, but that the membranes separating them being absent, imperfect, or absorbed, the two bodies were brought into close contact with each other, and coalesced by reason either of some inflammatory action or of the strong formative power existing at that period of uterine life. The late Prof. Charles D. Meigs entertained this theory, which is obviously wrong, since it fails to explain the law of unity of sex, homologous union, and right and left symmetry. Twins often differ in sex, and one-third of twins are contained in *one* amniotic sac, the very condition claimed to be most favorable to fusion, and yet in these cases the twins are usually of opposite sexes. Should union occur under these conditions, they would be joined in the most accidental and heterogeneous manner. (4) It has been demonstrated by early embryos in the eggs of birds, and by observations under the microscope of the transparent eggs of fish, that a double monster is the product of a single ovum, whose vitelline membrane develops two primitive traces—*i. e.* two neural axes—instead of one. In some cases the primitive traces were not entirely separated nor precisely equal in size, while in other cases the neural axis was only partially bifid. The various degrees and the extent to which the primitive trace is cleft, from the slightest amount of duplicity to complete duplication, account satisfactorily for all the forms of duplex development. Thus it is seen that the compound monster proceeds from a single germ, single sexuality, and being governed by identical germinal laws, homologous and symmetrical development and fusion must result. The degree of duplicity and the extent of fusion depend upon the proximity or remoteness of the primitive traces and the relative inclination of their axes.

The so-called parasitic monster is the minus proportional, the lesser or imperfectly-developed half, of a double monster. When the two individuals of a compound monster are equal and symmetrical, they represent the plus quantity. In a series of cases of non-symmetrical duplex developments we find every degree of falling off that pertains to the malformed single fœtus, resulting from the same causes—viz. arrested, retarded, or embarrassed development. Two authentic cases of triple-headed monsters are recorded, one human and one of a lamb. Their embryogenesis is readily explained by a double splitting of the primitive trace, whereby the cephalic extremity of the neural axis becomes trifid.

Limited space forbids us going into a detailed account of the numerous forms of double monsters which have occurred, even in the human subject. For particulars those interested may consult the essays of the present writer on *Diploteratology* in the *Transactions* of the Medical Society of the State of New York for the years 1865, 1866, 1867, and 1868, comprising 200 pages and 126 lithographic illustrations. It contains a chronological bibliography of the subject, embracing several hundred titles of works published during the past three centuries. The student of teratology will seek the works of Isidore Geoffroy Saint-Hilaire, Otto, Vrolik, Förster, Braune, and many others. GEORGE JACKSON FISHER.

Ter′bium, the name given by Mosander to a substance associated with erbium and yttrium in the mineral gadolinite, and supposed by him to be a new metal, but the experiments of other careful analysts have failed to discover such a metal, and its existence is consequently a matter of doubt. (See ERBIUM and YTTRIUM.)

Ter′burg (GERARD), b. at Zwolle in the Netherlands in 1608; received probably his first instruction in painting from his father; travelled through Germany and Italy, whose art, however, had no influence on him; painted in 1648 the sixty-nine plenipotentiaries who concluded the Peace of Münster; was invited to Madrid; visited Paris and London; gained great favor everywhere both by his person and by his art; returned home rich and renowned, and settled in Deventer, where he was chosen burgomaster. D. in 1681. His pictures are mostly genre pieces, representing scenes of the easy and elegant life of the upper classes. They are scattered all over Europe, and command immense prices.

Terce′ira, one of the Azores Islands (see AZORES), comprises an area of 220 sq. m., with about 40,000 inhabitants. The coasts are steep, wild, and, with exception of a few strongly fortified places which afford good harbors, perfectly inaccessible. The interior is much broken up by volcanic agencies, but the soil, mostly consisting of decomposed lava and tufa, is exceedingly fertile, and wine, oranges, and timber are largely exported. Cap. Angra.

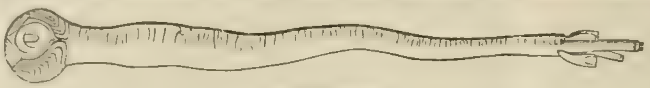
Ter′ebinth, Tiel Tree, or **Turpentine Tree,** the *Pistacia terebinthus*, of the order Anacardiaceæ. It is some thirty or forty feet high, and grows in the Levant. It produces the valuable Chian turpentine. The terebinth tree is noted for its extreme longevity.

Terebratula. See TEREBRATULIDÆ.

Terebratu′lidæ [Lat. *terebrare*, to "bore"], a name applied to a family of brachiopods of the order Arthropomata. The group, like the old Linnæan genus, has been much modified in extent, and successively restricted: at first it was nearly coequal with the order to which it belongs, but is now restricted by Davidson and others to include certain genera agreeing in the following characters: The shells are diversiform in shape in the several groups, but the beak is always more or less prominent and truncated by a subcircular perforation (for the passage of the peduncle), partly completed by a deltidium in one or two pieces; the shell-substance is punctated; the labial appendages are connected with each other by a membrane, are variously folded on themselves, and are more or less supported by calcified processes, which are diversiform in shape, but never spiral. The species live in the ocean, attached by a peduncle to rocks and other bodies. They are the most numerous and varied in development among the living brachiopods. In time the family has existed from at least the close of the Silurian period to the present time. The following genera are recognized by Davidson, and by Dall have been distributed under several sub-families—viz. (1) Terebratulinæ, including the genera *Terebratula*, *Dielasma* (*f.*), *Rensselaeria* (*f.*), *Terebratulina*, *Waldheimia*, and *Macandrevia*; (2) Stringocephalinæ, represented by the genus *Stringocephalus* (*f.*); (3) Magasinæ, embracing the genera *Terebratella*, *Terebrirostra* (*f.*), *Kingena* (*f.*), *Megerlia*, and *Magas*; (4) Kraussininæ, including the genera *Kraussina* and *Bouchardia*; (5) Platidinæ, typified by the genus *Platidia*; and (6) Megathyrinæ, represented by the genera *Megathyris* or *Argiope*, *Cistella*, and *Zellania*: the genera *Mannia*, *Gwynia*, *Trig-*

dolonis are also admitted by Mr. Davidson, and so are a number of sub-genera by Mr. Dall. (See Dall in *Am. Journ. Conch.*, vol. vi. pp. 88–117.) The greater number of these genera are still represented by living species, and those now extinct are indicated by the letter (*f.*) after them. (See also LAMP SHELL.) THEODORE GILL.

Teredin'idæ [from *Teredo*, Gr. τερηδών, the typical genus], a family of conchiferous or lamellibranchiate mollusks, notable in connection with the so-called "ship-worms," which are its chief representatives. The several forms are in nowise related to worms, and the only feature common between the two is the elongation of the body and of the tube which they form; they have, however, the true molluscan organization, and the elongation is simply due to the excessive protraction backward of the siphonal tubes and the reduction of the body. The abdominal or shell covered portion of the animal is comparatively very small and almost subglobular, and the siphonal portion is in proportion extremely long and worm-like; the siphons are united for the greater part of their length, but free toward their ends, and there armed with two peculiar elongated shelly appendages called "styles" or "siphonal palettes;" the mantle is well developed, its lobes united except at the pedal opening, reflected behind over the valves of the shell, and developed above into lobe-like expansions, which are also reflected over the hinges of the shell, and serve to keep the valves in place; the gills are large, and extend far into the siphonal portion; the mouth is provided with palpi, the foot is subcylindrical and sucker-like, with a foliaceous margin, moderately protractile, and well supplied with nerves, the shell is composed of two equal valves of peculiar form; these valves are not united at the hinge, but are only kept in place by the reflections of the mantle above referred to, and are thus susceptible of much independent interaction; the valves are, in the typical forms, severally divisible into three regions, indicated by a decided anterior notch as well as groove, and by a posterior furrow or groove crossing the shell in a curved line from behind the umbonal region; these limit (1) the anterior projecting cockle-like part, (2) the median deep part, and (3) the posterior true shell-like (*e. g.* like the posterior portion of the shell of a *Pholas* or *Mya*) part. The sculpture often varies much on these several parts, although all resulting from modifications of the lines of growth. In the *Teredo navalis*, *e. g.*, (1) the anterior portion is ribbed like a cockle-shell, the ribs (developed from lines of growth) radiating backward from the incurved anterior margin, transversely furrowed, and abruptly terminating at the groove dividing the anterior and median regions; (2) the median portion, on its anterior slope, has the lines of growth developed into rows of acute cuneiform denticles; and (3) the rest of the surface has concentric wave-like folds or distant striæ; the incurved protuberances of the valves support long spine-like apophyses which point downward within the shell toward the lower margin. The animal forms a long trabes in which it conceals itself. Such are the principal characters which distinguish this type. The significance of some of the details noted will be soon obvious. First, however, the several modifications of the type should be adverted to. The family has quite a number of representatives, most of which bore in wood, but a few live in the bottom of the water, and the tubes they form in that case serve to protect them from the inflow of mud into their burrows. The members of the several subordinate groups and species are essentially similar, but differ much in details as to form and sculpture of their shells, and still more in modifications of the siphonal palettes. On the modifications of those elements the family has been differentiated by E. Percival Wright into six genera—viz., *Teredo*, *Nausitora*, *Kuphus*, *Calobates*, *Xylotrya*, and *Uperotus*. Still another genus, *Lyrodus*, has been introduced by A. A. Gould. Not far from 40 species have been recognized by recent naturalists, most of which belong to the typical genus (*Teredo*). Representatives of the family are widely diffused, and some, more or less, are found in the seas of almost every country.



The Ship-worm.

Great ravages have been committed by species of the genus *Teredo*—especially *Teredo navalis*—and government commissions of inquiry have been instituted to investigate the natural history of the animals with a view to staying their destructive work. The literature involving the subject is therefore very voluminous. The most noteworthy reports are those made during the years 1860–65 by a commission authorized by the government of the Netherlands, and of which an abstract was published in 1866 by the secretary of the commission, E. H. von Baumhauer. In this abstract the subject is considered under the following heads, with the results indicated:

I. *The Mechanism of the Apparatus by means of which the Teredo navalis perforates its galleries.*—Recalling the armature of the valves already described—the file-like ribs and rows of denticles—it was inferred, and has been demonstrated by experiment, that the excavations of the animal are effected by the continuous action of the valves, whose hard anterior surfaces act by attrition in the manner of a file, and gradually rasp away the wood attacked. The foot is a delicate organ of touch, and serves to guide the animal.

II. *On the Mode of Life of the Teredo.*—The sexes are divided, and in unequal number, there being about twenty males to one female, according to Quatrefages. The female is oviparous, and expels the eggs through the branchial siphon in the months of June and July in Middle Europe. The young attach themselves to wood, and soon (within even two weeks) perforate into it, the openings being naturally small and the holes increasing with the size of the animal. The wood is bored in different directions, but the several individuals skilfully avoid intrusion into the burrows of their neighbors, although frequently leaving very narrow partitions. Thus, the wood is often honeycombed, and, yielding to very slight force, is readily demolished. The fine particles of wood ground away are conveyed through the shorter siphon into the open water. The animal flourishes in clear pure water. Its most formidable enemy is a kind of worm, the *Lycoris fucata*, which penetrates into its burrows and devours it.

III. *On Circumstances which favor the Ravages of the Teredo.*—It has been found that the ravages of the animal have suddenly increased in certain years—*e. g.* in the Netherlands in the years 1731, 1770, 1827, 1858, and 1859—and it has been ascertained by elaborate investigations that this increase was co-ordinated with three concurrent circumstances—viz. (1) the fall of a diminished amount of rain; (2) the consequent diminution of the inland bodies of water; and (3) the resulting increase of the saltness of the sea. In other words, the salter the sea is within certain limits, the better flourishes the *Teredo*.

IV. *Experiments undertaken to preserve Wood from the Attacks of the Teredo.*—These have been very numerous, and it must suffice to indicate that the Netherlands commission came to the conclusion that the only preservative against the ravages of the *Teredo* is creosote oil. Care must be taken as to the quality of the liquid, the manner of its application, and the nature of the wood on which it is employed. (Consult especially articles by E. H. Baumhauer (*Sur le Taret et les Moyens de préserver les Bois de ses Dégâts*, in *Archives Neerland. de Sciences exactes et Nat.*, vol. i. pp. 1–45, pl. 1–4), G. W. Tryon (*Monograph of the Family Teredidæ*, in *Proc. Acad. Nat. Sc.*, Philadelphia, 1862, pp. 453–482), and E. Percival Wright (*Contributions to a Natural History of the Teredidæ*, in *Trans. Linn. Soc. London*, vol. xxv. pp. 561–568, pl. 64–65). In these other references will be found.) THEODORE GILL.

Teredo. See TEREDINIDÆ.

Ter'ence (PUBLIUS TERENTIUS AFER), b. at Carthage 195 B. C.; became, though in a manner not known, the slave of Publius Terentius Lucanus. On account of the talents he early evinced he received a careful education, was manumitted, and lived, after the performance of his first comedy, *Andria*, in 166 B. C., in intimate intercourse with some of the best men in Rome, such as the younger Scipio, Lælius, and others. In 160 B. C. he went to Greece, and is said to have translated 108 comedies by Menander during his stay there; but he never returned. The reports of his death, however, differ very much, some even asserting that he was drowned before he reached Greece. Six of his comedies have come down to us—namely, *Andria*, *Hecyra*, *Heauton-timoroumenos*, *Eunuchus*, *Phormio*, and *Adelphi*. They all belong to the so-called *fabula palliata*—that is, they represent Greek characters, Greek customs, and Greek life; and they all are borrowed, to some extent, from Greek originals by Menander, Apollodorus, or Diphilus, two Greek comedies being often melted down into one by the Latin author. By the Roman public at large they were not received with any great applause; people left the theatre when they were played to see the acrobats; but their purity of language, elegance of diction, and refinement of humor and sentiment—merits which the rivals of Terence ascribed to the co-operation of Scipio and Lælius—made them great favorites and subjects of much imitation after the revival of letters in the Middle Ages. Among the latest editions are those by Parry (London, 1857), Wagner (London, 1869), and Umpfenbach (Berlin, 1870). There are

translations into English by Patrick (1745), Colman (1765), and Riley (1853).

Ter'govist, town of Wallachia, on the Jalomnitza, was formerly the capital of the country, and had celebrated glassworks and 30,000 inhabitants, but has now declined very much, and contains not more than 2600 inhabitants.

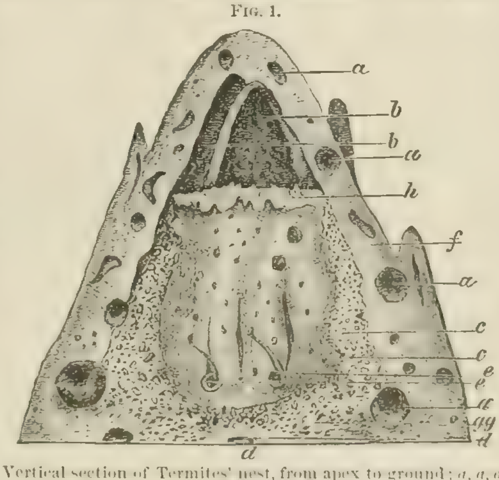
Terhune (Mary Virginia Hawes), known by her *nom de plume* "Marion Harland," b. in Amelia co., Va., about 1835; in 1856 married Rev. E. P. Terhune, then a clergyman in Virginia, who in 1859 became pastor of a Dutch Reformed church in Newark, N. J., which has since been her residence. She began to write for the press at a very early age, and when sixteen contributed to *Godey's Lady's Book* a sketch entitled *Marrying from Prudential Motives*, which was copied without credit into an English periodical, thence translated into French, from which it was retranslated into English, and in that shape republished in England and America. She has published—*Alone* (1854), *The Hidden Path* (1855), *Moss Side* (1857), *Miriam* (1860), *Nemesis* (1860), *Husks* (1863), *Husbands and Homes* (1865), *Sunnybank* (1866), *The Christmas Holly* (1867), *Ruby's Husband* (1868), *Phemie's Temptation* (1869), *Helen Gardner*, *The Empty Heart*, *At Last* (1870), *Common Sense in the Household*, a manual of domestic housewifery (1871), *True as Steel* (1872), *Jessamine* (1873), *From my Youth Up* (1874).

Terliz'za, town of Italy, province of Bari delle Puglie, in a fertile plain about 7 miles from the Adriatic, and very near the town of Barletta. It was a place of great strength during the Middle Ages, and the emperors of Germany and the kings of Aragon sought refuge here at different times. The old castle and the solid walls and towers of the city are still standing, but the deep and broad trench has lately been converted into a kind of boulevard. There is said to be a fine private gallery of pictures here. Grain, wine, oil, and fruits are exported to some extent, but good roads are greatly needed as a means of communication with the neighboring country. P. 18,261.

Ter'mini Imere'se (*Thermæ Himerenses*), town of Sicily, province of Palermo, 25 miles S. E. of the city of Palermo. It is situated on a hill on the left bank and near the mouth of the river Termini, which, as well as the town, derives its name from the warm springs in and near this place. It is a walled town, with a castle on the seaward side, and it contains a few noticeable buildings. In the principal church there are respectable paintings. On the Gothic front of the church of St. Caterina may be seen some very old bas-reliefs, and in the interior there are frescoes of interest. The exports of Termini are chiefly grain, fruits (especially almonds), sumach, cantharides, etc., and these will greatly increase with improved means of communication. It was under the walls of the ancient *Himera* that Gelon obtained his great victory over the Carthaginians (480 B. C.), and when, seventy years after, the Punic armies destroyed the city, the refugees made the new settlement of *Thermæ Himerenses*, which was a flourishing town in the time of Augustus. Little is heard of it during the Middle Ages, and its present interest consists chiefly in the ancient objects already excavated in and near the town, and in the promise it gives of a still richer antiquarian harvest. P. 19,739.

Ter'mites, improperly called **White Ants,** belong to the order Neuroptera, suborder Pseudoneuroptera. Though most abundant in hot climates, this family of insects reach far beyond the tropics, extending in our hemisphere N. and S. from New England to Chili, and E. and W. from ocean to ocean. The African species (*T. bellicosus*) build great pinnacled nests, 15 feet in perpendicular height and 60 feet in circumference at the base. Formerly, the plains of Africa were in many places thickly studded with these hills, but the advance of civilized man has driven them back from the neighborhood of the foreign settlements. The nests are destroyed partly to obtain the clay, which is valuable for building purposes, but principally to rid the country of the insects, which are the most formidable pests of that climate. In founding a nest the termites erect first a single pinnacle several feet high, and very small about the base, and then others near it; finally, these are all consolidated into a single dome, and the middle pinnacles, having performed their part as scaffolding, are removed. The pinnacles are built only while the nest is being enlarged. When it has reached its maximum size, the nest is a rounded dome, upon whose outer surface grass and weeds grow freely; in the dry season it looks not unlike a haycock. The outer shell (Fig. 1, *f f*) is built of hard, solid clay, which the sun bakes to a light yellow color; within is the dwelling proper. In the centre, at or above the level of the base, lies the queen's chamber *d d*. The walls of the royal cell are built of solid clay from one inch to one eighth of an inch in thickness. The floor is flat and smooth; from this an oval arch springs up, forming a chamber in the shape of a half ellipsoid cut through its major axis. In large nests the royal chamber sometimes measures 8 inches in length. Above and around this cell are irregular clay chambers *g g*, forming anterooms, where the royal attendants wait; or magazines, stored with gums and inspissated juices of plants; other chambers are scattered among these, which are formed of bits of wood glued together by means of what appears to be vegetable gums. These cells are nurseries, and in them the eggs are placed and the young reared. The nursery-walls are always found invested with what seems to be mould covered with small white specks. Under the microscope these specks are seen to be fungi not unlike the edible mushroom, and in large measure this forms the food of the larvæ. The congeries of cells extend to the outer shell of the nest on every side and two-thirds of the way up the enclosing dome. Between the roof of the cells *h* and the enclosing clay wall *f f* is left the arched hollow chamber *b b*, which serves as an air-chamber, and secures the proper degree of warmth and moisture. The walls of the dome are penetrated with many galleries *a a a*, and by means of these all parts of the dwelling intercommunicate; in some places arched bridges *e e* are sprung from the lower to the upper stories to secure quick and easy transit. There are no direct openings from the nest to the outside air; but from the interior long underground passages, sometimes 12 or 15 inches in diameter and many feet long, open into the outer world. The domes or pinnacled clay nests are so strong that they are used by the wild buffaloes as sentry-posts when they are guarding the feeding herds below. The clay of which the nest is built is hardened by some secre-

Fig. 1.



Vertical section of Termites' nest, from apex to ground; *a, a, a*, galleries penetrating outer dome; *b, b*, air-chamber; *c, c*, magazine and nurseries; *d, d*, royal chamber; *e, e*, bridges; *f, f*, outer shell; *g, g*, congeries of royal ante-chambers.

tion of the insects. *T. atrox*, another African species, erects mushroom-shaped nests filled with magazines and nurseries much like those already described. *T. arborum* builds upon trees huge nests of fragments of wood glued together, which are sometimes as large as a hogshead and 80 feet above the ground. *T. flavipes*, *T. lucifugus*, and others perforate stumps or fallen trees with innumerable galleries, leaving the surface intact, and some varieties even make their nests in the ground beneath flat stones.

In each nest there are several kinds of individuals: (1) sexual individuals, kings and queens; (2) neuters, abortive males and females, which are both workers and soldiers; (3) larvæ of males and females, workers and soldiers; and (4) nymphs of the same. The males and females when they come to maturity have wings. (Fig. 4.) Some time from May to September, according to the species and habitat, the perfect insects emerge from the nest in myriads and take flight. In a few hours they shed their wings—some authorities state that they voluntarily rid themselves of the wings like the ants—and they then fall victims to their numerous enemies, being greedily devoured by men and animals. Not more than one pair in a million escape, are secured by a queenless colony, and fulfil the apparent purpose for which they are created. In those species which incarcerate their royal pairs the cell is immediately built up about them. The size of a perfect king or queen is about thirty times that of a worker. The king retains this size, but the queen soon begins to grow; the skin (Fig. 5, s) between the abdominal rings s extends till the abdomen measures 4 inches or more in length and about 3 in its largest circumference. The figures given are of *T.*

lucifugus, where the proportions are not so greatly changed as in *T. bellicosus*. In the latter the head, legs, and thorax are not larger than those of our large black ants, while the abdomen measures several inches. The queen is the common mother of the community, and is estimated by some observers to lay 80,000 eggs a day. The workers measure from $\frac{1}{8}$th to $\frac{3}{8}$ths of an inch in length, according to the variety. They have soft white bodies, two articulated antennæ, two mandibles, and no eyes or ocelli; their

FIG. 2. FIG. 4. FIG. 5.

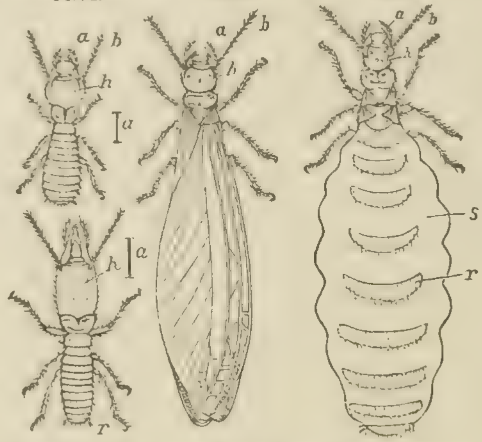


FIG. 3.
Fig. 2, Worker.—Fig. 3, Soldier. *a*, real length.

Perfect insect, male and female.

Fully-developed Queen.

business is to take the eggs when laid by the queen, carry them to the nurseries, where they are slightly glued to the walls, care for the larvæ when they hatch, and feed them, sometimes taking down the food themselves, and then regurgitating for the young. When the time comes for the metamorphosis of the nymphs, the workers assist in effecting it. Besides this, they collect the material for the nest, and build it, excavate the galleries, procure and store away the food, tend the sick, and provide for the royal wants. The soldiers (Fig. 3) form about 1 per cent. of the neuters; they resemble the workers except about the head, which is long, cylindrical, and furnished with large and strong serrated mandibles, which snip like a pair of sharp scissors; like the workers, they are totally blind. They stand posted at the entrances of the galleries in times of peace, but when the nest is attacked, one or more rush out, survey the ground, return to the nest, and soon return accompanied by hosts of comrades. They attack everything which comes in their way, striking about in a blind fury. When building or repairing is going on, the soldiers of *T. bellicosus* stand about as overseers, and idleness or relaxed energy calls forth a reprimand from them. The huge mandibles are struck upon the wall against which the soldier has posted himself; this call from the overseer is responded to by a hiss from the delinquent workers, and followed by redoubled industry. In *T. viarum*, the marching termites, the neuters have eyes. When making a progress through the wood, soldiers mount the grass and plant-stalks which overhang the moving column, and give admonitory strokes, which sound like the ticking of a watch. To this sound the column responds by a hiss, and redoubles its speed. In *T. lucifugus*, a French species, the soldiers do not oversee the workers.

The injuries wrought by these insects are terrible: they invade every vegetable fibre except cotton, and destroy wood, matting, linen and woollen clothing, books, and parchment by sap and mine. They habitually avoid the air and light, not because of an antipathy to them, but because of their helplessness and their necessity of a moist atmosphere. In consequence of this peculiarity their ravages are unobserved till everything sinks into ruins. When they desire to reach a certain point, a covered gallery is immediately built to that point, that they may reach it unseen. African villages which have been abandoned in a year or two have utterly disappeared, and the ground on which they stood is found covered with vegetation. Posts are sometimes so riddled that a slight kick will dissipate them, leaving nothing in their stead but a heap of dust and débris. At Tournay, Charente, France, a whole dinner-party, guests, host, table, and all, were let down through the floor into the cellar without a moment's warning in consequence of the termites' depredations in the flooring and beams. When *T. bellicosus* penetrates a room, the entire wood-work is destroyed in the course of twenty-four hours. Though so destructive, these little insects perform an important office in hot climates. They never attack living wood, but they hasten to assist and render harmless the rapid decomposition of vegetable matter in the tropics. Decaying matter which might poison the air for weeks is by their agency removed quickly and without harming any one. Ants are among the most dangerous enemies of the termites; when they meet, they invariably fight, and the ants, having the advantage of vision, a horny integument, and warlike instincts, generally come off victorious. Some of the native Africans make use of this antipathy of the ant, and when their huts are rendered almost uninhabitable by the presence of termites, they bear a colony of black ants to the spot; the soft, helpless termites are soon routed from their stronghold and destroyed.

S. B. HERRICK.

Tern. See STERNINÆ.

Ternant', de (JEAN), CHEVALIER, b. in France about 1740; served in the French army in America during the war of the Revolution; was appointed by Baron Steuben sub-inspector, with the rank of major, Apr., 1778; became lieutenant-colonel, and inspector of the troops in South Carolina and Georgia, Sept., 1778; taken prisoner at Charleston 1780; soon exchanged, and rendered good services in the Yorktown campaign; ambassador to the U. S. 1790–93; a colonel during the wars of the French revolution, and noted for ability and varied attainments. D. at Conches, Normandy, in 1816.

Ternate. See MOLUCCAS.

Ternaux' (GUILLAUME LOUIS), BARON, b. at Sedan Oct. 8, 1763; at the age of sixteen retrieved the fortunes of his family by his successful management of his father's woollen factory; represented the department of the Seine as deputy 1818–23; re-elected in 1827, and with 220 deputies stood against the government, bringing about the revolution of July, 1830, in which he was ruined; wrote several treatises on finance and manufactures, and was among the first to naturalize Thibetan goats in France and introduce spinning-machines for cotton and woollen fabrics, and greatly improved the national finances. D. at St. Ouen Apr. 2, 1833.

Ternaux (LOUIS MORTIMER), b. at Paris Nov. 22, 1808; was educated at the Collége Charlemagne; entered the civil service of the government in 1830; was elected a member of the Chamber of Deputies in 1842; joined the opposition in 1845; represented the Ardennes in the Constituent and in the Legislative assembly of 1848–49; protested against the *coup d'état* of 1851, and retired into private life. He published *Histoire de la Terreur, 1792–94, d'après les Documents authentiques et des Pièces inédites* (7 vols., 1862–69), besides several minor works.

Ternaux'-Compans' (HENRI), b. in France about 1810; was for many years in the French diplomatic service; collected a library peculiarly rich in MSS. and early printed books upon America, and edited two series of ten volumes each of *Voyages, Relations et Mémoires* (Paris, 1836–40), translated into French, chiefly from unpublished Spanish MSS. upon the discovery and conquest of America —a work of great value to the historical student. He also published a *Bibliothèque américaine, 1493–1700* (Paris, 1837), and various other works. D. in Dec., 1864.

Ternay', de (CHARLES LOUIS D'ARSAC), b. in France in 1722; was descended from an ancient and noble family of Bretagne; entered the French naval service 1738; commanded the squadron which captured St. John's, Newfoundland, June 2, 1762; was governor of the island of Bourbon 1772–79, and was in command of the fleet sent by France to the assistance of the U. S. in 1780, which conveyed the army of Count Rochambeau, landing at Newport, R. I., July 10. D. at Newport Dec. 15, 1780.

Ter'ni (*Interamna Umbrica*), town of Italy, province of Perugia, pleasantly situated near the banks of the Nera, about 10 miles S. S. W. of Spoleto and 55 N. N. E. of Rome. It is surrounded by a very ancient wall with square towers. Similar towers were once very common throughout the city, but they were nearly all destroyed by a brother of Boniface IX., who used them as material for the construction of a new fortress. One of the five gates is called *Tre Monumenti*, so named from the monuments of the historian Tacitus and of the emperors Tacitus and Florian, all of whom were born here. The streets are tolerably commodious, and open upon a very large square near the centre of the town. The cathedral is very old, and contains many early monuments and inscriptions, but the basilica of San Valentino is still more ancient. The church of San Salvadore is built on the ruins of a temple of the sun—that of Sant' Alò over a temple of Cybele. The episcopal palace stands, in part, on the site of an amphitheatre of the time of Tiberius, which, judging from the foundations, was capable of holding 10,000 spectators.

In the communal palace many Roman inscriptions are preserved. Terni was probably one of the ancient Umbrian cities, founded nearly as early as Rome itself. It was given up by Sulla to his soldiers; was sacked by Totila, and again by the Lombards; and had its share in the crimes and sufferings of the subsequent centuries. It is now a place of more than usual industry; besides woollen cloths, leather, etc., iron is manufactured here on an extensive scale. The environs of Terni are very attractive, and there are many villas in the neighborhood. P. 15,500.

Terodant′, town of Morocco, capital of the province of Soos, in an exceedingly beautiful and fertile region which produces much sugar, and is celebrated for its excellent leather and its dyed ostrich-feathers. P. 22,000.

Teror′, town of the Canaries, on the island of Grand Canary, has some warm mineral springs, which are resorted to on account of their curative effects. P. about 5000.

Terpan′der, b. at Antissa, island of Lesbos, in the first half of the seventh century B. C.; settled in Sparta, where, in 676 B. C., he gained the prize in the first musical contest instituted at the feast of Apollo Carneius. He is generally considered the founder of Greek music, as he increased the number of the strings of the lyre from four to seven; was the first to set poetry to music, both his own verses and those of Homer; established the first regular school of music, and made music a part of education.

Terpenes. See ISOMERISM, by H. WURTZ, A. M.

Terpsich′ore, one of the nine Muses, presided over song and choral dancing, and was represented with lyre and plectrum in her hands, and a wreath of flowers on the head.

Terraci′na [anc. *Anxur*, afterward *Tarracina*], town of Italy, province of Rome, on a hill near the sea-shore, not far from the mouths of the Ufento and the Amaseno, about 62 miles S. E. of the city of Rome. The town is divided into two parts, the old and the new; the former is badly built, but contains the cathedral, erected on the site of the temple of Jupiter, the great portico of which is still standing. The floor and the pulpit are of the time of Constantine. The new town is below, near the sea, and possesses some fine buildings. Terracina was an important Volscian city, and was finally subjugated by the Romans 400 B. C.; made a colony 329. Prosperous during the best Roman times, it was sacked by Totila, held for a century by the Arabs, and for a long time after their expulsion it was frequently plundered by African corsairs. The ancient port is now nearly filled up; the modern and smaller one only is used. The commerce and general industry of Terracina are insignificant, and to the fatal malaria is added the curse of brigandage. P. 7376.

Terra Cotta. See POTTERY, by S. BIRCH, LL.D.

Terra Cotta Records. See PRINTING, by W. S. PATERSON.

Ter′ra del Fue′go ("the land of fire"), a group of islands between lat. 52° 40′ and 56° S., at the southern extremity of South America, from which it is separated by the Strait of Magellan. It consists of one large island (King Charles's South Land or East Terra del Fuego), 21,260 sq. m. in area, and a number of small isles, of which the southernmost, Cape Horn, is the most remarkable. All the islands are high, mountainous, and probably of volcanic origin. The eastern shores are much indented and well wooded; the western are rugged, barren, and desolate. The climate is the most wretched on earth; storms of rain, hail, and snow drift in from the Atlantic, Antarctic, and Pacific oceans in everlasting succession, only broken by violent gusts of wind. Perpetual snow and ice cover the tops of the mountains, and glaciers, greenish gray, descend from the sides to the sea. On the eastern shores forests of stunted trees, the Antarctic beech, are found at the foot of the mountains, and higher up a belt of alpine herbs; but the wild celery and the spoon-wort are the only edible plants. The animal kingdom is represented by shellfish, sea otters, fowls, mice, and dogs, and mankind by an ugly, savage race, who in hard times eat first their dogs and then their old women, and whose most splendid feasts are dirt, filth, and misery. Several attempts to introduce Christianity among them have been in vain. Terra del Fuego was discovered in 1520 by Magellan, and received the name of the "Land of Fire" from the volcanic fires he observed along its coasts. Missionaries have sometimes tried to give quite an attractive description of the island, but sailors who have doubled Cape Horn describe this arena, where the tempests of the Pacific and Atlantic oceans meet and fight till those of the Antarctic step in and decide, as the most dreary and horrible region of the globe.

Terra di Bari, Italy, now BARI (which see).

Ter′ra di Lavo′ro, or **Caserta**, province of Italy, stretching along the Mediterranean N. of the province of Naples, and traversed by the Garigliano and the Volturno, comprises an area of 2206 sq. m., with 697,403 inhabitants. Its agriculture, cattle-breeding, and manufacturing industry are flourishing. Cap. Caserta.

Terra di Otranto. See OTRANTO, TERRA DI.

Ter′ra Fir′ma, a term sometimes used to designate the Spanish main or the north-western portion of South America; also, that part of the Italian mainland which formerly acknowledged Venice as mistress. The term designates continental regions as opposed to islands.

Ter′ra Japon′ica [Lat.], an old pharmaceutical designation of CATECHU (which see), which was formerly regarded as an earthy mineral.

Terrano′va di Sici′lia, town of Sicily, province of Caltanisetta, on the S. coast of the island, near the mouth of the river of the same name. It is well built, has good churches, and the inhabitants are engaged in traffic and navigation. The harbor has been recently somewhat improved, and about 800 vessels enter it annually. This town occupies the site of an ancient city (probably *Gela*), as is proved by the remains of a Doric temple and by the many old sepulchres found in the neighborhood, whose contents have enriched the museum of Palermo. P. 14,911.

Ter′rapin [Fr. *terrapine*], a name given to tortoises (Testudinata) of the family Emydidæ. (1) It is by some applied to all the typical forms (Emydinæ) of the family. (2) In the U. S. it is more specifically used for the *Malaclemmys* (*Malacoclemmys*) *palustris* (see EMYS), or salt-water terrapin, a species held in high estimation for the delicacy of its flesh. This species is an inhabitant of the salt-water marshes from New York to Texas. It has a large head, covered with a soft naked skin (whence the name *Malaclemmys*), and the alveolar surface of the upper jaw is broad and divided in front by only a slight groove; the neck is short and thick; the shell oval, moderately convex, slightly keeled, and the scales marked with concentric, generally impressed, lines; the skin is gray, spotted, and otherwise marked with black. It rarely much exceeds eight inches in length, and is generally less than that. It is the most esteemed for the table of any species of the family, and is caught in large numbers for the markets of Baltimore, Philadelphia, New York, and other cities. It commands a price of from $12 to $36 a dozen, according to season and demand. It is shy and active in the water, swimming well, and on land running with considerable speed. (See TORTOISES.) THEODORE GILL.

Terrebonne′, county of Quebec, Canada, extending N. W. from the river Jésus, called also the N. branch of the Ottawa. It is fertile. Cap. St. Jerôme. P. 19,591.

Terrebonne, p.-v., Terrebonne co., Quebec, on the N. shore of the navigable river Jésus, 16 miles by land N. of Montreal. It is a beautiful place, and is the seat of Masson College (Roman Catholic), a large and prosperous school. It has a fine water power, utilized in a number of manufactories. Its stone-quarries are valuable. P. 1650.

Terrebonne, parish of South-eastern Louisiana, bordering on the Gulf of Mexico, drained by Bayous Terrebonne, Black, and Caillou, and intersected in its N. part by Louisiana and Texas R. R. Surface flat and marshy, with numerous shallow lagoons. Staples, sugar, molasses, Indian corn, rice, and a little cotton. Cap. Houma. Area, 1610 sq. m. P. 12,451.

Terrebonne, p.-v., Terrebonne parish, La., on Morgan's Louisiana and Texas R. R., 56 miles W. of New Orleans.

Terre Haute, p. v. and tp., Henderson co., Ill. P. 139.

Terre Haute, city and cap. of Vigo co., Ind., on Fort Harrison Prairie (a long, narrow area of gently rolling prairie land in the western portion of the State) and on Wabash River. The county, on account of the rare fertility of its soil, is hardly surpassed in the State for agricultural purposes. In Vigo and adjacent counties is found a superior quality of block coal in almost inexhaustible quantities; consequently, Terre Haute has many extensive manufactories, affording employment for a large number of mechanics. It has a newspaper press not excelled by that of any other Western city of equal population, comprising 3 dailies, 1 tri-weekly, and 6 weeklies. It is rapidly becoming a prominent railroad centre, and has 9 railroads. It has 27 churches of all denominations, and the State Normal School, the finest educational structure in the State. The city is noted for the beauty of its streets and its many elegant private residences. It has gas and water-works, and all the modern metropolitan conveniences. P. 16,103 (1870); 25,000 (1876). GEO. H. HEBB, MANAGER "EXPRESS."

Ter′rell, county of S. W. Georgia, watered by affluents of Flint River, and traversed by South-western R. R. Surface nearly level, soil productive. There are saw-mills and several manufactories. Staples, cotton, Indian corn,

and lumber. Cap. Dawson. Area, about 300 sq. m. P. 9053.

Terre Noire, tp., Clarke co., Ark. P. 576.

Terre Rouge, tp., Hempstead co., Ark. P. 1439.

Terrestrial Magnetism. See MAGNET, by PROF. A. M. MAYER, PH. D.

Ter'rier [from *terra*, the "earth," since they were once employed to enter the burrows of game], a name for a large number of breeds of small dogs distinguished for vivacity and courage. Among the best known are the English or black-and tan terrier: the bull-terrier, a miniature bulldog in courage, and often in shape; the fox-terrier, formerly used to unearth foxes: the Scotch or rough-haired terriers, including the Skye, the Dandie Dinmont, and other strains; and the toy-terriers, crosses with some of the small lapdogs. Most of the various breeds of terrier are especially trained to the killing of rats and other vermin.

Ter'ritories, a term technically employed in the U. S., and in some Spanish-American republics which have derived it from the U. S., to denote an incipient State before being endowed with the plenitude of sovereignty, and still under the direct control of Congress. Territories are erected by Congressional enactment from the unsettled or sparsely-settled public lands now confined to the Upper Missouri and the Pacific slope. The governor and the administrative and judicial officers are appointed by the President, but a Territorial legislature is entrusted with limited powers, subject to the approval of Congress. When a Territory attains a population sufficient to entitle it to one Representative in Congress, it is usually given permission by a special act to form a State constitution, and is then admitted into the Union with rights equal to those of the other States. There are at present but 8 Territories, and they may all be expected to become States within a score of years.

Terror, Reign of. See REIGN OF TERROR.

Terry, p.-v., Hinds co., Miss.

Terry, tp., Bradford co., Pa. P. 1079.

Terry (ALFRED HOWE), b. at Hartford, Conn., Nov. 10, 1827; educated at schools in New Haven and at the law school of Yale College; entered upon the practice of law in 1848, and was clerk of the superior and supreme courts of Connecticut from 1854 to 1860. For some years prior to the civil war he had been an active member of the State militia, and since 1854 in command of the 2d Connecticut militia, which regiment was mustered into the service of the U. S. in response to the call for three months' troops, and, with Terry still in command, was engaged in the first battle of Bull Run. Returning at the expiration of the three months, Terry then organized the 7th Connecticut Vols., of which regiment he was appointed colonel, Sept., 1861, and which he commanded in the expeditionary corps of Gen. T. W. Sherman at the capture of Port Royal, S. C. At the siege of Fort Pulaski he was commended for zeal, and placed in command of that work upon its capture. Promoted to be brigadier-general of volunteers in Apr., 1862, he served in the operations about Charleston, in making a successful demonstration up Stone River during the descent on Morris Island, and in the siege operations at Forts Wagner and Sumter. In the Virginia campaign of 1864 he commanded a division in the army of the James, and was engaged at Drury's Bluff, Bermuda Hundred, and siege of Petersburg, being in command of the corps May–July, 1864. Upon the failure of the first attempt to capture FORT FISHER, N. C. (which see), Terry was selected in Jan., 1865, to command the new expedition, which successfully carried that work by assault Jan. 15. For his services on this occasion he was promoted to be a major-general of volunteers and made a brigadier-general in the regular army. Congress passed a vote of thanks to him and his command. In the capture of Wilmington he rendered efficient aid, and in Mar., 1865, was placed in command of the 10th corps, which he held during the subsequent operations of the campaign in North Carolina. In June, 1865, he was placed in command of the department of Virginia: commanded the department of the South 1869–72, and the department of Dakota 1872.—In the summer of 1876 he took the field in the active operations against the hostile Sioux Indians. G. C. SIMMONS.

Terry (EDWARD), U. S. N., b. Jan. 24, 1839, in Connecticut; graduated at the Naval Academy in 1857; became a lieutenant in 1861, commander in 1871; during the civil war served on board the Richmond in the battle of New Orleans, the passage and reduction of Vicksburg and Port Hudson, and the battle of Mobile Bay, and was everywhere conspicuous, according to the reports of his commanding officers, for "heroic conduct and marked ability." FOXHALL A. PARKER.

Terry (SILAS W.), U. S. N., b. Dec. 28, 1842, in Kentucky; graduated at the Naval Academy in 1861; became a lieutenant-commander in 1862; served with great gallantry during the Red River expedition, and highly commended by Rear-Admiral Porter in his official despatch of Apr. 28, 1864. FOXHALL A. PARKER.

Ter'rysville, p.-v., Litchfield co., Conn.

Terschel'ling, the third of the chain of islands which lie in the North Sea along the north-eastern coast of Holland, comprises an area of 45 sq. m., and consists of low and rich meadow-land protected by downs and dykes against the sea. The inhabitants, numbering 3128, are much engaged in shipbuilding, fishing, and pilotage.

Ter'tiaries, in the Roman Catholic religious orders, are those members who from marriage or other cause are not received into the full order, but nevertheless take lifelong vows. The members of the Third Order of St. Francis are the most celebrated class of Tertiaries. They have long, in fact, constituted a separate order in the Church, and have a general of their own. The Third Order embraces congregations of both males and females. Other orders have houses of Tertiaries, who are not to be confounded with the lay brethren and sisters of the orders.

Tertiary Strata and **Tertiary Time.** See GEOLOGY, by PROF. J. W. DAWSON.

Tertul'lian (QUINTUS SEPTIMIUS FLORENS), father of Latin theology and of the church language, one of the greatest men of the early Church, was b. about 160 in Carthage, and was the son of a Roman proconsular captain of the legion. He received a liberal secular education, all his writings showing that he was well trained in law, philosophy, the learning of the day, and that which could fit him for a place in politics, which he seems to have occupied. He lived in heathenism, a reckless, licentious life, till his conversion at the age of thirty or forty, when he joined the Christians from a deep conviction of the truth of their doctrines. He threw himself into his new life with the same fiery and fearless spirit he had shown before, but turned from every trace of moral laxity to even excessive austerity. He entered the ministry of the Church, and served at Carthage, and perhaps at Rome. He remained a presbyter through life. In 202 he followed the bent of his ascetic spirit and joined the puritanic sect of the Montanists. They were orthodox in doctrine, but stern in spirit and discipline. Tertullian was attracted by these characteristics and their chiliasm, and was perhaps influenced, according to Jerome's account, by the worldliness that had already shown itself in the Roman Church, and by the envy and insults of the clergy. He remained true to the faith of the Catholics, but fought them vehemently on matters of morality and discipline. He was also a representative of the African opposition to Rome. He was a rare genius, original, fresh, eccentric, having vehement passions, large culture, though not a broad spirit. In his writings he appears glowing, fervid, witty, keen, skilful, learned in law and philosophy, though not symmetrical, writing on almost all Christian topics, a vehement debater, and a remorseless opponent. He died still a Montanist, in 220 or 240. He has left rich writings in which, with all their errors, are the seeds of the theology wrought out by Augustine and the Reformers.
ISAAC RILEY.

Teruel', town of Spain, capital of the province of Teruel, on the Turia, is an old-fashioned place, built by the Moors and in Moorish style—that is to say, the streets narrow to keep the sun out, but the houses substantial, and even elegant. It has a fine cathedral and some manufactures of leather. P. 10,500.

Tesch'en, town of Austrian Silesia, on the Elsa, manufactures woollen and linen stuffs, leather, liqueurs, glassware, and firearms. P. 9779.

Tes'tament [Lat. *testamentum*], in the Roman law, was the act or instrument by which a person nominated an heir who should succeed to the inheritance—that is, the one to whom the entire aggregate of the testator's property, rights, and obligations should pass. For a long time the testament simply named the heir, and the law then conferred upon him the whole inheritance. Although this always continued to be its essential and chief feature, yet in later times the practice arose of adding particular gifts, called legacies, out of the inheritance, to designated individuals; and the heir was bound to pay over these gifts to the legatees. Various laws and imperial constitutions regulated the proportionate part of the inheritance which could thus be diverted from the heir and given to legatees. In the earliest and strictest periods of the Roman law there were three modes or forms of making a testament. In the first, called *calatis comitiis*, the testator declared his will before the *comitia curiata*, or assembly of the patrician

gentes. The second, termed *procinctum,* was made by a soldier just before the army set out (*in procinctu*), and required less formalities than the others. The third, *per æs et libram* (by the copper and balance), was a feigned sale of the inheritance by means of the form called "mancipation" (*mancipatio*). The seller summoned five witnesses and the official "balance-holder" (*libripens*), and in their presence and by their aid sold the inheritance to a sort of trustee called the *familiæ emptor.* The testator then declared orally what disposition this purchaser should make of the inheritance, or else produced a writing in which his intentions were stated. The *familiæ emptor* was bound to follow these instructions, and hand over the inheritance to the designated heir. In process of time the sale was disused, and the written instrument became the principal act. At length the prætor, by virtue of his legislative power, introduced another kind of testament, which consisted simply of a written instrument published and declared by the testator in the presence of seven witnesses, who must affix their names and seals thereto. This simple form was recognized by various constitutions, and continued in use without substantial change during the remaining periods of the Roman law. Exceptions were made in favor of soldiers when in active service. They were permitted by various constitutions to execute a testament in the most informal manner, and even an oral declaration in the presence of witnesses was valid under the name of a "nuncupative testament." The term "testament" is used in the English and American law as synonymous with "will," although the modern will has little resemblance to the Roman testament.

JOHN NORTON POMEROY.

Testament'ary Guard'ian is a guardian appointed by the last will of a father over the persons and property of his infant children, whose office continues, unless otherwise directed by the will, until the wards reach the age of twenty-one years. The power to create this guardianship was first conferred in England by the statute 12 Car. II., ch. 24, which enacted that a father may by will or deed dispose of the custody of all his infant children, born or to be born, who should be unmarried at his decease; that he may provide for the guardianship to last until the children are twenty-one, or for any less time; that such appointment shall be effectual against all persons claiming as guardians in socage or otherwise; and that the guardian shall have custody of the infant's person and of all his property, real and personal. The statute does not confer any such privilege on the mother, nor does it extend the father's authority to his illegitimate children. The same legislation substantially has been enacted in most of the States of this country. The legislature of New York in 1861 materially restricted the power of the father in that State by prohibiting him from disposing of the custody of his infant children, and from appointing a testamentary guardian over them, unless their mother, if alive, should consent thereto in writing. (For a description of the testamentary guardian's powers and duties see GUARDIAN.)

JOHN NORTON POMEROY.

Testaments, Old and New. See BIBLE, by PROF. W. G. SUMNER, A. B.

Testicle. See HISTOLOGY, by COL. J. J. WOODWARD, M. D.

Testimony. See EVIDENCE, by PROF. J. N. POMEROY, LL.D.

Test'ing, in Chemistry. The methods of testing substances chemically for detecting the presence or absence of different elements belong to *qualitative analysis,* which will be found explained under the head of CHEMICAL ANALYSIS, by PROF. S. W. JOHNSON.

Test Oath. See OATH, by PROF. T. W. DWIGHT, LL.D.

Testudinata. See TORTOISES.

Testudin'idæ [*Testudo*—the old Latin name of a species—the typical genus], a family of tortoises (Testudinata) distinguished by their club shaped feet and their special adaptation for terrestrial life. In general aspect they are not very dissimilar from the box tortoise (*Cistudo clausa*) of the Northern U. S., and the gopher of the Southern part of the U. S. is a true representative species; the neck is retractile in a longitudinal axis under the shell, and of moderate length; the head of moderate size; the jaws naked, and with the upper overlapping the lower; the shell is oval, with the carapace more or less convex, and behind decurved, and the plastron connected with it by very wide bridges; the shields are in normal number on the carapace and plastron, save that generally the posterior marginal shields of the carapace are united, although sometimes (in *Manouria*) separate as usual; the feet are club shaped or columnar, with the toes short and enclosed together; the claws are four or five in number, and generally the anterior are blunt and straightish, and the posterior subacute and curved. Less superficial characters are found in modifications of the head, shell, and feet; the skull is massive and has complete orbits, whose hinder edges are moderate; the zygomatic arches are well developed, and there are large cavities for the temporal muscles above; the plastron has four transverse pairs of bones; the toes have each only two phalanges. This family contains all the pre-eminently land tortoises, the so-called "land-turtle" of the Northern U. S. (*Cistudo*) being a member of the family Emydidæ, and having webbed feet. Species are found in the tropical and subtropical or warm temperate countries of all the continents except Australia, and on many neighboring islands. Indeed, two groups of islands—the Mascarene (Bourbon and Mauritius) and the Gallapagos—are remarkable for the gigantic species which they now (or rather formerly) possess. The latest monographer of the family—Dr. J. E. Gray in 1870 and 1872—recognized 32 species, which he distributed among 9 genera under two sections—viz. I., with the genera *Testudo, Peltastes, Testudinella, Pyxis, Chersina, Homopus,* and *Kinixys*; and II. (Manourinæ), with the genera *Manouria* and *Scapia.* The North American species are *Testudo carolina* and *Testudo Agassizii.* The species are long-lived and very tenacious of life, and can live for a long time without food; they subsist upon herbage (grass, vegetables, and roots), and travel, in some cases at least, periodically to watercourses to drink. In temperate climates they hybernate in burrows through the winter.

THEODORE GILL.

Tet'anus [Gr. τετανος], a dangerous spasmodic disease characterized by paroxysms of tonic muscular contraction, succeeding each other with varying frequency for days or weeks. The spasms usually appear first in the muscles of mastication, producing the condition popularly known as "lock-jaw," then involve the large muscles of the trunk, then those of the extremities and those concerned in respiration. In a paroxysm the patient's face is livid or purple, his respiration suspended, his whole body rigid and usually arched backward, owing to the greater power of the muscles of the back. Such a spasm lasts several seconds, and may cause death by arrest of respiration. Fever of varying intensity is present, and extreme exhaustion follows the paroxysms. Death is the more common issue in acute cases, occurring in two or five days. Occasionally, tetanus of less intense type becomes chronic, lasting weeks. The causes of tetanus are wounds, especially ragged and punctured wounds in parts richly supplied with nerves, and certain atmospheric conditions not yet accurately known. Dampness and great variations between the diurnal and nocturnal temperature seem to favor the occurrence of the disease. It is probable that tetanus arises from unknown causes independently of injury. The essential pathological condition of the nervous system in tetanus is not known, though a number of recent investigations seem to indicate that in many cases there exists a diffuse central myelitis, or inflammation of the spinal cord. Tetanus has been successfully treated by chloral hydrate, opium, chloroform, and by timely removal or separation of the nerves which are irritated by the wound.

E. C. SEGUIN.

Tête de Pont [Fr., "head of a bridge"], in fortification, a fieldwork, generally open at the gorge, resting its flanks on the banks of a river in order to cover one or more bridges. (See FORTIFICATION.)

Tête des Morts, tp., Jackson co., Ia. P. 920.

Tetradec'apods [Gr. τετρα, "four," δεκα, "ten," and πους, "foot"—fourteen feet], an order of Crustacea which normally have seven cephalic segments and pairs of appendages, and seven foot-rings or pairs of feet, of which the Isopods (which see) are an example.

Tet'rads [Lat. *tetras*], a term applied in chemistry to the tetravalent elements or radicals, each of which in combining represents four atoms of hydrogen. (See CHEMISTRY.)

J. P. BATTERSHALL.

Tetradymite. See TELLURIDES, by PROF. H. W[illegible].

Tetragonur'idæ [from *Tetragonurus*—Gr. [illegible] "quadrate," and οὐρα, "tail"], the only known [illegible] family of teleost fishes of the order Teleo[illegible] [illegible] suborder Percesoces. Th[illegible] gate fusiform and subcylindrical, and the t[illegible] and keeled above and below, giving [illegible] pect, to which the generic name a[illegible] moderate, and arranged in oblique [illegible] the exposed surfaces rhomboid[illegible] [illegible] parallel with the axis of the [illegible] slightly curved upward, and continuous [illegible] in profile and scaly; the eyes are [illegible] bones unarmed; the nostrils [illegible] eral cleft; the upper jaw is not protractile [illegible]

deep rami; the teeth are compressed and uniserial on the jaws, and are also developed on the palate; the branchial apertures are wide and confluent below; branchiostegal rays five; dorsal fins two, the first elongate and with slender short spines, the second oblong, anal opposite and similar to the second dorsal; caudal moderate, recurrent above and below on the tail; pectorals small; ventrals sub-abdominal, inserted considerably behind the bases of the pectorals. There are four gills and pseudobranchiæ; the stomach is pointed behind, and near the pylorus is thickened; pyloric cæca are developed in large number; there is no air-bladder; the vertebræ are numerous, 36 abdominal and 22 caudal having been observed in *Tetragonurus Cuvieri*. This singular type has been variously distributed by ichthyologists, but most have referred it to the same family with the Mugilidæ or Atherinidæ, or isolated it as a peculiar one near them; it seems amply to deserve full family rank. But one species, the *Tetragonurus Cuvieri*, is certainly known, and that is very rare, and has only been found in the Mediterranean Sea and at the island of Madeira; it is apparently an inhabitant of deep water. It attains a length of somewhat more than a foot, and is of a blackish color. THEODORE GILL.

Tetragram'maton [Gr.], the name of the mystic number four, often symbolized to represent the Deity, whose unpronounceable name was expressed in Hebrew by four letters, יהוה. (See JEHOVAH.)

Tetrahe'dron [Gr. τετρα-, "four," and ἕδρα, "side"], a solid having four bounding planes, four angles, and six edges. If regular, its sides are equilateral triangles.

Tetraon'idæ [from *Tetrao*—the generic name of the grouse—and the family suffix *-idæ*], a family of birds comprising the grouses, the partridges and quails, and related forms. The general aspect of the birds is familiar in connection with the kinds just indicated; the bill varies considerably in size, being in some quite robust and in others rather weak; it is broad at the base, and thence compressed, and the culmen is always arched to the tip, which is obtusely hooked and decurved over the lower mandible; the nostrils are basal and lateral, in some (*e. g.* Tetraoninæ) concealed by feathers, in others partly covered by a hard scale; the wings are short, rounded, and concave; the tail diversiform, but generally short and depressed; the tarsi strong, variously clothed; the toes moderate, the three anterior free, the posterior elevated; the claws stout and adapted for scratching. With these are associated certain osteological characters, indicated by Prof. Huxley, contrasting with those exhibited by the nearly-allied Phasianidæ: "(1) The post-acetabular area is very broad; the ilia are truncated, nearly opposite the end of the sacrum, and it is the external angle of the posterior edge of the ilium which is rather the longer; (2) the ulnar and distal edge of the basal phalanx of the second digit is produced; and the phalanx of the third digit has a strong basal tubercle; (3) the anterior margin of the deltoid crest is less oblique, and the angle of the crest is sharper and more prominent; (4) the hypocleidium has straight edges and a triangular form, the apex of the triangle being directed forward; (5) the tarso-metatarsus is not half as long as the tibia; (6) the mandibular foramen is very large." (Huxley, *Proc. Zool. Soc. London*, 1868, p. 301.) These characters are best expressed in the grouse, and are deviated from somewhat in the less typical forms. As here defined, the family embraces five of the six sub-families admitted in it by G. R. Gray—viz. (1) Tetraoninæ, (2) Ortyginæ or Odontophorinæ, (3) Perdicinæ, (4) Rollulinæ, and (5) Caccabininæ (in part); the Turnicinæ have been isolated by Huxley not only as a distinct family, but as a peculiar super-family or sub-order, under the name Turnicimorphæ. (See also TETRAONINÆ, ORTYGINÆ, and PERDICINÆ.) THEODORE GILL.

Tetraon'inæ [from *Tetrao*—as above—and the sub-family affix *-inæ*], a sub-family of the family Tetraonidæ, containing the various species of grouse. The distinctive characters of the group are found in the bill and feathering of the nostrils and tarsi; the bill is moderately produced and compressed (essentially as in the Perdicinæ and not as in the Ortyginæ), and the lower mandible unarmed; the nasal fossæ are filled with feathers, which cover up the nostrils; and the toes have pectinated margins, resulting from modifications of the scales. The species are confined to the northern hemisphere, and some of them (the ptarmigans or *Lagopi*) are among the most northern of birds. They are found in Europe and Asia, but their head-quarters are North America. About twenty species are known, and these have been distributed among eight genera—viz. (1) *Tetrao*, with two or three species in Northern Europe, the best known of which is the "capercailzie" or "cock of the wood," *T. urogallus*; (2) *Lyrurus*, also confined to the Old World, and represented by but one known species, the black grouse, *L. tetrix*; (3) *Canace*, with two species (but divisible into five sub-species) in North America and one in Siberia; (4) *Pediocætes*, represented by the sharp-tailed grouse of the Western plains, *P. phasianellus*; (5), *Centrocercus*, whose only known species is the sage cock, *C. urophasianus*; (6) *Cupidonia*, framed for the celebrated pinnated grouse or prairie hen, *C. cupido*; (7) *Bonasa*, with one species in Europe (*B. betulina*), and another (the ruffed grouse, *B. umbellus*, divided into three sub-species) in North America, and (8) *Lagopus*, including the ptarmigans, represented in both hemispheres by about six species. (See also CAPERCAILZIE, GROUSE, PRAIRIE-HEN, PTARMIGAN, SAGE-COCK, etc.) THEODORE GILL.

Tetrapol'itan Confession [that is, the "confession of the four cities" of Constance, Strasbourg, Memmingen, and Lindau], the confession of faith of the Sacramentarians, a former body of Lutherans, who held the doctrine of Carlstadt and Zwingli with regard to the Eucharist. The confession was drawn up in 1531, probably by Bucer. It was defended also by Capito, and was presented at the Diet of Augsburg. For many years it was received in the four cities which gave it a name.

Te'trarch [Gr. τετράρχης, "governor of the fourth part"], strictly designated, in ancient times, the viceroy or monarch of the fourth part of a country (Thessaly, etc.); but in later times it was a title bestowed, especially under the Romans, upon the minor tributary princes of the East.

Tetrodont'idæ [from *Tetrodon*—Gr. τέτρα-, "four," and ὀδούς, "tooth"—the name of the oldest genus, which was identical with the present family], a family of teleost fishes of the order Plectognathi and sub-order Gymnodontes, distinguished by the development of the jaws into four tooth-like margins. The form is normally more or less oblong, but the abdomen is capable of much distension, and thus the true form is often disguised; the skin, especially on the belly, is mostly covered with larger or smaller dermal ossifications or spines; the head is oblong and covered with skin, so that the opercular and other bones are concealed; the nostrils are diversiform; the mouth terminal or sub-terminal, and with the cleft mostly transverse; the inter-maxillary and supramaxillary bones are confluent, but those of the opposite sides are divided by a suture, as is also the dentary bone of the lower jaw; the teeth are represented by the trenchant edges of the jaws and are otherwise wanting; the branchial apertures are narrow slits in front of the pectoral fins; the branchiostegal rays are entirely enclosed within the integuments; the dorsal is chiefly composed of articulated and branched rays, and is generally short (rarely oblong) and far behind; the anal is like the dorsal, and obliquely opposite, but rather farther behind; the pectorals are narrow and high up; the ventrals are wanting, and even the pelvic bone is undeveloped. With these characters are co-ordinated certain osteological features—*e. g.* development and relations of the maxillary bones and those of the anterior region of the skull, the development of the frontals, and the bifurcation of the neurapophyses of comparatively few (3–4) of the dorsal vertebræ—which confirm the isolation of this group as a peculiar family. It is, however, nearly related to the family Diodontidæ, which has generally been combined with it under the common name Tetrodontidæ. The species are quite numerous, between sixty and seventy being now known, and represent a number of quite distinct genera, but they have not yet been properly grouped in the genera indicated. It is certain, however, that they naturally fall into three primary groups well distinguished by modifications of the skull, although not trenchantly differentiated by external characters. These groups may perhaps be considered of sub-family rank. They are (1) Xenopterinæ, known externally by the multiradiate dorsal and anal fins (D. 32–38, A. 28–32), and represented by but one known species (*X. naritus*); (2) Tetrodontinæ, comprising most of the species; and (3) Psilonotinæ, distinguishable superficially by the compressed body, keeled back, and elongated snout, and embracing about thirteen species. Representatives of the family are found in all tropical and warm temperate seas. Several are natives of the seacoasts of the U. S., two (*Tetrodon lævigatus* and *Chilichthys turgidus*) extending to the eastern coast, and one (*Tetrodon politus*) occurring along the Californian coast. These species are called by the fishermen and others "puffers," "swell-fish," "blowers," etc. The puffing is due to the development of a largely dilatable air-sac, which closely adheres to the peritoneum, and has a valvular communication with the œsophagus, through which the air is received. The species are of no economical importance, and some are indeed poisonous. THEODORE GILL.

Tetuan', town of Morocco, in lon. 5° 18' W., near the mouth of the river Martil, in an exceedingly fertile and

well-cultivated region, especially celebrated for its oranges. The town is fortified and well built, and has several fine mosques and an active trade in woollen and silk stuffs, leather, and fruit. P. 12,000.

Tetz'el, or **Tezel**, a diminutive of *Tietze*, his father's name, *Thietzel*, *Dözel* (JOHANN), b. at Leipsic between 1450 and 1460; studied theology and philosophy at the university of his native city, and distinguished himself by industry and natural ability. In 1489 he entered the Dominican monastery of St. Paul in Leipsic, and soon became noted as a very impressive popular preacher. In 1502 he was appointed to preach an indulgence in Zwickau and its vicinity, and he was so successful—that is, he made so much money for the papal treasury—that henceforward he was steadily employed in the indulgence business for fifteen years. His territory was enlarged and his authority increased. There was some scandal connected both with the person and the business. He travelled around like a mountebank in a blaze of gorgeous advertising. His frauds and his dissipations were equally ill concealed, and all sensible people turned away from him with disgust; but the ignorant mass he caught. At Innspruck in 1512 he seduced the wife of a citizen, and was sentenced as an adulterer to be sewn in a sack and thrown into the river, but the emperor Maximilian I. commuted the sentence to imprisonment for life, and he was actually confined for some time in Leipsic. The Church, however, could not spare him; he was soon out again, and active in his business. Roman Catholic writers deny that he sold indulgences *without repentance* or indulgences for sins *not yet committed*; but their argument rests solely on the words of the papal commission, which are vague, and prove nothing with respect to the practice of the man as it has been reported by eye-witnesses. To Leo X. money was the first, decency only a secondary question, and when he determined to grant a great, a universal indulgence, he made Tetzel *inquisitor*, and commissioned him to preach the indulgence through the whole of Germany. Tetzel now appeared in his highest glory, journeying from town to town and levying his contributions, as has been described by contemporary writers; but when from Brandenburg he approached the Saxon frontier in the middle of 1517, he was unexpectedly met by Luther's *theses*, nailed to the church-door in Wittenberg Oct. 31. In the beginning he, like Leo X., considered this event simply as a tedious and impertinent disturbance. He burned Luther's theses at Jüterbogk, and wrote some theses himself, which the students burned at Wittenberg, while he defended them in a disputation at Frankfort-on-the-Oder. But this illusion did not last long; and when, in 1518, Miltitz, the papal ambassador, arrived at Leipsic, he not only suspended Tetzel, but spoke so harshly to him that the poor man fell sick of fright and humiliation, and d. in July, 1519.

Teu'cer, according to ancient Greek legends, was the first king of Troy, and the Trojans are sometimes called Teucri, after him. But the legends differ with respect to whether he was a native of Troy, giving his daughter, Arisbe, in marriage to Dardanus of Samothrace, or whether he immigrated, together with Scamander, into Troas from Crete. Homer mentions another *Teucer*, son of Telamon, king of Salamis, and Hesione of Troy. He accompanied his step-brother, Ajax, to Troy, and was the best archer among the Greeks. But when the Greeks returned after the capture of Troy, Telamon would not receive Teucer in Salamis because he had not avenged Ajax, and he then sailed to Cyprus, which he received from Belus, king of Sidon, and where he founded the town of Salamis.

Teuf'fel (WILHELM SIGISMUND), b. at Ludwigsburg, Würtemberg, Sept. 27, 1820; studied classical languages and literature at the University of Tübingen, where he became professor in 1849. Besides minor essays, some of which have been collected in his *Studien und Charakteristiken* (1871), he wrote *Geschichte der römischen Literatur* (2 vols., 1868-70), translated into English (London, 1874), and was one of the editors of the *Encykl. der Alterthumswissenschaft* (Stuttgart, 1839-52, 7 vols.). D. Mar. 8, 1878.

Teuthid'idæ [from *Teuthis*, the ancient name of a cuttle fish, unhappily applied by Linnæus to representatives of the two following families as a generic name], a name that has been bestowed in some form on two very distinct families of fishes, both, however, belonging to the order Teleocephali and sub-order Acanthopteri, and approximated next to each other in the ichthyological system.

I. By Günther (*Cat. Fishes, Brit. Mus.*, vol. iii., pp. 313-324) it is retained for the genus variously called *Siganus*, *Centrogaster*, and *Amphacanthus*, and to which the name Teuthis has been restricted by some authors. By others the family name Amphacanthidæ has been given to the group. These fishes have an almost quite symmetrically ovate form, the regions above and below the longitudinal axis being nearly equally developed; the body is much compressed; the scales are cycloid, very small, and closely adherent; the lateral line concurrent with the back and uninterrupted; the head is short, and has a rounded profile; the eyes are lateral; the opercular bones unarmed; the mouth is mostly transverse; the teeth on the jaws are trenchant incisors, and in a single row; palate edentulous; branchial apertures confined to the sides; branchiostegal rays in five pairs; dorsal and anal fins almost exactly opposite behind, the former with a very long spinous portion and short soft portion (xiii. + 10), the latter with a moderately long spinous portion and a short soft one (vii. + 9); caudal well developed, and on a slender peduncle; pectorals moderate, and with branched rays; ventrals inserted considerably behind the bases of the pectorals, and with the inner as well as outer rays developed as spines, between which intervene three articulated rays. The vertebral column has ten abdominal and thirteen caudal vertebræ. The family is remarkable for the constancy of its characters, especially the number of the rays, and the unique development of inner ventral spines. Between twenty and thirty species are known, which are confined to the Pacific and neighboring oceans, and are most numerous in the waters surrounding the Indo-Molaccan islands.

II. By the older naturalists were included in the same family with the preceding (generally under the name Teuthyes) certain other fishes now considered as representing a peculiar family called Acanthuridæ or Acronuridæ, and having the following characters: The form is also oval, but there is a tendency toward outgrowth of the anterior portion of the back and nape; the body is quite compressed; the scales are minute and diversiform (sometimes truly scale-like, and occasionally bristle-like), and there are generally developed on each side of the caudal peduncle lancet-like spines recumbent forward; the lateral line is concurrent with the back and continued to the tail; the head is short and diversiform, sometimes rounded in front, and at others with the forehead more or less produced forward; the eyes are entirely lateral, the opercula unarmed; the mouth terminal, and mostly transverse; the teeth on the jaws uniserial and diversely developed, and wanting on the palate; the branchial apertures are entirely lateral; the dorsal and anal fins, as far as they go, are similar and opposite, and almost exactly coterminal behind, but unlike the preceding, the soft portions are at least as long as, if not longer than, the spinous; both are very long, the dorsal commencing behind the nape, and the anal not far behind the ventrals (D. iii.-ix. + [illegible]-31, A. ii.-iii. + 18-31); the caudal is well developed, and inserted on a slender peduncle; the pectorals moderate, and with the rays branched; the ventrals inserted under the bases of the pectorals, and each provided with a spine, and, generally, with five (sometimes with only three) articulated rays. The vertebral column has mostly nine (or eight) abdominal and thirteen (or twelve) caudal vertebræ. Species are distributed in all tropical seas. Nearly seventy-five have been more or less satisfactorily made known. By Günther they have been grouped under only five genera, viz. (1) *Acanthurus*, (2) *Acronurus*, (3) *Prionurus*, (4) *Naseus*, and (5) *Keris*.

The species of both these families are herbivorous, and co-ordinate with the habits are the extensive [illegible] of the intestinal canal. THEODORE GILL.

Teu'toburg Forest [Ger. *Teutoburger Wald*; Lat. *Teutoburgiensis saltus*], the collective name, used only in books, of several ranges of low and less wooded hills which extend for a distance of about 80 miles through Westphalia and the principality of Lippe, with an elevation of about 1,400 feet. Here the Roman legions under Varus were routed and massacred by Hermann, the chief of the Cherusci, 9 A. D., and in 1875 a colossal monument by Bandel was raised in commemoration of this event on the summit of the Grotenburg, near Detmold.

Teuton'ic Knights, a military ecclesiastical order organized at Acre in 1190 by Frederick, duke of Swabia, and confirmed by Celestine III. in 1192. The [illegible] were pious North German merchants, [illegible] but noblemen were received. A little later [illegible] half brothers, not noble, were admitted. [illegible] the two vows of chastity and poverty. [illegible] were offered the sovereignty of Prussia [illegible] gaged in the conquest of that country. [illegible] expelled from Acre by the [illegible] gave them Prussia. They served [illegible] Louis 1248-50, and then [illegible] ed Königsberg in 12[illegible] in 1283; removed their [illegible] Venice 1291, to M[illegible] years involved in w[illegible] Poland, [illegible]

and West Prussia, Esthonia, Pomerania, and other neighboring countries. In 1466, Königsberg became their capital. In 1525 their grand master, Albert of Brandenberg, became hereditary duke of Prussia, and in 1527 their seat was transferred to Mergentheim in Swabia. In 1561 they lost all their Livonian possessions. In 1805 the emperor of Austria became grand master of the order. In 1809, Napoleon declared the order abolished, and gave its lands to various German sovereigns. In 1840 the Austrian emperor reorganized the Teutonic Knights, and in 1865 the order was still further reorganized. The Teutonic knighthood is at present a merely titular honor.

Teu'tons. (1) ***The Name.***—**Over the derivation of** this substantive, as well as the corresponding adjective, "Teutonic," reigns a good deal of unclearness and uncertainty. So much, however, may be said, we think, to be true in regard to it from a *historic* stand-point—viz. that the earliest indigenous form of the noun was *thiuda*, which signifies *das Volk*, "the people," and that the indigenous adjective derived therefrom was *diutisc*, the later *deutsch*, but that our words Teutons and Teutonic are rather the Latin corruptions "Teutones" and "Teutonicus," through which language we derive them.

(2) *The Peoples embraced under the Name.*—The uncertainty **about the derivation manifests itself most clearly** in the extent of the application. The Greek and Latin authors seem to have used the word to designate only a certain portion of the great race then inhabiting the lands N. of the Alps and E. of the Rhine—viz. that portion with which they first became acquainted—that portion which undertook, in company with the Cimbri, to invade the Roman empire about 113 B. C., and whose original abode had been probably the W. coast of Schleswig-Holstein and **the territory about the mouth of the Elbe. It was then that Rome first became aware of the *existence* of a people** of untamed might dwelling N. of the Alps, and distinct **from the Celtic tribes; and it is quite natural that the** Romans, in their ignorance of the extent of the race, should have taken the word which this tribe used, in *common* with **all the other tribes, to designate itself, and have applied it in a Latinized form in *particular* to this one, and then,** upon becoming acquainted with the larger extent of the race, **have adopted, as they did, another word, the Belgic-Celtic word *Germani*, for the name of the entire race. We find,** however, that some of the *Latin* authors—as, for instance, Martial and Claudian—used the adjective *Teutonicus* as of like meaning with *Germanicus*, and after the beginning of the tenth century the Latin "Teutonicus" displaces, even in *German* authorship, the indigenous "Theotiscus" as the comprehensive race-adjective, while we of this modern age, still using the Latin names, have turned them wholly about **in the extent of their application, designating the race by the term Teuton, and that portion of the pure or nearly pure stock inhabiting the European continent by the term *German*.** In this broadest sense we must include under the name Teuton, in first degree, the Germans of the Continent **—viz. the inhabitants of the German empire, of Austria proper, of the northern and north-eastern cantons of Switzerland, and of Holland and the Scandinavians of the two** northern peninsulas; in the second degree, the English, **the inhabitants of Lower Scotland, and the inhabitants of** the U. S.; while in the ethnological composition of almost every truly European nation—that is, every nation W. of Russia proper and Turkey—the Teutonic component enters **in a greater or less degree. At the close of the fifth century, when the great movement known in European history as the "migration of the peoples" ended, we find the Teu**tons the ruling race from Carthage to the Vistula; the Van**dals in Africa from Carthage to Gibraltar; the Visigoths** from Gibraltar to the banks of the Loire; the Suevi occu**pying about the present Portugal; Burgundians from the** upper course of the Loire to the centre of the present Swit**zerland; the Ostrogoths from the last-mentioned boundary** to that of the present Turkish empire on the E., and from the Mediterranean Sea on the S. to the Danube on the N.; **the Franks from the lower Loire to Thuringia; Saxon conquerors upon the English coasts;** Saxons, Frisii, Thuringians, Marcomanni, Bavarians, and Longobardi still upon **the original German soil, the latter, however, moving down** a little later (last half of the sixth century) into Italy, and **occupying the plain of the upper Po, while the Scandinavic** branch not only occupied the two northern peninsulas, but reached round the entire E. and S. E. shore of the Baltic and far inland. Within the present year (1876) **Privy Counsellor von Löher, in a lecture before the Academy of** Science at Munich, affirmed that he had discovered, furthermore, in the Guanchen of the Canary Islands descendants **of the old Vandals, who wandered through Hispania in the** fifth century, and emigrated to these islands as early as the **eighth.**

In the far-off lands of Africa, Hispania, South-western Gaul, and Middle and Southern Italy the Teutonic element **disappeared almost entirely in the amalgamation with the** great mass of the Romanic population; while, on the other hand, the inhabitants of Northern and North-eastern France, of Belgium, of Northern Italy, and of Russia's Baltic provinces manifest still most strongly the ethnological characteristics of the Teutons.

(3) *Characteristics of the Teuton.*—(*a*) *Physical.*—Besides the usual Caucasian peculiarities of the "oval head; the lines of eye and mouth dividing the whole face into three nearly equal parts; the large eyes with their axes at right angles with the line of the nose; the 90° facial **angle; the full beard, covering to the ears; the white com**plexion, and the tall, straight, and well-proportioned stature"—which the Teuton possesses in *common* with all Europeans, he is further somewhat distinguished from these by a larger frame, a whiter and more florid complexion, a bluer eye, and a lighter shade of hair. (*b*) *Mental.*—The **distinction between the Teutonic and the Romanic nature** is even more manifest in the mental than in the physical **constitution. The Greco-Roman world mediated the connection between the ancient civilization and the modern. Its geographical position and historical connections with the Oriental world preserved in the Greek and the Roman the inheritance of the Oriental traits, which the differences of climate and soil, geography and topography, have indeed modified, but not destroyed. The prevailing tempera**ment of the Romanic peoples is still a mixture of the sanguine and the melancholic, the latter element predominating, **while fancy and imagination, vacillation and mysticism, are among the chief traits in their intellectual, moral, and religious character. On the other hand, the Teuton, with** more of the phlegm and the choler in his temperament, evinces the deeper insight, the more constant purpose, **and the greater *éclaircissement*.**

(4) *Institutions.*—These differences of mental constitution are most clearly seen in the fundamental institutions which **they have produced. We may take the Roman imperium and the Roman Church as the great historical product of the Roman spirit. In both of these the sum and substance of all authority is viewed, imaginatively and mystically, as inherent in an office, and all law as proceeding out of it, from above down, over, and independent of the governed.** On the other hand, personal individual liberty and worth **were the fundamental principles of the old Teutonic life and polity. In the old assemblies of the village, the hundred, and the tribe it was the will of the freemen which was the authority of law. While in Rome the *central*** power was the strongest, and there existed no local power worth the name save as an imperial agency, among the Teutons, again, the *local power* was always the strongest, **and centralization always opposed, defied, and overthrown. When Marbodius the Marcomannic duke, and even the brave Arminius, to whom the German tribes were indebted** for the expulsion of the Roman legions from their soil, at**tempted to retain in time of peace the centralized authority** which they had exercised as leaders in war, the one was obliged to flee to Rome in order to save his life, while the **other fell a victim to his fatal ambition. And thus we see at the very first contact of the Teutonic with the Romanic world the irrepressible conflict between freedom and authority enkindled which has shaken Europe from that day to this. Then it was Teutonic liberty against the Roman imperium. In the Middle Ages, after contact and connection with the Roman world had given the Germans kings** and emperors, it was the emperor against the pope; in the **transition period from the mediæval age to the new time,** it was the German Protestant against the Roman Catholic; **and to-day it is Teutonic science against the Syllabus and** the Vatican. The Teutonic spirit has given to the modern **civilization its freedom of thought and conscience, its estimation of the man above the institution, its science, its** Protestantism, its doctrine of popular authority, its local **self-government, and its national development. It can therefore be truly said to be the spirit of the modern civilization.**

Sources.—*Vorgeschichte der deutschen Nation*, Wietersheim; *Geschichte der Völkerwanderung*, Wietersheim; *Die Guanchen der canarischen Inseln*, Von Löher; *Deutsche Verfassungsgeschichte*, Waitz; *Culturgeschichte des deutschen Volks*, Rückert; *Rom und die Deutschen*, Bluntschli; *De Bello Gallico*, Cæsar; *De Vita, Moribus, et Populis Germaniæ*, Tacitus; *Monumenta Germaniæ historica*, edited by Pertz.

J. W. BURGESS.

Teutop'olis, p.-v. and tp., Effingham co., Ill. P. 1033.

Tewkes'bury, town of England, county of Gloucester, on the Avon near its influx in the Severn, manufactures stockings, hosiery, malt, leather, and nails. P. 5409.

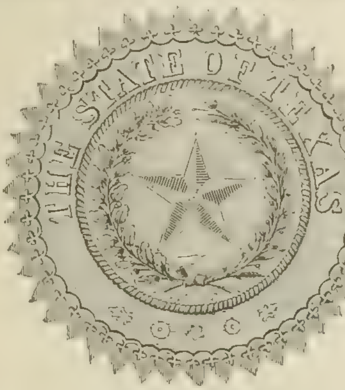
Tewks'bury, p.-v. and tp., Middlesex co., Mass. P. 1944.

Tewksbury, tp., Hunterdon co., N. J. P. 2327.

Texa'na, p.-v., cap. of Jackson co., Tex.

Texarkana, p.-v., cap. of Miller co., Ark., on the boundary-line between Texas and Arkansas, and at the junction of several proposed railroads, has a weekly newspaper.

Tex'as, a south-western State of the American Union, once a part of the republic of Mexico, which it still joins on its western border, lying between the parallels of 25° 51' and 36° 30' N. lat., and between the meridians of 93° 27' and 106° 43' W. lon. from Greenwich. It is of very irregular form, and most of its boundaries are natural lines of river or gulf; on the N. it is bounded by the Indian Territory, the N. fork of the Canadian forming substantially the boundary on the line of 36° 30', and the Red River from the 100th meridian eastward, while that meridian forms the eastern boundary from the Red River to the N. fork of the Canadian; the Sabine River forms the eastern boundary between Texas and Louisiana as far as the 32d parallel, and the meridian of 94° 10' thence to the Red River, separating it from both Louisiana and Arkansas; S. E. its long coast-line is washed by the Gulf of Mexico; S. W. the Rio Grande divides it from the Mexican republic, and where



The Seal of Texas.

that river crosses the line of American soil the Territory of New Mexico becomes its north-western and northern boundary. Its extreme length from S. E. to N. W. is somewhat more than 800 miles, and its greatest breadth is about 750 miles. As it has never been very carefully or accurately surveyed except as to the Mexican and Louisiana lines, its exact area is to some extent a matter of conjecture. The U. S. land-office and census-office give it as 274,356 sq. m., or 175,587,840 acres, but other high authorities give it as 237,504, 268,684, 274,000, and 274,365 sq. m. When the western and south-western government surveys are completed, we shall probably have the exact figures. Taking the government estimate as nearest the truth, it has almost 74,000 sq. m. more than the republic of France, whose area is 200,671 sq. m., and has territory enough for six States as large as Ohio, New York, or Pennsylvania. A still better idea of its vast size may be gained from the statement that its territory equals that of all the Atlantic States from the N. line of Pennsylvania to the southern boundary of Georgia, including West Virginia in the number—viz. Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, and Georgia.

Face of the Country.—This vast extent of territory has every variety of surface and soil. The coast is low and sandy; there are bars at the mouths of all the rivers; and the same formation of low and sandy islands and peninsulas which prevails along the coast of the S. Atlantic States. Galveston is built on one of these islands, and a succession of them line all the coast to the mouth of the Rio Grande, enclosing long and narrow sounds or lagoons of no great depth. This alluvial deposit, known as the "low coast belt," extends inland from 40 to 60 miles; much of it is barren and waste, and when there is vegetation it is in the form of impenetrable thickets of cactus and other thorny shrubs, commonly called chapparals. Beyond this, for a breadth of 150 miles or more, lies the "prairie belt," rolling lands with a rich and fertile soil, with islands of live oak and deciduous forest trees, and traversed by broad streams with heavily timbered bottom lands. In Eastern Texas these prairies have much more extensive forest tracts than W. of the Trinity River. Beyond (that is, N. and N. W. of the prairie belt), the land rises to a height of about 1000 feet, and presents a rough, broken surface, with abrupt slopes and sharp bluffs. These lands are excellent for grazing, and much of them for cultivation, but toward the N. W. and W. they continue to rise to the arid plateaus or *mesas* of the Llano Estacado, or Staked Plain, where there are no trees except the mesquite, and the vegetation is scanty from the limited rainfall. Yet even these lands, unpromising as they seem, yield nourishing pasture to wild horses, buffaloes, and to the vast herds of cattle now driven over a part of their surface. Farther W., the region lying between the Rio Pecos and the Rio Grande is filled with mountains, outlying spurs of the great Rocky Mountain range. Beginning at the W. bank of the Rio Pecos, we have in succession the Sierra Charrote, the Horsehead Hills (lying N. of the Rio Grande), the Sierra Santiago, the Sierra del Muerto, Paheut Mountains and other groups of the Apache range, the Guadalupe Mountains, a continuation of a New Mexican chain, and farther W. and S. W. the Sierra del Diablo, Eagle Mountains, Sierra Cariso, Sierra Monizo, Sierra Huecos, Sierra Blanca, and many others. Some of these summits attain an elevation of about 5000 feet. The gradual character of the ascending slope of the country is indicated by the following elevations, ascertained by the Coast Survey and railway surveys: Goliad, 50 feet; Gonzales, 150; Webberville, 394; Brenham, [illegible]; Austin, 650; San Antonio, 600; Sisterdale, in Kendall co., 1000; Fort Inge, Uvalde co., 845; Fort Clark, Kenney co., 1000; Fort Davis, Presidio co., 4700; and Fort Bliss, El Paso co., 3830 feet.

Rivers, Bays, etc.—The State, except in the region of the Llano Estacado, is well watered. The Canadian River, an affluent of the Arkansas, crosses Bexar territory in the extreme N. of the State. The Red River, which forms part of the N. boundary of the State, has its source in the Llano Estacado, but neither this nor the Canadian has any large tributaries in the State, though each receives numerous creeks or "branches." The Sabine, which forms part of the E. boundary, and the Neches, both discharge their waters into Sabine Lake, draining the extreme eastern portion of the State. Trinity River, rising in Grayson co. in the N., and the San Jacinto, a smaller stream, both discharge their waters into Galveston Bay. The Brazos, one of the largest rivers in the State, has its source in the N., near the Llano Estacado, and flows into the Gulf of Mexico about 36 miles below Galveston; the Colorado, another large river having its source in the Llano Estacado, pursues a course nearly parallel with that of the Brazos, and empties into Matagorda Bay. Both these rivers have numerous "forks" or affluents, but none of them of great size. The Guadalupe and San Antonio rivers, each having numerous affluents, drain a considerable portion of Southern Texas, and unite just before their entrance into San Antonio Bay. Passing the Aransas River, a little stream falling into Aransas Bay, we come to the Nueces, a larger river, and at one time claimed by Mexico as the boundary between her and Texas. This stream and its affluents drain a wide region in S. W. Texas, and its waters are discharged into Corpus Christi Bay. Between this river and the Rio Grande eight or ten creeks of no great length flow sluggishly through the sands into the long land-locked sound known as the Laguna de la Madre. The Rio Grande del Norte, a very long but shallow river, having its source in Colorado, divides the State from Mexico, and with its principal tributary, the Rio Pecos, and numerous small streams and creeks, drains most of Western Texas. None of the Texan rivers are navigable for any considerable distance except at high water, but by dredging, and the construction of a short canal, Galveston Bay and Buffalo Bayou have been rendered navigable for vessels drawing 9 or 10 feet of water, as far as Houston. The only bays not already mentioned are East and West Bays, forming a part of Galveston harbor; Tres-palacios, Lavaca, and Espiritu Santo bays, all connected with Matagorda Bay and harbor; and Copano Bay, lying W. of Aransas Bay. We have already spoken of the islands—long sand reaches on the coast. There are few lakes in the State; Sabine Lake is rather an estuary than a lake. Perry and part of Caddo Lake extend from the chain of lakes in Louisiana into Marion and Harrison cos.

Geology and Mineralogy.—The geology of Texas, so far as explored, is simple; the coast belt, like that of the other Gulf and Southern Atlantic States, is alluvial, though less fertile than the deposits of the Mississippi delta; the prairie or rolling lands, forming a belt about 140 miles in width, are Tertiary, varying in character in different sections, in some places having extensive deposits, sometimes [illegible] feet thick, of lignite or the brown coal of the [illegible], and in others spathic or other iron ores. The Cretaceous groups succeed the Tertiary, following a line from N. E. to S. W., which begins near the [illegible] Texas, and passes due S. W. near Austin, through San Antonio to the Rio Grande at or near [illegible]. The Cretaceous formations form the [illegible] of the greater part of the remainder of the State, extending from the Red River to the Rio Grande in a [illegible] track, and turning northward cover the Llano Estacado

and about three-fifths of the Territory of New Mexico. Between the two arms of this vast Cretaceous deposit, extending over the western half of the Indian Territory, and following up the valleys of the Pecos and Canadian rivers, the Triassic and Jurassic rocks come to the surface, their presence being indicated by immense deposits of gypsum. In this region the Colorado, Brazos, Red, and Canadian rivers have their sources, and from it they receive their principal tributaries. Between the 97th and 100th meridians and the parallels of 32° 50′ and 34° 50′ there is an irregular tract belonging to the true coal-measures, and furnishing coal of excellent quality. Nearly in the centre of the eastern arm of the Cretaceous deposits, and occupying the greater part of Williamson, Burnet, Lampasas, San Saba, Mason, and Llano cos., is a singular outcrop of Palaeozoic rocks; at the N. the lower coal-measures reappear, the coal strata being anthracite, or semi-anthracite; to this succeeds immediately an extensive and irregular outcrop of Silurian, which in turn embraces a triangular tract of gneiss and other Eozoic rocks. In the extreme western part of the State, between the Rio Pecos and the Rio Grande, the Guadalupe, Apache, Sierra Blanca, and Sierra Hueco mountain-ranges, as they rise from the chalk and clay of the plateau, have Jurassic or Triassic rocks in the foot hills on the eastern slope, gneiss, granite, and metamorphic rocks on the abrupt western slope, and Silurian rocks generally on the summits, except the Apache Mountains, which are primitive to their highest peaks. Directly E. of the larger coal-bed in the N. W. is a long, narrow, wedge shaped tract of Tertiary sand and clay, extending from the Red River to Fort Graham.

Minerals.—Copper is the most abundant metallic product of the State. The copper belt extends from the Red River and the counties of Clay, Archer, Wichita, Haskell, etc., across to the Rio Grande through the counties of Pecos and Presidio, and yields in immense quantities an ore which will smelt on an average 55.44 per cent. of pure copper, and large masses have been found yielding 68 per cent., besides some silver. This ore occurs in hills like the iron ores of Pilot Knob and Iron Mountain, and is above the surrounding levels. In the immediate vicinity are found coal, timber, limestone, and soapstone for smelting, and the Texas Pacific R. R. will pass through the entire copper belt. Argentiferous galena, very rich in silver, is found in large quantities in N. W. Texas; manganese, cobalt, nickel, and bismuth are found in such quantities as to make the deposits of commercial value. Iron occurs in the same region as copper, and in magnetic, spathic, specular, and haematite ores. In Mason, Llano, and more western counties magnetic iron is found in true veins in immense quantities, and average specimens yielded 74.93 pounds of metallic iron to 100 pounds of ore. The large coal field, about 6000 sq. m. in extent, is an outlying spur of the great Missouri coal-field, and yields a bituminous coal having 52 per cent. of fixed carbon, and is of similar quality to the Belleville (Ill.) coal. The smaller coal-field, in Brown, Coleman, Comanche, and Hamilton cos., is said to be anthracite or semi-anthracite of good quality. The lignites or brown coals of the Tertiary formation occupy larger tracts, and though soft, sulphurous, and ashy, are said to be superior to the German brown coals. In Webb co., on the Rio Grande, is a cannel coal belonging to the Tertiary which is dense and fine in texture, and proves to be a fine gas-coal. Asphaltum is found in eight counties in different parts of the State. Salt is extensively produced in the State in the salt lakes near the coast and in salt springs in Lampasas, Llano, and El Paso cos. Caves in Burnet and Blanco cos. yield saltpetre largely. Gypsum is a geological formation rather than a mineral. It is found throughout the Cretaceous deposits. Potter's and fire clays, marble, roofing-slate, grindstones, soapstones, feldspar, alum, antimony, arsenic, mineral oils and pigments, marls and other fertilizers, are found in great quantities in the State.

Vegetation and Botany.—Eastern Texas, E. of Trinity River, is a region of abundant timber, and, although the most densely populated portion of the State, more than one half of its surface is still covered with forests. There are two species of pine here, known as the "long-straw" and "short-straw" pine, both of large size and producing excellent lumber, while the long straw yields a superior quality of turpentine. There are also in Eastern Texas several species of oak, including the live-oak, which is found all over the State, the post oak, and black jack; the ash, elm, black walnut, butternut, pecan, box elder, pride of China; and, toward the coast, the magnolia (here a stately tree), the cypress, palmetto, etc. In Northern Texas there are two immense belts of woodland extending from the Red River southward, called the "Lower" and "Upper Cross Timbers." They are each about 40 or 45 miles wide, and extend southward from 150 to 200 miles; the first commences in Cooke and Grayson cos. along the Red River, and extends to McLennan co.; the second, which is the smaller, occupies parts of Wise, Jack, Palo Pinto, Hood, and Erath cos. Most of the trees in these forests are post oak and black jack oak, and they stand so wide apart that a wagon can be driven between them in any direction. Central Texas is mainly rolling prairie, but with plenty of timber, generally of good quality, though sometimes cottonwood, buckeye, black gum, and sweet gum in the river and creek bottoms. There are also islands of forest trees, live-oak, cypress (which grows on the hills here), post oak, and mesquite, scattered through the prairies. The coast belt has no forest trees, but frequent "chapparals," composed mainly of the opuntia or prickly pear and other species of cactus. This region has also in the spring and early summer rich and nutritious grasses and a profusion of brilliant flowering plants; Western and Northwestern Texas is scantily wooded, though even here the cypress, the mesquite, and to some extent the live-oak, are found. The mesquite is a very hardy and valuable tree, which endures severe drought, having roots which strike deep into the earth. It yields a sweet and nutritious bean in its long pods, which is much relished by cattle. Its sap dries into a gum like gum arabic, and its bark and heart-wood are regarded as the best materials in the world for tanning leather. The bois d'arc (or Osage orange) and the pecan tree are among the other valuable forest trees of Texas. The bois d'arc grows in almost all soils; its wood is very hard and durable, and its thorns and rapid growth make it excellent for hedges. The other plants and shrubs of North-western Texas, including the least sterile portions of the Llano Estacado, are the yucca and four or five species of cactus, including the opuntia or prickly pear, the melocactus, the mammilaria, and the cereus. The sage shrub, so common on this plateau farther N., is occasionally found here, but is not so abundant as in New Mexico and Colorado. Among the grasses of the State should be mentioned the mesquite grass, which is said to be more nutritious and better liked by horses, cattle, and sheep than any other shrub, grass, or cereal in the world.

Zoology.—There are large though diminishing herds both of buffaloes and antelopes in the N. W. part of the State. In Western Texas the mustang, the Mexican wild horse, still feeds on the prairies; the wolf, of great strength and ferocity, the black bear, the puma, the jaguar, the wild-cat, and the lynx are found in the wooded and thinly-inhabited districts; and deer, foxes, peccaries, raccoons, opossums, hares, and squirrels are very numerous, especially in the wooded districts. The principal game-birds are the wild turkey, pheasant, quail, snipe, many species of wild ducks, brant, and teal, wild geese, etc., and the birds of prey, the vultures, hawks, kites, pelicans, herons, kingfishers, flamingoes, cranes, etc. The streams abound in fish, of which the black bass is perhaps the finest of the fresh-water tribes, and the fish of the bays and Gulf are much the same as those of the other Gulf States. Alligators, turtles, etc., are abundant in the lower portion of the rivers and bayous, and more rarely the manatee, octopus, etc., are seen. There are in the mountainous and wooded districts rattlesnakes, moccasin snakes, and the milk adder, several species of the black snake (our North American boa), and numerous harmless snakes. The gecko and other lizards, horned frogs, salamanders, etc., are found in considerable numbers, and the insect tribes are both numerous and formidable. The centipede, the large jumping spider, the horse-flies, buffalo-gnats, and mosquitoes are sufficiently annoying, but no two of them are found in all parts of the State. The insects injurious to vegetation are less numerous here than in the older States.

Climate.—The great extent of the State and the varying elevation of the different sections ensure marked varieties in its climate. The isothermal curve indicating a mean annual temperature of 68° passes nearly along the parallel of 29° 40′, or from the mouth of the Sabine to the junction of the Pecos River with the Rio Grande. S. of this line the temperature increases, till at Brownsville, near the Rio Grande, in lat. 25° 57′, the annual mean is 75°; northward, this mean decreases with the greater elevation, till in the Llano Estacado, about lat. 32° 55′, it falls to near 55°. The prevailing winds for most of the year are S. and S. E. from the Gulf, but from November to February there are occasional N. winds, culminating at times in the cold wind-storms known as "northers." These generally blow for three days. The rainfall is, on the whole, increasing. It ranges from 54.47 inches at Galveston to 36.90 at San Antonio, 20 inches in the Pecos Valley, and 12 to 16 in the Llano Estacado. The following table gives more specific particulars concerning the temperature and rainfall for five prominent towns of the State, and the prevailing directions of the winds for three:

Meteorological Data.	Galveston, lat. 29° 18′, lon. 94° 40′, elevation 40.2 feet, 1873-74	Austin, lat. 30° 15′, lon. 97° 47′ 02″, elevation — feet, 17 years of observations	Indianola, lat. 28° 32′, lon. 96° 38′, elevation 25 feet, 1873-74	San Antonio, lat. 29° 25′, lon. 98° 14′, elevation — feet, for six years	Moreason's, Grimes Co. Two years of observation. Rainfall only, for lat. [illegible] lon.
Temperature.	°	°	°	°	
Mean annual temperature...	72.8	68.03	70	68.85	
Maximum temp. of year......	98.5	107	100	98	
Minimum temp. of year......	35.5	6	36	16	
Range of annual temp........	64.5	101	64	82	
Mean temp. of spring.........	69.3	68.78	69.4	69.94	
Maximum temp. of spring...	89.5	103	90.5	98	
Minimum " " ...	44	21	41	31	
Range of spring temp.........	45.5	82	49.5	67	
Mean temp. of summer.......	82.9	85.32	82.6	83.56	
Maximum temp. of summer	98.5	107	100	98	
Minimum " "	73	62	70	65	
Range of summer temp.......	25.5	45	30	33	
Mean temp. of autumn	75.8	65.95	70.8	68.95	
Maximum temp. of autumn	91	98	89.5	94.5	
Minimum " "	49	20	42.5	31	
Range of autumn temp.......	42	78	47	63.5	
Mean temp. of winter.........	63.3	52.44	57.4	52.94	
Maximum temp. of winter...	80	88	78.5	86	
Minimum " " ...	35.5	6	36	16	
Range of winter temp.........	44.5	82	42.5	70	
Rainfall.	Inches.	Inches.	Inches.	Inches.	Inches.
Mean annual rainfall..........	54.47	35.12	45.32	36.90	42.35
Rainfall of spring................	12.27	16.00	5.22	8.15	7.01
Rainfall of summer.............	18.18	5.98	13.81	14.80	8.40
Rainfall of autumn..............	17.01	7.64	18.66	12.05	13.90
Rainfall of winter................	7.01	5.50	7.63	1.90	13.04
Winds. Prevailing directions in the order of mention....	S., S. E., N., N. E., E., N.W., and S. W.	......	S., S. E., N., N. E., E., S. W., and W.	Calm, S. E., S., N. E., S. W., N.W., and W.	

Manufacturing, Mining, and other Industrial Products.—There were in 1870, according to the ninth census, 2399 manufacturing establishments, using 13,044 horse-power to move their machinery, employing 7927 hands—viz. 7450 men, 157 women, 320 children—and a capital of $5,284,110, paying $1,787,835 wages, using $6,273,193 of raw material, and producing goods to the amount of $11,517,302. Of these manufactures the most important at that date was lumber, of which 192 saw-mills produced $1,736,482; next in importance and value were the packing establishments of beef and other meats, in which in 15 establishments packed meats, condensed meat essences, meat biscuits, etc., were put up to the value of $1,052,156; 4 cotton mills produced cotton goods to the amount of $574,598; saddlery and harnesses were made in 138 establishments to the value of $348,307; tin, copper, and sheet-iron ware in 71 establishments produced goods to the value of $334,665. The other principal manufactures were carriages and wagons, hides and tallow, flouring mill products, and sash, doors, and blinds, but neither of these industries produced goods to the amount of $300,000. Since 1870 manufacturing has made great progress in Texas, especially at Houston and some of the more eastern towns, and the present aggregate of manufactured goods is probably nearly three times what it was in 1870. The census of 1870 reported but 1 mining establishment in Texas, employing but 2 men, with $150 capital and $900 product, but there are now several valuable copper mines and smelting furnaces, a number of saltworks, and coal mines which supply fuel to the furnaces and manufactories.

Agricultural Productions.—The following table shows the agricultural productions of the State according to the census of 1870, together with such particulars as can be ascertained of the production of 1875:

	1870	1875
Acres of land improved.................	2,964,836	79,306,618 (improved and unimproved)
Unimproved, acres	15,931,682	
Value of farms.	$60,149,950	$107,641,691
Value of farming implements	$3,396,793	
Wages for laborers.................. . .	$4,777,668	
Value of farm products	$41,186,170	est. 69,125,000
Value of orchard products.....	$89,172	
Value of market gardens	$74,924	
Harvest products..................	$66,841	
Value of home manufactures.........	$[illegible],308	
Value of live-stock................. .	$37,425,194	38,888,734*
Number of horses.	429,704	888,2[illegible]2* (horses, mules and asses)
Number of mules and asses	61,[illegible]2	
Number of milch cows	428,048	3,182,904* (milch cows, work oxen and stock cattle)
Number of work oxen.	132,407	
Number of stock cattle.....	2,933,588	
Number of sheep	714,351	1,6[illegible]2,071*
Number of hogs.............	1,202,445	1,347,400
Bushels of wheat..	411,103	1,474,000
Bushels of rye..................	28,[illegible]21	4[illegible]
Bushels of Indian corn.................	20,554,538	28,016,000
Bushels of oats..........	762,663	1,118,000
Bushels of barley.	44,531	65,000
Bushels of buckwheat..................	49	
Rice, pounds......................... . .	63,884	
Tobacco, pounds............................	59,706	141,000
Cotton, bales.............................. ...	350,628	340,000
Wool, pounds.......................	1,251,318	
Peas and beans, bushels................	42,651	
Irish potatoes, bushels....	208,[illegible]83	2[illegible]7,400
Sweet potatoes, bushels..	2,188,041	2,[illegible]25,000
Wine, gallons................................	6,216	
Butter, pounds.......	3,712,747	
Cheese, pounds.........	31,[illegible]42	
Hay, tons...................................	18,982	62,000
Cane-molasses, gallons	24[illegible]0[illegible]2	
Sorghum-molasses, gallons...	174,509	
Beeswax, pounds.........	1[illegible]5	
Honey, pounds..........	27[illegible]464	

Railroads.—At the beginning of 1875 there were 1,540.5 miles of railway in the State, the cost of which, for road, equipment, lands, etc., was about 60 million dollars. The following table gives the principal particulars of these railways:

Railways.	Miles in operation.	Capital stock.	Stock paid in.	Amount expended.	Indebtedness.	Receipts for transportation.	Expenses.	Locomotives: [illegible]	Locomotives: [illegible]	Miles run by trains.	[illegible]	Acres of land: Sold.	Acres of land: Unsold.
		$	$	$	$	$	$						
Houston and Texas Central.......	501.47	822,700	822,700	20,817,941.18	11,702,485.14	3,23[illegible]	1,26[illegible]	71	11[illegible]	[illegible]	10.4	111,760	177,[illegible]
Texas and Pacific	300.00	50,000,000	600,000		22,741,891.7[illegible]	1,219,[illegible]	4[illegible]	28	116	[illegible]	[illegible]		1,16[illegible]
International and Great Northern	502.00	25,000,000	5,500,000	17,000,404.97	13,129,[illegible]	1,061,[illegible]	796,[illegible]	40	[illegible]	[illegible]	1.[illegible]		1,13[illegible]
Gulf Western Texas and Pacific. .	68.80	12,000,000		1,[illegible]81.79	1,586,000.00	[illegible]	[illegible]		70	71,[illegible]	1.[illegible]		
Galveston Houston and Henderson	50.00	1,000,000	1,000,000	61,274.95	1,637,340.72	71[illegible]	147,[illegible]†	1[illegible]	[illegible]76	[illegible]	[illegible]		
Galveston Harrisburg and San Antonio	109.25	2,000,000	2,000,000	549,750.00	1,605,000.76	[illegible]	77,003.49†	7	11	108,[illegible]	[illegible]		[illegible]
Totals	1540.52	90,000,000	9,922,700	38,5[illegible]	[illegible]	[illegible]	[illegible]	161	28[illegible]	1,1[illegible]	[illegible]	[illegible]	

The only canal in the State is a short ship-canal, now nearly finished, in aid of the navigable channel from Galveston harbor to Houston. It is 4 miles long and 12 feet deep, and connects the San Jacinto River with the bay through Morgan's Point.

Finances.—The State debt on Feb. 1, 1876, was as follows: bonded debt, $4,249,757; floating debt, $543,137.84; making an aggregate of $4,792,894.84. Besides this there is claimed as due to the State university fund and the common school fund $537,008.21 for warrants lost and destroyed during the late war, together with interest on this amount to Feb. 1, 1876, the whole amounting to $842,210.26. These claims are set down in the comptroller's report as of doubtful validity. If allowed, they would increase the State debt to $5,635,105.10. The receipts from all sources, [illegible] balance in the treasury from Aug. 31, 1874, to Aug. 31, 1875, the close of the fiscal year, were $2,800,07[illegible], and the disbursements for the same period, $2,497,27[illegible], [illegible] balance in the treasury of $302,799.32. Of the [illegible] was expended for frontier defence and other [illegible] accounts, and $307,525.70 for interest on the public debt. The remainder ($1,477,728.37) was for the [illegible] expenses of the government and for the maintenance of public schools.

Commerce and Navigation.—Texas has five customs districts. The following table gives the [illegible] of the foreign commerce and navigation of the State for the year ending June 30, 1875:

* The returns marked with a * were those of the county assessors in 1875, and are incomplete, as well as under-estimated. Gov. Coke says that the increase from 1874 should have been at least 12 per cent., while the assessment-rolls make it but about 2 per cent. There has been a material increase in the production of butter, cane and sorghum sugar and molasses, wool, rice, and orchard and market-garden products since 1870, and ramie and several other products have been added.

† These two roads had paid in addition considerable sums (nearly $400,000 in the aggregate) for labor-rolls and other expenses.

Customs districts.	Foreign imports for year ending June 30, 1875.	Domestic exports for year ending June 30, 1875.	Foreign goods re-exported for year ending June 30, 1875.	Entrances into port for year ending June 30, 1875.			Clearances from port for year ending June 30, 1875.			Registered, enrolled, and licensed tonnage for year ending 1875.	
				Vessels.	Tonnage.	Crews.	Vessels.	Tonnage.	Crews.	Vessels.	Tonnage.
Brazos de Santiago........	$2,002,748	$833,312	$997,658	49	30,984	1252	41	20,956	993	14	1,547
Corpus Christi.......	322,803	205,557	243,966	8	5,142	147	9	5,930	171	35	774
Galveston	1,218,034	15,876,632	349,275	163	91,913	2349	206	127,579	3190	250	18,116
Paso del Norte....	308,991	40,323	....	18	4,080	234	18	4,079	234	......	....
Saluria.........................	97,663	237,294	40,165	18	16,785	435	28	24,359	627	46	1,612
Totals......	$3,950,239	$17,193,118	$1,629,064	256	148,904	4417	302	182,903	5215	345	22,049

Population.—There has been no trustworthy census of the State since 1870, but there is no room for doubt that its population has increased since that date, mainly from immigration, more rapidly than that of any other Southern State, and perhaps than any other State of the Union. It is claimed that for the last four years from 200,000 to 250,000 persons have annually been added to its population, and in 1875 the State authorities estimated the number of inhabitants at 1,500,000. The number of inhabitants at the earliest dates in the following table are as estimated by its historians, usually from imperfect and partial enumerations:

Year of enumeration.	Total population.	Males.	Females.	White.	Free colored.	Slaves.	Indians, Mexicans, and Chinese.	Natives.	Foreigners.	Density.	Ratio of increase.	No. of dwellings.	No. of families.	Persons in a family.	Persons in a dwelling.	Illiteracy.	Of school age, 5 to 20.	Of military age, 18 to 45, males.	Of voting age, 21 and over, males.	Male citizens.
1806	7,000	.. ...	......	......	......	......	......	......	......	0 0.	......									
1834	21,000	.... ..	......	......	......	......	......	......	......	0.07	300.									
1836	52,670	33,500	19,170	30,000	5,000	......	17,670	......	......	0.19	150.									
1845	150,000	91,000	59,000	......	......	......	......	......	......	0.54	185.									
1850	212,592	113,780	98,812	154,034	397	58,161	.....	191,433	17,681	0.77	41.70	27,988	28,377	5.44	5.52	10,583	83,206	43,909	52,666	40,048
1860	604,215	320,167	284,048	420,891	355	182,566	40	560,793	43,422	2.20	184.22	77,425	76,781	5.49	5.45	18,476	233,417	119,362	143,951	100,042
1870	818,579	423,557	395,022	564,700	253,475	......	724	756,168	62,411	3.02	36.46	141,685	154,483	5.30	5.18	221,703	319,233	158,765	184,094	169,215

Education.—The policy of Texas, both as a State and a republic, has been to favor public-school education, and liberal endowments of its public lands were early made to aid in the maintenance of public schools. But owing to the sparseness of the population and the slow sales of public lands, very little was done for some years. In 1854 the school fund amounted to $128,668, and in that year $2,000,000 was added to it from the $10,000,000 paid by the U. S. government for the purchase of the Santa Fé territory. During the five years from 1856 to 1860 about $106,000 of interest annually from this fund was distributed among the schools. During the war the school fund was appropriated to other purposes, and the schools generally suspended. After the war, new grants of land were made for schools, and an attempt made to reorganize the school system. In 1868 the reconstruction convention set apart all the sales of public lands, one-fourth of the State revenue, and a poll-tax of one dollar per head on each male citizen between twenty-one and sixty years of age as a revenue for schools. In that year the permanent fund was said to be $2,000,000. In 1870 there were 221,512 persons over ten years of age who could not read or write, of whom 70,895 were whites and 150,617 colored. In 1871 two school laws were passed, one in April, the other in November. Both these proving objectionable, another was passed, repealing the former, May 22, 1873, which was further amended in May, 1874, and Mar., 1875. The constitutional convention of Sept., 1875, made radical changes in the school system, not generally for the better, but these have not yet gone into operation. The following are the statistics of the public schools under the laws of 1873–75: The school age was from six to eighteen. In 1875 the permanent school fund amounted to $2,604,202.95 in bonds, $80,721.61 in currency, and $41,963.69 in specie. The available school fund for the year was $10,500 in bonds of Brazos co., $728,466.30 in currency, and $125,891.15 in specie. The balance on hand after the year's disbursements was the Brazos co. bonds and $108,260.92 in currency. The enumeration taken in July, 1875, shows a school population (6–18 years) in 145 counties of 331,400. The school reports returned for 1875 were from only 97 counties; in these counties (which had a school population of 210,922) 124,567 were enrolled in the schools, and there was an average daily attendance of 84,415. There were 2924 schools organized and 3100 teachers employed; the average duration of the schools was 78 days (a little short of 4 months); the average salaries of teachers per month was $53. From these data the superintendent estimates the actual enrollment in the State as 184,705; the average attendance as 125,224; the number of schools organized as 3898, and of teachers employed 4030. The Peabody fund paid in 1875, $4800 in aid of the public schools of the State. The new constitution, adopted Feb. 15, 1876, abolishes the office of State superintendent, restricts the expenditure for school purposes to the amount of the available school fund (in 1876, $655,000), and so cripples the whole system that except in the more populous counties the existence of the public school will for the present be impossible, even in the large towns. Gov. Coke says the school age must be from eight to thirteen years if the schools are to be maintained for five months, and in many places it will only be possible to contract with private schools to give the most elementary instruction at the State's expense.

The following table summarizes the statistics of higher education:

Universities, Colleges, and Professional Schools.

Universities, Colleges, and Professional Schools.	Location.	Year of organization.	Under what control.	Professors and instructors.	Students.				Value of buildings, grounds, and apparatus.	Amount of productive endowment.	Income from productive endowment.	Income from all sources.	Number of endowed scholarships.	Volumes in library.
					Preparatory.	Collegiate.	Male.	Female.						
Universities, etc.									$	$	$	$		
Austin College..............................	Huntsville....	1850	Presbyterian	3	...	...	...	...	60,000	5,000	500			
Baylor University	Independence.	1845	Baptist	5	...	87	87	...	65,213	30,213	3,021	.....	....	1,300
Colorado College	Columbus....	....	Lutheran.											
Henderson College	Henderson....	1871	Non-sectarian....	5	100	...	53	47						
Marvin College	Waxahatchie .	1869	Methodist	7	90	23	43	47	30,000	......	.....	3,500		
St. Joseph's College........................	Brownsville...	1868	Roman Catholic..	7	60	...	60	...	18,000	......	.....	3,000	....	200
St. Mary's College	San Antonio..	....	Roman Catholic..	10	360	...	360	...	......	......	.....	.....	....	1,200
Salado College	Salado........	1860	Non-sectarian....	7	94	47	83	58	60,000	......	.....	5,500		
Soule University............................	Chappell Hill.	....	M. E. Ch., South.	3	80	...	48	32	20,000					
Texas Military Institute....................	Austin........	1868	Non-sectarian....	4	...	112	112	...	75,000	......	.....	7,500	....	1,200
Texas University............................	Georgetown...	1873	M. E. Ch., South.	4	...	69	69	...	162,000	......	.....	2,000		
Trinity University..........................	Tehuacana....	1869	Cumb. Presb.....	13	225	203	240	188	56,000	15,000	700	8,200	....	2,700
University of St. Mary	Galveston	1854	Roman Catholic.	13	110	26	136	...	150,000	......	.....	4,500	....	320
Waco University.............................	Waco.........	1861	Baptist	9	120	95	112	103	53,000	13,000	1,000	6,800	....	2,350
Wiley University............................	Marshall	1873	Methodist Epis....	6	260	...	145	115	20,000					
The Masonic Institute	Rusk	1872	Masonic order....	3	98	...	50	48	10,000	1,000	.....	2,100		
Odd Fellows' University.....................	Bryan.... ...	1872	I. O. O. F........	3	22	50	...	72	13,000	......	.....	2,000		
School of Science.														
Agricultural and Mechanical College of Texas.	Bryan	1876	State.............	not	full	y or	gan	ized						
School of Theology.														
Theological department, Baylor University....	Independence	1870	....	2	...	13	13							
Professional Schools.														
Texas Medical College and Hospital..........	Galveston	1873	....	7	...	15	15	...	......	5,000	500	3,500	....	40
American Dental College.....................	Austin........	1873	....	6										

There is no normal school in the State, though the organization of three or more has been strongly urged. Waco University at Waco has a normal department, and educates a considerable number of teachers.

Special Education.—There is an institution for the deaf and dumb at Austin, having 3 instructors and teachers and 47 pupils. The expenditure, paid wholly by the State, is about $12,000 per annum. There is also an institute for the blind at Austin, with 8 teachers and instructors and 54 pupils; its current expenses are about $10,650.

Counties (172 organized, 2 unorganized).

Counties.	Total pop., 1870.	Males, 1870.	Females, 1870.	Total pop., 1860.	Assessed valuation, 1875.	True valuation, ninth census, 1870.
					$	$
Anderson	9,229	4,664	4,565	10,398	2,178,713	1,668,111
Angelina	3,985	1,981	2,004	4,271	531,622	323,197
Aransas	new	county.	......	......	552,438	
Archer	new	county.	......	......	......	205,072
Atascosa	2,915	1,513	1,402	1,578	842,135	925,847
Austin	15,087	7,823	7,264	10,139	2,462,914	2,497,870
Bandera	649	369	280	399	205,270	146,181
Bastrop	12,290	6,467	5,823	7,000	2,599,843	2,100,947
Baylor	new	county.				
Bee	1,082	550	532	910	630,146	
Bell	9,771	5,099	4,672	4,799	2,981,186	1,255,533
Bexar *	16,043	8,104	7,939	14,454	8,013,699	4,281,672
Blanco	1,187	625	562	1,280	517,524	249,599
Bosque	4,981	2,631	2,350	2,005	1,263,947	880,963
Bowie	4,684	2,372	2,312	5,052	1,028,263	575,631
Brazoria	7,527	3,913	3,614	7,143	2,067,217	1,681,554
Brazos	9,205	4,726	4,479	2,776	2,378,117	1,493,571
Brown	544	288	256	244	372,504	
Burleson	8,072	4,266	3,806	5,683	902,976	999,060
Burnet	3,688	1,966	1,727	2,487	1,142,878	484,718
Caldwell	6,572	3,374	3,198	4,481	1,643,266	1,229,084
Calhoun	3,443	1,760	1,683	2,642	1,012,152	1,609,616
Callahan	new	county				
Cameron	10,999	5,971	5,028	6,028	1,499,719	1,731,972
Camp	new	county.	......	......	541,419	
Cass †	8,875	4,592	4,283	8,411	1,470,697	703,435
Chambers	1,503	770	733	1,508	590,536	325,435
Cherokee	11,079	5,556	5,523	12,098	10,574,516	917,284
Clay	new	county.	......	109	228,542	
Collin	14,013	7,246	6,767	9,264	4,714,567	2,784,695
Colorado	8,326	4,258	4,068	7,885	2,664,155	1,978,675
Coleman	347	217	130	......	69,711	
Comal	5,283	2,788	2,495	4,030	1,371,540	1,280,536
Comanche	1,001	525	476	709	625,061	
Concho	new	county.				
Cook	5,315	2,794	2,521	3,760	1,556,414	681,467
Coryell	4,124	2,080	2,044	2,666	1,302,872	698,376
Crockett	new	county.				
Dallas	13,314	6,900	6,414	8,665	7,918,511	2,997,238
Dawson	new	county.	......	281		
Delta	new	county.	......	......	554,625	
Denton	7,251	3,785	3,466	5,031	2,436,983	1,419,309
De Witt	6,443	3,313	3,130	5,108	1,900,238	1,520,711
Dimmit	109	74	35			
Duval	1,083	625	458			
Eastland	88	50	38	89	63,029	
Edwards	new	county				
Ellis	7,514	[illegible]	3,491	5,246	3,608,369	1,474,419
El Paso	3,671	2,028	1,643	4,051	396,527	454,301
Encinal	427	260	167	43	281,045	19,157
Erath	1,801	941	860	2,425	705,711	607,567
Falls	9,851	5,122	4,729	3,614	2,243,661	1,403,508
Fannin	13,207	6,868	6,339	9,217	3,163,745	1,994,170
Fayette	16,863	8,677	8,186	11,604	4,806,106	3,730,255
Fort Bend	7,114	3,562	3,552	6,143	2,145,892	1,238,995
Franklin	new	county.				
Freestone	8,139	4,148	3,991	6,881	1,919,288	1,116,034
Frio	309	164	145	42	370,471	
Galveston	15,290	7,843	7,447	8,229	19,191,861	16,379,724
Gillespie	3,566	1,871	1,695	2,736	894,360	701,820
Goliad	3,628	1,793	1,835	3,384	1,170,480	835,401
Gonzales	8,951	4,603	4,348	8,059	2,688,195	1,648,715
Grayson	14,387	7,476	6,911	8,184	5,822,991	1,962,168
Gregg	new	county.	......	......	999,900	
Grimes	13,218	6,954	6,264	10,307	2,365,672	2,076,264
Guadalupe	7,282	3,771	3,511	5,444	2,057,379	1,736,144
Hamilton	733	391	342	489	457,380	
Hardeman	new	county.				
Hardin	1,460	740	720	1,353	119,119	95,954
Harris	17,375	8,762	8,613	9,070	11,967,038	10,816,897
Harrison	13,241	6,712	6,529	15,001	3,930,283	2,912,043
Haskell	new	county.	......	......	......	183,419
Hays	4,088	2,124	1,964	2,126	1,142,460	613,570
Henderson	6,786	3,387	3,399	4,595	[illegible]	[illegible]
Hidalgo	2,387	1,313	1,074	1,182	295,790	282,424
Hill	7,453	3,867	3,586	3,653	1,729,274	1,295,927
Hood	2,585	1,362	1,223	......	878,877	411,404
Hopkins	12,651	6,397	6,254	7,745	1,915,287	1,196,237
Houston	8,147	4,053	4,094	8,058	2,041,164	1,663,911
Hunt	10,291	5,281	5,010	6,630	1,789,540	1,257,256
Jack	694	374	320	1,000	368,306	273,603
Jackson	2,278	1,164	1,114	2,612	648,846	912,318
Jasper	4,218	2,055	2,163	4,037	374,671	
Jefferson	1,906	956	950	1,995	741,385	671,405
Johnson	4,923	2,575	2,348	4,305	2,225,429	1,080,496
Jones	new	county				
Karnes	1,705	959	746	2,171	658,771	678,513
Kaufman	6,895	3,554	3,341	3,936	2,064,107	1,026,535
Kendall	1,536	817	719	......	285,335	361,215
Kerr	1,042	598	444	634	323,877	204,697

Counties.	Total pop., 1870.	Males, 1870.	Females, 1870.	Total pop., 1860.	Assessed valuation, 1875.	True valuation, ninth census, 1870.
					$	$
Kimball	72	41	31			
Kinney	1,204	784	420	61	147,089	
Knox	new	county	.	.	......	91,464
Lamar	15,790	[illegible]	[illegible]	10,136	3,851,791	2,266,391
Lampasas	1,344	734	610	1,028	564,704	288,120
La Salle	69	43	26			
Lavaca	9,168	4,671	4,497	5,945	1,854,018	1,519,510
Lee	new	county.	......	......	1,416,494	
Leon	6,523	3,380	3,143	6,781	1,407,198	
Liberty	4,414	2,214	2,200	3,189	474,424	533,983
Limestone	8,591	4,523	4,068	4,537	2,558,462	1,328,368
Live Oak	852	497	355	593	733,776	
Llano	1,379	735	644	1,101	403,452	332,243
McCulloch	173	97	76			
McLennan	13,500	6,880	6,620	6,206	4,663,590	2,637,910
McMullen	230	137	93	......	197,054	
Madison	4,061	2,080	1,981	2,238	684,777	574,026
Marion	8,562	4,453	4,109	3,977	1,550,499	2,209,099
Mason	678	354	324	630	314,684	134,343
Matagorda	3,377	1,745	1,632	3,454	1,340,748	750,753
Maverick	1,951	1,113	838	726	294,845	
Medina	2,078	1,080	998	1,838	828,404	552,423
Menard	667	533	134	......	56,135	
Milam	8,984	4,713	4,271	5,175	1,821,763	991,541
Montague	890	487	403	849	452,787	206,247
Montgomery	6,483	3,348	3,135	5,479	1,433,932	775,714
Morris	new	county	......	......	439,215	
Nacogdoches	9,614	4,806	4,808	8,292	1,127,233	1,865,231
Navarro	8,879	4,623	4,256	5,996	3,567,064	2,061,282
Newton	2,187	1,101	1,086	3,119	259,553	
Nueces	3,975	2,152	1,823	2,906	3,552,456	1,330,573
Orange	1,255	614	641	1,916	391,310	276,733
Palo Pinto	new	county.	......	1,524	314,670	
Panola	10,119	5,140	5,979	8,475	1,281,232	792,947
Parker	4,186	2,156	2,030	4,213	1,557,845	938,129
Polk	8,707	4,205	4,102	8,300	533,667	761,518
Presidio	1,636	1,142	494	580	83,123	
Pecos	new	county				
Rains	new	county.	......	......	377,778	
Red River	10,653	5,382	5,271	8,535	1,732,787	1,237,822
Refugio	2,324	1,259	1,065	1,600	819,386	657,296
Robertson	9,990	5,272	4,718	4,997	3,185,742	959,245
Rockwall	new	county.	......	......	391,623	
Runnels	new	county				
Rusk	16,916	8,569	8,347	15,803	2,014,738	1,382,090
Sabine	3,256	1,615	1,641	2,750	326,061	292,170
Somerville	new	county				
San Augustine	4,196	2,092	2,104	4,094	1,049,926	1,210,619
San Jacinto	new	county.	......	......	471,991	
San Patricio	602	339	263	620	160,869	
San Saba	1,425	756	669	913	541,843	498,922
Shackelford	455	230	225	11	67,490	
Shelby	5,732	2,941	2,791	5,362	840,159	556,407
Smith	16,532	8,293	8,239	13,392	3,241,066	1,841,230
Starr	4,154	2,444	1,710	2,406	[illegible]	750,434
Stephens	330	190	140	230	[illegible]	
Tarrant	5,788	3,012	2,776	6,020	[illegible]	1,115,457
Taylor	new	county.				
Throckmorton	new	county	......	124	11,617	246,842
Titus	11,339	5,818	5,521	9,648	1,184,405	1,242,203
Tom Green	new	county.	......	......	186,412	
Travis	13,153	7,288	5,865	8,080	12,119,752	5,281,256
Trinity	4,141	2,066	2,075	4,392	[illegible]	[illegible]
Tyler	5,010	2,554	2,456	4,525	407,822	[illegible]
Upshur	12,039	6,005	6,034	10,645	[illegible]	[illegible]
Uvalde	851	476	375	506	659,871	491,555
Van Zandt	6,494	3,290	3,204	3,777	[illegible]	514,455
Victoria	4,860	2,415	2,445	4,171	1,734,421	[illegible]
Walker	9,776	5,095	4,681	8,191	[illegible]	[illegible]
Waller	new	county.	......	......	1,515,293	
Washington	23,104	11,948	11,156	15,215	5,006,125	4,578,481
Webb	2,615	1,465	1,150	1,397	432,661	367,215
Wharton	3,426	1,720	1,706	3,380	702,784	440,420
Wichita	new	county				
Wilbarger	new	county				
Williamson	6,368	[illegible]	3,070	4,529	2,701,226	1,666,968
Wilson	2,556	1,369	1,187		[illegible]	409,224
Wise	1,450	770	680	160	[illegible]	290,672
Wood	6,894	3,450	3,444	4,968	1,175,377	712,412
Young	135	92	43	[illegible]	132,965	[illegible]
Zapata	1,488	807	681	1,248	[illegible]	267,644
Zavala	133	71	62	26		
Total	818,579	[illegible]	[illegible]	604,215	249,275,979	
Value of [illegible] acres of land and town lots tendered by railroad companies					1,113,547	
Amount of property rendered by Western Union Telegraph Company					116,005	
Amount of property rendered by Texas and Pacific Telegraph Company					18,228	
Total value					[illegible]	[illegible]

There are also two other counties set off, but as yet unorganized—Hempstead and Wegefarth—and several others will doubtless be formed ere long from the territory in the N. W. part of the State, now comprised in Bexar and Young territories, Tom Green, Pecos, Presidio, Crockett, and El Paso cos.

Principal Towns and Cities.—Austin, the capital of the State, in 1870 had 4428 inhabitants; in 1875 its population was estimated at 6000. Galveston, the largest seaport and principal city, had 13,818 inhabitants in 1870, and not less than 25,000 in 1875. Houston, 9382 in 1870, and, according to a census taken in Mar., 1875, 25,968. San Antonio had 12,256 in 1870, and has largely increased since. Jefferson, Waco, Marshall, Dallas, Corpus Christi, Brownsville, Paris, Crockett, Clarksville, New Braunfels, Indianola, Laredo, and Brenham are all growing towns, ranging from 3000 to 6000 inhabitants each.

Charitable and Corrective Institutions.—The State lunatic asylum of Texas is at Austin. It had, Sept. [illegible] 152 patients (87 males, 65 females), 217 [illegible] present during some portions of the year. Its current expenses are nearly $50,000 per annum. Of the patients [illegible] in 1875, 33 were discharged restored, [illegible] incurable, 2 escaped, and 9 died. Of the [illegible] the year, 21 had been insane [illegible].

Immigration.—The greater part of the [illegible] who eventually find a home in Texas [illegible] at New York or other Northern ports, or at New Orleans, [illegible] 1875, of the nearly [illegible] States as well as foreigners, who immigrated [illegible] in

* Also Bexar district, since organized as counties. P. in 1870, 1077: males 895, females 182.

† Cass county had its name changed to Davis in 1862, but has since resumed the old name.

1875, 135 (72 men and 63 women) came thither direct from Europe.

Banks and Savings Banks.—In 1875 there were 10 national banks in Texas, having a capital of $1,250,000, $914,000 of bonds on deposit, and $817,700 outstanding circulation. There were also 10 State banks, having an aggregate capital of $2,075,000. Two of these, having a capital of $160,000, were savings banks. There were also 90 private banking-houses.

Insurance Companies.—At the beginning of 1876, Texas had 8 fire and marine insurance companies, 5 of which were at Galveston, 2 at Houston, and 1 at Tyler. These 8 companies had an aggregate paid-up capital of $1,500,000, and gross assets of $2,180,130.49. Their total income for 1875 was $644,657.50, their total expenditures $565,403.09, and their total liabilities $612,172.92. There was 1 mutual life company at Galveston in 1873, with $300,000 capital and about $350,000 assets, but it has since closed up its business.

Prisons, etc.—The State penitentiary is at Huntsville, Walker co. It is entirely inadequate to the needs of the State, having, even with improvements not yet completed, accommodations for only 600 convicts, while the total number Jan. 1, 1876, was 1723, and 266 had escaped, 28 had been killed, 109 had died, 96 had been pardoned, and 182 could not be accounted for. The governor urges very strongly the immediate erection of two more prisons. The large number of escapes is mainly due to the fact that, owing to the want of room, there were Jan. 1, 1876, 1380 prisoners who were employed in agriculture, on railroads and saw-mills under guard in camps at different places in the State. The labor of the prisoners is leased for fifteen years from 1871 to a firm which assumes the entire expenditure, and pays to the State $5000 per year for the first five years, $10,000 for the next five, and $20,000 for the last five years; the firm also pays all salaries, $10,000 a year for sheriffs' fees, $20 and a suit of clothes to each discharged convict, and the entire expense of guarding, feeding, and clothing the prisoners. The prison is seriously mismanaged, not from any evil disposition on the part of the lessees, but from the circumstances in which they are placed. The county jails are in general very poor and badly managed.

Newspapers.—In 1870 there were 112 newspapers and periodicals of all classes in Texas, having an aggregate circulation of 55,250; of these, 12 were dailies, 5 tri-weeklies, 5 semi-weeklies, 89 weeklies, and 1 semi-monthly. In Jan., 1876, there were 145 newspapers, of which 20 were dailies, 1 tri-weekly, 122 weekly, and 2 monthly: 138 of the whole number are political, 4 religious, 1 temperance, 1 educational, and 1 devoted to Odd Fellowship.

Churches.

Denominations.	No. of church organizations, 1870.	No. of church edifices, 1870.	No. of sittings, 1870.	Value of church property, 1870.	No. of church organizations, 1875.	No. of church edifices, 1875.	No. of clergymen, ministers, or priests.	No. of church members or communicants, 1875.	Adherent population, 1875.	Value of church property, 1875.
All denominations	843	647	199,100	$1,035,430	2025	1724	1259	124,930	729,400	$1,779,700
Baptists (regular)	275	211	61,700	195,549	1047	853	590	59,637	298,000	427,500
Christian Connection and Disciples	18	17	4,450	11,650	30	28	19	2,216	11,000	27,400
Congregationalists	1	1	500	5,000	8	7	7	329	1,500	18,000
Protestant Episcopalians	32	31	11,400	109,400	45	38	41	2,612	12,000	168,400
Jews	1	1	400	6,000	2	2	2	210	1,000	13,000
Lutherans	23	21	7,650	47,900	43	39	22	3,427	12,000	73,100
Methodists of all kinds	355	244	69,100	251,140	687	524	391	49,293	265,000	409,800
Presbyterians (regular)	86	70	22,750	128,500	133	124	72	4,712	22,000	218,000
Presbyterians (Cumberland, etc.)	15	14	4,850	14,100	31	28	21	2,416	11,500	49,000
Roman Catholics	36	36	16,000	264,200	98	80	93	....	95,000	374,500
Union	1	1	300	1,000	1	1	1	80	400	1,000

Constitution, Courts, Representatives in Congress.—The leading provisions of the new constitution, ratified Feb. 15, 1876, are: every male citizen of the U. S. of the age of twenty-one years and upward, without distinction of race, color, or former condition of servitude, who shall have resided in the State for one year and in the county in which he offers to vote for sixty days next preceding an election, is entitled to vote, but the legislature may pass laws to exclude from office, from serving on juries, and from the right of suffrage, persons who have been convicted of bribery, perjury, forgery, or other high crimes. The governor, lieutenant-governor, treasurer, comptroller, land commissioner, and attorney-general are elected by the people for two years; the secretary of state is appointed by the governor for two years. The legislature consists of a senate and house of representatives—the senate, elected for four years, to consist of 31 members and no more; the house of representatives, of 93 members, elected for two years; the number may be increased by one additional member for every additional 15,000 inhabitants until it reaches 150. Sessions of the legislature are biennial. The judiciary consists of one supreme court of three judges, elected for six years, having appellate jurisdiction in civil cases only; of one court of appeals of three judges, elected for six years, having appellate jurisdiction in all criminal cases of whatever grade, and in all civil cases originating in the county courts and below; of 26 district courts, the judges elected for four years; of county courts for each county, the judges elected for two years; of justices' courts, not less than four nor more than eight to a county. A collector of taxes is elected for each county having over 10,000 inhabitants. Neither the State nor any county, city, or town can lend its credit to any individual, firm, or corporation, municipal or otherwise. No private corporation can be created except by general laws. Legal rate of interest, 8 per cent., but parties may agree to any rate up to 12 per cent.: beyond this is usury and punishable. No banking or discounting corporations to be created. No current wages for personal service shall ever be subject to garnishment. Wives allowed to hold property separate from their husbands. Homesteads protected from forced sale to the amount of 200 acres of land in the country, or $5000 of property in the cities. The number of members of Congress to which the State is entitled is six.

History.—The name of Texas has been said to be of Spanish origin, but recent investigations prove conclusively its Indian derivation, and that it was known to De la Salle, who landed at Matagorda Bay in 1687, and erected Fort St. Louis on the Lavaca, as the generic title of the numerous tribes of Indians who inhabited the region of Texas and Louisiana—the Caddoes, Lipans, Tonkawas, etc.—just as the name of Sioux includes numerous minor tribes of Indians at the North-west now. The colony of De la Salle was short-lived. He met with serious misfortunes in his attempt to return to the Mississippi, and was murdered by his own men near the Neches River in 1687. The garrison which he left in the fort was treacherously slaughtered by the Indians, except two men, who escaped and lived some years among the Indians, but finally fell into Spanish hands and were sent to the mines. A Spanish officer, Capt. Alonzo de Leon, was sent to the wild and unexplored country N. and E. of the Rio Grande to hunt out and expel the French. He described the territory of the Texas, but found the fort destroyed and only two guns remaining. In 1690 he established on the site of this fort the mission of San Francisco with 110 men and some friars, and soon after the mission and trading-post of Nacogdoches. Against these settlements Capt. de St. Denis, then commanding at Natchitoches, vigorously protested, claiming the country for the king of France by virtue of De la Salle's discovery and possession, and also because these Indians of the Texas were a part of the same family with those of Louisiana. His protest was unheeded, but a series of misfortunes and the hostility of the Indians led to the abandonment of the settlement. They subsequently established themselves at El Paso, and perhaps at one or two other places on the Rio Grande, but penetrated no farther for the time into Texas. In 1714, Crozat, then commanding the province of Louisiana, sent Capt. de St. Denis, a son of the one mentioned above, to effect a settlement on the Rio Grande. He was taken prisoner by the governor of Coahuila, but marrying the daughter of the commandant of the Spanish mission of San Juan, he was instrumental in introducing three Spanish missions into Texas. These were—one on the Bay of St. Bernard, the famous Mission Dolores, W. of the Sabine and near the coast, and the still more famous Alamo, near San Antonio. Not long after, a mission was again planted at Nacogdoches, and another near San Augustine, and the name of the "New Philippines" given to the country. The Spaniards retained their sway without molestation for twenty years; but in 1735, St. Denis, true to his old love, removed a French colony from the Red River into Texas, the Texas Indians aiding him in doing so. This time the Spaniards protested, but without effect. But neither French

nor Spaniards were long at peace with the Indians, and, after the massacre of the colonists at the San Saba Mission by the Indians in 1758, the missions declined. In the subsequent cession of Louisiana to Spain in 1763, its retrocession to France in 1803, and its sale to the U. S. the same year, Texas, which had an inconsiderable white population, was neglected; but after our Louisiana purchase, there came a conflict in regard to boundaries, Spain claiming lands E. of the Sabine, and the U. S. the territory W. to the Rio Grande. This difficulty was finally settled by an agreement between the Spanish general Herrera and Gen. Wilkinson, consenting to regard the territory between the Sabine and Arroyo Honda as neutral ground. The region afforded such facilities for smuggling that many adventurers engaged in it. It was a part of the projected empire of Aaron Burr, and within the next fifteen years at least eight or ten expeditions were fitted out either from the U. S. or the West Indies to take possession of it. Of these best known were those of Col. Ellis P. Bean, Lieut. Magee, Col. Kemper, Col. Perry, Xavier Mina, and Lafitte, called "the pirate of the Gulf." Galveston Island was repeatedly captured, and in the various battles several thousands on both sides lost their lives. By the treaty of 1819, in which Spain ceded Florida to the U. S., our government guarantied to Spain her possessions W. of the Sabine River. The Western adventurers were displeased with this, and in 1819, Dr. James Long headed a revolutionary expedition to Nacogdoches. This was a failure, but he led a second, and captured La Bahia, but was taken prisoner and sent to Mexico, where he was assassinated in 1822. Mexico having become independent, in 1820, Moses Austin of Connecticut obtained a grant of lands in Texas, but died before occupying it. His son, Stephen F. Austin, had the grant confirmed to him in 1823, having the year before led a large colony to what is now Austin co. His colony grew rapidly, and Austin made arrangements to bring 800 families into the settlement. The Mexican republic had, like the Spanish authorities, united Coahuila and Texas in one government, and, as Coahuila was exclusively Mexican, undertook to govern both entirely by Mexican officers. This led to gross injustice to the Texan colonists, and their dissatisfaction was increased by the overbearing conduct of the Mexican officials, who employed a band of American criminals and outlaws styling themselves "Regulators" to annoy and harass the colonists. In 1830 the Mexican president, Bustamente, prohibited colonists from the U. S. from entering Texas. The colonists now numbered over 20,000, and they resolved to separate from Coahuila. Foiled in this through the craftiness of Santa Anna, who beguiled them with promises and delayed their action till he could quietly occupy the state with his troops, there was nothing left for them but a revolution and open war. The first fighting occurred at Gonzales Oct. 2, 1835. They had already established committees of safety, and made Col. Stephen F. Austin their commander-in-chief. On Oct. 9 the Texans captured Goliad, and on the 28th the action of Concepcion occurred. On Nov. 12, 1835, a provisional government was organized, Henry Smith being chosen governor, and Gen. Austin, having resigned, was sent as a commissioner to the U. S., and Gen. Sam Houston succeeded him as commander. After being cannonaded for six days, San Antonio de Bexar was captured Dec. 10, 1835, by Gen. Houston, and the Mexican troops, over 1000 in number, who had surrendered, were sent to Mexico, and Texas was freed from an armed Mexican force. Santa Anna, enraged at the defeat of his favorite general, gathered a force of 7500 Mexican troops, and, commanding it in person, marched for San Antonio, which Gen. Houston had caused to be dismantled. The Alamo, a strong fort not far off, formerly a Spanish mission, was garrisoned by a force of 140 Texans (afterward increased to 172) under command of Col. W. B. Travis. The famous David Crockett was one of the garrison. Santa Anna invested this with a force of 4000 men, bombarded it for eleven days, and finally carried it by storm on Mar. 6, 1836, and put the whole garrison to the sword, sparing only a woman, a child, and a servant. The Mexican loss was over 1600. On the 27th he murdered Col. Fannin's command at Goliad in cold blood, after accepting their surrender. But in the mean time the Texans on Mar. 17 had held a convention, adopted a constitution, and elected David G. Burnet president of the republic of Texas. The atrocities of Santa Anna and several defeats of small bodies of Texan troops had created great alarm, and Gen. Houston retreated across the Colorado, the Brazos, and finally to San Jacinto, in order to scatter and divide the Mexican troops. Santa Anna followed closely, and at San Jacinto, on Apr. 21, was fought the decisive battle of the war, Gen. Houston with 800 troops defeating twice the number of Mexicans and taking 730 prisoners, including Santa Anna himself. (See SAN JACINTO, BATTLE OF.) This practically concluded the war of independence. Gen. Houston, who was wounded in the battle, resigned the command, and in Sept., 1836, was elected president of the republic. In Mar., 1837, the United States acknowledged the independence of Texas. For nearly ten years Texas maintained her existence as a republic—ten years of struggle, and at times of great despondency. Her population increased from 52,000 in 1836 to 150,000 in 1845. Twice she had sought to be annexed to the U. S., but her offers had been declined. When her condition became more prosperous, the U. S. under Presidents Tyler and Polk became the wooing party. Annexation was finally accomplished by the vote of Congress Dec. 27, 1845, and the acceptance of the act by the Texan people Feb. 19, 1846. The Texans claim that in these negotiations promises were made by the U. S. commissioners in regard to the harbors of Texas, the improvement of her rivers, fortifications, and coast defences, and her protection from the forays of Mexican banditti and the murderous expeditions of the Indians; which were declared to be authorized by the government, and without which annexation would have been spurned. They claim, further (Hon. Ashbel Smith, secretary of state under Pres. Jones, the last president of the Texas republic, being their advocate and spokesman), that these pledges have never been fulfilled. There seems to be no doubt that these stipulations were made with the Texan government by the late Major A. J. Donelson and ex-Gov. Yell, the commissioners of the U. S., but whether they were authorized to make such pledges is a matter of doubt. The Mexican war followed, and resulted in a clear title to the Rio Grande and the annexation of other territory. In Aug., 1850, Congress paid the State $10,000,000 in 5 per cent. bonds to relinquish a portion of her territory to New Mexico, and to give up her claims against the U. S. The State increased rapidly in population, and when the secession movement came up, though the governor, Gen. Sam Houston, was a Union man, the State followed the rest of the South in seceding from the Union. The Texan troops were among the bravest of the Confederacy. Several important battles were fought in the State, and it was the last of the Confederate States to surrender. The State was under military command till 1869, when, a new constitution having been adopted, and the other requirements of Congress complied with, it was restored to the Union by act of Congress in Mar., 1870. In Feb., 1876, the State adopted a new constitution. The people of Texas are now entering upon a career of prosperity which will speedily obliterate the prejudices of the past, and place their State in the front rank at the South-west. The rapid increase of its population since 1870, and the energetic efforts making to develop its great agricultural, mineral, and manufacturing resources, and to find ready access to the markets of the world, ensure a magnificent future.

Executive Officers of Texas.

I. *Provisional Governor before the Declaration of Independence of Mexican control.*

Henry Smith, from Nov. 12, 1835, to Mar. 18, 1836.

II. *Presidents under the Republic.*

David G. Burnet, Mar. 18, 1836–Oct. 22, 1836.
Sam Houston, Oct. 22 1836–Dec., 1838.
Mirabeau B. Lamar, Dec., 1838–Dec., 1840.
David J. Burnet (acting), Dec., 1840–Dec., 1841.
Sam Houston, Dec., 1841–Dec., 1844.
Anson Jones, Dec., 1844–Feb. 19, 1846.

III. *Governors of the State.*

J. Pinckney Henderson	1846–47
George T. Wood	[illegible]
P. Hansborough Bell	[illegible]
Edward M. Pease	[illegible]
H. G. Runnels	[illegible]
Sam Houston	[illegible]
Edward Clark (acting)	[illegible]
Francis R. Lubbock	[illegible]
Pendleton Murray	[illegible]
A. J. Hamilton, *Prov.*	[illegible]
J. W. Throckmorton	[illegible]
Edward M. Pease	[illegible]–70
Edmund J. Davis	[illegible]–74
Richard Coke	1874–[illegible]

Electoral and Popular Votes for President and Vice-President.

Year.	Candidates for whom the electoral votes of the State were cast.	Electoral votes.	Popular vote.	Opposition candidates.	Popular vote.
1848	[illegible] P. / [illegible] V. P.	[illegible]	[illegible]	Zachary Taylor, P. / Millard Fillmore, V. P.	[illegible]
1852	[illegible] P. / [illegible] V. P.	[illegible]	[illegible]	Winfield Scott, P. / Wm. A. Graham, V. P.	[illegible]
1856	[illegible] P. / [illegible] V. P.	[illegible]	[illegible]	Millard Fillmore, P. / A. J. Donelson, V. P.	[illegible]
1860	[illegible] P. / [illegible] V. P.	[illegible]	[illegible]	John Bell, P. / Edward Everett, V. P.	[illegible]
[illegible]	No vote.				
[illegible]	No vote.				
[illegible]	[illegible] Greeley, P. / [illegible] Gratz Brown, V. P.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Samuel J. Tilden, P. / Thos. A. Hendricks, V. P.	[illegible]	[illegible]	[illegible]	[illegible]

The writer acknowledges his [illegible] to His Excellency Gov. Richard Coke, [illegible] Hon. A. W. De Berry, secretary of state, [illegible] historical data to Hon. F. W. [illegible] Centennial Association, Houston, Tex. [illegible]

Tex'as, county of S. Missouri, drained by Current River and affluents of the Gasconade. Surface generally hilly, soil fertile along the streams, with large forests of yellow pine. Staples, Indian corn, wheat, tobacco, lumber, and live-stock. Cap. Houston. Area, about 1250 sq. m. P. 9618.

Texas, tp., Macon co., Ala. P. 598.

Texas, tp., Craighead co., Ark. P. 181.

Texas, tp., St. Françis co., Ark. P. 710.

Texas, tp., De Witt co., Ill. P. 1064.

Texas, v., Baltimore co., Md. P. 640.

Texas, p.-v. and tp., Kalamazoo co., Mich. P. 1109.

Texas, tp., Dent co., Mo. P. 870.

Texas, p.-v. in tp. of Mexico, Oswego co., N. Y. P. 150.

Texas, tp., Crawford co., O. P. 566.

Texas, tp., Wayne co., Pa. P. 4449.

Texas, tp., Marathon co., Wis. P. 284.

Texe'ira (PEDRO), b. in Portugal about 1570; spent several years of his youth in Portuguese India and Malacca; returned to Portugal by way of the Philippine Islands and Mexico 1600–01; went again to Goa 1603; made a voyage up the Persian Gulf, and crossed Persia and Turkey to Italy 1604. His account of this journey, *Relacion de los Reyes de Persia y Ormuz, Viage de la India Oriental hasta Italia por Tierra el año de 1604* (Antwerp, 1610), contains a compendium of Persian history, of which it was long the most accessible account. The time and place of his death are unknown.

Tex'el, the first and largest of the chain of islands which stretches along the north-eastern coast of Holland, is separated from the Helder by Marsdiep, and contains about 35,000 acres of rich meadow-land. The surface is very low, but protected by dunes and dykes against inundation. The inhabitants, numbering 6176, are mostly engaged in sheep-rearing, shipbuilding, fishing, and as pilots. The northern part of the island is called Eijerland (*Eggland*), because wild birds gather here in numberless multitudes to breed; large quantities of eggs are gathered and brought into market.

Texier' (CHARLES FÉLIX MARIE), b. at Versailles Aug. 29, 1802; studied first architecture in the School of Fine Arts in Paris; devoted himself afterward to archæology; undertook under the support of the government extensive explorations in the East between 1833 and 1843, and after his return was made inspector-general of public buildings in France and Algeria. The results of his explorations he communicated in his two magnificently illustrated works—*Description de l'Arminie, de la Perse et de la Mésopotamie* (2 vols. fol., Paris, 1842–45), and *Description de l'Asie mineure* (4 vols., 1839 *seq.*), of which he published the latter part, in connection with R. P. Pullan, simultaneously in French and English. He also wrote *Édesse et ses Monuments en Mésopotamie* (1859), and in conjunction with R. P. Pullan, *Byzantine Architecture* (1864) and *The Principal Ruins of Asia Minor* (1865).

Text'ile Fabrics. For the constituents of the various fabrics see FIBRE. For their manufacture, etc., see under the different headings of the materials. See also KNITTING, LACE, LOOM, NETS, SPINNING, WEAVING, etc.

Te'za, town of Morocco, capital of the province of Hiaena, on the river Teza at its junction with the Sebu, is the handsomest city of the country, with broad and convenient streets lined with fine buildings. It carries on a considerable trade, especially in grain. P. about 10,000.

Tezcu'co, town of Mexico, 16 miles N. E. of the City of Mexico, on the shore of Lake Tezcuco, was before the arrival of the Spaniards one of the principal seats of Mexican wealth and civilization, but it is now only a field of ruins covered with heaps of rubbish, on which a modern town has been built, having some industry. P. 5000.

Thaa'rup (THOMAS), b. in Copenhagen Aug. 21, 1749; devoted himself to literature; was for some time director of the royal theatre. D. on his estate, near Hirschholm, 1821. He was a pupil of Thomson, and his lyrical poems and dramas, which made an enormous sensation, contributed much to introduce among the Danes a taste for English poetry.

Thach'er (JAMES), M. D., b. at Barnstable, Mass., Feb. 14, 1754; studied medicine; entered the army before Boston as surgeon's mate to Dr. John Warren 1775, and served as surgeon through the war, being present at many of the principal battles, and keeping a diary, afterward published as a *Military Journal of the Revolution* (1824; 3d ed. 1854). He settled at Plymouth 1783; was a member of the Academy of Arts and Sciences, and a frequent contributor to periodicals. D. at Plymouth May 24, 1844. Author of *American New Dispensatory* (Boston, 1810), *Modern Practice of Physic* (1817), *American Orchardist* (1822), *Treatise on the Management of Bees* (1829), *American Medical Biography* (2 vols. in 1, 1828), *Essay on Demonology, etc.* (1831), *History of the Town of Plymouth* (1832), and *Observations relative to the Execution of Major John André* (1834).

Thacher (OXENBRIDGE), b. at Milton, Mass., in 1720, grandson of Rev. Peter (1651–1727), first minister of that place; graduated at Harvard 1738; studied theology, and for some time officiated as a minister, but exchanged the pulpit for the bar on account of delicate health; was a distinguished opponent of British aggressions in the Massachusetts assembly, and author of *Considerations upon reducing the Value of the Gold Coins within the Province* (1760), and of *The Sentiments of British Americans* (1764), the latter being a spirited attack upon the Navigation act. D. at Boston July 8, 1765.

Thacher (PETER), D. D., son of Oxenbridge, b. at Milton, Mass., Mar. 21, 1752; graduated at Harvard 1769; was ordained minister of Malden 1770; was an active patriot during the Revolution; wrote, at the request of the Massachusetts committee of safety, a *Narrative of the Battle of Bunker's Hill;* framed the spirited resolutions adopted by the town of Malden; was a delegate to the constitutional convention 1780, and frequently chaplain to the assembly; was famous for pulpit eloquence and colloquial powers, and was pastor of Brattle street church, Boston, from 1785 to his death, at Savannah, Ga., Dec. 16, 1802. Author of many published sermons, addresses, and essays, including *Observations on the State of the Clergy in New England* (1783) and *Memoirs of Dr. Boylston* (1789).

Thacher (SAMUEL COOPER), son of Dr. Peter (1752–1802), b. at Boston, Mass., Dec. 4, 1785; graduated at Harvard 1804; visited Europe with his friend, Rev. J. S. Buckminster, 1806; was librarian of Harvard 1808–11; ordained pastor of the New South church, Boston, as successor of Rev. Dr. Kirkland, May 15, 1811; was considered an elegant scholar and an eloquent preacher; contributed much to periodical literature; prefixed a *Life* to the *Sermons of Rev. J. S. Buckminster* (1814), and published several essays and addresses. D. of consumption at Moulins, France, Jan. 2, 1818. A volume of his *Sermons* (1824) was edited, with a *Memoir*, by Rev. F. W. P. Greenwood.—His brother, PETER OXENBRIDGE, b. at Malden Dec. 22, 1776; graduated at Harvard 1796; became a distinguished lawyer at Boston, and was municipal judge from 1823 to his death, Feb. 22, 1843. His decisions in criminal cases were esteemed high authority, and were collected and edited in 1845 by Horatio Woodman. Author of several pamphlets on legal subjects.

Thacher (THOMAS), b. at Salisbury, England, May 1, 1620, son of Rev. Peter, minister at that place; came to Boston, Mass., 1635; studied theology under Chauncey; was ordained pastor of the church at Weymouth Jan. 2, 1644; moved to Boston 1664, and practised medicine there until chosen first pastor of the Third (Old South) church Feb. 16, 1669. D. at Boston Oct. 15, 1678. He prepared a *Hebrew Lexicon* which was never printed, and his *Brief Rule, etc. in the Small Pox and Measles* (1677) is said to have been the first medical tract published in New England. He was an ancestor of all the distinguished persons of the name above mentioned.

Thacher (THOMAS ANTHONY), LL.D., b. at Hartford, Conn., Jan. 11, 1815, and graduated at Yale College, Conn. He has been professor of the Latin language in Yale College since 1842, and has published an edition of Cicero, *De Officiis*, of Madvig's *Latin Grammar*, etc.

Thack'eray (ANNE ELIZABETH), daughter of William Makepeace, b. in England about 1842; has published *The Story of Elizabeth* (1863), *The Village on the Cliff* (1867), *Old Kensington* (1873), *Toilers and Spinsters* (1873), *Bluebeard's Keys* (1874), *Miss Angel* (1876), and various miscellaneous pieces.

Thackeray (WILLIAM MAKEPEACE), b. at Calcutta, India, in 1811, son of a gentleman who held a lucrative post in the civil service of the East India Company, and descended from an ancient Yorkshire family; came to England 1818; was educated at the Charter-house School, London, and at Trinity College, Cambridge, where he was a contemporary of John M. Kemble and the brothers Tennyson, but left without taking a degree; was left an orphan in youth with a fortune estimated at £20,000; was noted from boyhood for literary, and especially for artistic, proclivities, being addicted to making humorous sketches illustrating every conceivable actual or possible episode of every-day life; travelled and studied on the Continent, especially in Italy, with a view to becoming a painter; spent a season (1830–31) at Weimar, enjoying free access to the ducal court and becoming intimate with the aged

Goethe and his brilliant circle; soon afterward made some incidental contributions to the press, but did not formally devote himself to a profession until about 1838, when, having lost most of his fortune, partly by the fault of others, partly by his own speculations, he resolved to support himself by his pen; became a correspondent of the *Times*; wrote humorous papers for the *New Monthly Magazine*, for *Fraser*, and for *Punch* over a variety of signatures, such as "Michael Angelo Titmarsh" and "The Fat Contributor;" published collections of his magazine articles with original illustrations, as *The Paris Sketch-Book, by Mr. Titmarsh* (1840), *Comic Tales and Sketches* (1841), including the *Yellowplush Papers*, *The Irish Sketch-Book* (1843), which were read with great satisfaction, but being anonymous did not at once make for him a literary reputation; visited the East in 1845, and published as the result *Notes of a Journey from Cornhill to Grand Cairo* (1846); was first recognized as a literary celebrity upon the publication of his novel *Vanity Fair*, in monthly numbers (Jan., 1847, to July, 1848); studied law, and was called to the bar May 26, 1848, but never practised; availed himself of his recently-acquired popularity to issue several small volumes made up from earlier articles, *Our Street* (1847), *The Book of Snobs* (1848), *Dr. Birch and his Young Friends* (1848), and *The History of Samuel Titmarsh and the Great Hoggarty Diamond* (1848); brought out in monthly parts (Nov., 1848, to Oct., 1850) his second novel, *The History of Pendennis*, which confirmed his already high reputation, and made him in popular estimation a rival of Dickens for the first place in modern English fiction; lectured with brilliant success on the *English Humorists of the Eighteenth Century* in London 1851, and in the U. S. 1852; published *The History of Henry Esmond* (1852), *The Newcomes* (1853–55), and *The Virginians* (1857–59), completing the series of his five really great novels; lectured in the U. S. 1855–56, and afterward in England, on *The Four Georges*; presented himself unsuccessfully as a Liberal candidate for the representation of the city of Oxford in Parliament 1857; founded the *Cornhill Magazine* (1859), in which he published his two latest novels, *Lovel the Widower* (1860–61) and *The Adventures of Philip* (1861–62), both admitted to be inferior to his earlier productions, and a series of articles collected as *Roundabout Papers* (1862), and resigned his editorship Apr. 11, 1862. D. at Kensington Palace Gardens, London, Dec. 24, 1863, being found dead in bed from effusion on the brain, and was buried in Kensal Green Cemetery. A marble bust by Marochetti has been erected to his memory in Poet's Corner, Westminster Abbey. The last years of his life were saddened by the insanity of his wife. Thackeray has been often represented as a cynic, probably on account of the keenness of his satire of human frailties, but surely without justice, as witnessed by the many noble and sympathetic creations of his genius, especially in *Esmond* and *The Newcomes*. The long-pending debate as to his merits as a novelist in comparison with Dickens can never be absolutely decided, but it may be confidently asserted that Thackeray appeals to a higher literary and artistic criterion than his great rival, and one that will probably gain in appreciation by lapse of time. He left an unfinished novel, *Denis Duval*, printed in 1867. Collected editions of his early writings appeared in the U. S. under the title *Miscellanies in Prose and Verse* (4 vols., 1855–57), and rival editions of his complete works are now published at Boston, New York, and Philadelphia. A collection of his fugitive articles was issued by James T. Fields as *Early and Late Papers* (Boston, 1867). *The Orphan of Pimlico, and other Sketches, Fragments and Drawings* (1875) was edited by his daughter. A volume of his inimitable caricatures and marginalia has since appeared as *Thackerayana* (1876). No formal biography has been written, but James Hannay, Theodore Taylor, and William B. Reed have published valuable monographs.

PORTER C. BLISS.

Thaer or **Thär** (ALBRECHT DAVID), b. at Celle, Hanover, May 14, 1752; studied medicine and natural sciences at Göttingen; was appointed court physician at Hanover in 1780; established an agricultural school at Celle in 1790; removed in 1804 to Berlin; founded the Royal School of Agriculture at Mögelin, near Potsdam, in 1807; was appointed professor of political economy and agriculture at the University of Berlin in 1810. D. at Mögelin Oct. 26, 1828. He wrote—*Einleitung zur Kenntniss der englischen Landwirthschaft* (3 vols., 1798–1804), *Ueber die [illegible] Schafzucht* (1811), *Leitfaden zur allgemeinen landwirthschaftlichen Gewerbslehre* (1816), and *Grundsätze der rationellen Landwirthschaft* (4 vols., 1809), which work has been often reprinted, and translated into English by W. Shaw and C. W. Johnson (London, 1844; New York, 1849).

Tha'is, an Athenian courtesan, as celebrated for her wit as for her beauty, accompanied Alexander the Great on his expedition into Asia, and is said to have instigated him, during a festival at Persepolis, to set fire to the palace of the Persian kings in revenge for the calamities which Xerxes had brought on her native city. After the death of Alexander, she entered into a connection with Ptolemy Lagi, king of Egypt, who is said to have married her, and to whom she bore two sons and a daughter.

Thal'berg (SIGISMUND), b. at Geneva Jan. 7, 1812, a natural son of Prince Dietrichstein; received his musical education at Vienna under the guidance of Hummel, and made his first concert-tour as a pianist in 1830; visited subsequently all the larger cities of Europe; went in 1855 to Brazil, in 1856 to the U. S., in 1863 again to Brazil. D. at his villa, near Naples, Apr. 27, 1871. His compositions for the piano, mostly consisting of *fantaisies* upon opera airs, and his two operas, *Florinda* and *Christina di Svezia*, are not of great interest, but as a performer he acquired a wide celebrity.

Tha'ler [for etymology, see DOLLAR], a coin and money of account in several European countries. The new German *Thaler* of silver is worth \$0.729. The Norwegian specie *daler* is equal to \$1.107. Denmark has a gold ten thaler piece worth \$7.861.

Tha'les [Θαλῆς], the earliest of the Greek philosophers, with justice called "the father of philosophy," b. at Miletus about 640 B. C., and d. about 550. He was of Phœnician descent, and his father's name appears to have been Examuel (perhaps *Samuel*; see *Acta Societat. Philolog. Lipsiensis*, vol. iv. p. 328 *seq.*). He was one of the Seven Sages, a practical man, an astronomer and a mathematician, as well as a philosopher. He was the first man in the Western World who placed reason above sense, looking for the ground of things in the former—*i. e.* in an abstraction. He defined his abstract, universal ground of things as *water*, being led to this, perhaps, by observing that all nourishment contained moisture. (See Aristotle, *Metaph.* A. 3.) He may be said to have been the discoverer of Material Cause, although of course he made no distinction between matter and form, or between being and becoming. Still less had he any notion of efficient or final cause, although, having observed the action of the loadstone, he affirmed (according to Diogenes Laertius) that all things were full of spirits (δαίμονες). Thales left no writings behind him, and even in Aristotle's time considerable doubt prevailed regarding his opinions. The chief sources of our knowledge respecting him are Aristotle and Diogenes Laertius. (Cf. Byk, *Die Vorsokratische Philos. der Griechen*, vol. i. pp. 25–34.) He is said by Herodotus (i. 74) to have predicted an eclipse of the sun which happened, according to Oltmanns, in B. C. 609; according to Airy (*Philosophical Transactions*, vol. cxliii. p. 179), in 585.

THOMAS DAVIDSON.

Thali'a, in Greek mythology, one of the nine Muses, presided over dramatic and idyllic poetry; later, more especially over comedy, and was generally represented with a mask in one hand and a shepherd's staff in the other.

Thal'lium [Gr. θαλλός, "young shoot"], one of the rarer elements, a metal, discovered in 1861 almost simultaneously by Lamy in France and Crookes in England, working independently of each other, by means of the spectroscope. It is characterized by a green band, which makes up *its whole spectrum*, and hence the name given by Crookes (from θαλλός, a "branch," "sprig," or "sprout"—a rather far fetched derivation).

Occurrence.—Found as a small constituent of some iron and copper pyrites found in many parts of the world, in both native and artificial sulphur, in blende and calamine, in lepidolite, in mother-liquors of saltworks at Nauheim, etc.

Preparation.—The most productive source of thallium has been from the condensed fume found in the flues of furnaces in which thalliferous pyrites is burned for the manufacture of sulphuric acid. The dust from these flues is washed with boiling water, which dissolves sulphate of thallium; muriatic acid is then added to precipitate thallous chloride, TlCl, which is nearly insoluble in cold water. The impure chloride is treated with [illegible] vitriol, and the resulting acid-sulphate fused, [illegible] water, and treated with sulphuretted hydrogen, [illegible] throw down some lead, silver, mercury, a[illegible] or bismuth, the filtrate boiled with ex[illegible] which separates iron and alumina, an[illegible] On cooling, pure sulphate of thalliu[illegible] prisms. From the solution of this [illegible] may be obtained by precipitation w[illegible] electrolysis. It deposits in brillian[illegible] needles, like those of the so-called [illegible] preserved, according to [illegible] water which has been boiled to remove t[illegible] oxygen [illegible] oxidizes almost like [illegible] and p[illegible] W[illegible]

tains the pure metal by decomposing the oxalate in a glass tube by heat, and fusing the residual metal.

Properties.—It is nearly as white as silver, with a high lustre. The densities on record, eight in number, indicate, by the geometric law of volumes of the writer (see *Am. Chemist*, Mar., 1876), four distinct allotropes, of which the densities, computed by the law for zero Centigrade, and obtained by experiment at normal temperatures, are as follows:

Computed.		
11.794	11.777	Werther.
11.825	11.81	Cast thallium, Crookes.
11.87	11.852	Lamy.
11.938	11.91	Wire, Crookes.

It is a very soft metal, easily scratched by the nail, and even softer than lead. It marks paper like lead. Like the latter, it is almost or quite destitute of elasticity, and acquires none by hammering or rolling. It is nevertheless crystalline in its internal structure, and gives, when bent, a "cry" almost equal to that of tin. It fuses about 555° F., expanding considerably. Its density in fusion has not been ascertained. It may be *welded* perfectly at the ordinary temperature by pressure, like the soft alkali-metals. Its spectrum is the simplest one known, and becomes no more complex at intense temperatures in flames, but in sparks from an induction coil, between thallium points, five more lines come out, and the photographic spectrum is by no means simple. Thallium has not been recognized in the sun. It is strongly diamagnetic, nearly as much so as bismuth, and conducts electricity about like tin and lead. At a red heat it volatilizes in the air, giving brown-colored oxidized vapor, and boils at a heat below whiteness. Hydrogen passed over the highly-heated metal carries it along in vapor, and such hydrogen, even when cool, retains enough thallium to burn with a bright-green color. It burns brilliantly in oxygen. It is attacked with some difficulty by dilute sulphuric acid, but scarcely at all by muriatic acid; by nitric acid with violence. Its salts are highly poisonous, and some of them are sensitive to light, like silver-salts, and might be used in photography, though not sensitive enough to possess any advantages. It alloys with copper to a hard, brittle, white compound; with lead, to a malleable alloy; with platinum, very readily, with evolution of great heat; with tin, to a malleable compound. Mercury readily amalgamates it, forming a crystalline mass.

Compounds of Thallium.—This metal and its compounds are as yet but curiosities of the laboratory, and for details of its compounds the chemical textbooks must be consulted. Its protochloride is with difficulty soluble, like chloride of lead. It forms also a sesquichloride in yellow crystalline scales. It forms two oxides, Tl_2O (being monatomic, like silver and the alkali-metals) and Tl_2O_3. The compound formed by thallous oxide with $H_2O_2H_2Tl_2$, called hypothetically "thallous hydrate," is soluble in water, like hydrate of baryta. Lamy made a glass containing thallous and plumbous oxides—about 7.25 per cent. of the first—which had a density of 4.233, which was more refractive, as well as denser, than any other known glass. HENRY WURTZ.

Thal'lus [Gr. θαλλός, a "shoot"], in cryptogamic botany, an expanded structure which may be regarded as a fusion into one mass of what in the higher grade of plants would be root, stem, leaves, etc.; in its simpler forms reduced to separate threads or rows of cells. The term is practically restricted to the lower orders of the Cryptogamia. See LICHENS.

Thames, a river of England, rises under the name of Isis (*Tamises*, signifying the "broad Isis," and *Isis*, signifying "water") near Cirencester, at an elevation of 376 feet above the level of the sea, and flows in an eastern direction to the North Sea. At London Bridge its width is 290 yards; at Woolwich, 490 yards; at Gravesend, 800 yards; 3 miles below Gravesend it expands into a large estuary, 6 miles broad at its mouth, at the Nore Light. Its entire course is about 250 miles, and it is navigable for vessels of 1400 tons burden up to Blackwall, 6 miles below London Bridge, and barges may ascend as far up as 200 miles from the mouth. Through a vast system of canals it communicates with the southern and western coasts.

Thames, a river of the province of Ontario, Canada, flows in a S. W. course for 160 miles, and then enters Lake St. Clair. The towns of London, Chatham, and Oxford are on this river. It is navigable by vessels of 8 or 10 feet draught to Chatham, 18 miles, but there is a troublesome bar at the mouth of the river.

Thames, a river in Connecticut, is formed at Norwich by the junction of Yantic, Shetucket, and Quinebaug rivers. It is a navigable tidal channel 14 miles long, and reaches the sea at New London, lat. 41° 18′ 58″ N., lon. 72° 5′ 4″ W.

Thames'ville, p.-v., Bothwell co., Ont., Canada, on the river Thames and on Great Western Railway, 50 miles S. W. of London, has a weekly newspaper, and was formerly called *Tecumseh*. P. about 500.

Thanatophid'ia [from θάνατος, "death," and *Ophidia*, from ὄφις, a "serpent"], a name given to those ophidians or serpents provided with poison-glands and fangs, and thereby capable to a greater or less degree of inflicting deadly wounds. The group, however, is rather a physiological than a morphological one, and embraces forms differing widely in structure. The only common and at the same time exclusive character, indeed, is the possession of poison-fangs, and some or other teeth channelled or hollowed to serve as ducts and media of ejection. Exclusive of some suspicious colubrids, the true poisonous snakes belong to seven families, which may be grouped under two primary divisions—viz. (1) Solenoglypha, comprising the families Crotalidæ, Viperidæ, Causidæ, and Atractaspididæ; and (2) Proteroglypha, embracing the families Najidæ, Elapidæ, and Hydrophidæ. THEODORE GILL.

Thane [Ang.-Sax. *thegen*, a "servant"], in English history, was the title among the Anglo-Saxons and early Normans of certain military tenants and freeholders in the king's service. Subsequently classed with the barons, the title of the thanes disappears in Henry II.'s time, and doubtless the descendants of the more powerful became nobles, while the less wealthy as a rule seem to have become heads of gentle but not noble families. In Scotland the thanes were a class of non-military tenants of the Crown. The opinion that the Scottish title *thane* was equivalent to *earl* is entirely erroneous.

Than'et, Isle of, is the north-eastern extremity of the county of Kent, England, separated from the mainland by the branches of the river Stour, and comprising an area of 26,500 acres, with about 40,000 inhabitants. The ground is elevated, the surface level, and the soil fertile though light. It contains three fashionable watering-places—Ramsgate, Margate, and Broadstairs.

Thanks'giving Day, an annual religious festival in the U. S., celebrated in New England from the first settlement by the Pilgrims, and long peculiar to the Northern States of the Union, but which in recent times has extended to nearly all the States, and has become a national institution since 1862. The day, which is usually the fourth Thursday of November, is designated by a proclamation signed by the governor or the President.

Thann, town of the German empire, province of Alsace, has a fine church of the fifteenth century with an elegant spire of open-work, and large manufactures of cotton and linen fabrics, chemicals, machinery, dyestuffs, and leather. P. 8854.

Tha'sos, an island in the Ægean Sea, 30 miles N. E. of Mount Athos, belongs to Turkey, and comprises an area of 85 sq. m., with about 6000 inhabitants. It is high, mountainous, covered with wood, but not very fertile. Timber, honey, marble, and oil are exported.

Thatch'er (BENJAMIN BUSSEY), b. at Warren, Me., Oct. 8, 1809; graduated at Bowdoin College 1826; became a lawyer at Boston; was a frequent writer for the press, especially during two years' travel and residence in Europe 1836–38. D. at Boston July 14, 1848. Author of *Indian Biography* (New York, 2 vols., 1832), *The Boston Tea-Party* (1835), *Tales of the American Revolution* (1846), and other publications; edited the *Boston Book* (1837); contributed eight articles to the *North American Review*, and left in MS. an account of his travels in Europe.

Thatcher (HENRY KNOX), b. May 26, 1806, in Maine; entered the navy as a midshipman Mar. 4, 1823; became a lieutenant in 1833, commander in 1855, commodore in 1862, rear-admiral in 1866; retired in 1868. Commanded the first division of Porter's fleet in both the Fort Fisher fights, and the West Gulf squadron during the bombardment of Fort Alexis and Spanish Fort in Apr., 1865, just prior to their being stormed and carried by the army, their surrender being immediately followed by that of the city of Mobile. In his official report of Jan. 28, 1865, Rear-Admiral Porter says: "Commodore Thatcher's ship, the Colorado, was handled with admirable skill. There is no reward too great for this gallant officer; he has shown the kind of ability naval leaders should possess, a love of fighting and invincible courage." D. Apr. 5, 1880.
FOXHALL A. PARKER.

Thaumaturgus, St. Gregory. See GREGORY THAUMATURGUS.

Thay'er, county of S. E. Nebraska, formed since the census of 1870; intersected by Little Blue and Big Sandy rivers, and crossed in its N. part by St. Joseph and Denver City R. R.; soil fertile. Cap. Hebron. Area, 576 sq. m.

Thayer, p.-v., Neosho co., Kan., on Leavenworth Lawrence and Galveston R. R., has an excellent school system, 1 bank, 1 newspaper, rich coal-deposits, 3 dry-goods houses, and a Masonic hall. P. about 500.

C. T. Ewing, Ed. "Head Light."

Thayer (John Milton), b. at Bellingham, Mass., Jan. 24, 1820; graduated at Brown University; studied law and came to the bar; went to Nebraska, where he became brigadier-general of militia and member of the Territorial legislature; in Mar., 1863, was appointed brigadier general of volunteers for services at Fort Donelson and Shiloh; Senator from Nebraska for the term ending 1871, and was appointed governor of Wyoming 1875.

Thayer (Joseph Henry), D. D., b. in Boston, Mass., Nov. 7, 1828; graduated at Harvard in 1850, and at Andover in 1857; supplied the Evangelical Congregational Church in Quincy, Mass., one year; was settled over the Crombie street church in Salem, Mass., Dec. 29, 1859; was chaplain of the 40th Massachusetts Vols., nine months, from Sept., 1862; and was dismissed from his pastorate in Feb., 1864, to accept the associate professorship of sacred literature in Andover Theological Seminary, which position he still (1876) holds. Besides occasional sermons, review articles, and contributions to the American edition of Smith's *Bible Dictionary*, he has published a translation of the 7th German ed. of Winer's *New Testament Grammar*, on the basis of Masson's English translation of the 6th ed. (1869), and a translation of Alex. Buttmann's *New Testament Grammar* (1873). He received the title of D. D. from Yale College in 1873.

R. D. Hitchcock.

Thayer (Lorenzo Rockwood), D. D., b. at Winchester, N. H., Dec. 2, 1814; graduated at Wesleyan University 1841; has held important pastorates in the Methodist Episcopal Church, and was one of the trustees of Harvard University 1857–69.

Thayer (Simeon), b. at Mendon, Mass., Apr. 30, 1737; removed to Rhode Island in youth; served in Rogers's Rangers in the French war, in Arnold's expedition against Quebec, where taken prisoner 1775–76; distinguished for gallantry at Red Bank and at Fort Mifflin, for which he received a sword from the Rhode Island legislature. D. at Cumberland, R. I., Oct. 14, 1800. His *Journal of the Invasion of Canada* was edited by E. M. Stone in 1867.

Thayer (Sylvanus), b. at Braintree, Mass., June 9, 1785; received a classical education at Dartmouth College, and Feb. 23, 1808, graduated, after an eleven months' course, at the U. S. Military Academy, and promoted to a second lieutenancy of engineers. After some service in the defences of the eastern coast and of New York harbor, he was called to the field in 1812, and was chief engineer to Gen. Dearborn on the Niagara frontier; of the right division of the Northern army under Gen. Hampton on Lake Champlain line of operations in 1813; of Gen. Moses Porter's troops in the defence of Norfolk, Va., in 1814, where he was brevetted major Feb. 20, 1815. Subsequently ordered for professional duty to Europe, he had opportunities of witnessing the operations of the allied armies before Paris, and of studying the military works and schools of France, the Netherlands, etc., and examining the battlefields and theatres of war. In after life there was probably no other living man (save perhaps Jomini) so thoroughly and minutely acquainted with the campaigns of Napoleon. In July, 1819, he was selected as superintendent of the Military Academy, which office he filled for fifteen years, during which time that institution was organized upon its present basis, and under his administration became one of the most thorough, comprehensive, and successful of the military educational institutions of the world. (See Military Academies.) On being relieved from the superintendency July 1, 1833, he was charged with the construction of the fortifications of Boston harbor, upon which, in union with his duties as president of the "board of engineers for permanent fortifications," he was engaged during the remainder of his term of active service. During a period embracing parts of 1857 and 1858 he was in command of the corps of engineers, exercising the functions of chief engineer of the U. S. Consistently with long maintained views on this point, he declined to transfer his headquarters to Washington, and on his own application was placed on leave of absence. He so remained till July 1, 1863, when he was placed on the retired list with the rank of colonel. Previous to his death he had founded at Dartmouth College the Thayer School of Civil Engineering. He had also bestowed the sum of $10,000 upon the town of Braintree for the establishing of a public library; and in his will ("desirous of promoting the cause of education according to my ability, and of benefiting the town of Braintree, the place of my birth"), he bequeathed a large sum in trust (estimated at about $260,000) for a free school, limited to scholars who "shall have been born in Quincy, Braintree, or Randolph." The secretary of war, in announcing his death in orders, said: "The great worth and services of this veteran soldier are gratefully remembered by the graduates of the Military Academy, of which he is justly styled 'the Father,' and his name will be entwined with the laurels which many of them have gained on the battle-field." D. at South Braintree Sept. 7, 1872.

J. G. Barnard.

Thayer (Thomas Baldwin), D. D., b. at Boston, Mass., Sept. 10, 1812, and educated in that city; was ordained Dec. 5, 1832, and was pastor in Lowell, Mass., from 1833 to 1845, then from 1845 to 1851 in Brooklyn, N. Y.; in 1851 returned to Lowell until 1857; from 1857 to 1867 was pastor at Boston, Mass. He is editor of *The Universalist Quarterly*, and has been one of the board of overseers of Harvard College, Mass. He has published *Christianity against Infidelity*, the *Theology of Universalism*, etc.

Thayer (William Makepeace), D. D., b. at Franklin, Mass., in 1820; graduated at Brown University 1843; was pastor of a Congregational church at Ashland, Mass., 1849–68; subsequently returned to Franklin. Author of numerous juvenile works, including a series of biographies and a *Youth's History of the Rebellion* (4 vols., 1864–66); editor of the *Home Monthly* and the *Mother's Assistant*, and contributor to the *Puritan Recorder* and the *Congregationalist*.

The'atines [named from the bishop of *Theate*, afterward Pope Paul IV.], a Roman Catholic order of regular clerks and nuns, founded in 1524 by the bishop of Theate and several of his friends. They spread into various countries, opposed Protestantism, and labored for the reform of the clergy and the extension of the Oriental missions. They are now almost entirely confined to Italy. There were two bodies of Theatine nuns, those of the Congregation and those of the Hermitage, both extinct.

Theatres, Laws as to. In the old English law, whether common or statutory, playhouses were controlled by very stringent rules. Strolling actors, like mountebanks who travelled about the country exhibiting themselves without a license, were classed among vagrants. Although a playhouse erected in a city or town was not a nuisance *per se*, it might become such if it occasioned a disturbance in its neighborhood or if the performances therein were considered as injurious to good morals. At a very early day a special license from the lord chamberlain appears to have been requisite in order to open and maintain a theatre in any important city or town, while in smaller country places the license was granted by the local courts called the quarter or general sessions. Particular companies of actors, however, were often maintained by the king, who probably performed by virtue of his license, and for whom he sometimes made the selection of plays, as was frequently the case during the reign of Queen Elizabeth. In the process of time, as actors began to rely more upon the general support of the public than the private patronage of king and nobility, the jurisdiction over them, over the licensing and regulation of theatres, and over the production of plays became at length exclusively settled in the lord chamberlain. No new play or addition to an old one could be enacted unless it had first been submitted to the lord chamberlain for his examination, and had received his license. This peculiar function, which for a long time was freely exercised, still exists in England, although the license is granted almost as a matter of course, unless the substance of the play or its mode of acting should be personally libellous or grossly immoral. In the various States of the U. S. the authority to license and to regulate theatres has been almost exclusively left to the municipal corporations as a part of their local government. New York, and perhaps some other States containing great cities, have placed upon their statute-books some prohibitory legislation against certain classes of theatres which are grossly outrageous to public decency and exceedingly corrupting to the morals of the young. With these few exceptions, the law has seldom interfered further than to require a license and to demand payment of the fee.

John Norton Pomeroy.

The'baine, or **Paramorphine** ($C_{19}H_{21}NO_3$), an organic base contained in Opium (which see). It was discovered in 1835 by Pelletier. In its preparation [illegible] tract of the opium is treated with an ex[illegible] lime, and the resulting precipitate wa[illegible] dried, and then digested with hot [illegible] evaporation deposits a residue from w[illegible] extracted by ether. Thebaine crys[illegible] possessing a silvery lustre, and [illegible] It is highly poisonous, produ[illegible] insoluble in water, but [illegible] zene, and in chloroform [illegible] deep red by concentrate[illegible] thebaine do not crystal[illegible]

[illegible] Battershall.

Thebes, the *Diospolis* of the Greeks, the *No* or *No-Ammon* of Scripture, was for a long time the capital of Egypt, and was regarded by the ancients as the oldest city of the world. It stood in Upper Egypt, in lat. 25° 41′ N., on both sides of the Nile, and covered the whole plain between the two mountain-chains which enclose the valley of the Nile, being 3 miles broad and 5½ miles long. It was one of the largest and most magnificent cities which has ever been built; but when Lower Egypt began to rise and Memphis became the seat of the government, it began to decline. In 525 B. C. Cambyses conquered and sacked it, and in 86 B. C. Ptolemy Lathyrus pillaged it and left it in ruins. These ruins, however, are most stupendous, and give evidence of an art gigantic in its dimensions, sublime in its beauty, and most admirable in its skill; the celebrated head in the British Museum known under the name of the Young Memnon, and the famous obelisk which adorns the Place de la Concorde in Paris, are both taken from the ruins of Thebes. The western part of the city seems to have consisted mostly of a number of palaces and temples rising in terraces from the bank of the Nile, connected with each other by magnificent flights of steps and avenues of colossal sphinxes, and leading to the necropolis of the city, rows and tiers of sepulchres and gorgeous mausoleums in which the mummies were deposited, and which, hewn into the natural rock, cover for miles the side of the mountains which separate the valley from the Libyan desert. Among the most conspicuous remnants of this part of the city are the two Memnon statues, 60 feet high, of which the one is preserved almost entire, and is much spoken of as the singing Memnon on account of the sound it emitted at sunrise. The eastern part seems to have contained the bulk of the population, but it also contained the palace of Luxor and the temple of Karnak, the main hall of which is 329 feet long, 179 feet broad, and 80 feet high, the roof of the central part of the hall resting on 10 columns 66 feet high and 11 feet in diameter, and that of the other parts on 122 columns of less gigantic dimensions (42 feet high, 9 feet in diameter), and of the most exquisite workmanship.

Thebes, town of Greece, is regularly laid out and well built. It has about 5000 inhabitants, and is celebrated for the excellent meerschaum which is dug on the adjacent Sphinx Mountain.

The ancient Thebes occupied the same site as the modern town, and was one of the most famous and most magnificent cities of Greece. It stood at the head of the confederacy of the Bœotian cities, and was always striving to get the supremacy in Greece. It fought Athens, but without success. But when the Spartans, after the Peloponnesian war, became supreme in Greece, it was Thebes which checked them. After the decisive victory of Leuctra in 371, and as long as Epaminondas lived, Thebes was the leading city of Greece, but in her wars with Philip of Macedon she was unfortunate, and was compelled to receive a Macedonian garrison within her walls. On the death of Philip she expelled the foreign garrison, and called on all Greece to fight for its independence. But she thereby excited the anger of the young Alexander to such a degree that, with the exception of the temples and the house of Pindar, he razed the whole city to the ground and sold the inhabitants into slavery. It was rebuilt by Cassander, but did not prosper.

Thebes, tp., Alexander co., Ill. P. 473.

Thecodon'tia [Gr. θήκη, "case," and ὀδούς, "tooth"], a name formerly employed by Owen, as well as Cope, for certain reptiles now referred to the order of Crocodilians, and based primarily on the genus *Belodon* of the "keuper beds" of Würtemberg. By Cope it was characterized by having "limbs ambulatory: *a third trochanter on femur;* sacrum of two or three vertebræ; acetabulum entire; *pubes united;* ribs double-headed; *external nostrils posterior;* zygapophyses only, and chevron bones (*sic*)." (Cope, *Trans. Am. Phil. Soc.*, vol. xiv. p. 32.) The italicized parts of the diagnosis exhibit the peculiarities in contrast with the living crocodiles. THEODORE GILL.

Thecomed'usæ [from θήκη, "case," and *medusa*, a general name for acalephs], an order of acalephs recently instituted by Prof. Allman for a very small form occurring in the efferent orifices of certain horny sponges at slight depths off the southern coasts of France. It is a compound form "whose zooids are included in cup-like receptacles resembling the hydrothecæ of the calyptoblastic hydroids; but these zooids, instead of being constructed like the hydranths of a hydroid, are formed on the plan of a medusa. It has plainly very decided affinities with the Hydroida, but is nevertheless removed from these by a distance at least as great as that which separates from them the Siphonophora." For this new form—at once the type of a new family (Stephanoscyphidæ) and order (as above)—the name *Stephanoscyphus mirabilis* has been proposed. (Consult *Nature*, vol. x. p. 251, July 30, 1874.)

THEODORE GILL.

The Dalles, p.-v. and cap. of Wasco co., Or., has a weekly newspaper.

Thedford, Canada. See WIDDER STATION.

Theed (WILLIAM), b. at Trentham, England, in 1804; educated at Ealing, and became eminent as a sculptor. Among his works are several marble and bronze statues of Prince Albert, statues of Sir Isaac Newton, Edmund Burke, Hallam, Mackintosh, Sir Robert and Sir William Peel.

Theft. See LARCENY, by PROF. GEORGE CHASE.

The Gold Mines, tp., Franklin co., N. C. P. 932.

The'ine ($C_8H_{10}N_4O_2.H_2O$), the alkaloid of tea and coffee. (See CAFFEINE, and TEA, PHYSIOLOGICAL RELATIONS OF.)

Thei'ner (AUGUSTIN), b. at Breslau, Prussian Silesia, Apr. 11, 1804; studied theology, philosophy, and jurisprudence at the university of his native city; obtained the degree of *doctor juris* at the University of Halle for his *Commentatio de Romanorum Pontificum Epistolarum Decretalium Collectionibus antiquis* (1829); travelled with the support of the Prussian government to Vienna, Paris, and London; settled in 1831 in Rome, and was in 1851 appointed keeper of the secret archives of the Vatican. D. at Cività Vecchia Aug. 9, 1874. He held originally quite liberal views of the relation between the papal see and the Roman Catholic Church; he assisted his brother in the publication of *Die Einführung der erzwungenen Ehelosigkeit bei den christlichen Geistlichen und ihre Folgen* (2 vols., 1828). But during his residence in Rome he attached himself more and more closely to the Ultramontane party, and developed an astonishing literary activity in its service. Besides a number of minor essays and pamphlets, historical, critical, and polemical, he wrote—*Geschichte der geistlichen Bildungsanstalten* (1835), *Disquisitiones in præcipuas Canonum et Decretalium Collectiones* (1836), *Versuche und Bemühungen des Heiligen Stuhls in den letzten drei Jahrhunderten, die durch Ketzerei und Schisma von ihm getrennten Völker des Nordens wiederum mit der Kirche zu vereinen; nach geheimen Staatspapieren* (1837), *Die neuesten Zustände der katholischen Kirche beider Ritus in Polen und Russland seit Katharina II.* (1841), *Geschichte der Zurückkehr der regierenden Häuser zu Braunschweig und Sachsen in den Schoss der katholischen Kirche* (1843), *Die Staatskirche Russlands im Jahre 1839* (1844), *Le cinque Piaghe della S. Chiesa* (1849), *Zustände der katholischen Kirche in Schlesien von 1740–58* (2 vols., 1852), *Geschichte des Pontificats Clemens XIV.* (2 vols., 1852), *La Souveraineté temporelle du Saint-Siège* (1861), etc. But his principal works are his new edition and continuation of Baronius's *Annales Ecclesiastici*, and his publications of documents relating to the history of the Church among various nations—*Documents inédits relatifs aux Affaires religieuses de la France 1750–1800* (2 vols., 1858), *Vetera Monumenta Hungariam sacram illustrantia* (2 vols., 1859), *Monuments historiques relatifs aux Règnes d'Alexis Michaëlowitsch, Theodor III. et Pierre le Grande de Russie* (1859), *Vetera Monumenta Poloniæ Gentiumque Finitimarum Historiam illustrantia* (4 vols., 1860–64), *Codex diplomaticus Dominii temporalis Sanctæ Sedis* (3 vols., 1862), *Vetera Monumenta Slavorum meridionalium Historiam illustrantia* (1863), and *Vetera Monumenta Hibernorum et Scotorum Historia illustrantia* (1864).—His elder brother, JOHANN ANTON THEINER, b. at Breslau Dec. 15, 1799, was appointed professor of scriptural exegesis in 1824; became a pastor in 1830; resigned his office in 1845, and joined the German Catholics; lived as a private teacher in Breslau, and was appointed secretary of the library of the university in 1855. D. May 15, 1860. He wrote, besides the above-mentioned work on celibacy, *Die reformatorischen Bestrebungen in der katholischen Kirche* (1845), *Das Seligkeitsdogma der römisch-katholischen Kirche* (1847), *Acts of the Council of Trent* (2 vols., 1866), etc.

The'ism [Gr. Θεός, "God"] is distinguished from pantheism by the relation which it establishes between God and the world, and from deism by the relation which it establishes between God and man. To the pantheist, God and the world are one and the same, even though his idea of the divine may approach very near to that of a free personality; while to the theist, God is not only an existence, with all the attributes of personality, but also absolutely independent of the world. In the abstract the deist's idea of God may be very similar to that of the theist, but as he rejects the doctrine of God's revelation to man, he denies that whole series of relations between God and man which to the theist results from that very doctrine. (See PANTHEISM, by DR. KRAUTH, and FREE-THINKERS, by O. B. FROTHINGHAM.)

Theiss, a river of Hungary, is formed by the junction of the Black and White Theiss, both of which rise in the Carpathian Mountains, and flows with a winding southern course to the Danube, which it joins 22 miles E. of Peterwardein. Its entire length is 828 miles, for the greatest part of which it is navigable even for large vessels. After entering the Hungarian plain, its breadth is from 400 to 800 feet, its shores are low and marshy, and its current is sluggish. It is rich in fish, especially sturgeon.

Thel'wall (JOHN), b. in London, England, July 27, 1764; was for a short time apprenticed to a tailor; studied law for several years, but from conscientious scruples did not apply for admission to the bar; went through an extensive course of private study in literature, metaphysics, and theology; afterward pursued anatomy, physiology, and chemistry; devoted himself to literature and politics; edited a magazine for some time; became a prominent orator in the societies favoring the French revolution; was thrown into the Tower, tried for treason, and acquitted along with John Horne Tooke and Thomas Hardy 1794; lectured on politics and political history for several years; began his career as a teacher of elocution 1801, meeting with great success in curing stammering and other defects of utterance, and communicated papers on that subject to medical and other journals, in which he anticipated some of Dr. Rush's leading principles. D. at Bath Feb. 17, 1834. Author of *Poems on Several Subjects* (2 vols., 1787), *Poems written in the Tower and in Newgate* (1795), *The Tribune* (3 vols., 1796), *Political Miscellanies*, *The Peripatetic* (3 vols., 1793), a novel entitled *The Daughter of Adoption*, and other publications. His *Life* was published by his widow (1837).

The'mis, a daughter of Uranus and Ge, the wife of Zeus, and mother to the Horæ, Eunomia, Dice, Eirene, the Mœræ, the Hesperides, etc., lived in Olympus on good terms with Hera, and held the office of convening the assembly of the gods. She represented the order of things, such as it was established by law, custom, and equity, and was imagined to preside over the assemblies of men. She was worshipped at Thebes, Olympia, Athens, Tanagra, and Trœzene, and was generally represented as resembling Athena, but having in her hands a horn of plenty and a pair of scales.

Themis'tocles, b. at Athens about 514 B. C., the son of Neocles, who occupied no prominent social position, and a foreign—that is, not Athenian—woman; became the political leader of Athens after the expulsion of Aristides by ostracism in 483. He was impetuous and shrewd; sagacious in his judgment of actual circumstances and their probable consequences; swift in arriving at a resolution; inexhaustible in devices for the realization of his plans; possessed of a most impressive eloquence; energetic, cunning, and unscrupulous. But the foundation of his character is very obscure. His actions show a blending of rank ambition and lofty statesmanship; of egotism sometimes even sordid, and an elevation of mind truly noble, which simply becomes the more inexplicable the better known his ways and means become. Nevertheless, in a most decisive crisis he was the saviour of Athens—yea, of Greece. After the battle of Marathon (490) people generally believed that the Persian war was ended. Themistocles, however, felt that a still heavier storm was coming, and he understood that a strong fleet would be the most effective means of victory, and the only safe means of rescue in case of defeat. Thus, the development of the Athenian navy became the goal of his policy. He induced his countrymen to spend the income of the silver-mines of Laurium, which had hitherto been distributed among the citizens, in the organization of a powerful fleet. He carried a law that twenty new triremes should be built every year. He procured, when the armament of Xerxes was heard of, and the whole of Greece became alarmed, an oracle from Delphi saying that Athens should defend herself by wooden walls—that is, by her fleet; and when, finally, the pass of Thermopylæ was forced, when the battle off Artemisium, in which he consented to fight under the Spartan commander, though the number of the Athenian ships was the greatest, had proved ineffective, and the Persian hosts streamed down over Bœotia and Attica, he persuaded the Athenians to leave their city to the protection of its tutelary deities, to bring their women and children in safety to the island of Salamis, and to go on board the fleet. In the Bay of Salamis the entire Greek fleet lay assembled; but various opinions prevailed in the council whether to give battle here or at the isthmus, whether to give battle at all, or to separate, etc. It was Themistocles who held the fleet together by declaring that if the Greeks now separated the Athenians would leave Greece for ever, take their women and children, and set sail for Italy—a plan as sound as grand, and one which he no doubt was able to carry out. It was also he who finally compelled the Greeks to give battle by entering into negotiations with the Persian commander and hastening the approach of the Persian fleet. The Greeks were surrounded without knowing it, escape was impossible; fight had become a necessity. During the night Themistocles rowed from the Athenian division of the fleet to the Spartan, from the Spartan to the Corinthian, etc., busy to the last. In Salamis the women and children of Athens watched in prayer; on the opposite coast of the mainland carpenters were raising a throne from which Xerxes would look at the battle. In the morning (Sept. 20, 480) the Persian fleet stood up the narrow sound; the battle began, and it terminated in a most glorious victory for the Greeks. Themistocles was now the first man, not only in Athens but in Greece; when visiting Sparta, he was presented with the best chariot the nation possessed, and accompanied to the borders of Tegea by a guard of 300 horsemen—honors unheard of hitherto. To his native city he did one more great service. When, after the battle of Salamis, the Athenians began to rebuild their city, Sparta, from sheer jealousy, dissuaded them from rebuilding the fortifications, and even threatened them with an armed interference. Themistocles hastened to Sparta, bribed the ephori, deluded the assembly of the elders by lies and dissimulations, deceived the whole community, and kept the question floating and undecided until it became superfluous, the walls not only of Athens, but also of Piræus, having reached a sufficient height to be defended with effect. Then he returned home, loaded with the hatred of all Spartans. But soon after this event he disappears from public life. The last part of his history, that which follows after the rebuilding of Athens, is as obscure and confused as the first, that which precedes the expulsion of Aristides. He was accused of treasonable connections with the Persians, but acquitted; then ostracised in 471, exiled to Argos, and again accused of treason by the Spartans; an order to arrest him was issued, and he fled from Argos to Corcyra, Thrace, Ephesus, and arrived finally at Susa, the residence of the Persian king, in a covered carriage, such as was generally used to convey women to the royal harem. At the Persian court there was a party, headed by the widow of Xerxes, which demanded his execution immediately; but Themistocles understood how to impress the reigning monarch, Artaxerxes, so favorably that he was not only left unmolested, but received rich dotations and acquired considerable influence. Deeply implicated in the Persian plans for the subjugation of Greece, he d. suddenly at Magnesia in Asia Minor in 449 B. C.

CLEMENS PETERSEN.

Thénard' (LOUIS JACQUES), b. at La Louptière, Champagne, France, May 4, 1777; studied chemistry at Paris; became teacher in the École Polytechnique in 1798, professor at the Collége de France in 1804; was created a baron in 1821 and a peer of France in 1832. D. at Paris June 21, 1857. Besides a number of minor essays in *Annales de Chimie* and other scientific periodicals, he wrote *Traité élémentaire de Chimie théorique et pratique* (4 vols., 1813–16), which has been often reprinted, and translated into several foreign languages; and, in connection with his intimate friend, Gay Lussac, *Physico-chemical Researches made with the Voltaic Pile* (2 vols., 1811).

Thenard's Blue. See BLUE and COBALT.

Theo'bald (LEWIS), b. at Sittingbourne, Kent, England, about 1690; educated at Isleworth, and became a lawyer, but devoted himself chiefly to literature; published *Electra, a Tragedy* (1714), *A Critical Discourse on Homer's Iliad* (1714), *A Translation of the First Book of the Odyssey* (1716), *The Censor*, a periodical (1717), *Memoirs of Sir Walter Raleigh* (1719), *The Double Falsehood* (1720), a play which he attributed to Shakspeare, and some 20 other plays, none of which had much success or are now remembered. He is chiefly known as a Shakspearian editor, having published *Shakspeare Restored, or Specimens of Blunders [illegible] in Pope's [illegible] of this Poet* (1726), which brought upon him the wrath of Pope, and procured him the post of hero of the first edition of the *Dunciad* (1729), and in 17[illegible] issued an edition of Shakspeare (7 vols.), which completely super[illegible] of Pope. His emendations were few in number [illegible] with great care, and are acknowledged [illegible] ment, having been reproduced without [illegible] by many subsequent editors. D. in Se[illegible]

Theobroma. See BYTTNERIACE[illegible] THEOBROMINE.

Theobro'mine [Gr. Θεός, "G[illegible] $C_7H_8N_4O_2$, an organic base [illegible] therefore in chocolate. It [illegible] with warm water, adding [illegible] strained solution, con[illegible] hydrogen through th[illegible] evaporating the second [illegible] an [illegible]

alcohol. It may be further purified by heating between two watch-glasses, when it is obtained as a dazzling white sublimate. Theobromine is a colorless crystalline powder, but sparingly soluble in boiling water, and still less so in alcohol and in ether. It has a bitter taste, and gives crystalline salts with several of the acids. Upon heating argentic theobromide with iodide of methyl, CAFFEINE (which see) and argentic iodide are produced, which reaction is deemed by some to prove that caffeine is a methyl compound of theobromine, and not a true homologue thereof, as might be supposed from its formula.

J. P. BATTERSHALL.

Theoc'ritus, b. at Syracuse in the beginning of the third century B. C.; resided for some time in Alexandria, where he enjoyed the friendship of the poet Aratus and the favor of the king, Ptolemy Philadelphus, but returned afterward to Syracuse, and lived at the court of King Hiero II. He is the originator of the so-called pastoral or bucolic poetry. Besides 22 epigrams, 30 idyls by him have come down to us. These idyls give pictures of the every-day life of the Sicilian peasantry, and some of them have in this respect a very great interest; thus, the 21st idyl contains the only representation we possess of the life of the Greek fishermen. Their character is often erotic, sometimes tragical, sometimes humorous, even satirical, and their form ranges from that of an Anacreontic song to that of a Sophronian mime. Theocritus, however, is not only the originator of this genre of poetry, but also one of its best representatives. His delineation and sentiment are simpler, sounder, and more veracious than those of many later productions of the kind. Yet his idyls bear ample evidence of having been written at the court, and not in the field. They are not the genuine outbursts of the fisherman, the shepherd, the farmer's boy, etc., but a picture only in which a man finds comfort after being tired out by the intrigues of the court and the clamors of the philosophical school. The best editions are by Ahrens (Leipsic, 1855), Meineke (Berlin, 1856), Paley (Cambridge, 1869), and Fritsche (Leipsic, 1865). English translations by Creech (1681), Fawkes (1767), Polwhele (1786), Chapman (1836), and Calverly (1869).

Theodolite. See HYPSOMETRY, by C. A. SCHOTT, M. N. A. S.

Theodo'ra, b. in the island of Cyprus in A. D. 508, the daughter of one Acacius, who took care of the wild beasts of the green faction in Constantinople; became a pantomimic dancer after the death of her father, and was soon as notorious for her licentiousness as celebrated for her talent. Having gone through many adventures, she happened to attract the attention of the young prince Justinian, and by degrees she acquired so firm a hold on his passions that he married her in 525, and when he ascended the throne in 527 proclaimed her empress, and required all public functionaries to take the oath of allegiance not only in his own, but also in her name. She was a spirited and determined character, and the Byzantine historians generally agree in ascribing to her a considerable influence both on the emperor and on the government, even in ecclesiastical matters. At all events, her influence on the legislation of Justinian concerning the theatres is very apparent. At that time the theatrical manager was generally the owner of the members of his troop. They were perhaps not exactly his slaves, but he had bought them while children of their parents or guardians, perhaps for considerable sums; he had had them educated and trained them, and they were now legally bound to repay him by their services through a number of years. Thus, an illustrious actor whose name was known in every corner of the Mediterranean countries, and whose art brought in large sums every night, might be himself not only a poor man, but subjected to the most barbarous and humiliating treatment from a manager from whom he perhaps could not get loose until he drifted away an old, broken down, valueless wretch. Still worse, the managers generally traded in the charms of their actresses, and when Theodora accompanied Ecebolus in great state to Pentapolis as his concubine, and soon after returned barefooted to Constantinople, she had perhaps learned that Ecebolus had made two bargains—one with her and one with her manager. All this was completely changed by the legislation of Justinian, and even the force of contracts already existing was broken by a law which determined that an actor who became a Christian, and felt his conscience hurt by his profession, could not be compelled to go upon the stage again. But after the enactment of such laws it became impossible for the managers to keep a troop together, and in the theatres, where once the free citizens had performed their tragedies and comedies to the honor of their gods, where afterward a number of speculating managers had exhibited the skill and the charms of their slave-troops to the appetite of the rabble, the stage now became silent and empty after the time of Theodora. D. at Constantinople in 548.

CLEMENS PETERSEN.

Theodore, king of Abyssinia. See ABYSSINIA, by A. J. SCHEM.

Theodore'tus, b. about A. D. 393 at Antiochia, the only son of rich and influential parents; entered when only seven years old a monastery in his native city, and was in 420 elected bishop of Cyrus, or Cyrrhys on the Euphrates, where he d. in 457. In the discharge of his diocesan duties he was eminently successful, bringing back by his eloquence and power of persuasion numbers of heretics to the Catholic Church. At last, however, he himself was accused of heresy. He had a strong sympathy for Nestorius, and in 449 he was even deposed from his see by the synod of Ephesus, though he was reinstated by the synod of Chalcedon in 451. Of his works, comprising a history of heresies, a dialogue against Eutychianism, commentaries, etc., the *History of the Church from 325 to 429* is the most important; translated into English in 1854 in Bohn's "Ecclesiastical Library." Collected editions of his works by Schulze and Nösselt (Halle, 1769–74), and in Migne's *Patrologie grecque.*

Theod'oric the Great, b. about 455, the son of Theodemir, king of the Ostrogoths, who at that time were settled in Pannonia and Mœsia under the authority of the East Roman emperor; was educated at the Byzantine court, whither he was sent as a hostage while still a young boy, and where he spent about eleven years. In 475 he succeeded his father as king of his nation, and for some time was a true ally of Zeno, the Constantinopolitan emperor. But dissensions soon arose. Zeno feared the barbarian swarm which hung rather loose on the outskirts of his empire, and in 488 succeeded in persuading Theodoric to remove to Italy and fight the usurper Odoacer. Late in the fall the whole nation broke up, 200,000 warriors, it is said, on horseback, women and children and all movable property loaded on wagons drawn by oxen; and slowly this multitude moved toward the Alps to brilliant victory or complete annihilation; a third issue was an impossibility. Odoacer was defeated in three great battles—at the Isonzo, near Aquileia, Aug. 28, 489; at Verona, Sept. 27, 489; and on the Adda, Aug. 11, 490. He then shut himself up in Ravenna, was besieged there for over two years, and finally assassinated Mar. 5, 493, at a banquet shortly after he had surrendered himself. After his victories, Theodoric naturally considered the soil of Italy as belonging to himself—only the persons and the movable property were respected in those days—and a part of it, one-third, it is said, he partitioned out among his warriors, thus covering Italy with a network of Gothic military colonies. But in other respects he retained the administrative machinery of the Empire, and he understood how to work it. During his long reign Italy was not only quiet but progressive. In commerce and industry, in science and art, old damages were repaired and new undertakings started. Cassiodorus, Boethius, Symmachus, and other literary men of eminence lived at his court in Verona as his intimate friends. In his foreign policy he was also wise and successful, and among the German tribes he became a hero (*Dietrich of Berne*), around whose name legends grew thick during the Middle Ages. The last days of his life were sombre, however. He and the nation to which he belonged were Arians, and the Arians were persecuted throughout the Eastern empire. He tried to interfere, but failed. Embittered, he began to retaliate and persecute the orthodox in Italy. The pope was thrown into prison. In the heat of the conflict his passions, barbarian at the bottom, took fire, and he d. at Ravenna Aug. 30, 526, amidst murder and bloodshed. The magnificent mausoleum in which he was interred is still existing, at least partly, but after the overthrow of the Gothic authority in Italy the popes scattered to the winds the Arian dust of his body.

Theodosia, or **Feodosia.** See KAFFA.

Theodo'sius, a celebrated Roman general from whom a line of emperors descended, was sent in 367 by Valentinian I. to Britain; expelled the Picts and Scots, who had invaded the province and advanced, plundering and devastating, as far S. as the Thames; drove them back behind the rampart of Antoninus; strengthened the military positions on the frontiers, and restored security and order in the country. After his return (in 370) he was for some time stationed on the upper Danube, where he defeated the Alemanni, but in 372 was sent to Africa, where the maladministration of the governor, Count Romanus, had caused Firmus, one of the principal Moorish chiefs under Roman authority, to rise in revolt. Other chiefs had joined him, and Firmus even came into possession of the whole of Numidia and Mauritania. But Theodosius defeated him repeatedly in a long and very difficult though also very brilliant campaign, pursued him from place to place, and finally reduced the province to submission, Firmus strangling himself in despair. Short-

ly after, however (in 376), Theodosius himself was beheaded at Carthage by order of the emperor Valens, but for some unknown reason. The history of his campaigns in Britain and Africa is told by Ammianus Marcellinus.—His son, THEODOSIUS I., THE GREAT, Roman emperor from 379 to 395, was b. in Spain in 345, either at Italica, the birthplace of Trajan, or at Cauca in Galicia, and educated in his father's camp. He early received an independent command in Mœsia, and distinguished himself by a great victory over the Sarmatians in 374, but after the execution of his father in 376 he retired from public life and returned to his native place. After the defeat and death of Valens in the battle of Hadrianopolis (in 378), Gratian recalled him to the court, made him commander-in-chief against the Goths, and even declared him *Augustus* (Jan. 19, 379), placing Egypt, Asia, Thrace, Macedonia, and Dacia under his sceptre. The new emperor of the East was very successful. By shrewd negotiations he dissolved the union between the Ostrogoths and the Visigoths, drew the latter over to his side, and incorporated a considerable number of them in the Roman army, overpowered the former, and finally (in 382) succeeded in settling all the Goths as peaceful allies and *confederati* within the boundaries of the Roman empire. In 383, Gratian was defeated and killed by Maximus at Lyons, and Theodosius acknowledged the usurper as emperor of Britain, Spain, and Gaul, but secured Africa, Italy, and Illyricum for Gratian's brother, Valentinian II. In 387, however, Maximus broke from Gaul into Italy, and the weak Valentinian II. and his mother Justina, who was the true regent of the empire, fled for safety to Theodosius. Theodosius, who had first been married to a Spanish woman, Placilla, who bore him Arcadius, Honorius, and Pulcheria, but who now was a widower, became so infatuated with Valentinian's beautiful sister, Galla, that he promised to restore him to the throne in order to obtain her hand. Maximus was defeated and put to death in 388, and Valentinian II. was reinstated as emperor of the West, but in 392 was killed by Arbogastes, who, not venturing to assume the purple himself, raised the rhetorician Eugenius to the throne. Theodosius hesitated long before he entered on a new war, but in 394 he marched against Eugenius and Arbogastes, and defeated them at Aquileia, thereby uniting the whole Roman empire under his sceptre. He died shortly after, however (Jan. 17, 395), at Milan, leaving the Eastern empire to Arcadius, the Western to Honorius. Theodosius was very zealous in all religious matters, and this contributed, probably, more than his political and military successes, to his great fame with the after-world. Constantinople was at that time the chief seat of Arianism, but the emperor was educated and—shortly after his accession to the throne—baptized into the orthodox Church. Damophilus, the Arian archbishop of Constantinople, was deposed, exiled, and succeeded by Gregory of Nazianzen in 380. In 381 an œcumenical council was held in Constantinople to confirm the Nicene Creed and condemn all different opinions; and afterward edict followed edict, deposing and exiling all Arian priests, installing inquisitors to watch over the orthodoxy of the congregations, ordering the demolition of all pagan temples, punishing the Manichæans with death, etc. During the reign of Theodosius the orthodox Church of the religion of love feasted on persecutions and devastations.—His grandson, THEODOSIUS II. (408–450), b. in 401, succeeded his father, Arcadius, as emperor of Constantinople. He was weak, almost silly, and divided his time between prayers, hunting, and calligraphic exercises. The government was carried on by his sister, Pulcheria (b. in 399, declared *Augusta* in 414), and for some time by his wife, Eudoxia. The *Codex Theodosianus*, a collection of all the constitutions issued since the conversion of Constantine, was promulgated in 438.

Theog'nis flourished at Megara in the middle of the sixth century B. C. He was both by birth and conviction an aristocrat, and during the great political convulsions which his native city passed through at that time he shared the fortunes of his party. Having been exiled by the democrats, he visited Eubœa, Sparta, and Sicily, but returned to Megara when the oligarchs once more came into power, and d. there after 490. Of his poems, all belonging to the elegiac and gnomic kind of poetry, 1388 verses are still extant, mostly relating to the political incidents of his life. Edited by Welcker (Frankfort, 1826), in Schneidewin's *Delectus Poetarum Græcorum* (1838), and in Bergk's *Poetæ Lyrici Græci* (1868); translated in *Theognis Restitutus* by Frere (Malta, 1842).

Theol'ogy [Gr. Θεος, "God," and λογος, "word"] signifies, literally, "discourse concerning God." The term has come down to us from the Greek philosophers, who used it in the sense of "account of the gods." Plato so used it in speaking of what Homer and Hesiod in their poems have said of the gods, though he also employs the word "mythology," which by common consent has been adopted by Christian writers as the more appropriate term. The word "theology" seems to have first come distinctly into Christian use during the great controversies of the fourth century respecting the divinity of Christ and his relation to the Godhead, the term then meaning sometimes the doctrine of the divine nature of Christ as distinguished from his human nature (οἰκονομια), and sometimes the doctrine of the Trinity. Theodoret in the fifth century appears to have been the first to use the term in the sense of "doctrine of God." He proposes and discusses the question, Why Moses did not preface his account of the creation with θεολογια, the doctrine of God—*i. e.* with some explicit teaching respecting the nature and attributes of God? It was not until the twelfth century that theology assumed something like the comprehensiveness of its modern meaning. Abelard, having prepared a compend of his lectures on some of the then most prominent doctrines of faith, entitled it "Christian Theology" (*Christiana Theologia*). From the time of Abelard the term rapidly widened in meaning till it came to include all that is now comprehended under it. Theology now denotes not merely the doctrine of God, or theology proper, but also the doctrine of man in his relations to God, or anthropology; the doctrine of the salvation of man through the person and work of Christ, or soteriology; the doctrines of the final states of all men, or eschatology; and the doctrine of the Church, its constitution and government, or ecclesiology. Theology may therefore be defined as the science which treats of God and man in all their known relations to each other. It has sometimes been defined as "the science of the supernatural," and very commonly as "the science of religion." The last two definitions, however, are vague and inexact; both, with any definiteness of meaning, would necessarily include much that does not properly belong to theology, and omit still more that does. The last named, "the science of religion," from its apparent simplicity and comprehensiveness, has gained great popular currency, which has also been promoted by indefinite notions as to the nature of both religion and theology.

Religion exists as an inward state of feeling—a sense of duty toward a Being or beings regarded as divine and supreme—and also as an outward expression of that feeling in acts of worship and service. The science of religion, therefore, should analyze and classify the various religions of the world, as well as the convictions and feelings of men, of which their religions are simply the natural expression. Theology, on the other hand, deals exclusively with the facts, whether of consciousness or of revelation, from which religion, both subjective and objective, proceeds, and, educing the truths and principles which the facts embody, it formulates and groups them into the doctrines which constitute theology.

The right of theology to be called a science, which in late years has been warmly disputed, can be determined only by answering the two following questions: first, Can the facts with which it has to do be proved to be indubitably real, and what they are supposed to be? and secondly, Can the methods which it adopts in dealing with its facts be shown to be in accordance with the acknowledged laws of mind? In its broad sense as a science it must gather its facts from the wide fields of nature, consciousness, and the sacred Scriptures. In a narrower and contracted sense of the term its facts, according to one class of theologians, are to be found only in the sacred Scriptures, and are strictly historical: according to another class, even in the narrower sense of the term, the facts of the moral consciousness should not be overlooked, this latter class, holding that the ultimate and decisive appeal must ever be to the Scriptures, yet maintaining that the facts of the moral consciousness when properly scrutinized will be found to be explanatory, supplemental, and corroborative of those of the Scriptures. Now, as to the facts, so far as they are historical they are amenable to the bar of criticism, just like the facts of any other history, and must vindicate their trustworthiness by precisely the same kind of evidence; and so far as they are from the moral con[illegible] [illegible], they are open to the inspection of every one [illegible] be submitted to the same kind of analyses and [illegible] other facts of mind. As to methods, there [illegible] liability to error in theology as in any oth[illegible] [illegible] various possible methods in de[illegible] [illegible] nature, some one is of com[illegible] [illegible] entific, and that one, with such m[illegible] as may be necessary to fit it to [illegible] is scientific in dealing with the [illegible] so that if a science of astrono[illegible] [illegible] of ethics, be possible, there [illegible] Science differs from m[illegible] certitude and exactness [illegible] the essential principle[illegible] capable of exact state[illegible]

The chief ground for denial of the right of theology to be called a science is found in its liability to resort to theory when facts are wanting, and to hypothesis in the absence of evidence. Its danger of becoming in this way unscientific is doubtless greater than that of most other sciences. The facts of revelation on which the science of theology rests presuppose and imply all those fundamental facts of being which it is the office of ontology (metaphysics) to interpret: and of these facts some kind of explanation or philosophy is to every enlightened mind a necessity. The theologian must have his explanation, and it is to him the source of his greatest danger of becoming unscientific. His metaphysic is perpetually suggesting to him its method of rounding his theology into the completeness of a system. To what is strictly scientific in his theology he is continually tempted to add what is purely theoretic. It is because theology has been so encumbered by what is purely theoretic—by theories of the Trinity, theories of sin, and theories of the Divine Providence, of the atonement, of regeneration, etc.—that its right to be entitled a science has been disputed. But to any one who looks impartially at the materials out of which theology builds, and at the inductive method which it may justly adopt, its right to be called a science would seem to be as clear as that of any other species of knowledge.

Theology has been divided into two kinds, which have been designated according to the supposed sources of their materials. Thus, we have NATURAL THEOLOGY (see article by PRES. CHADBOURNE) and revealed theology. By the first is meant that knowledge of God, his existence, attributes, and government of the world, which may be gathered from nature—*i. e.* from the external world and from the mental and moral constitution of man; and by the second is meant that knowledge of God and man, and of their mutual relations, which may be gathered from the Bible alone, or at least that knowledge alone which the Bible sanctions. But it may be doubted if the line of separation between the two is so clearly marked as is commonly supposed. The Bible assumes and incorporates into itself no small portion of what must be regarded as fundamental in natural theology, and few if any of the sources of natural theology have failed to be irradiated by the light of revelation. It is now wellnigh impossible to distinguish between what is taught by nature and what by revelation.

Revealed theology has been distributed into a variety of species, each of which has received its designation either from its special aim or from its special method of treatment. Thus, to particularize, we have systematic theology, the aim of which is to reduce all revealed truths to a series of statements that together shall constitute an organized whole; dogmatic, which aims pre-eminently to state what is authoritatively taught, whether by the Scriptures, the councils, or the creeds; philosophical, in which the formal statements of truth are more or less directly determined either by the postulates or by the conclusions of some special system of philosophy; metaphysical, in which the aim is to substantiate the teachings of the Bible by an appeal to those primitive cognitions and primary beliefs which the Bible always assumes; speculative, in which theory predominates over Scripture and all other authority; rational, which gives to human reason the highest authority in determining what is theological truth; biblical, which, indifferent alike to philosophy and dogma, and making system but a secondary consideration, aims simply to state the teachings of the Bible; doctrinal, which contents itself with simply formulating its statements of truth with a view to their being understood and accepted; and practical, which, on the other hand, seeks so to shape its statements of truth as to secure conformity of life with what is stated; polemical, which is quite as intent on overthrowing the positions of other systems as in defending its own; moral is a designation which has now among Protestants fallen into general disuse, but once denoted a discussion of moral law and human duty as laid down in the Ten Commandments and the Sermon on the Mount, and covered ground which is now occupied by moral philosophy or Christian ethics; and historical, which traces doctrines through the controversies amid which they were enunciated, and under the influence of which they were formulated. The term theology, unaccompanied by an epithet, now commonly denotes a completed series of the classified doctrines of Christianity. Doctrines are formal statements of Christian truth, and scientific theology consists of the whole circle of doctrines arranged according to some determinate plan.

Theology as a science has had a clearly-marked history—a history covering special controversies under which specific doctrines took form, and those broader and less violent discussions in which all doctrines, under the influence of metaphysical philosophies, were adjusted into the various systems which, taken together, now constitute the science as a whole. This history, beginning with the time immediately succeeding that of the apostles, naturally divides itself into three great periods, the first extending to A. D. 730, the second from 730 to 1517, and the third from 1517 to our own time.*

During the first period, theology was in its forming state. No complete treatise on it was then written. The nearest approach to one was by Isidore of Seville, who died 636. He wrote what he styled "Three Books of Sentences" (*Tres Libri Sententiarum*), but it was, as its title indicated, a mere collection of extracts from the Church Fathers. The period, however, was not unproductive of results. It gave to the Church universal that admirable digest of Christian faith called the Apostles' Creed. Among the churches of the East were elaborated the great doctrines of the Trinity and of the person of Christ, which were formulated in the creeds adopted by the Council of Nice in 325, of Ephesus in 431, and Chalcedon in 451. Within the same period also—that is, during the first quarter of the fifth century—the equally important doctrines of anthropology (specifically of the fall of Adam and its effects on the human race) were discussed, chiefly among the churches of the West under the leadership of Augustine and Pelagius. Augustine maintained that all men sinned in Adam; that by his fall all were physically and morally corrupted (original sin), and incapacitated to will or do aught but evil; that all there is of good in any one is by sovereign grace in fulfilment of a predestinating purpose. Pelagius, on the other hand, maintained that Adam alone was injured by the fall; that every one of his descendants begins life with a nature as pure as his was, and with a will as free to choose good as evil; that grace simply assists natural power, and is bestowed on those who by right use of natural power deserve it. Augustinism was adopted as the orthodox doctrine of the Church by the Council of Ephesus in 431. Semi-Pelagianism denied the positions of Augustine and softened the statements of Pelagius. Wiggers in his history of the three views aptly says: "Augustinism makes man to be morally *dead;* Pelagianism makes him to be morally *well;* Semi-Pelagianism makes him to be morally *ill.*"

The second period (from 730 to 1517) produced three great writers on theology—viz. John of Damascus, Peter the Lombard, and Thomas Aquinas. John (d. 754) wrote what he styled "An Accurate Summary of the Orthodox Faith" (Ἔκδοσις ἀκριβὴς τῆς ὀρθοδόξου Πίστεως, or *De Orthodoxa Fide*). He is the only writer of note on systematic theology which the Greek Church has ever produced. He drew his materials from the earlier Fathers, and chiefly from the three great Cappadocian teachers, Gregory Nazianzen, Gregory of Nyssa, and Basil the Great. He was the first to apply the formulas of Aristotle to theological investigation, and thus to introduce the dialectic or scholastic method. His views of the moral state and ability of man, like those of all the Greek Fathers, are much less rigid than those of Augustine. His work is chiefly of value to one who would understand the history of the doctrine of the person of Christ. Peter the Lombard (d. 1164) compiled from the Latin Fathers, chiefly from Augustine and Gregory the Great, what he styled "Four Books of Sentences" (*Quatuor Libri Sententiarum*). His method is formal and dialectic, but he shows great acuteness and skill in his aim at reconciling the opposing views of the authors whom he quotes—an aim the opposite of that of Abelard (d. 1142), who had sought in his "Yes and No" (*Sic et Non*) to array the Fathers against one another. The work of Peter became the great authority in the Roman Church, the ablest theologians for a long time contenting themselves with simply commenting on it. But the greatest of mediæval theologians, perhaps one of the ablest of any age, was Thomas Aquinas (d. 1274). He wrote, according to the fashion of his time, elaborate commentaries on the *Sentences* of the Lombard, to which he also gave the alternative title of "Sum of Theology" (*Summa Theologiæ*). He is pre-eminently scholastic in method, but transparent in thought and exhaustive in treatment. The Lombard simply recognized the rising controversy between the Realists and the Nominalists; Aquinas was a pronounced and earnest Realist. He was also more Augustinian in his anthropology than Lombard, and, setting aside the mythical theory of the atonement, which Lombard had accepted from the Fathers, and which made the death of Christ to have been a ransom paid to Satan,

* With a broader definition of theology than the one adopted in this article, we might distribute under *four* periods, making the first to be the apostolic period, in which case we could dwell, after the manner of Neander (see his *Planting and Training of the Christian Church*), on the theological diversities of method in the apostolic teaching. Modern Germans have carried this notion of an apostolic period of theology to the extent of writing treatises on the theology of Jesus as distinguishable from that of the apostles.

he maintained, and established for all time since, the Anselmic theory, that the death of Christ was a satisfaction for sin to the justice of God. The mythical theory had prevailed until the beginning of the twelfth century, when Anselm, archbishop of Canterbury (d. 1109), elaborated the theory which now bears his name, and the final acceptance of which made as distinctly, though less violently, an epoch in the progress of theological science as had been made more than seven centuries before in the adoption of the Augustinian views of human nature. The *Summa* of Aquinas is one of the highest authorities in the Roman Catholic Church.

The third great period, covering the last 350 years, has been more fruitful of treatises on scientific theology, and has contributed more to its progress, than all the Christian centuries preceding. Until the sixteenth century only two great doctrines or groups of doctrines—viz. of God, including the Trinity, Christology, etc., and of man, including sin, free-will, sovereign grace, etc.—had been comprehensively discussed. The Reformation under Luther turned on controversies over the doctrines of soteriology, or of the divine method of making the work of Christ available for men. The Roman Church, under guidance of mediæval theologians, had come to make the process of salvation to be a mere external work (an *opus operatum*) wrought by the efficacy of the sacraments. Luther maintained that it could be wrought only through a personal faith (a *fides justificans*). In prosecution of the controversy the Reformers, cutting loose from scholastic theology, entered at once on the study of the Bible and of Christian truth for themselves. The first Protestant treatise on scientific theology, the "Common Places" (*Loci Communes*) of Melanchthon, had its origin in a course of lectures on the Epistle to the Romans, the chief object of which was to collate and expound such passages of the Epistle as bore directly on the questions in dispute. Out of the biblical studies of the Reformers, German, Swiss, and French alike, grew those statements of soteriological doctrines now found in all systems of Protestant theology.

From the middle of the sixteenth century theology presents itself under three clearly-defined types—the Lutheran, the Reformed (the Calvinist), and the Roman Catholic. At the beginning of Protestantism the Lutherans and the Calvinists were essentially one in doctrine. Both adopted the Augustinian views of sin and grace, and both held firmly to the Nicene and Chalcedon creeds. Luther was himself pre-eminently Augustinian, and even wrote a book (*De Servo Arbitrio*) to prove that the will of man is enslaved. And Melanchthon, when he wrote the first edition of his *Loci*, as well as the Augsburg Confession (*Confessio Augustana*) and the apology for it (*Apologia Confessionis*), was no less Augustinian. But Luther propounded and defended a doctrine of the real presence of the body and blood in the Lord's Supper under the title of consubstantiation; and Melanchthon, gradually swerving from the Augustinian views of sin and irresistible grace (monergism), maintained the existence of a co-operative power of the human will in regeneration (synergism), and favored the Reformed view of the Supper rather than the Lutheran; the Reformed, under the lead of Calvin, adhered to Augustine's views of human nature, and maintained that in the Supper the Lord is present, not in the bread and wine, but in the heart of the communicant through partaking of the consecrated elements; the differences between the Lutheran and Reformed, slight at first, rapidly widened into complete separation. The historical progress of dogmatic theology may be traced under the three above-mentioned types—the Roman, the Lutheran, and the Reformed or Calvinist.

The Roman.—The Roman Catholic Church, in which theological studies had fallen into neglect, was roused into immediate activity by the outbreak of the Reformation. But in the canons of the Council of Trent (1545–63) it reaffirmed the theology of its mediæval writers, particularly of Aquinas, and authorized the preparation of the Roman Catechism (*Catechismus Romanus*), which popularizes and reiterates the decrees of the council. Its great writers, such as Bellarmine and Petavius, contented themselves with acting on the defensive, simply reaffirming the dogmas of the Church, and the interpretations which priestly authority had put upon them.

The Lutheran.—The *Loci* of Melanchthon, first published in 1521, became at once the great Lutheran authority, and was the first in a series of learned and able treatises. It was clear in thought, admirable in style, and entirely free from every trace of scholasticism both in language and method. Sixty editions in Latin and a large number (estimated at more than twenty) of translations into German were published during its author's lifetime. The later editions were so changed from the earlier as to make it almost another work. Theologians immediately succeeding Melanchthon contented themselves with writing commentaries on the *Loci*; but during the 200 years following his death (d. 1560) the Lutheran Church abounded in great writers on theology, many of whom were noted for their learning as well as for their extraordinary grasp and acuteness of intellect. Of these may be mentioned, Chemnitz, Gerhard, Callixtus, Calovius, Quenstedt, and others. Of these authors, some sided in their anthropology with Luther, but the majority with Melanchthon, while almost unanimously they went with Luther in his views of the sacrament of the Supper. But the simultaneous appearance of Rationalism and Pietism about the middle of the eighteenth century interrupted the sluggish flow of Lutheran theology, few or no treatises of any special value for a half century or more from that date having made their appearance. The Rationalists were too intent on their work of destruction to construct a scientific theology; and the Pietists, regarding religion as much more a matter of the heart than of the intellect, were indifferent to doctrinal discussions. The only strictly rationalist treatise on systematic theology worthy of note was that of Wegscheider (*Institutiones Theologiæ Christianæ Dogmaticæ*); the Pietists produced no dogmatic treatise; but Pietism and Rationalism have, one or the other, largely determined the methods and conclusions of subsequent treatises.

The Reformed (Calvinist).—At the head of all the Reformed theologians, and, in the estimation of some, of all Protestant as well, stands John Calvin. He was eleven years old when Melanchthon published the first edition of his *Loci*, and was but twenty-seven when he published the first edition of his own *Institutes of Theology* (*Christianæ Religionis Institutio*). Few if any writers on theology have surpassed him in transparency of thought, in depth or breadth of view, in strength of grasp, or in logical force and consistency. The Reformed theology has gained wide currency among different nations. Its adherents had so multiplied and organized themselves into Churches under Calvinistic creeds among different nations as to admit, with varying degrees of accuracy, of national designations. Thus we have the Swiss French or Genevan Church, founded by Calvin (he published at Geneva the revised edition of his *Catechism* (1541), the *Creeds*, *Consensus Tigurinus* (1549), *Consensus Genevensis* (1552), and the revised and standard edition of his *Institutes* (1559)); the Anglican, which through Cranmer and Ridley expressed itself in the XXXIX. Articles, 1551; the German Reformed Church, which crystallized around the Heidelberg Catechism, 1562; the Dutch (Netherlands), which culminated in the Synod of Dort, 1618, and afterward signalized itself by the origin of the federal theory or covenant system, 1648; the Anglo-Scotch, which proclaimed itself in the Westminster Confession and Catechism, 1646–48; and finally, we have the American type of theology, which, having begun under the Westminster Symbols (the Congregationalists adopting them 1648, and the Presbyterians 1729, while the Dutch brought with them the Heidelberg Catechism, and the Episcopalians the XXXIX. Articles), now presents itself under new and ever increasing variations.

The Calvinist theology, unlike the Lutheran, has been subject to many modifications, and has subdivided itself into a variety of schools. Some of these modifications have had their origin in reactions against extremes of view or of method, and others have resulted from the influence of special schools of speculative philosophy, to which the Reformed theology has always been much more sensitive than the Lutheran. Thus, near the middle of the seventeenth century the Calvinist writers of the Netherlands had become excessively scholastic and formal. In opposition to their method, Cocceius (in German *Koch*, and English *Cook*) conceived the federal method or the system of covenants—a covenant of works between God and man, and a covenant of grace between God and Christ—a method which he regarded as founded on the historical order of the Scriptures. Francis Burman at Utrecht and Herman Witsius at Leyden adopted the federal theory. The Cartesian philosophy, just then engaging the attention of Europe, was accepted by the Federalists, who adopted it so far as [illegible] the capacity of the unaided reason of man to [illegible] his character; the Scholastics assailed it [illegible] Maestricht (who styled it the gangrene of [illegible]) specially bitter in their denunciations [illegible] Netherlands were agitated with contr[illegible] [illegible]isticism, federalism, and Cartesi[illegible] [illegible] were equally moved by [illegible] [illegible]tinctively Calvinistic doctrines [illegible] [illegible]putation. The professors at S[illegible] [illegible] tions of the then current [illegible] Amyraldus (Amyraut) [illegible] but propounded in [illegible] by a hypothetic [illegible] Amyraut at Saumur [illegible]

the doctrine of immediate imputation—*i. e.* the notion of a direct imputation of Adam's guilt to his innocent descendants—and affirmed the doctrine of mediate imputation—*i. e.* the imputation of Adam's guilt to his descendants as made guilty by an inherited evil nature (a doctrine held by Jonathan Edwards and certain writers, including the late Dr. Robert J. Breckenridge, of the Presbyterian Church of this country). The views of both Amyraut and Placæus were opposed by Rivetus in France, by Francis Turretin at Geneva, and by J. H. Heidegger at Zurich. Against them, Heidegger was appointed by the Swiss to draw up a new symbolical book, the *Consensus Helveticus*, which was much discussed, but could never be lifted into a position of authority. Turretin, a sympathizing friend of Heidegger, in his treatise on theology (*Institutio Theologiæ Elencticæ*, a great authority among a class who in this country and Scotland claim to be pre-eminently orthodox and Calvinistic) adopted the covenant theory of Coccejus and affirmed immediate imputation and absolute predestination. Again, during the first half of the eighteenth century the philosophy of Leibnitz having been adopted and adjusted to theological inquiries by Wolff, some of the Swiss theologians followed the Wolffian method. Wolff had maintained, and attempted to show by a most elaborate treatise, that the truths of natural theology were capable of demonstration, and that revealed theology, resting on natural, could thus be made to stand on a basis of science and certainty. But Wolff had also resolved all theological truths, whether of revealed or of natural religion, into mere abstract principles and definitions; and the theologians who constructed their systems after his method, while making a great show of logic, reduced theology to a mere system of formal and arid propositions. Notably of this class were Daniel Wyttenbach and J. F. Stapfer of Berne. Schleiermacher, under the triple influence of rationalism, pantheism, and the Moravian teaching of his youth, gave to the German Reformed theology, during the first quarter of the present century, a tendency and a modification which still continue. He mediated, however, between the Lutheran and the Reformed system, thus influencing to some extent the methods and results of both. His example in mediation has been followed by Nitzsch in his *System of Christian Doctrine*.

Theologies in Antagonism with the Reformed.—Socinianism.—At a very early period in the history of Protestant theology there was opposition to the doctrine of the Trinity. This opposition culminated in the person of Servetus, and he was put to death by burning. The opponents of trinitarianism gathered in Transylvania, and finally, organized by Faustus Socinus (d. 1604), became known as Socinians. Socinus wrote a brief treatise on theology, and a catechism which comprehended only the points in dispute between him and the trinitarians. The views of the Socinians are found in the Racovian Catechism and in the *Bibliotheca Fratrum Polonorum*.

Arminianism.—In reaction against the rigid high Calvinism of the Netherlands, Arminius denied the doctrine of absolute predestination, and propounded in its stead the doctrine of a predestination founded on the foreknowledge of God. Violent controversies ensued; the followers and successors of Arminius addressed a remonstrance to the state authorities; the Synod of Dort was convened, and the Remonstrants were excluded from the Reformed Church. Episcopius and Limborch elaborated the Arminian theology into a self-consistent system.

Existing State of Theology among the Different Divisions of Christendom.—The *Greek Church* has produced no complete system of theology. It has contented itself with its early Fathers, who discussed only christological questions, and with John of Damascus, who compiled his treatise from their writings. The *Roman Catholic Church*, which claims for itself unity and stability of doctrine, has had its full share of conflicting theories. To say nothing of mediæval controversies, of the bitter doctrinal disputes between the Jansenists and their opponents, it is only by ecclesiastical power that the dissidence of some of its living writers from the authority of its dogmas can be kept in check. There has been no dearth of modern theological treatises in the Roman Church, but the most complete and ablest of them all is that of Cardinal Perrone (*Prælectiones Theologicæ*), which first appeared in 1835, and of which very many editions have since been published. It is specially able in its presentation of the Roman theory of the Church and the sacraments. The *Anglican Church* and the *Protestant Episcopal Church* of this country have taken little or no interest in the cultivation of systematic or scientific theology. Neither of the three great parties composing these churches has any taste for this kind of literature. Stackhouse, Tomline, and Hey, whatever may have been their influence in the past, are laid aside now. Pearson on *The Creed* and the popular expositions of the XXXIX. Articles by Bishop Burnet, and more recently by Brown, bishop of Exeter, are not in any proper sense scientific treatises on theology. The *Lutheran Church* has made but little progress in its theology as a whole since the period of its great writers in the sixteenth and seventeenth centuries. Its later writers have either contented themselves with justifying the statements of its creeds by citations from the older authors, or, like Thomasius and Gess, have restricted themselves to a re-elaboration of its doctrines of the Person and Work of Christ. The *Reformed* theologians have in our day been actively engaged in a resurvey of the whole domain of systematic theology. Among the Germans may be mentioned, of the orthodox wing, Ebrard, Lange, and Heppe, and of the rationalist, Schweizer and Schenkel. Calvinist treatises on systematic theology in the English language still continue to abound. Among the Calvinist denominations of this country the study of systematic theology is pursued with unabated zeal. The *Methodists*, both of England and this country, who have inherited the theology of the Arminians, have produced no theologian since Watson. The *Unitarians*, who have inherited the faith of the Socinians, have produced no systematic theology at any time.

Relation of Theology to Metaphysical and Physical Science.—The rise and progress of systems of theology have always been coincident with the rise and progress of systems of philosophy. Mediæval theology is intelligible only by understanding the realistic or nominalistic philosophies of its authors; and the modern systems of Protestant theology can be fully understood only by understanding the systems of philosophy which underlie them. And it is remarkable that while the great theological writers anterior to the sixteenth century, who are appealed to as common authorities by Roman and Protestant writers alike, were philosophical realists, the chief theological systems of the Protestant Churches rest either upon avowed and unadulterated nominalism or upon nominalism in the disguised form of conceptualism. But with the traditional influence of metaphysical systems the natural sciences have in our day been rapidly coming into collision. It is the office of these sciences to ascertain what is really knowable of the processes of nature, and to reduce this knowledge to exact forms of statement. In fulfilment of this office, these sciences, in their manifold departments, are not only rendering an invaluable service to the science of mind, by bringing metaphysicians to observe its actual phenomena rather than to build on definitions of its processes, but are doing a work of equal value to theology, by requiring theologians to deal with law, government, sin, righteousness, character, and other fundamental truths, not as mere names or conceptions, but as the most real of realities. The theology of the future, which is to stand the test of criticism and control the consciences of men, must, like the teachings of the New Testament, rest on a basis of reality, and find in the consciousness of mankind an unequivocal testimony to its truth.

Literature.—Petavius, *Opus de Theologicis Dogmatibus*; Bellarmine, *Disputationes de Controversiis Fidei*; Möhler, *Symbolism*; Köllner, *Symbolik aller christlichen Confessionen*; Gass, *Geschichte der protestantischen Dogmatik*; Polenz, *Geschichte des Calvinismus*; Heppe, *Dogmatik des deutschen Protestantismus*; Hase, *Hutterus Redivivus*; Schweizer, *Die Glaubenslehre der evangelischen Reform-Kirche*. The church histories of Neander, Gieseler, Hase, and Guericke; Neander, *Christliche Dogmengeschichte* ("History of Christian Dogmas," translated by J. E. Ryland); Hagenbach, *History of Doctrines* (the translation revised and enlarged by H. B. Smith); Winer, *Comparative Darstellung des Lehrbegriffs der verschiedenen christlichen Kirchenparteien*; Schneckenburger, *Vergleichende Darstellung des Lutherischen und reformirten Lehrbegriffs*. The *Dogmatik* of Bretschneider, Ebrard, and Lange. Knapp, *Christian Theology*, a translation by L. Woods.

E. G. Robinson.

Theopaschites, the Greek name for Patripassians (which see).

Theophras'tus, b. at Eresus, in the island of Lesbos, about 372 B. C.; studied philosophy in Athens, first under Plato, then under Aristotle, whose favorite he became, and whom he succeeded in the Lyceum. He is said to have had 2000 disciples, and died, highly respected, at Athens about 287 B. C. According to the list of his works in Diogenes Laertius, he was a prolific writer, but besides fragments and smaller treatises, among which is a considerable portion of an essay on metaphysics, there are now extant only two treatises on botany and his *Ethical Characters*, edited by Schneider (1818–21, 5 vols.). The ethical characters, 30 sketches of general human vices under individual forms, have been frequently edited separately, and translated into most modern languages—into French by La Bruyère (1688), into English by Francis Howell (1824), into German by Schnitzer (1859).

Theoph'ylact, surnamed SIMOCATTA, b. at Locri, of Egyptian descent, came to Constantinople in 610 A. D., held various offices during the reign of Heraclius, and d. there about 629. From his *Historia Mauricii Tiberii Imperatoris Libri VIII.* (first edited with a Latin translation in 1604, lastly by Bekker in 1834), it is evident that he wrote this work, or at least commenced it, during the reign of Phocas. He also wrote 85 letters, *morales, rustica et amatoriæ*, and *Quæstiones Physicæ*, edited by Boissonade (Paris, 1835).

Theophylact, b. at Eubœa, seems to have come early to Constantinople, where he obtained great reputation for learning, and was appointed teacher to Constantinus Porphyrogenitus. In 1078 he was made archbishop of Bulgaria, and took up his residence at Achrida, where he d. in 1107. His ecclesiastical duties he discharged with great zeal, but he suffered much from the rudeness and barbarity of the people. He was also a prolific author, and wrote, besides a number of letters and an essay on royal education, commentaries on the New Testament, which are still consulted with advantage. His collected works were published in a splendid edition by Maria de Rubeis (4 vols. fol., Venet., 1754–63).

Theos'ophists [Gr. θεόσοφοι, "wise in respect to God"], a name vaguely applied to those religious teachers and writers who profess by meditation and superhuman illumination to have arrived at unusual knowledge of divine things.

The Plains, p.-v., Fauquier co., Va.

The'ra, or **Santorin,** an island of Greece, one of the Cyclades, is geologically very interesting on account of the volcanic phenomena which its history records. The whole island is really only but one side of an immense crater, whose other side has fallen down, and from whose middle several small islands have been raised at different periods, the last in 1710. The soil is dry but fertile; wine and cotton are produced in large quantities and of superior quality. The inhabitants, who number about 21,000, carry on extensive fisheries and a large shipping business.

Theram'enes, an Athenian politician whose name figures in all political transactions during the last years of the Peloponnesian war, now on the side of the demagogues, now on the side of the oligarchs, always in the character of a traitor. After the battle of Arginusæ (406 B. C.), in which he held a subordinate command in the right wing of the Athenian fleet, he was ordered to return to the scene of action and save as many as possible of the disabled galleys and their crews. A heavy storm set in, which made the execution of the order impracticable, and a great number of Athenian citizens were drowned. In order to escape the odium of this incident, Theramenes speedily repaired to Athens and accused the commanders-in chief of having taken no measures in the case. In 404 B. C. he was sent first to Lysander, who besieged Athens, and afterward to Sparta, to negotiate a peace, but he postponed the final conclusion of a treaty until the Athenians were reduced to such a degree that they were compelled to accept any conditions whatever. After the peace he was elected one of the thirty tyrants, but as he opposed the violent measures of that body, he became suspected by Critias, was accused by him as an enemy of the state, and finally forced to drink poison. He was a man of eloquence, and, according to Diodorus, a disciple of Socrates.

Therapeu'tæ [Gr. θεραπευταί, "worshippers," "servants," or "healers"], a sect of Jewish contemplative ascetics, kindred to, though distinct from, the Essenes. Their chief seat was on Lake Mareotis in Egypt. They were not strictly celibate, but rejected wine and animal food. It has, however, been denied that they were Jews at all, and some critics question their existence at any time.

There'sa, p.-v. and tp., Jefferson co., N. Y., has a private bank. P. of v. 798; of tp. 2564.

Theresa, p.-v. and tp., Dodge co., Wis. P. 2248.

Theresa, or **Teresa** (SAINT), b. at Avila, Spain, Mar. 28, 1515, her full name being TERESA SANCHEZ DE CEPEDA; entered (Nov. 2, 1536) the Carmelite monastery at Avila, and in 1562 founded a reformed branch of Carmelite nuns. She made a prolonged study of theology, and wrote several mystical and ascetic treatises, which are accounted among the Spanish classics, and obtained her a great reputation. D. at Alba Oct. 4, 1582. Wrote *Discurso ó Relacion de su Vida* (1562), an autobiography giving an account of her interior conflicts and visions; *El Camino de la Perfeccion* (1563); *El Libro de las Fundaciones*; *El Castillo interior, ó las Moradas* (1577), a mystic description of the heavenly life; and *Santos Conceptos de Amor de Dios*.

Theresiopel, or **Maria-Theresiopel.** See SZABADKA.

Theriaca. See MOLASSES.

Thermal Springs. See APPENDIX.

Thermidor' ("hot month"), the eleventh month of the French republican calendar, began on the 19th of July and ended with the 18th of August.

Ther'mo-Chemistry. See APPENDIX.

Thermodynam'ics. The science of thermodynamics, as the term implies, relates to the principles of dynamics applied to the phenomena of heat. It is therefore to be expected that, in addition to the elementary principles which have been enumerated in the article DYNAMICS for the ordinary forms of dynamical problems, the science of thermodynamics will embrace special theorems or laws depending on observations and experience in connection with heat, and also special forms of mathematical investigation by which the applications of these laws may be brought within the scope of mathematical analysis.

The first assumption that is made (the truth of which is derived from experience) is, that the state of a body in regard to heat may be expressed by the relation

$$f(p, v, t) = 0, \tag{1}$$

p, representing the external pressure upon a unit of the surface of the body; v, the volume of unit of weight; and t, the temperature. These are quantities which can be determined by measurement or observation, and it is known by experience that a change in either of them, the other two remaining the same, will alter the condition of the body in regard to heat. When such a relation is given, one of the quantities may be expressed in terms of the other two; thus, we may have the same relation expressed by the equation

$$t = f(p, v). \tag{2}$$

Then for any change in t, changes will take place in p and v, which can usually be determined by the methods of the calculus. In general, when a change in one quantity involves simultaneous changes in two others, whatever these changes may be, we may suppose the quantities to be represented by u, x, and y, and related in such a way that

$$u = f(x, y); \tag{3}$$

$$\text{then } du = \frac{du}{dx}dx + \frac{du}{dy}dy. \tag{4}$$

The quantities u, x, and y may be quantities of heat, temperatures, pressures, or volumes; and when the relations expressed by the above equation (3) are known, this equation becomes a specific expression from which the differential equation may be derived. For instance, for the permanent gases it is known from observation, without regard to any theory of heat, that the above relation is

$$p.v = R.T., \tag{5}$$

p being the pressure upon a unit of surface; v, the volume of unit of weight; T, the absolute temperature of the gas; and R a constant for each particular gas. These three quantities p, v, t, and *quantities of heat*, are the quantities which are chiefly to be considered in the study of thermodynamics.

The special theorems on which this science is founded are the *equivalence of heat and work* and the *equivalence of transformations*, sometimes called the *first and second laws* of thermodynamics. The first law of thermodynamics may be expressed by the equation

$$E\,dQ = dW + dR + dL, \tag{6}$$

in which E represents the dynamic equivalent of a unit of heat (see HEAT); dQ, an indefinitely small variation of heat; dW, the variation of the living force due to a change in the vibratory heat motions of the particles of the body; dR, the corresponding variation of work of the attractive forces of the particles; and dL, the variation of the work of the external pressure. If in the expression $E\,dQ = dW + dR + dL$ the symbol A is introduced for $\frac{1}{E}$, it becomes

$$dQ = A(dW + dR + dL). \tag{7}$$

This expression may be simplified by including the terms dW and dR in one term dU, which will then represent the [illegible], including the work due to [illegible] of oscillation, or work of the living force of the [illegible] and the variation of the work of the mol[illegible]. dL will then represent the variation of [illegible] of the body, and the expression may b[illegible]

$$dQ = A\,dU + dL [illegible]$$

The quantity U will represent the [illegible] work stored in the body, or the energy of the [illegible] ured directly; but as the [illegible] of the interior work is the quan[illegible] tions of the principle, [illegible]

Since a change in the [illegible] panied by a change [illegible]

two of these variables determine such a change, U may be regarded as a function of any two—p and v, for instance—and we shall have

$$U = F(p, v). \quad (9)$$

Between two states the change of interior work will be $F(p_2 v_2) - F(p_1 v_1)$; and the change will become zero whenever the initial and final values of p and v are equal, whatever may be their intermediate values.

If the expression $U = F(p, v)$ be differentiated, we have

$$d\,U = \frac{d\,U}{d\,p}\,d\,p + \frac{d\,U}{d\,v}\,d\,v, \quad (10)$$

or, representing $\frac{d\,U}{d\,p}$ by X, and $\frac{d\,U}{d\,v}$ by Z,

$$d\,U = X\,d\,p + Z\,d\,v. \quad (11)$$

This formula gives the variation of *interior work* when the pressure p and volume v of unit of weight of the body increase by $d\,p$ and $d\,v$; and since the second member of the expression is an exact differential, the law of change being invariable, we have—

$$\frac{d\,X}{d\,v} = \frac{d\,Z}{d\,p}. \quad (12)$$

The exterior work represented by $d\,L$ depends not only on the initial and final values of the variables which determine the condition of the body—the pressure and volume, for instance—but upon their intermediate values. The difference between *interior* and *exterior* work, in this respect, is that the mode of change of interior work for any body cannot be varied or altered by any external agency, since it is governed by the physical laws of the constitution of the body; but the *exterior* work depends on the external pressure, which holds in equilibrium the elastic force of the body, and which may be varied at will; and in determining the *exterior* work it is necessary to assume the law of change of the external pressure with the change of volume.

It is also generally assumed that the external pressure shall be regarded always as equal to the elastic force of the body, or, according to the dynamical principles of equilibrium, an infinitely small difference only being supposed necessary to accompany the phenomena of external motion. This being established, an expression for the value of the external work may be found. p being the pressure upon a unit of surface, normal and equal at all points, the external work for an elementary change of volume will be $p\,d\,v$, and we shall have—

$$d\,L = p\,d\,v, \quad (13)$$

$$\text{and } d\,Q = A\,(d\,U + d\,L) = A\,(X\,d\,p + Z\,d\,v + p\,d\,v) = A\,(X\,d\,p + Y\,d\,v), \text{ putting } Y = Z + p.$$

The total quantity of heat involved in a change of the condition of the body between the limits in which the pressure and volume are $p_2\,v_2$ and $p_1\,v_1$, will be found by integrating the expression

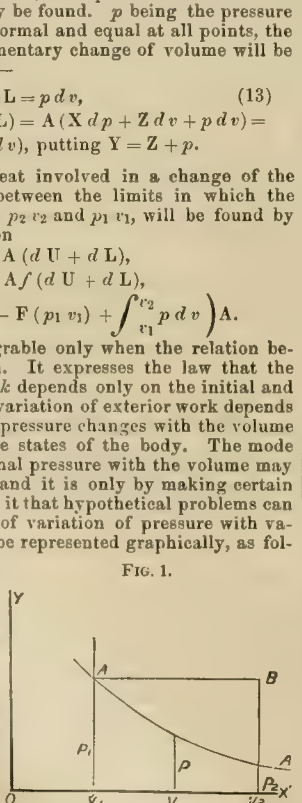
$$d\,Q = A\,(d\,U + d\,L),$$

or (14) $$\int d\,Q = A \int (d\,U + d\,L),$$

or (15) $$Q = \left(F\,(p_2\,v_2) - F\,(p_1\,v_1) + \int_{v_1}^{v_2} p\,d\,v\right) A.$$

This expression is integrable only when the relation between p and v is known. It expresses the law that the variation of *interior work* depends only on the initial and final states, but that the variation of exterior work depends on the law by which the pressure changes with the volume through the intermediate states of the body. The mode of variation of the external pressure with the volume may be indefinitely modified, and it is only by making certain assumptions in regard to it that hypothetical problems can be presented. The law of variation of pressure with variations of volume may be represented graphically, as follows (Fig. 1): Let O X and O Y represent co-ordinate axes at right angles, and let the abscissas O v_1 O v_2 represent the successive volumes, the corresponding ordinates representing the pressures. A line drawn through the extremities of the ordinates will represent the law of change of pressure. Such lines are commonly called "curves of expansion" or "compression." Those which are of the greatest interest in the dynamic theory of heat, and also in technical applications, are the curves or lines of *constant pressure*, of *constant volume*, the *adiabatic curve*, the *isothermal curve*, and the *isodynamic curve*.

Fig. 1.



If the pressure remain constant, the value of the integral $\int_{v_1}^{v_2} p\,d\,v$ will become $p \int_{v_1}^{v_2} d\,v = p\,(v_2 - v_1)$, and the line of pressures will be a straight line A B parallel to the axis of X. If the volume of the body remain constant, the variation of pressure must be represented by a straight line parallel to the axis of Y. The value of the integral $\int_{v_1}^{v_2} p\,d\,v$ will evidently in that case be 0, and the exterior work will be zero; and equation (14) shows that the heat supplied to or abstracted from the body is manifested only in a change of interior work.

The *adiabatic* curve is the curve of pressures A A, on the supposition that no heat is supplied to or abstracted from the body during change of volume. In this case in equation (14) $d\,Q = 0$ and $p\,d\,v = -d\,U$, and in equation (15)

$$\int_{v_1}^{v_2} p\,d\,v = F.\,(p_2\,v_2) - F.\,(p_1\,v_1).$$

This shows that the total change of *interior work* is equal to the *exterior* work. The expression applies to compression as well as to expansion.

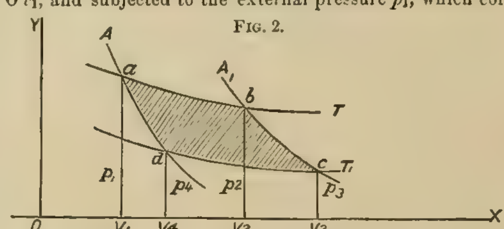
The equation of the adiabatic curve will be expressed by a relation between p and v, under the assumption that no heat is supplied to or abstracted from the body during change of volume. Eliminating $d\,U$ from equations (11) and (14), making $d\,Q = 0$, we have

$$X\,d\,p = -(Z + p)\,d\,v. \quad (16)$$

The integration of this equation will give the equation of the adiabatic curve in any case where the values of $X = \frac{d\,U}{d\,p}$ and of $Z = \frac{d\,U}{d\,v}$ are known, in functions of p and v.

In the case of the isodynamic curve the *interior work* remains constant. In this case $d\,U = 0$, and the equation $d\,U = X\,d\,p + Z\,d\,v$ will give $0 = X\,d\,p + Z\,d\,v$. We also have from equation (14) $d\,Q = A\,p\,d\,v$, which shows that in the expansion of a body by the isodynamic law all the heat supplied to the body is converted into *exterior* work; and in compression for the exterior work applied to the body there must be an equivalent quantity of heat abstracted. Suppose the unit of weight of a body having the volume O v_1, and subjected to the external pressure p_1, which cor-

Fig. 2.



responds to the initial state represented in Fig. 2 by a, to expand in such a manner that the curve T represents the curve of pressures with increasing volumes; when the pressure has been reduced to p_2, and the volume increased to v_2, let the body expand according to another curve A_1 until the pressure is reduced to p_3, and the volume increased to v_3. Then let the volume be reduced by increasing the pressure until it just overcomes the elastic force at the pressure p_3, and suppose the pressures during the reduction of volume to follow the curve T_1, which is of the same kind as the curve T. When the volume has been reduced to v_4, and the pressure increased to p_4, let the volume be still further reduced to the original volume v_1, and the pressure increased to p_1, the pressure following the law of the curve A_1. The shaded area in the diagram is embraced by two couples of curves of the same kind, and the diagram represents what is called a *simple cycle* of operations or transformations. If at each instant the external pressure is equal to the elastic force of the body, such a cycle is also a *reversible* cycle, because the contour of the area may be traversed in the opposite direction.

In this cycle the external work performed by the body, which may be called positive, is represented by the two areas $v_1\,a\,b\,v_2$ and $b\,c\,v_3\,v_2$. The work performed by the external pressure on the body, or negatively, is represented by the areas $v_3\,c\,d\,v_4$ and $d\,v_4\,v_1\,a$, and it is evident from the figure that the difference between the positive and negative work is represented by the shaded area. The body has performed more work during expansion than has been expended to bring it back to its original state.

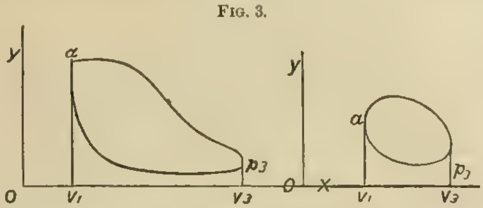
For greater definiteness, suppose the curves T and T_1 to be isothermal curves, and the curves A and A_1 to be adiabatic curves. The curve T is then that which gives the pressure when the body expands at constant *temperature*. In expanding from a to b at constant temperature, it will be

necessary that a certain quantity of heat shall be communicated to the body at each instant; otherwise, the temperature could not remain constant. Let Q_1 represent the total quantity of heat imparted to the body during the expansion from a to b. The expansion from b to c is accomplished, by hypothesis, without the addition or abstraction of heat, the curve $b\,c$ being an adiabatic curve. Q_1 is then the total quantity of heat added to the body during the expansion from v_1 to v_3. During the compression from c to d heat must be abstracted, because experience shows that to prevent a rise of temperature during compression heat must be abstracted. Let the total quantity of heat withdrawn from the body be represented by Q_2. During compression from d to a by the adiabatic curve no heat is transmitted, and the temperature and pressure rise to the values corresponding to the initial state a.

During this cycle the *interior* work has changed, it being different in the four states a, b, c, and d; but since this interior work does not depend on the mode of variation of external pressure, its positive and negative values are equal when the body returns to the same initial state. The expression $d\,Q = A\,(d\,U + d\,L)$, integrated for the whole cycle, will give $Q = A\,F$, F being the sum of the positive and negative integrals of the exterior work represented by the shaded area in the diagram. But we have the positive values of Q_1, corresponding to the positive work, and the negative values Q_2, corresponding to the negative values of the exterior work; and hence $Q = Q_1 - Q_2 = A\,F$; which shows that the exterior work is the dynamic equivalent of the difference between the heat supplied to and abstracted from the body during the cycle. If the cycle represented in the above diagram were traversed in the opposite direction, the same reasoning and formulas would apply, but the result would show an excess of negative work, or work of compression.

Any closed curve, such as that represented below (Fig. 3), may represent a reversible cycle; it is only necessary

FIG. 3.

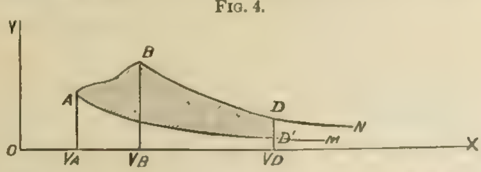


that this curve shall represent the law of pressures and volumes, and that the external pressure shall at each instant be equal to the elastic force. The perimeter of such a curve may be considered as a polygon of an infinite number of sides, these infinitely small sides being isothermal curves and adiabatic curves successively. For such a *composite* reversible cycle the same law may be proved true as for the simple cycle—viz. $Q_1 - Q_2 = A\,F$.

The simple cycle as above described, in which the influence of the interior molecular work is eliminated, was first introduced into science by Sadi Carnot. The application of this method to determine the total exterior work of a cycle represented by the expression $\int p\,d\,v$, was first made by Clapeyron in his commentaries on the work of Carnot.

The following illustrations and demonstrations of Rankine are useful to fix the ideas in regard to the actual energy of any body, and the change of actual energy between two given states:

FIG. 4.



In Fig. 4 let the co-ordinates of the points A and B represent respectively the pressures and volumes of a body in two conditions of heat. Let A M and A N represent two adiabatic curves indefinitely prolonged through the points A and B, and the curve A B the curve representing the pressures as the volume changes from A to B. Suppose the body to pass through the cycle of transformations represented by the lines A B D D′ A, D D′ representing the diminution of pressure at constant volume V_D. The external energy exerted by the body will be represented by the shaded area of the diagram; and the farther the line D D′ is removed, the nearer this area approaches to the area included between the curve A B and the two adiabatic lines A M and A N. This area, then, represents the dynamic equivalent of the heat absorbed by the body between the states A and B. The exterior work produced by the expansion from A to B is represented by the area A B V_B V_A, and the difference between this area and the area M A B N, which represents the equivalent of the whole heat received, represents the difference between the whole heat absorbed and the exterior work produced, expressed the same units in the change from A to B. Since the line A B is common to these two areas, their difference will not be affected by the form of the line, but only by the values of the co-ordinates of its extremities. Hence the *difference* between the whole heat absorbed and the exterior energy exerted during the operation, represented by any such curve as A B, depends only on the initial and final states of the body, and not on the intermediate values of the pressures and volumes. This is a graphical demonstration of the proposition already enunciated in the equation $E.\,d\,Q = d\,W + d\,R + d\,L$; $d\,W + d\,R$, representing the actual and potential energy stored during the change of state; and since

$$\int E.\,d\,Q - d\,L = \int d\,W + d\,R,$$

the difference between the whole heat absorbed and the external work exerted is equal to the total variation of interior work or internal energy between the two states for which the integrals are taken.

Another law, which serves as a basis on which the general mathematical expressions of the principles of thermodynamics are founded, has been alluded to as the second law of thermodynamics. In regard to the enunciation and demonstration of this law, it is difficult to find two writers who agree either in the statement of the principle on which it is based or in the methods of establishing the principle itself. By some eminent writers it is called "the principle of Carnot," by others, "the principle of equivalence of transformations," and by others, "the second law of thermodynamics," while others regard the second law as a sort of corollary of the principle of equivalence. Whatever nomenclature may be adopted, the essential fact remains true, that in developing the mathematical expressions which constitute the fundamental equations of thermodynamics, that which results from the principle of equivalence, $d\,Q = A\,(X\,d\,p + Y\,d\,v)$, is not sufficient. This expression, if true without any further relation between p and v would show that the integral of $d\,Q$ depends only on the initial and final states of the quantities p and v, and we should have

$$\frac{d\,Y}{d\,p} = \frac{d\,X}{d\,v};$$

whereas it may be shown by introducing for Y its value $Z + p$, and finding the value of $\frac{d\,Y}{d\,p}$, that instead of the above equation we shall have

$$\frac{d\,Y}{d\,p} - \frac{d\,X}{d\,v} = 1. \qquad (17)$$

This equation, just established by Clausius, constitutes the *first fundamental equation* of thermodynamics, and shows the relation which exists between X and Y, as derived simply from the principle of equivalence.

It is necessary, therefore, that a further and independent relation shall be found between Q, p, and v, or between Q and t, since p and v are by hypothesis functions of t. We must, then, go to the original conditions of the investigation, and find whether there is any independent relation between Q or $d\,Q$ and the temperature.

The signification of the term "temperature" has been given in the article HEAT. It is a quantity which may be divided arbitrarily into equal parts called degrees. The *absolute* temperature is the temperature estimated from an absolute zero. At the absolute zero all bodies are supposed to be devoid of heat, and as the temperature rises from this point, the power of any body to produce changes either of work or of heat in other bodies increases with the absolute temperature. The capacity of the body for producing changes either of work interior and exterior, or of heat [illegible] known as its sensible heat, this sensible heat or energy depending on the intensity of the molecular oscillation [illegible] it is this sensible heat that is indicated or measured [illegible] thermometer.

The quantities p and v, the pressure and [illegible] those in terms of which the mechanical w[illegible] been estimated; the quantity Q may [illegible] resenting the total heat which a bod[illegible] represents in thermal units the [illegible] which can be exerted by the b[illegible] small change in the value of Q [illegible] terms of p and v, is not the [illegible] is the rational explanation of [illegible] expression $d\,Q = A\,(X\,d\,p + Y\,d$[illegible]

But admitting [illegible] tion of the term "temperature," [illegible]

ergy of a body, that the actual energy is proportional to the absolute temperature, that axiom, applied to the mechanical work which a body is capable of performing at any instant, is expressed by Clausius in the following words: "The mechanical work which can be done by heat during any change of the arrangement of a body is proportional to the absolute temperature at which that change occurs." Here it is important to note the words "at which that change occurs," because experience shows that any change of heat involves a change of absolute temperature. The axiom may be made to accord in phraseology with similar enunciations in ordinary dynamics by stating that the *virtual* work which can be done by the heat of a body during any *virtual* or *infinitesimal* change of the arrangement of the particles is proportional to the absolute temperature.

Let, now, $d\,Q$ represent one of the infinitesimal equal parts into which the heat Q of a body may be divided, $d\,Q$ being the expression for this work in thermal units, and $A\,d\,W$ being the expression for the same quantity in foot-pounds or dynamic units. The axiom above quoted is equivalent to stating that the change of *mechanical arrangement* of the body for this infinitely small quantity of heat at different temperatures is inversely proportional to the absolute temperature. If $d\,P$ represent this change of mechanical arrangement, called by Clausius "the *disgregation* of the body," we shall have for the absolute temperatures $T_1\ T_2$—

$$\frac{T_1}{T_2} = \frac{(d\,P)_2}{(d\,P)_1} \text{ and } \frac{T_2}{T_3} = \frac{(d\,P)_3}{(d\,P)_2}, \text{ etc. etc.,}$$

$$\text{or} \qquad T_1\,d\,P_1 = T_2(d\,P)_2 = T_3(d\,P)_3, \text{ etc. } \frac{d\,Q}{A} = d\,W,$$

or, generally,

$$\frac{d\,Q}{A} = T.\,d\,P \text{ and } \frac{d\,Q}{A\,T} = d\,P.$$

These expressions show that if the elementary changes in mechanical arrangement of a body at different absolute temperatures be multiplied by the absolute temperatures at which the changes occur, the products will represent the corresponding infinitesimal change of heat $d\,Q$, or of work $A\,d\,W$.

The proposition just demonstrated shows that the same elementary quantity of work performed by a body or impressed upon a body at different absolute temperatures will cause a change of heat in the body which will be represented by $\frac{d\,Q}{T}$, T being the absolute temperature at which the change occurs. A new relation is thus established between T, p, and v, by means of which the equation $d\,Q = A.(X\,d\,p + Y\,d\,v)$ may be rendered integrable. Dividing both members of this equation by T, we have

$$\frac{d\,Q}{T} = A\left(\frac{X}{T}\,dp + \frac{Y}{T}\,d\,v\right), \tag{18}$$

and $d\,Q = A\,T\left(\frac{X}{T}\,dp + \frac{Y}{T}\,d\,v\right)$, which is integrable when

$$\frac{d}{d\,v}\left(\frac{X}{T}\right) = \frac{d}{d\,p}\left(\frac{Y}{T}\right). \tag{19}$$

Effecting the differentiation, we have

$$T\left[\left(\frac{d\,Y}{d\,p}\right) - \left(\frac{d\,X}{d\,v}\right)\right] = Y\left(\frac{d\,T}{d\,p}\right) - X\left(\frac{d\,T}{d\,v}\right);$$

and since from a previous result,

$$\frac{d\,Y}{d\,p} - \frac{d\,X}{d\,v} = 1, \tag{20}$$

we have

$$T = Y\left(\frac{d\,T}{d\,p}\right) - X\left(\frac{d\,T}{d\,v}\right). \tag{21}$$

These two equations constitute the *first and second fundamental equations* of the dynamic theory of heat. The last equation shows the relation which exists between the quantities T, X, and Y.

Since T is a function of p and v, we have

$$d\,T = \left(\frac{d\,T}{d\,p}\right)d\,p + \left(\frac{d\,T}{d\,v}\right)d\,v. \tag{22}$$

We now have the following equations:

$$(a) \qquad \left(\frac{d\,Y}{d\,p}\right) - \frac{d\,X}{d\,v} = 1;$$

$$(b) \qquad T = Y\left(\frac{d\,T}{d\,p}\right) - X\left(\frac{d\,T}{d\,v}\right);$$

$$(c) \qquad d\,Q = A\,(X\,d\,p + Y\,d\,v).$$

Substituting the values of Y and X found from equation (b) successively in equation (c), and simplifying the results by means of equation (a), will give the following:

$$(d) \qquad d\,Q = \frac{A}{\left(\frac{d\,T}{d\,p}\right)}\,(X\,d\,T + T\,d\,v);$$

$$(e) \qquad d\,Q = \frac{A}{\frac{d\,T}{d\,p}}\,(Y\,d\,T - T\,d\,p).$$

Equations (a), (b), (c), (d), and (e) may be considered the fundamental equations of thermodynamics. The last three, (c), (d), and (e), give identical values of $d\,Q$, and for the solution of particular problems that one may be chosen which is most convenient, or for which the relation between the variables will give the most simple solution.

These equations are applicable to problems when the relation between the pressure, volume, and temperature of a body is known, and are those which are usually applied to discussions in relation to the permanent gases and vapors. The expression $\frac{d\,Q}{A\,T} = \frac{X}{T}\,d\,p + \frac{Y}{T}\,d\,v$, when integrated for a complete reversible cycle, becomes $\int \frac{d\,Q}{A\,T} = 0$, because the integral of the second member becomes zero when the values of p and v are the same at the end of the cycle as at the beginning. If the cycle is not *reversible*, it may be shown that the value of the integral must always have the same sign; and the form applicable to cycles, $\int \frac{d\,Q}{A\,T} \leqq 0$, is often given as the general analytical condition expressing the second law of thermodynamics.

The determination of the *efficiency* of a fluid in heat-engines in terms of the absolute temperature may be derived directly from the second law of thermodynamics, as enunciated by Clausius, and expressed by the relation

$$\frac{d\,Q}{A\,T} = \left(\frac{X}{T}\,d\,p + \frac{Y}{T}\,d\,v\right) = d\,P,$$

$$\text{or} \quad \frac{d\,Q}{A} = d\,W = T\left(\frac{X}{T}\,d\,p + \frac{Y}{T}\,d\,v\right) = T\,d\,P.$$

Suppose a body having an initial volume O v (Fig. 5), and initial pressure $v\,a$, to expand according to the adiabatic curve A A. Since no heat is received or given out, $d\,Q$ in these equations will be zero, and hence $d\,P$ will be zero, or the quantity represented by (P) is constant for the same adiabatic curve. If the body expands from a to b, according to the isothermal curve $T_1\ T_1$, the temperature being constant, the quantity of heat expressed in units of work expended will be $\int \frac{d\,Q}{A} = \frac{Q_1}{A} = T_1\,(P_b - P_a)$.

Continuing the expansion from b to c, by the adiabatic curve, the value of the exterior work will be equal to the variation of the interior work, or $\int p\,d\,v = -\int d\,U. = -\frac{Q_2}{A}$. If, now, the body be compressed according to the isothermal curve $T_2\ T_2$ from c to d, the quantity of work will be given by the expression $\frac{Q_3}{A} = -T_2\,(P_b - P_a)$.

Continuing the compression by the adiabatic curve $d\,a$ to the point of beginning, the work required for compression will be $-\int p\,d\,v = d\,U = +\frac{Q_2}{A}$. Adding these quantities of work, with their proper algebraic signs, we have $\frac{Q_1 - Q_3}{A} = (T_1 - T_2)\,(P_b - P_a)$. This is the quantity of heat expressed in units of work produced in the cycle, and which has been represented by $A\,F = Q_1 - Q_2$, shown in the shaded area of the diagram.

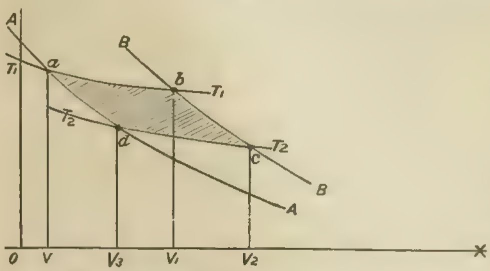
The efficiency of the body in producing work is found by dividing the expression $\frac{Q_1 - Q_3}{A} = (T_1 - T_2)\,(P_b - P_a)$ by $\frac{Q}{A} = T_1(P_b - P_a)$, member by member, which gives $\frac{Q_1 - Q_2}{Q_1} = \frac{T_1 - T_2}{T_1}$; from which we obtain $Q_1 - Q_2 = \frac{Q_1}{T_1}\,(T_1 - T_2)$. In this expression $\overline{Q_1 - Q_2}$ represents the heat transformed into dynamic energy, and Q_1 the whole heat received by the fluid or body during the cycle.

From the above expression may be obtained at once, by performing the operations indicated, $\frac{Q_1}{T_1} = \frac{Q_2}{T_2}$, or $\frac{Q_1}{A\,T_1} = \frac{Q_2}{A\,T_2}$, which shows that the ratios obtained by di-

viding the quantities of heat expended by the corresponding absolute temperatures are equal when a body expands according to the isothermal law between the same adiabatic curves.

The diagram (Fig. 5) may be assumed to illustrate an elementary heat-engine of maximum efficiency, the cycle

FIG. 5.



of changes which the fluid undergoes being such that the whole reception of heat takes place at a constant temperature, and the whole rejection of heat at another lower constant temperature. In an actual heat-engine the efficiency is theoretically in such a case the greatest possible between the given limits of temperature, and is independent of the nature of the fluid employed.

Among the most important applications of the fundamental equations of thermodynamics are those which relate to gases and vapors; and these equations are to be transformed into more specific equations for these classes of bodies by the exact relations which have been established experimentally between the pressure, volume, and temperature for any particular gas or vapor. The fundamental equations being given—

$$\frac{dY}{dp} - \frac{dX}{dv} = 1, \qquad \text{(I.)}$$

$$T = Y\left(\frac{dT}{dp}\right) - X\left(\frac{dT}{dv}\right), \qquad \text{(II.)}$$

$$\left.\begin{aligned} dQ &= A\,(X\,dp + Y\,dv), \\ dQ &= \frac{A}{\left(\frac{dT}{dp}\right)}\,[X\,dT + T\,dv], \\ dQ &= \frac{A}{\left(\frac{dT}{dv}\right)}\,[Y\,dT - T\,dp], \end{aligned}\right\} \qquad \text{(III.)}$$

The transformation of these equations to forms directly applicable to gases is made under the following assumptions:

(1) A perfect gas is a substance in such a condition that it obeys the law of Mariotte and Gay-Lussac rigorously. This gives for the relation between p, v, and T, $p\,v = \text{R.T}$; p being the pressure upon a unit of surface; v the volume of unit of weight (the specific volume); R a constant; and T the absolute temperature of the gas. Air and the so-called permanent gases may also be assumed to follow the same law, the quantity R being assumed constant, although for these gases this is not strictly true.

(2) The specific heats at constant pressure and constant volume of these gases are assumed to be constant. The values of these specific heats are given by the following:

$$d\,Q_p = c_p\,d\,T, \qquad (23)$$

$$d\,Q_v = c_v\,d\,T, \qquad (24)$$

the first giving the quantity of heat to be furnished to a unit of weight of the gases when it is heated under constant *pressure* by the amount d T, and the second the quantity of heat to be furnished to a unit of weight of the gas when it is heated under constant *volume* by the amount d T.

The last of the fundamental equations (c) gives for $d\,Q_p$, under the constant condition ($d\,p$ being zero), or p,

$$d\,Q_p = \frac{A\,Y}{\left(\frac{dT}{dv}\right)}\,d\,T, \qquad (25)$$

and the second from the last (d),

$$d\,Q_v = \frac{A\,X}{\left(\frac{dT}{dp}\right)}\,d\,T. \qquad (26)$$

From these equations we get

$$c_p = \frac{A\,Y}{\left(\frac{dT}{dv}\right)}, \quad c_v = \frac{A\,X}{\left(\frac{dT}{dp}\right)},$$

and

$$Y = \frac{c_p}{A}\left(\frac{dT}{dv}\right), \quad X = \frac{c_v}{A}\left(\frac{dT}{dp}\right).$$

The values of $\frac{dT}{dv}$ and $\frac{dT}{dp}$ are found by differentiating the equation

$$p\,v = \text{R. T.}$$

$$\left(\frac{dT}{dp}\right) = \frac{v}{R}, \quad \left(\frac{dT}{dv}\right) = \frac{p}{R}.$$

These values, substituted in the expressions for Y and X above, give

$$X = \frac{c_v\,v}{A\,R}, \quad Y = \frac{c_p\,p}{A\,R}$$

and

$$\frac{dX}{dv} = \frac{c_v}{A\,R}, \quad \frac{dY}{dp} = \frac{c_p}{A\,R}$$

which, substituted in the first fundamental equation, give

$$c_p - c_v = \text{A. R.} \qquad (27)$$

showing that the difference of specific heats is a constant quantity for each particular gas.

From this result the value of the dynamical equivalent of a unit of heat is $E = \frac{1}{A} = \frac{R}{c_p - c_v}$, which furnishes a verification of the experimental determinations of the dynamic equivalent, R being known for air, and c_p and c_v by experiments. In French units R = 29.272, and $c_p = 0.23751$, $c_v = 0.16844$, E = 423.80, the number found by Joule experimentally being E = 423.55.

The second fundamental equation becomes, on substituting the values of X, Y, $\frac{dT}{dp}$, and $\frac{dT}{dv}$, already found,

$$T = \frac{c_p - c_v}{A\,R} \cdot \frac{P\,v}{R}; \qquad (28)$$

and since $\frac{c_p - c_v}{A\,R} = 1$ and $p\,v = \text{R}\,(273 + t)$, according to the law of Mariotte and Gay-Lussac, we have $T = 273 + t$; t being the ordinary temperature in Centigrade degrees—a formula for finding the absolute temperature when the thermometric temperature is given.

The fundamental formulas furnish the means of determining the quantity of heat which is required for a change of state of a body. To apply these equations to gases, the values of X, Y, $\frac{dT}{dp}$, and $\frac{dT}{dv}$, already found for gases, are to be substituted in each particular case.

It is to be remarked, in the first place, that the specific heat at constant pressure c_p for various gases is obtained from direct experiments. It is greater than the specific heat at constant volume by a quantity which is the thermal equivalent of the work required in expanding the volume of the gas against the constant pressure for an elevation of temperature of one degree. The *ratio* of these specific heats, or $K = \frac{c_p}{c_v}$, determined by various methods, is known for air, and approximately for some other gases, its value for air being K = 1.41; and it is by means of this ratio that the specific heat at constant volume is found. For air it is 0.16844. Denoting the specific heat at constant volume by c, the specific heat at constant pressure will be K c. The substitutions referred to will then transform the equations into the following for gases:

$$\text{(III.)}' \left\{\begin{aligned} dQ &= \frac{c}{R}\,(v\,dp + \text{K}.\,p\,dv), \\ dQ &= c\,dT + \left(\frac{\text{A.R.T}}{v}\right)dv, \\ dQ &= k\,c\,dT - \left(\frac{\text{A.R.T}}{p}\right)dp. \end{aligned}\right.$$

To apply these equations, it is necessary to assume the law by which the pressure changes with the volume. Among the most interesting and important cases in which this law is known are those in which the curves of expansion and compression are the isothermal curve, the isodynamic curve, and the adiabatic curve.

For the isothermal curve the equation [illegible] R.T. becomes $p\,v = \text{R}\,T_1$ = constant. The [illegible] for the permanent gases is therefore an [illegible] hyperbola. This curve can be constructed [illegible] pv is known. Denoting by $p_1 v_1$ the [illegible] we have $p\,v = p_1 v_1 = \text{R}\,T_1$, and $p = \frac{p_1 v_1}{v} = \frac{\text{R}\,T_1}{v}$.

The isodynamic curve [illegible] followed when the interior work is con[illegible] general equation $d\,Q = \text{A}\,d\,U$ [illegible] $\text{A}\,p\,dv$, and the second [illegible] equation (III.)'

for gases becomes, when combined with the equation $p = \frac{R\,T}{v}$,

$$d\,Q = c\,d\,T + A\,p\,d\,v; \qquad (29)$$

hence $d\,U = c\,d\,T$. If $d\,U = 0$, then $d\,T$ must also be zero, or T will be constant: which shows that for the permanent gases, for which the law of Mariotte and Gay-Lussac applies, the *isothermal* and *isodynamic* curves coincide.

The quantity of heat Q expended for any degree of expansion may be found by integrating equation (29), and is $Q = c\,(T - T_1) + A \int p\,d\,v$, and for the isothermal and isodynamic curves, since T is constant, it becomes $Q = A \int p\,d\,v = A\,L$.

Moreover, since the integral of $d\,U$, or the interior work, is represented by $c\,(T - T_1)$, it is thus independent of any particular relation between p and v during the change of temperature $(T - T_1)$, and hence it is established that when a permanent gas passes from one state of pressure and volume to another, the temperature being the same in the two states, the heat furnished is equal to the external work divided by the dynamic equivalent of the unit of heat. The work $L = \frac{Q}{A} = \int_{v_1}^{v_2} p\,d\,v$ may be given in another form:

$$L = \frac{Q}{A} = \int_{v_1}^{v_2} \frac{R_1\,T_1}{v}\,d\,v = R\,T_1 \int_{v_1}^{v_2} \frac{d\,v}{v}; \qquad (30)$$

$$L = R\,T_1 \log \frac{v_2}{v_1} = p_1\,v_1 \log \frac{v_2}{v_1} = p_1\,v_1 \log r; \qquad (31)$$

r being the ratio of expansion, and the logarithms being taken in the Napierian system.

For the adiabatic curve of expansion for the permanent gas the first of equations (III.)′, when $d\,Q = 0$, becomes $v\,d\,p + K\,p\,d\,v = 0$. Dividing by $v\,p$, this becomes $\frac{d\,p}{p} + K \frac{d\,v}{v} = 0$. Integrating, this equation gives

$$p\,v^k = p_1\,v_1^k = \text{constant}; \qquad (32)$$

$p_1\,v_1$ being the initial state. This is the equation of the adiabatic curve passing through the point whose co-ordinates are $p_1\,v_1$.

From the last equation may be obtained the following

$$\frac{p\,v}{p_1\,v_1} = \left(\frac{v_1}{v}\right)^{k-1},$$

or

$$\frac{T}{T_1} = \left(\frac{v_1}{v}\right)^{k-1},$$

or

$$\frac{T}{T_1} = \left(\frac{p}{p_1}\right)^{\frac{k-1}{k}};$$

equations which give the relations between the temperatures and volumes, and temperatures and pressures, when the change of state occurs according to the adiabatic law.

In the work performed during expansion the equation $d\,Q = c\,d\,T + A\,p\,d\,v$ gives, when $d\,Q = 0$ (the condition that the adiabatic law is followed),

$$c\,d\,T + A\,p\,d\,v = 0,$$

$$\text{or} \int c\,d\,T = c\,(T - T_1) = \int A\,p\,d\,v = A\,L;$$

hence the exterior work performed is equal to the change of interior work, and is easily found when the extreme or limiting *temperatures* are given.

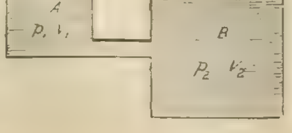
When, however, the initial and final volumes v_1 and v_2, and the initial and final pressures p_1 and p_2 are given, the exterior work is found by the equations—

$$\left.\begin{aligned} L &= \frac{c}{A\,R}\,p_1\,v_1 \left[1 - \left(\frac{v_1}{v_2}\right)^{k-1}\right], \\ L &= \frac{c}{A\,R}\,p_1\,v_1 \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{k-1}{k}}\right] \end{aligned}\right\} \qquad (33)$$

In these expressions $\left(\frac{c}{A\,R}\right)$ may be replaced by $\left(\frac{1}{k-1}\right)$.

The above cases are sufficient to illustrate the applications of the fundamental formulas. Other suppositions in regard to the pressures and volumes lead to special problems of interest: as, for instance, when the pressure remains constant, when the volume remains constant, and when the pressure and volume follow any special law, such as $p^m\,v^n$ = constant. It is unnecessary to follow such cases, as they may be referred to in works on the mechanical theory of heat.

Fig. 6.



Problems connected with the flow of gases and vapors from one reservoir to another, or from a reservoir into the atmosphere, may be solved by the application of the principles of thermodynamics. Suppose two reservoirs A and B, Fig. 6, to be connected by a cylindrical passage, and let the pressure on unit of area in the first reservoir be p_1, the specific volume in the reservoir being v_1. Let the pressure in the second reservoir be p_2, less than p_1, and let v_2 be the specific volume of the gas or vapor in the second reservoir. If V represent the velocity of flow through the passage connecting the two, the living force of unit of weight of the gas or vapor due to this velocity will be $\frac{V^2}{2g}$. The flow being caused by the elastic force of the gas or vapor, a variation of heat equivalent to the work performed by this elastic force will take place, which will be represented by $d\,Q = A(d\,U + p\,d\,v)$. The last term of this equation is in this case equivalent to two terms, $d\left(\frac{V^2}{2g}\right)$ and $d(p\,v)$, since not only actual or sensible velocity is given to unit of weight of the gas or vapor, but a certain quantity of work due to expansion from the specific volume v_1 to v_2 is performed, and we may write

$$d\,Q = A\left(d\,U + d\,(p\,v) + d\left(\frac{V^2}{2g}\right)\right),$$

$$\text{or } d\left(\frac{V^2}{2g}\right) = -\,d\,(p\,v) - d\,U + \frac{d\,Q}{A}. \qquad (34)$$

For a permanent gas,

$$d\,(p\,v) = R\,d\,T,$$

$$d\,U = \frac{c}{A}\,d\,T,$$

and the equation becomes

$$A\,d\left(\frac{V^2}{2g}\right) = -\,A\,R\,d\,T - c\,d\,T + d\,Q,$$

$$\text{or } A\,d\left(\frac{V^2}{2g}\right) = -\,K\,c\,d\,T + d\,Q, \qquad (35)$$

$$\text{since } A\,R - c = K\,c.$$

These are general equations by which particular problems are to be discussed.

The solution of any particular problem requires that the law of expansion shall be known; and since in most cases there is no heat furnished to or abstracted from the gas or vapor during the flow, the law by which the pressures are connected with the volumes may be for such cases assumed to be the adiabatic law, for which $d\,Q = 0$. The above expression then becomes

$$A\,d\left(\frac{V^2}{2g}\right) = -\,K\,c\,d\,T. \qquad (36)$$

In this case we have also

$$\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{K-1}{K}};$$

T_1 being the absolute temperature in the first reservoir, and T_2 that in the plane of the orifice, or near it in the second reservoir.

The value of $\frac{V^2}{2g}$ is found by integration:

$$A\,\frac{V^2}{2g} = K\,c\,(T_1 - T_2);$$

and, combining the two last equations, we have

$$V = \sqrt{2g\,\frac{K\,c}{A}\,T_1\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{K-1}{K}}\right]}. \qquad (37)$$

In practical applications the theoretical velocity must be multiplied by a coefficient, on account of loss due to friction, and the area of the outlet by a coefficient of contraction. (For a full discussion of these coefficients see Zeuner's papers published in the *Civil Ingénieur*.)

The application of the fundamental equations to vapors requires a knowledge of the relation which exists between the pressure p and temperature t, from which the value of the differential coefficient $\frac{d\,T}{d\,p}$ may be found. The experiments of Regnault (see articles Heat and Steam), confirmed by others, show that no simple relation exists between p and t, but that for saturated vapors $p = f\,(t)$: that is, the *pressure depends on the temperature alone*. In a given quantity of a liquid and its vapor the pressure is independent of the proportions of vapor and liquid, and depends only on the temperature. The differential coefficient $\frac{d\,p}{d\,T}$ will then be equal to $\frac{1}{\frac{d\,T}{d\,p}}$.

Regnault's *empirical* formula, applicable to all saturated vapors, for the relation between the pressure and temperature, as given by Rankine, is

$$\log. p = A - \frac{B}{T} - \frac{C}{T^2}, \qquad (38)$$

in which p is the pressure, T the absolute temperature of the boiling-point, and A, B, and C constants. The values of these constants, where they are known from experiments, substituted in the formula, will determine the pressure for any particular vapor. From the above formula the value of $\frac{dp}{dT}$ may be obtained. The values of this coefficient, calculated for different pressures and temperatures, may be found for steam and some other vapors in works on thermodynamics.

Suppose unit of weight of a liquid at the temperature zero and a given pressure to be heated until all the liquid is transformed into vapor at the constant pressure p and a given temperature t. The total heat required will be composed of (1) the quantity of heat necessary to raise the temperature of the liquid to the boiling point t, corresponding to the pressure p; (2) the heat necessary to overcome the molecular attractions of the liquid; and (3) the heat necessary for the expansion of the vapor from the initial volume of the liquid to the volume of the liquid and vapor at the temperature t. Suppose s' to be the initial volume of the liquid; this initial volume may be supposed constant, since the expansion of most liquids by heat is small. Let s be the specific volume of the vapor, then the work of expansion will be $L = \int p\,dv = p\,(s - s') = p\,u$, u being the difference $(s - s')$; and the quantity of heat in units of heat, corresponding to the third quantity of heat above mentioned, will be $(A\,p\,u)$.

The total heat of evaporation from zero degrees will be

$$\lambda = q + r,$$

q being the quantity of heat necessary to raise the temperature of the liquid from 0 to t degrees, and r the latent heat of evaporation at the temperature t. If we subtract $(A\,p\,u)$ from both members, we have

$$J = \lambda - A\,p\,u = q + r - A\,p\,u.$$

The quantity $A\,p\,u$ is the part of the heat which has been transformed into external work. The quantity of heat J therefore represents the part of the heat added which remains in the liquid and vapor. Representing by ρ the quantity $r - A\,p\,u$, this quantity will be that portion of the heat supplied to the liquid which remains in the vapor, or which has not been transformed into exterior work.

If we now consider unit of weight of a *mixture of liquid and vapor*, we may suppose that x represents the proportion by weight of the vapor (a fraction of a pound or kilogramme), and $(1-x)$ the proportion of the liquid, since $x + (1 - x) = 1$. The volume of the vapor will be $x\,s$, and that of the liquid $(1 - x)\,s'$; and the sum of these two volumes will be the volume of unit of weight of the *mixture*, or v, and

$$v = x\,s + (1 - x)\,s'; \qquad (39)$$

or, since $s - s' = u$,

$$v = x.\,u + s'. \qquad (40)$$

In this expression the quantity u remains constant while the temperature is constant, and s' may be regarded as constant; so that $dv = u.\,dx$. When heat is applied to this mixture, a quantity of liquid represented by dx is transformed into vapor, and the heat required is $dQ = r.\,dx$.

From these two equations we obtain the result

$$dQ = \frac{r}{u}\,dv. \qquad (41)$$

The fundamental equation

$$dQ = A\,(X\,dp + Y\,dv)$$

becomes, when t is constant, and consequently p constant, and $dp = 0$,

$$dQ = A\,Y\,dv; \qquad (42)$$

and the fundamental equation

$$dQ = \frac{A}{\left(\frac{dT}{dp}\right)}\,[X\,dT + T\,dv],$$

because $dT = 0$ becomes

$$dQ = \frac{A.T.}{\left(\frac{dT}{dp}\right)}\,dv = A.T.\left(\frac{dp}{dT}\right)dv. \qquad (43)$$

From these results we obtain

$$A\,Y = \frac{r}{u}$$

$$\text{and } \frac{r}{u} = A.\,T.\,\frac{dp}{dT}. \qquad (44)$$

Dividing both members of this last expression by $A\,p$, gives

$$\frac{r}{A\,p\,u} = T\,\frac{dp}{dT}, \qquad (45)$$

an expression from which the value of $A\,p\,u$ for any temperature or pressure may be determined, since r and $\frac{dp}{dT}$ may be found from the results of Regnault's experiments.

When heat is applied to unit of weight of mixture of a liquid and its vapor, the total quantity of heat will be represented by the general expression $\int dQ = \int A\,dU + dL$, from which $dQ = A\,dU + dL$. The external work dL may be represented by $p\,dv$, and this equation becomes $dQ = A\,dU + A\,p\,dv$. The units of heat corresponding to the interior work, dU or $A\,dU$, will be represented by two terms dq, the variation of the heat of unit of weight of the liquid ($= c\,dt$), and $d\,(x\,\rho)$, the variation of the interior work of this vapor, so that the value of $(A\,dU)$ will be $dq + d\,(x\,\rho)$; and the value of dQ becomes

$$dQ = dq + d\,(x\,\rho) + A\,p\,dv, \qquad (46)$$

a general form of equation applicable to mixtures of a liquid and its vapor.

This equation contains the quantities q, ρ, p, x, and v, of which q and ρ may be expressed in terms of p or t, and the quantities x and v may either be expressed in terms of the other, by virtue of the equation $v = x\,u + s'$, expressing x in terms of v, or $x = \frac{v - s'}{u}$, and considering q, ρ, and u as functions of p.

The equation giving the value of dQ is transformed to

$$dQ = \frac{d}{dp}\left(q - \frac{\rho}{u}\,s' + \frac{\rho}{u}\,v\right)dp + \frac{r}{u}\,dv. \qquad (47)$$

Another transformation is obtained by supposing s' constant; then $dv = d\,(x\,u)$ and $A.\,p.\,dv = A.\,p.\,d\,(x\,u)$; and putting for $(\rho + A\,p\,u)$ its value r, the value of dQ may finally be written

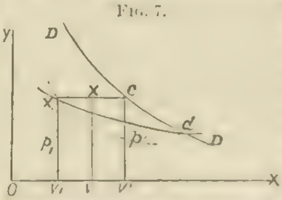
$$dQ = dq + d\,(x\,r) - \frac{x\,r}{T}\,dT. \qquad (48)$$

These expressions for the value of dQ are sufficient for the solution of most practical problems in connection with vapors.

The lines or curve of expansion or compression for vapors when the external pressure is equal to the elastic force may by hypothesis be made the isothermal line, the isodynamic line, the adiabatic line, and a line or curve which has been called the *curve of quantity of vapor constant*.

In Fig. 7 let O X and O Y represent two co-ordinate axes, and suppose unit of weight of saturated vapor having a specific volume v' and pressure p' to expand, the abstraction or supply of heat to be so regulated that the quantity of saturated vapor remains constant. In such a case there is neither condensation nor vaporization, and the corresponding curve of expansion is that of the *quantity of vapor constant*.

Fig. 7.



Dr. Zeuner gives as the probable form of equation of this curve $p\,v^n$ = constant, in which $n = 1.0646$. If, now, in a unit of weight of the mixture of liquid and vapor the quantity of vapor is x_1, less than 1, and the initial volume v_1, the point x_1 in Fig. 7 corresponding to the volume v_1 will be the point at which the pressure is p_1. Whatever curve of expansion be followed, if such a curve cut the line D D of quantity of vapor constant, the expansion beyond that will be that corresponding to superheated vapor.

Suppose, first, that the expansion takes place by the isothermal line. The quantity of heat required for the work of expansion, including both *interior* and *exterior* work, will be given by the equation $dQ = dq + d\,(x\,r) - \frac{x\,r}{T}\,dT$, which may be put under the form

$$dQ = dq + T\,d\left(\frac{x\,r}{T}\right).$$

The isothermal line being that for which the temperature is constant, the quantity in this equation [illegible] 0, and [illegible] constant, and

$$\int dQ = r \int dx,$$

or $$Q = [illegible] \qquad (49)$$

It is evident, also, since p [illegible] line for vapor is a right [illegible] the line x_1 [illegible] in Fig. 7 [illegible] $= p\,u$ [illegible] for compression.

Suppose, now, the expansion to take place according to the *isodynamic* line, or the line for which the interior work remains constant. In this case $d\,U = 0$, the value of $d\,U$ being given by the equation $d\,U = d\,q + d\,(x\,\rho)$. Making $d\,U = 0$, gives $d\,q + d\,(x\,\rho) = 0$. This equation and the equations $v = x\,u + s'$ and $v_1 = x_1\,u_1 + s'$ furnish the means of tracing the curve of expansion between given temperatures or pressures, and also of finding the final values of x_1 and v_1. It may be shown that in all cases there is *a greater proportion of vapor at the end of the expansion than at the beginning*; and hence when a mixture of vapor and liquid expands according to this law, the expansion is accompanied by *vaporization*; and, inversely, there is a *condensation* during compression.

The probable equation of the isodynamic curve for water is given by Dr. Zeuner, $p\,v^n =$ constant, in which $n = 1.0456$. For the quantity of heat required for expansion the general equation $d\,Q = A\,(d\,U + p\,d\,v)$ gives for $d\,U = 0$, $d\,Q = A\,p\,d\,v$; which shows that all the heat furnished for expansion is transformed into external work. It is to be observed that this curve of *expansion* can be followed only when there is liquid in presence of the vapor.

Suppose the vapor at the beginning be saturated, and the value of $x = 1$—or, in other words, no liquid being present—and let it be required to find how much heat must be supplied to cause it to remain saturated during the work of expansion; in which case the expansion curve would be the curve D D, the initial point being c, Fig. 7. The equation $d\,Q = d\,q + d\,(x\,r) - \frac{x\,r}{T}\,d\,T$, by substituting for $d\,q$ its value $c\,d\,T$ and effecting the integration in the second member, may be put under the form

$$d\,Q = (1 - x)\,c\,d\,T + r\,d\,x + x\left(c + \frac{d\,r}{d\,T} - \frac{r}{T}\right), \quad (51)$$

or

$$d\,Q = (1 - x)\,c\,d\,T + r\,d\,x + x\,h\,d\,T, \quad (52)$$

in which $h = c + \frac{d\,r}{d\,T} - \frac{r}{T}$. If now in this expression $x = 1$ and $d\,x = 0$, which accords with the conditions of the problem, then

$$d\,Q = h\,d\,T. \quad (53)$$

h then may be regarded as the specific heat of saturated vapor, the quantity of vapor remaining constant. By integration we have

$$Q = \int_{t_1}^{t_2} h\,d\,T. \quad (54)$$

The equation which gives the value of h shows that it may have a positive or negative sign: and as h depends on the temperature, there will be a point of temperature for every vapor at which the sign h will change. Moreover, the value of $Q = \int_{t_1}^{t_2} h\,d\,T$ shows that whether heat is to be supplied or abstracted during expansion depends on the sign of h. For most vapors at ordinary temperatures h is negative, the vapor of ether excepted; and since t_2 is less than t_1, Q will have a positive value. It is then necessary to supply heat *during expansion in order to maintain the quantity of vapor constant*. If no heat be supplied, a portion of the vapor will be condensed. This law is reversed at the temperature at which the sign of h changes; for ether this is $-150°$ C. For water the point of inversion is $520°$ C.

The adiabatic curve of expansion or compression is one for which no heat is supplied to or abstracted from the vapor during expansion or compression. This condition, introduced into the general equation $d\,Q = d\,q + d\,(x\,r) - \frac{x\,r}{T}\,d\,T$, or the same under the form $d\,Q = d\,q + T\,d\left(\frac{x\,r}{T}\right)$, gives for $d\,Q = 0$,

$$0 = d\,Q + T\,d\left(\frac{x\,r}{T}\right); \quad (55)$$

an equation which becomes, by integration,

$$\frac{x\,r}{T} + \int \frac{d\,q}{T} = \text{constant}, \quad (56)$$

or

$$\frac{x\,r}{T} + \tau = \text{constant}. \quad (57)$$

This equation furnishes the means of finding the value of x and the ratio of expansion when the initial value of x and the limiting temperatures are given, r and q being dependent on the temperature. This expression, which is applicable to a mixture of vapor and liquid, may be written

$$\frac{x\,r}{T} + \tau = \frac{x_1 r_1}{T_1} + \tau_1. \quad (58)$$

If applied to the vapor of water, it may be proved by examples that expansion by the adiabatic curve of dry and saturated vapor is accompanied by condensation, the value of x diminishing during the expansion.

If liquid water only is present in the initial state, the quantity x_1 being zero, it appears that there will be vaporization during expansion. The same is true for most vapors at ordinary temperatures. Whether there will be vaporization or condensation during expansion depends, then, on the proportion of the mixture which exists in the liquid state at the initial temperature. For water, when the mixture is about $\frac{5}{10}$ths, or one-half, the same proportion will exist at the end of the expansion, there being at first vaporization, and then condensation of nearly the same quantity.

The quantity of exterior work performed or expended when the change of state occurs according to the adiabatic law may be found from the expression $d\,Q = A\,(d\,U + d\,L)$. Making $d\,Q = 0$, gives

$$A\,d\,L = -A\,d\,U,$$

or

$$A\,d\,L = -d\,q - d\,(x\,\rho),$$

and by integration

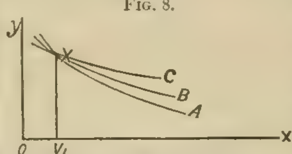
$$A\,L = q_1 - q + x_1\,\rho_1 - x\,\rho. \quad (59)$$

The equation of the adiabatic curve expressing the relation between p and v has a probable form for vapors, according to Zeuner, $p\,v^n = p_1\,v_1{}^n$, in which n is variable, depending on x_1, the quantity of vapor in unit of weight of liquid at the initial temperature. For water the values of n are for

$x_1 = 1$ .... $n = 1.135$
$x_1 = 0.9$ .... $n = 1.125$
$x_1 = 0.8$ .... $n = 1.115$
$x_1 = 0.7$ .... $n = 1.103$

The relative positions of the three curves, the adiabatic, the curve of quantity of vapor constant, and the isodynamic curve, for a mixture of liquid and vapor, all the curves passing through the same initial point, are shown in the following diagram, Fig. 8, in which A is the adiabatic curve, B the curve of quantity of vapor constant, and C the isodynamic curve.

FIG. 8.



The quantity of work of expansion for any gas or vapor, the equation of which is $p\,v^n = p_1\,v_1{}^n =$ constant, is

$$L = \frac{p_1 v_1}{n - 1}\left[1 - \left(\frac{v_1}{v_2}\right)^{n-1}\right]$$

or

$$L = \frac{p_1 v_1}{n - 1}\left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}}\right] \quad (60)$$

the exponent n having a value which depends on the nature of the fluid which expands. For air and the permanent gases n may be taken equal to 1.410. For saturated steam, in presence of its liquid, n is variable, and depends on the relative initial quantities of liquid and vapor.

For superheated vapor, according to the law of Hirn, the isodynamic curve is an equilateral hyperbola, starting from the point of condensation, its equation being $p\,v = p_1\,v_1 =$ constant. The law established by Hirn being that the product $p\,v$ is proportional to the *interior work* for superheated vapors, if that work is constant, or if the isodynamic curve is followed, the above equation will represent the curve.

The adiabatic curve for superheated vapor has the probable form $p\,v^n = p_1\,v_1{}^n$, in which n, according to Zeuner, is equal to $\frac{4}{3}$, or 1.333.

The isothermal curve for superheated vapor differs from that for the permanent gases. In a perfect gas all the heat introduced at constant temperature is transformed into external work, while in superheated vapor a part of this heat, especially near the point of condensation, is transformed into interior work. The equation of the isothermal curve has the probable form, according to Zeuner, of

$$p\,v = B\,T - C\,p^{\frac{n-1}{n}}, \quad (61)$$

in which for steam $n = \frac{4}{3}$, $C = 192.50$, $B = 50.933$, p being expressed in kilogrammes per square mètre.

Applications of the principles of thermodynamics to the flow of vapors may be found in various works on the subject, the investigations of Dr. Zeuner being the most recent and complete. The reader is referred for full expositions of the subject of this article to the works of Clausius, Rankine, Sir William Thomson, Zeuner, Hirn, Briot, Verdet, and others. W. P. TROWBRIDGE.

Thermo-Electricity. See ELECTRICITY, by PRES. H. MORTON, PH. D.

Thermometer. See THERMOMETRY.

Thermom′etry [Gr. θέρμη, "heat," and μέτρον, "measure"], the art of measuring temperatures by the expansion of solids, liquids, and gases, or by means of some electrical, acoustic, or other physical phenomena. Liquids have been found best adapted to measuring lower temperatures, the expansion of solids being too small and that of gases too great for ordinary purposes. It is probable that Cornelius Drebbel, a Hollander, in the year 1630 first proposed a method for indicating changes of temperatures by means of a glass bulb with a small elongated stem, which was dipped into a liquid; as the air became heated, the liquid was depressed by the expansion of the air, a reduction of temperature causing a corresponding elevation. This instrument, which was the origin of the air thermometer, was open to several objections: it was too delicate in its indications and too large in size to be of much practical use; besides, differences in atmospheric pressure independent of temperature affected the volume of the air. The latter difficulty was remedied by totally excluding the air, two bulbs being blown at the two ends of a tube, which was bent twice at right angles and a liquid enclosed in the stem. But this instrument, which is termed a *differential thermometer*, only indicated differences of temperature between the two bulbs, and not variations in the atmosphere generally; for some purposes, however, it is still advantageously employed. The next improvement was effected by Boyle, who suggested the use of alcohol in a closed tube, to which a scale indicating the changes of temperature was attached. Newton next took advantage of the fact that the melting-point of ice and the boiling-point of water furnish two fixed temperatures, and divided the intermediate range between these points into equal parts, extending both above and below the two fixed marks.

Alcohol and mercury possess many advantages for thermometrical purposes. Alcohol does not solidify at any known degree of cold. Mercury has a very high boiling-point, follows nearly the same law of expansion as gases, possesses a wide range of liquidity, has a low specific heat, but a high conducting power, and can be obtained in a state of great purity. Its use in the construction of a thermometer was first suggested by Römer. The ordinary mercurial thermometer consists of a glass tube, at the end of which is blown a spherical or cylindrical reservoir, termed the bulb. In its manufacture three operations are comprised—viz. the calibration of the tube, the introduction of the mercury, and the graduation of the scale. The calibration of the tube is effected by introducing a column of mercury about an inch in length, and ascertaining that it retains the same length in all parts of the tube, care being taken that the metal is maintained at a uniform temperature. The tube, which is advantageously provided at its open extremity with a funnel or a bulb, is next filled with mercury by gradually introducing the metal, inclining the tube, and heating the bulb, in order to expel the air, until both the bulb and stem are completely filled. The mercury is then heated to boiling, and the tube hermetically sealed by melting it below the funnel or upper bulb. The graduation of the thermometer is accomplished by first determining the two fixed points—*i. e.* the melting point of ice and the boiling-point of water. The former is ascertained by immersing the bulb and part of the tube in snow or pounded ice which is contained in a vessel provided with an aperture allowing the escape of the water; the latter, by surrounding the thermometer with steam, external contact with the air being prevented. It is also necessary, in the latter determination, to take into consideration the barometric pressure of the air, and in case this be other than 760 millimètres, a correction of the result should be made. The interval or range between the freezing and boiling points is next subdivided into equal parts or degrees. In accurate thermometers the scale is marked on the stem itself. This is done by covering the stem with a thin coating of wax, in which the divisions and their corresponding numbers are traced with a finely-pointed steel, exposing it to the action of hydrofluoric acid, which etches in the glass the traced figures, and afterward removing the remaining wax. The degrees are usually represented by a small cipher, placed above the right of the number indicating the temperature, those below the zero or freezing point of water having the minus sign (−) placed before them. It is a source of regret that unanimity does not prevail in different countries in regard to the number of divisions made between the two fixed points. In the thermometer used for ordinary purposes in this country and in England and Holland, *Fahrenheit's* (1720) scale is employed, in which the range between the freezing and boiling points of water is subdivided into 180 degrees. This division was based upon a very erroneous and arbitrary assumption of the inventor, the original manufacturer, that the temperature indicated by 32° below the freezing-point of water represents the absolute absence of heat. In France, and on the Continent generally, the scale introduced by *Celsius* (1742) is employed. In this thermometer, which is commonly known as the *Centigrade*, the interval between the freezing and boiling points is divided into 100 equal parts. For scientific purposes the Centigrade thermometer is, at present, almost universally used. A third scale, suggested by *Réaumur*, is still employed in Russia and Germany. In it the range between the fixed points, which are the same as in the Centigrade scale, is divided into 80 degrees. The degrees indicating the temperature of melting ice, the intermediate range, and the temperature of boiling water in the three scales are as follows:

	Temperature of melting ice.	Intervals.	Temperature of boiling water.
Centigrade scale (C.).....	0°	100°	100°
Fahrenheit's scale (F.)...	32°	180°	212°
Réaumur's scale (R.)......	0°	80°	80°

The reduction of degrees from one scale into those of another is accomplished by the simple formulæ:

Fahrenheit to Centigrade, $\frac{5}{9}(F.^\circ - 32) = C.^\circ$
Centigrade to Fahrenheit, $\frac{9}{5}C.^\circ + 32 = F.^\circ$
Réaumur to Fahrenheit, $\frac{9}{4}R.^\circ + 32 = F.^\circ$
Fahrenheit to Réaumur, $\frac{4}{9}(F.^\circ - 32) = R.^\circ$
Centigrade to Réaumur, $\frac{4}{5}C.^\circ = R.^\circ$
Réaumur to Centigrade, $\frac{5}{4}R.^\circ = C.^\circ$

When the measurement of low temperatures is required, the alcoholic thermometer is advantageously employed. In other instances the irregular expansion and low boiling point of the alcohol (78.4° C.) are serious objections to its use. The latter difficulty may, however, be overcome to some extent by the substitution of amylic alcohol, which indicates correctly temperatures up to 120° C. In all cases the alcohol should be distinctly colored, usually by boiling with cochineal, and the scale compared with that of a standard mercurial thermometer.

In a good thermometer the mercury will fall through the tube on inversion, thus proving the perfect exclusion of air. Slight variations of temperature are best indicated when the capillary tube is very small and the bulb large. On the other hand, if the bulb be small, the thermometer more rapidly assumes the temperature of the surrounding medium. Upon immersing the bulb and stem in melting ice, the top of the mercury column should exactly indicate 0° C. or 32° F., and the mercury should remain stationary at 100° C. or 212° F. when the thermometer is surrounded by steam generated by boiling water in a metallic vessel at a barometric pressure of 760 millimètres. The volume of the degrees should be perfectly uniform. Whether this is the case may be ascertained by detaching a little cylinder of mercury from the main column and passing it from one part of the stem to another, when, if the scale be properly graduated, it will occupy an equal number of degrees in all parts of the tube.

Thermometers, even when constructed with the greatest care, are liable to undergo changes which affect their accuracy. One source of error consists in a deviation of the zero point, which is liable both to a temporary depression and elevation, and to a permanent elevation. The former changes ensue when a thermometer has been repeatedly heated, a temporary fall then occurring, and when it has been much cooled, a temporary rise then taking place. The second change, which is probably due to a diminution of the volume of the bulb, and to the influence of atmospheric pressure on the stem, is avoided by allowing the filled tube and bulb to remain at rest for two or three years before the instrument is graduated. The assumption that equal increments of heat produce an equal amount of expansion is not absolutely correct, the expansion of mercury, for example, between 0° and 10° C. being less than the expansion between [illegible] and 100° C. In the mercurial thermometer, however, this difference is nearly equalized by the increased capacity of the glass [illegible] temperature between the freezing and boiling points [illegible] to those above 100° C. the compensation is [illegible]. Certain precautions are to be observed in [illegible] temperature indicated by a thermometer [illegible] should be held in a perfectly vertical position [illegible] scale is a little distant from the mer[illegible] should be taken that the line of sight [illegible] the scale. In very accurate observations [illegible] should possess the same temperature [illegible] taken with the assistance of a te[illegible]

Besides the kind of thermo[illegible] several other varieties are [illegible] purposes.

Breguet's metallic th[illegible] expansion of metal[illegible] It consists of three [illegible] gold, and silver, wh[illegible]

of which is fixed, the other being connected with a light needle, which moves round a scale, graduated in Centigrade degrees by comparison with a standard mercurial thermometer. The most expansible metal, silver, forms the internal side of the spiral, platinum forming the external; gold is placed between the other two metals, as its expansibility is intermediate between that of silver and platinum. When the temperature rises, the silver expands more than the gold or platinum, and the spiral unwinds, and communicates a motion to the index-needle, an opposite motion being produced by decrease of temperature.

In meteorological observations it is often necessary to know the highest temperature of the day and the lowest temperature of the night. The instruments which most readily permit of these determinations are termed *registering* or *maximum and minimum thermometers*. *Rutherford's maximum and minimum thermometer* consists of a mercurial thermometer with a horizontal stem, in the bore of which a small piece of steel wire is included above the mercury. Upon an increase of temperature the mercury expands, pushing the steel wire before it, but as it contracts and recedes the wire is left in a position corresponding to the greatest temperature recorded by the thermometer. The minimum temperature is observed by an alcoholic thermometer, arranged like the mercuric one, but having an index consisting of a small piece of enamel sunk below the surface of the liquid. As the alcohol contracts, the index is carried along by capillary attraction; when the temperature rises, the liquid readily passes the enamel, which is thus left in a position indicating the greatest point of contraction of the alcohol. The same object is attained by the use of *Six's maximum and minimum thermometer*, consisting of a large bulb filled with alcohol, to which is joined a tube bent in the form of an inverted syphon, in the lower part of which a small column of mercury is contained. The extreme points reached by the mercury, as it is moved by the expansion and contraction of the alcohol, are registered by a small enamelled wire index, sliding in the leg of the bent tube, which is prevented from falling by its own weight by means of a small spring. Six's thermometer has been applied with success in measuring the temperature of the ocean at great depths, where an ordinary thermometer would give erroneous indications in consequence of the pressure sustained by the bulb. For this purpose it is necessary to surround the bulb with a second bulb nearly filled with alcohol, which protects it from the heat caused by the compression of the water. The *maximum thermometer of Negretti and Zambra*, which is simple in form and not liable to derangement, consists of an ordinary mercurial thermometer placed horizontally with a narrow contraction in the tube just above the bulb, which allows the mercury to pass as it expands, but prevents its receding as the temperature falls. *Phillips* has constructed a *maximum thermometer*, the index of which is merely a small portion of the mercurial column, which is separated from the rest by a minute globule of air. In these two latter thermometers the mercurial column is restored to its place by placing the instrument in a vertical position and giving it a few shakes.

For the determination of temperatures higher than the boiling-point of mercury, but lower than the melting-point of glass, the method of *air thermometry of Regnault* is occasionally resorted to. It consists in employing a cylindrical glass reservoir, which terminates at one end in a narrow glass tube, bent at a right angle, and drawn out to a fine point at its extremity. The instrument is introduced into the space the temperature of which is to be estimated until it has acquired the same temperature, when the narrow orifice is closed by fusing the glass, care being taken to note the barometric pressure and temperature of the surrounding air. The sealed point of the tube is then broken off in a vessel containing mercury, and the reservoir reduced to 0° C. by surrounding it with melting ice. As the air contained in the instrument contracts, a certain amount of mercury rises in the tube. The height of the column above the surface of the mercury contained in the vessel and the position of the barometer are ascertained, the tube is closed with a little wax, and the instrument removed from the vessel and weighed at the ordinary temperature of the air. It is then again weighed when completely filled with mercury, its weight when empty being also determined. The weight of the mercury necessary to entirely fill the instrument will bear to the difference between this weight and that of the mercury contained in it at the first weighing the same proportion as the total capacity of the thermometer, at the temperature of the mercury with which it was filled, bears to the volume occupied (at 0° C., and subjected to the atmospheric pressure diminished by the column of mercury, which extended above the vessel containing the metal) by the air which the thermometer contained when its orifice was sealed. Thus, the temperature to which the reservoir was exposed can be obtained, expressed in Centigrade degrees, by means of the formula—

$$W\,(1 + k\,t) = w\frac{h}{H}\,(1 + a\,t), \text{ or } t = \frac{W - w\,\frac{h}{H}}{w\,\frac{h}{H}\,a - W\,k},$$

where W is the weight of the mercury which completely filled the thermometer; w, the difference between this and the weight of the mercury contained at the first weighing; t, the temperature required; H, the barometer stand when the orifice of the tube was sealed; h, the pressure supported by the air in the instrument when it was closed with the wax—*i. e.* the barometric pressure noted at this moment—the column of mercury extending above the vessel; a, the coefficient of expansion of air for 1° C. = 0.00366; k, the coefficient of cubical expansion of the glass of which the thermometer is constructed = 0.0000305 for common glass between 0° and 300° C.

Radiant heat of very low intensity can best be measured by means of an instrument termed the *thermo-multiplier* of Melloni. The sensitiveness of this thermometer is so great that the heat of the human body produces effects upon it, even at the distance of several yards. It is constructed by first arranging a *thermo-electric battery*, connecting together successive pairs of two different metals, and heating the alternate junctions, the others being kept cool. Melloni employed such a battery, consisting of 36 pairs of small bars of bismuth and antimony. The heat generated is estimated by connecting the instrument with a very sensitive galvanometer. (See ELECTRICITY.) By the use of such an apparatus he was able to estimate very small amounts of radiant heat, even that emitted by insects. (See also RADIOMETER.) In order to determine temperatures higher than the boiling-point of mercury (360° C.) a modification of the thermometer, known as the *pyrometer*, which appears to have been first introduced by Musschenbroek in 1730, is employed. Numerous forms of this instrument have since been suggested, most of which are based upon one of the following phenomena: the expansion of metals; the contraction of baked clay; the expansion of vapors and gases; the fusing of metals or alloys; the increase of temperature imparted to a weighed quantity of water by a known weight of heated platinum or iron; electrical and thermo-electrical changes. The indications furnished by pyrometers based upon the linear expansion of metals have been found to be inaccurate; the data given by the contraction of baked clay when exposed to an increase of temperature are still less reliable.

The *air pyrometer of Erman and Herter* is similar in principle to that of Regnault above, and consists of a hollow copper or platinum sphere provided with a short, conically-shaped tube having a very narrow orifice, to which a copper cylinder, furnished with a stopcock at its extremity, can be attached. In order to determine the temperature of a furnace by means of this instrument, it is so placed in the heated place that a small portion of the tube extends out. As soon as the sphere has acquired the heat of the furnace, the copper cylinder is securely connected with the end of the tube, and the stopcock is closed. The apparatus is then withdrawn from the furnace, and as soon as it has become cool it is immersed in water, and the stopcock opened, when a certain quantity of water is drawn into the sphere, from the weight of which the amount of expelled air, and thereby the temperature to which the sphere was subjected, is calculated.

A method for measuring high temperatures suggested by Pouillet, which receives extensive practical application in metallurgical operations in the determination of the heat of furnaces, consists in heating in the fire-space a known weight of iron, and immersing it in a weighed quantity of water of a known temperature. The weight of the iron and water, the original and final temperature of the water, the specific heat of water and of iron, furnish the data from which the temperature desired can be easily calculated.

Our American physicist, Alfred M. Mayer, has recently determined high temperatures by observing the action of heat upon the wave-length of a wave of sound, which is made to traverse a tube exposed to the heat to be measured. (For a description of other methods of pyrometry see PYROMETER.) J. P. BATTERSHALL.

Thermo-Multiplier. See THERMOMETRY.

Ther'mopile, also called **Thermo-electric Pile.** See ELECTRICITY, by PRES. HENRY MORTON, PH. D.

Thermop'ylæ, a narrow defile between Mount Œta and the Maliac Gulf, leading from Thessaly into Locris. It was the only way by which an enemy could enter from Northern Greece into Hellas, and became celebrated as the scene of the heroic death of Leonidas and his 300

Spartans in their attempt to prevent the Persian hordes from passing through the defile. The localities are much altered now by the action of the sea and the rivers.

Thermot'ics, the science of HEAT (which see).

Théroigne' de Mirecourt', whose true name was ANNE JOSÈPHE TERWAGNE, b. at Marcourt, Luxemburg, Aug. 13, 1762; was educated in a convent, but went in 1789 to Paris, where she lived as a courtesan, and at times sank very low. By embracing the Revolution with great enthusiasm she made a new departure; appeared in public meetings as the Amazon of the Revolution; made speeches, was eloquent, and acquired some influence both over the mob and in the political coteries. In 1791 she was captured by the allies on a trip in Holland, and imprisoned in Vienna for nearly a year. Restored to liberty, she repaired to Paris, and became still more popular; but on May 31, 1793, while trying to defend her lover, Brissot, she was seized by a rabble of infuriated women in the garden of the Tuileries, stripped naked, and whipped. This drove her mad, and she spent the rest of her life in La Salpêtrière, where she d. June 9, 1817. (See Fuss, *Théroigne de Mirecourt*, 1854.)

Therol'ogy [Gr. θήρ, θηρός, "wild beast," and λόγος, "discourse"], a name sometimes substituted for the word "Mammalogy," on the ground that the latter is a hybrid compound of Latin and Greek, and therefore inadmissible on strict philological principles. It is, however, rarely used. (See MAMMALOGY.) THEODORE GILL.

Thesaurus. See LEXICON.

The'seus, in Grecian mythology, the national hero of Attica and the founder of the city of Athens, where he established the Panathenæan festival and the Pythian games; was a son of Ægeus and Æthra, and was married first to Antiope, the queen of the Amazons, whom he carried off, afterward to Phædra. He took part in the campaign of the Argonauts, in the Calydonian hunt, in the battle with the Centaurs, etc., but his most famous exploit was the slaying of Minotaur. Attica was bound to send annually a tribute of youths to Crete to be sacrificed to this monster. In order to put an end to this misery, Theseus repaired to Crete and won the affection of Ariadne, the daughter of King Minos, who provided him with a clue to the labyrinth and a sword to kill Minotaur; he slew the monster and carried off Ariadne, whom he afterward left on Naxos. During a revolution in Athens he fled to Scyros, where he perished by the treachery of King Lycomedes, but in 469 B. C. Cimon conquered Scyros and brought his bones back to Athens, where they were interred in the celebrated temple of Theseus, one of the finest buildings in Athens, which during the Middle Ages was used as a Christian church, but now is employed as a museum. By the sculptors Theseus was sometimes represented as resembling Hercules, with a lion's skin and a club, though of a lighter and fleeter form and of a more elevated expression; sometimes as resembling Hermes, with chlamys (a short cloak) and petasos (a cap).

Thesiger. See CHELMSFORD.

Thes'pis, a native of Icaria in Attica and a contemporary of Pisistratus, became the inventor of the Greek tragedy by introducing between the dithyrambic chorus at the festival of Dionysus an interlocutor, an actor, who in monologues, or perhaps in dialogues with the leaders of the chorus, narrated, or gave a mimetic representation of, the incidents to which the songs referred. Nothing of his writings, if he wrote anything, has come down to us, but it is probable that his dramatic representations were very far from that sublime and solemn character which we know from Æschylus. Nevertheless, the curious picture of Thespis strolling around from place to place and entertaining people with shows from his wagon is a misconception of a time in which the theatre and drama had lost all religious signification, and become a mere amusement of the multitude. It is Horace who gave currency to this idea.

Thessalo'nians, First Epistle of St. Paul to the, was written from Athens or Corinth in 53 A. D. to the Church at Thessalonica. It contains encouragement for the infant Church, and warnings against licentiousness and avarice.

The SECOND EPISTLE TO THE THESSALONIANS was written by St. Paul from Corinth soon after the first, to counteract certain misapprehensions as to the speedy second advent of Jesus Christ, and the consequent disposition to idleness. They are first in chronological order of Paul's Epistles.

Thessalonica. See SALONICA.

Thess'aly, or **Thessa'lia,** a large division of ancient Greece, bounded E. by the Ægean Sea, N. by Macedonia, and W. by Epirus. The surface is a plain, enclosed on all sides by mountains—Pelion and Ossa on the E., Olympus and the Cambunian Mountains on the N., Pindus on the W., and Orthrys on the S. The soil is very fertile, and the land was in ancient times famous for its wheat and its fine breed of horses. The inhabitants were Æolians, but very early the Epirotes invaded and conquered the country, and made the inhabitants their slaves. The government was oligarchical, but very often disturbed by internal wars, which was the reason why Thessalia never exercised any influence on the affairs of Greece. It was conquered by Philip of Macedon, and passed from Macedonia into the hands of the Romans.

Thet'ford, tp., Genesee co., Mich. P. 1260.

Thetford, p. v. and tp., Orange co., Vt. P. 1613.

The'tis, in Grecian mythology, a daughter of Nereus and Doris, and the leader of the Nereids, was married to a mortal man, Peleus, king of the Myrmidons in Thessaly, because an oracle had declared that she should bear a son who would become more famous than his father, for which reason none of the gods wanted to marry her. She bore several children to Peleus, but they all perished under her attempts to make them immortal, with the exception of the youngest, Achilles, whom the father saved by interrupting the mother's experiments. Provoked, Thetis left Peleus and returned to the waters whence she had come, but she followed the fortunes of her son with passionate sympathy.

Thévenot' (MELCHISEDECH), b. in Paris about 1620; travelled much in Europe; held official positions at Genoa in 1645 and in Rome 1652–54; became keeper of the Royal Library in Paris in 1684, and published *Relations de Divers Voyages curieux* (2 vols. fol., Paris, 1663–72) and *Recueil de Voyages* (1681), containing Marquette's *Découvertes dans l'Amérique septentrionale*. D. at Issy Oct. 29, 1692. His nephew, JEAN DE THÉVENOT, b. in Paris June 6, 1633; travelled extensively in Europe, Northern Africa, Central and Southern Asia. D. at Miana, Armenia, Nov. 28, 1667. His *Voyages* were published separately in 1664 and 1684; collected in 5 vols. in 1689. He introduced coffee into France in 1655.

Theza, town of Morocco, on the Sebu, in lat. 34° 9′ N., lon. 3° 55′ W., is fortified, has a fine mosque, and carries on some trade with Algiers, Tlemcen, and Fez. It is famous for its excellent water. P. 5000.

Thian'-Shan ("celestial mountains"), a lofty mountain-chain in Central Asia, extends in lat. 42° W. from lon. 80° to 90° E., forming the boundary between Thian Shan Nanloo, or Toorkistan, and Thian Shan Peloo, or Soongaria. It is volcanic, and several of its peaks rise to the height of 21,000 feet, but very little is known about it.

Thibaudeau' (ANTOINE CLAIRE), b. at Poitiers Mar. 23, 1765, where he subsequently practised as an advocate; was elected a deputy to the Convention in 1792; voted for the execution of the king without appeal to the people, but fell out, nevertheless, with the Terrorists; was chosen president of the Council of Five Hundred in 1796, but was proscribed by the Directory; became a member of the council of state under the Consulate and Empire, and was made a count in 1808, but was banished from France by the ordinance of July 26, 1815, and lived in Prague, engaged in mercantile business, till 1830, when he returned to France; was made a senator after the *coup d'état*, Dec. 2, 1851. D. Mar. 8, 1854. Besides several other works, he wrote *Mémoires sur la Convention et le Directoire* (2 vols., 1824) and *Mémoires sur le Consulat et l'Empire* (10 vols., 18[illegible]).

Thibaut', or **Thibaud,** b. at Troyes in 1201, a posthumous son of Count Thibaut of Champagne, and Blanche, daughter of King Sancho the Wise of Navarre; was educated at the court of Philip Augustus; took an active part in the political entanglements after the death of Louis VIII.; became king of Navarre in 1234; made an utterly unsuccessful crusade in 1239; persecuted the Albigenses in his territories, which in other respects he governed well. D. at Pampeluna July 10, 1253. Among the [illegible] he occupies a high rank. 66 poems by him were published in 1742 by Levesque de la Ravalière, and 81 are found in Tarbé's *Collection des Poëtes champenois* (1851).

Thi'baut (ANTON FRIEDRICH JUSTUS), b. at H[illegible] Hanover, Jan. 4, 1774; studied law at Göttingen, [illegible] berg, and Kiel, and became professor of [illegible] 1799 at Kiel, in 1802 at Jena, and in 18[illegible] at [illegible] where he d. Mar. 28, 1840. His *S*[illegible] *rechts* (2 vols., 1803) has been often [illegible] *Die Nothwendigkeit eines allgemeinen* [illegible] *für Deutschland* (1814) was [illegible] *Über Reinheit der Tonkunst* (18[illegible]) [illegible], but very interesting musical con[illegible]

Thib'et, or **Tibet** [illegible] the Thibetan words *thub pa* and *p*[illegible] and combined for the [illegible] the expression, **Eastern** and **Western.** [illegible] Marco Polo's travel[illegible]

valley lying between the Himalaya in the S. and the Karakorum or Thangla "pass over the steppes" in the N., and drained on the E. by the Tsang Po, which by some is considered to be the Brahmapootra, and on the W. by the river-systems of the Indus and Sutlej. Its eastern and western boundaries are formed by two mountain-ranges which run respectively in southern and south-western directions, under lon. 97° and 73° E. Its total area is estimated at 1,480,100 sq. m., of which Eastern Thibet, or the Chinese province of Thibet, comprises 1,000,000; Western Thibet, or the Cashmerian province of Ladak, 39,100; and the territory of the independent Kanjoot tribes in the valleys of Gilgit, Hunza, Nagar, and Yassin, W. of the Indus River, 9000 sq. m. With respect to its surface Thibet forms an elevated, undulating valley hemmed in between high mountain ranges, whose peaks in the Kailas or Gangri (Tise) group, near the watershed between the Indus and the Sutlej, reach a height of 22,000 feet: the watershed itself is situated at an elevation of 15,500 feet. This Gangri group and the adjoining Karakorum or Thangla range, as well as the desert-steppes which extend northward to the Kün-Lün, have been explored only in their western parts; no European has ever visited the central regions. We only know that a division takes place into two almost equally high branches, which to the N. and S. enclose a depression of no considerable depth, probably of an average height of 15,000 feet, and with an inclination from W. to E. The Kün-Lün (Kwen-Lun), the northernmost of the mountain-systems of High Asia, is beyond the boundary of Thibet. Its valleys are elevated plateaus, which, as far as we know, slope gently toward the Karakorum range. Lakes are numerous and of large size, but the precipitation not balancing the evaporation, they have lost considerably in bulk, and their waters have often become briny. In Southern Thibet are the Byanbrog, commonly written *Yamdok* or *Chamdok*, a fresh-water lake situated at an elevation of 13,700 feet, comprising an area of 116 quadrate kilomètres, and containing a large inhabited island whose hills rise 3000 feet above the water; the Namtso or Tengrinor, farther to the N., explored in 1872 by Indian pandits, and situated at an elevation of 15,190 feet; and beyond this four other lakes, as yet unexplored. In the region of the sources of the Sutlej are the two fresh-water lakes Mapang, or Mansaraner, situated at an elevation of 15,250 feet, and Lang-Tso or Rakutal, both of which play a conspicuous part in the mythology and pilgrimages of the Hindoos. Of the numerous salt lakes in Cashmerian Thibet the largest are the Tsomoriri, situated at an elevation of 14,900 feet, near the English frontier, and the Tsomoqualari, or Pang-Kong, consisting of two large basins, one above the other. Numerous rivers originate in Thibet. The chief stream to the E. is Tsang-Po, which by English-Indian geographers is considered to form the trunk current of the Brahmapootra, while others hold—and probably with more right—that this river is formed by the three streams, the Tsang-Po in the W., the Dibong in the centre, and the Lohit in the E., and that the last mentioned is the principal current, as it carries the greatest amount of water. To the W. the country is drained by the Sutlej, an affluent of the Indus, and the Indus, which flows steadily in a western direction to the western frontier of Thibet, where it suddenly turns to the S. The streams descending from the Karakorum and watering Eastern Toorkistan unite in the Tarim River. In spite of the low northern latitude, the climate is very cool, even at the bottom of the valleys, on account of the great elevation of the surface. At an elevation of 12,000 feet, at which densely peopled districts still occur, the mean annual temperature is only 41–43° F., and the lowest − 4° F. In winter the rivers are covered with ice at an elevation of 7000 feet, but in valleys below 10,000 feet snow is not sure to fall, on account of the extraordinary dryness of the atmosphere; cloud-formations and summer showers are rare, and many districts have only 1 per cent. of that amount of moisture which would be necessary to saturate the ground. The rich gold-deposits of Thibet were known, according to the researches of Prof. Schiern, to the ancient writers, and gave rise to the myth of the gold-digging ants. At present the yield is brought into market in a very impure state. Rich coal-deposits are found, and borax has become an article of the world's commerce. Hot springs are numerous, and form an object of the superstitious worship of thousands of pilgrims; but medical institutions have nowhere been established. Agriculture is of subordinate importance here, as in all mountain countries with a temperate climate; the chief wealth of the country consists in its pastures and cattle. The prevalent characteristic of the landscape is its absolute destitution of forest; from the snowfields far into the valleys the eye meets nothing but yellow, purple, or brown tints, square miles of bare rock without one speck of green. Meadows and fields are found only at the bottom of the larger valleys, and are so rare in the rest of Thibet that the villages separated many miles from each other have often received their names from their location in the neighborhood or within the limits of such a fertile spot. Single trees may be cultivated at an elevation of 12,000 feet, but generally bushes take the place of groves, and willows and poplars yield the scanty building materials. Coarse-fibred plants and dung serve as fuel. Fruit trees can be cultivated with profit only in the south-eastern and western districts; here apricots and currants form valuable articles of export. Among the cereals barley and various kinds of leguminous plants yield good crops; rye and wheat succeed in the valley of the Tsang-Po up to a height of 12,000 feet, but do not ripen until the end of September. As agriculture everywhere demands irrigation, it is confined to the bottom of the valleys and the lower slopes. The meadows are neglected, though lucerne grass yields a good crop even at an elevation of 13,000 feet. Hay is not made. The higher pasture-grounds are frequented during summer by wandering tribes, which during the winter return to the valleys. The cattle are a cross between the Thibetan bull, the yak, and the Indian cow. The sheep is the *Ovis barual* of Hodgson. Sheep are also employed as beasts of burden. The horse is small but vigorous; asses are kept only by the leaders of caravans. The goat has under its covering of long, overlapping hairs a coat of fine wool, the so-called *pashne*, which is of importance for the manufacture of shawls. Dogs are so numerous that they have become a nuisance. Poultry was introduced from Cashmere about twenty-five years ago. Game is numerous in the higher locations, where there are large uninhabited regions. The musk-deer is the most valuable game; the kyang, *Equus hemionus*, a kind of wild horse; the yak, *Bos* or *Poephagus grunniens*; a colossal mountain-sheep, *Ovis argali*, of the size of a stag, and the *Pseudovis nahoor*, another kind of sheep, of the size of a common deer. Millions of wild yaks roam in the northern part of Thibet. A bear, *Ursus himalayanus*, of small size, and a kind of leopard, *Felis macroscelides*, are the largest beasts of prey, but they avoid the inhabited valleys. The population is estimated at 5,250,000, of which about 5,000,000 belong to the Chinese, about 150,000 to the Cashmerian part, and about 21,000 to the western valleys inhabited by the Kanjoot. Considered with respect to its total area, Thibet is very thinly peopled; nevertheless, in its principal valleys the population is as dense as in the central cantons of Switzerland, though these valleys are situated about 3000 feet higher. In 1854 the capital, Lassa (11,700 feet), numbered 15,000 inhabitants, besides 1500 soldiers and a monastic population estimated at 18,000, the single monastery of Debang containing 7700 monks. Digarchi (Shegatse), farther to the W. (11,800 feet), has 9500 inhabitants, not reckoning the inmates of the famous monastery, Tashilumpo. Le, in the valley of the Sutlej (11,354 feet), has a fixed population of 4000, which in summer increases to 10,000. Ethnographically, the Thibetans belong to the Mongolian, more especially to the Turkish, race. Beyond Thibet they pushed onward into the Himalaya, and founded empires in Bootan and Sikkim. Attempts have been made, though in vain, to prove a connection between them and the aboriginal population of British India; the bodily development is decidedly different in the two races. On the other hand, there exist both in language and exterior striking resemblances between the Thibetans and the population of the northern part of the Indo-Chinese peninsula. With the Thibetans the skull is well developed; the forehead low but broad; the bridge of the nose very flat, and so much sunk that in profile it stands out very little, and sometimes does not show at all; the eyes set obliquely; the hair dark and bristly; the chest broad; the muscles strong and well developed; hands and feet small; stature lower than in Central Europe. Caste-divisions do not exist; they are even forbidden by the religion. But polyandry is quite common. On account of the sterility of the soil, and the great difficulties in providing for a numerous family, brothers or relatives often take a wife in common, and provide in common for the children. The consequence of this arrangement is that the women are very little bashful. They generally carry on, on their own account, some small trade, the profit of which they spend for their own personal wants. The girls are very lascivious, and the monks, compelled to live unmarried, commit the greatest excesses with them. The Thibetan is generally a straightforward man, and possessed of a quick understanding, though his fear of the priests verges on superstition. The common dress is made of thick woollen stuffs, and consists for both sexes of a cloak; the men wear trousers, the women under-cloaks. Socks lined with leather serve as boots. The head is covered with a close-fitting cap. Generally, the dress is in shabby condition, partly because it wears out very rapidly in travelling along the rough mountain-paths, partly on account of the enormous taxes paid to the priests. Whole

villages depend for their livelihood on mercantile enterprises in salt, borax, rhubarb, etc., on the carrying business, forming and conducting caravans, etc.; manufacturing industry is of little importance, felt and coarse woollen stuffs being the only articles worth mentioning. Commerce with India is much obstructed on the part of the Chinese officials by annoying pass regulations, by heavy duties, etc., but a lively intercommunication takes place between Thibet and the countries of the Yang-tse-Kiang, the native products being exchanged for tea, silks, and drugs. In Cashmerian Thibet the case is different. Here the English have constructed roads. In 1873 they compelled the maharajah of Cashmere to improve the road across the Karakorum pass, 18,550 feet high, and to abolish the heavy transit-duty, and in 1874 they opened Eastern Toorkistan for their goods by a commercial treaty with Kashgar. At the close of 1874 the newly-founded Central India Company formed a caravan at Lanor of 500 beasts of burden, loaded with English manufactures to a value of £25,000; it reached Kashgar in safety, and found a good market.

History and religion are more closely connected in Thibet than anywhere else. Tradition reaches back to the first century before Christ. At that time the country was divided into numerous small kingdoms. But in the first century after Christ fifty-three of these kingdoms became tributary to the dragon throne of China, and a prince of India united the others, on the Yarlung River, into one state. Under his successors commerce with India and agriculture flourished. The religion of Booddha was introduced in Thibet under King Srongtsan Gampo (617-698 A. D.), about twelve centuries after the appearance of its founder in India. It was brought to Thibet by some priests from Sinde, who sought refuge here from the persecutions by which, at that time, the Brahmans succeeded in extirpating Booddhism in India. These priests brought also the art of writing with them, and translated the sacred books of the Indian Booddhists into Thibetan. Monasteries were built, and they became here, as in Germany in the Middle Ages, centres of learned education and professional skill. At the same time, the empire was strengthened by conquests, the administration was improved, and the royal residence was removed from the Yarlung River W. to Lassa, the "city of the gods," which still is the capital of the country. Imprudent preference showed to the priests led in the ninth century to interior disturbances and the decay of the empire. In place of Booddhism the old worship of evil demons, the Bompa religion, was once more established, and the king was expelled. But after the lapse of eighty years a descendant of the legitimate dynasty came again into power, and with him the Booddhist priests. The western part of the country, however, separated, formed an independent state under the name of Maryul or Ladak, and became in the sixteenth and seventeenth centuries the cause of the establishment at Lassa of the temporal power of the Dalai Lama, the pope of the Booddhists of Central Asia. In the fourteenth century the priests had become mere jugglers. Then arose in Thibet a reformer, the monk Tsonkhapa, born in 1355 A. D. in the district of Amdo, where is now the famous monastery of Kunbum. Tsonkhapa strictly prohibited ordinary tricks and pretended miracles of charlatanism, and undertook with success the difficult task of uniting and reconciling the dialectical and mystical schools which Thibetan Booddhism had brought forth. He also published most comprehensive works. His innovations were never universally acknowledged; his followers, however, called Gelukpa or Galdaupa—a name derived from its principal monastery, Galdau, at Lassa—are the most numerous, and wear a yellow garb, while the others have chosen red. The old dogma that in times in which the religion of Booddha became forgotten a new Booddha should appear and show the way out of existing misery, was extended. It now taught that Booddha was always present on earth, manifesting himself through some representative. In the fifteenth century Gednu-Dub, provost of a large monastery, was the first to claim for himself the high dignity of being an incarnation of the Booddha who appeared for the last time in the sixth century before Christ. He assumed the magnificent title of the "very [illegible] teacher [illegible]." The Mongols called him Gyatso or Dalai Lama, the "[illegible] ocean," and under this title he became known in Europe. The clergy, called lama—that is, the "upper," "superior"—soon recognized the unassailable position of their chief as an excellent means of extending their influence. The number of monasteries increased [illegible]. The high priest took up his residence in the [illegible] monastery, [illegible]brang in Lassa. The Mongols [illegible] him as the highest wisdom, and afterward [illegible] the [illegible] defenders of his most extravagant pretensions. [illegible] favored the division of the country into numerous small principalities. Uniting with King Sengenamgyal of Ladak, the princes arose against the clergy, but the priests called in the Koshot Mongols, who were just arming for a campaign against the West, and by their aid they [illegible] their adversaries, and also took in 1640 the temporal government into their hands, conferring the executive power on a representative, a prime minister. Some gross impositions by which, in the beginning of the eighteenth century, a prime minister succeeded in concealing the death of the Dalai Lama for several years, led to a Chinese interference. The Chinese government assumed superintendence over the election of the Dalai Lama and the administration of the country, and from that time it has kept a standing army in the country and appoints all the officials. Thus, Thibet became a Chinese province. The election of the Dalai Lama is a mere form and a *faux pas*. When a Dalai Lama dies, peculiar signs occur. Thus, in the midst of the snow-fields one spot will suddenly become green, thereby indicating that Booddha descended to earth on this very point. But it is singular that such signs always occur at several places, and that it always is a child only a few years old which Booddha selects as his medium. An imperial committee examines the children in question, and the lots drawn with great solemnity finally decide among the pretenders. But the lots are painted on the outside according to a Chinese protocol, in order to guide the officials in the election, and prevent any child which might be disagreeable to the Chinese government from being elected. The child elected is then brought to a monastery, and trained by the priests in the pious deception which he is destined to practise all his life through. The last election took place in 1875, and a child from the western boundary, toward Ladak, was elected—a circumstance which seems to indicate a decrease of the Chinese influence, as formerly the Dalai Lama always arose in the eastern districts toward the Chinese frontier. Western Thibet, or Ladak, was in the last century exposed to frequent invasions of Turkish tribes from Toorkistan. The kings devoted themselves exclusively to religious exercises. The people became enervated, and the great number of monasteries ate up the substance of the nation. Thus the country fell without a blow to Cashmere when (in 1834) the ambitious ruler of that country, Runjeet Singh, invaded it and incorporated it with his kingdom as a province. The descendants of the old dynasty live in the capital, Le, unnoticed, upon a small annuity. Cashmere also attempted to conquer the western valleys of Gilgit, Hunza, Nagar, and Yassin. The inhabitants are Indians, not Thibetans, and present a low state of development. They are the Darden (Darada) of the Indian literature, the Kendschut of the travellers. The conquest of Gilgit was partly successful; the minor communities, however, in the more elevated valleys, are still independent and inaccessible to Europeans. An English officer, Hayward, made in 1870 an attempt to penetrate through Gilgit to the sources of the Oxus, but it cost him his life. Chinese Thibet is divided into the provinces of Kham, U, Thsang, and the territory of Guari Khorsum. The last division comprises the basins of the Sutlej and the Indus, but it is very thinly peopled on account of its great elevation, and it is occupied by China only for strategical reasons. In the three other provinces the administration is mostly in the hands of the territorial princes, who are vassals of the Chinese empire, and under the superintendence of Chinese mandarins. These mandarins, however, are generally not Mantchoos, but Thibetans, belonging to the wealthiest families, and provided with this or some other high-sounding title. The king, also, the proxy of the Dalai Lama, is a Thibetan, and always an ecclesiastic; in 1864 an insurrection, though an unsuccessful one, occurred because the king was not taken from the same monastery as hitherto. The same families hold also the lower offices of the civil service, and in the name of the supreme Chinese [illegible] or civil officers, or by [illegible] their authority, enormous taxes are laid on the people for the maintenance of the officials and the monasteries. The number of monasteries and [illegible] is almost incredible; 18,000 live in and around [illegible] [illegible] every thirteenth, and in some [illegible] seventh, man is a monk, and must be [illegible] [illegible]. The monasteries are not only [illegible] [illegible] their support a part of the [illegible] the [illegible] supplement by obstinate [illegible] on the superstition of the people. [illegible] people is very great—the moral depravity [illegible] Chinese keep 4000 Mantchoo [illegible] [illegible] male Thibetan [illegible] [illegible] in the militia; [illegible] with bows. The highest [illegible] highest civil authorities [illegible] between Chinese or [illegible] they have the power [illegible] any case between [illegible] expected under such [illegible]

1861 some French missionaries attempted to establish a Roman Catholic missionary station at Bonga, in South-eastern Thibet, in lat. 28° 30' N., lon. 96° 45' E. They were violently assailed by the lamas, and the Chinese authorities excused the disorder by alleging the religious fanaticism of the people. The missionaries remained unprotected, and were at last compelled to leave Thibet. On every occasion the Thibetan clergy and the Chinese officials show themselves equally eager to prevent the development of the people in order not to lose the influence which they now enjoy on account of the general ignorance and superstition. Italian Capuchins arrived at Lassa in the beginning of the seventeenth century, and in 1732, Horacio de la Penna visited it as a Roman Catholic legate, but was soon compelled to leave it. In 1811, Manning reached it from India, and in 1845, Huc and Gabet from the N. But since that time no European has entered it, the Chinese and Thibetan officials and soldiers keeping a very severe police superintendence along the frontier. The administration of the Cashmerian province of Ladak or Western Thibet has made great progress since 1867. An English official was at that time sent from British India to Le, the capital of the province, at an elevation of 11,354 feet, to superintend the fulfilment of the toll treaty. In 1871 the maharajah of Cashmere also appointed an Englishman as his commissioner, and finally conferred on him all the powers of a vizir, an office which had formerly always been filled by a Mohammedan.

Language and Literature.—The language is monosyllabic, and forms words and sentences by juxtaposition of roots and particles; with the verbs, however, changes in the roots are quite frequent. There is considerable resemblance between the Thibetan language and the dialects of Northern Burmah; exhaustive philological researches are still wanting, however. A circumstance of particular interest is this: the Thibetan became a written and literary language more than 1200 years ago; nevertheless, on account of the religious or idolatrous reverence with which the written word is regarded by the Booddhists, the Thibetan language has, with some few and insignificant exceptions, maintained its written forms of sounds unchanged up to this very day, while the style and the oral speech underwent considerable alterations. This clinging to the old, full pronunciation of many sounds characterizes Eastern and Western Thibet, while in Central Thibet, the principal seat of national civilization, a refined but somewhat effeminate pronunciation of the consonants may be observed; here also occurs the greatest difference between the spoken and the written sound. In 632 A. D. the Indian Devanagari alphabet was adapted to the Thibetan language by orders of King Srongtsan Gampo, and from it are derived the quadrangular letters of the Mongols; it is written from the left to the right. Paper is made from the *Daphne canabina*; it is gray and coarse. King Srongtsan Gampo ordered the sacred Indian books treating on Booddhist doctrines to be translated into Thibetan. The work of translation was carried on with a remarkable zeal: for the sake of uniformity, vocabularies of the Sanskrit proper names and of the technical and philosophical terms occurring in the original texts were prepared. King Srongtsan Gampo and his learned translators also issued books written in their native tongue, and, beginning with Tsonkhapa, the great reformer of the fourteenth century, native literature developed itself on a larger scale; even Mongolians write in Thibetan, as it is the language in the divine service. In the beginning of the eighteenth century all the Sanskrit translations were collected in two large and voluminous works, to which were added the sacred and profane native publications of different periods. These compilations bear the title of *Kanjoor* ("The Translated Word" of Booddha) and *Tanjoor* ("Translation of the Doctrine"). The *Kanjoor* contains 100 volumes, which are classed under seven divisions—discipline, transcendental wisdom, association of Booddhas, jewel-peak aphorisms, deliverance from emancipation, from existence, mysticism. The *Tanjoor* comprises 225 volumes, divided into mysticism and discipline; its contents are of a more miscellaneous character. (For a detailed abstract see Emil Schlagintweit, *Booddhism in Tibet*, London, 1863.) These collections have been printed with engraved wooden blocks; the first edition was prepared at Narthang in Southern Thibet by order of Mivang, regent of Lassa (1728–46); in Europe the whole of the *Kanjoor* and *Tanjoor*, besides many other native works not contained in these collections, are to be found in the libraries of St. Petersburg and London; the *Kanjoor* also at Paris. For printing, capital letters are always used, which for the requirements of running hand in manuscripts are somewhat modified. The books are not folded, but consist of loose leaves laid between boards kept together by a string. The Hungarian Csoma was the first who brought (1832) Thibetan language and literature within the reach of European students. In 1875 a German Moravian missionary, H. A. Jäschke, published a most learned Thibetan-German dictionary.
E. SCHLAGINTWEIT.

Thibet Language and Literature. See THIBET.

Thibodeaux′, p.-v., cap. of Lafourche parish, La., on Bayou Lafourche, 55 miles W. of New Orleans, has 6 churches, 1 college and 1 female institute, 2 newspapers, a foundry and boiler-works, 1 copper and sheet-iron workshop, 2 carriage-factories, 3 hotels, and Masonic and Odd Fellows' lodges. Principal business, planting and mechanical working. P. 1922.
GRISAMORE & SANCAN, EDS. "SENTINEL."

Thick′-Knee, a name applied to the species of the genus *Œdicnemus*. These belong to the family of Charadriidæ or plovers, and are distinguished among them by the moderately long and straight bill (a little longer than the head), which is compressed and wedge-shaped at the terminal half, the linear open nostrils, some distance from the base of the bill, and the elongated tarsi (three or four times as long as the middle toe) covered with hexagonal scales. The species are peculiar to the Old World, save one (*Œdicnemus superciliaris*), which has been described from Peru; nine are recognized by G. R. Gray. They are migratory birds, and resort to the temperate regions to rear their young. They affect mostly open inland plains. The common European species is *Œdicnemus crepitans*, which attains a length of about seventeen inches. THEODORE GILL.

Thielt, town of Belgium, province of West Flanders, has several good educational institutions, and extensive manufactures of linen and cotton fabrics, lace, hats, oil, soap, and chemicals. P. 11,497.

Thiene, or **Tiene,** town of Italy, province of Vicenza, about 9 miles N. of the town of Vicenza. The vicinity has long been remarkable for its excellent wines. P. 5945.

Thierry′ (JACQUES NICOLAS AUGUSTIN), b. at Blois May 10, 1795; educated at the college of his native town and the normal school of Paris; attached himself in 1814 with great enthusiasm to Saint-Simon, whom he assisted in his literary labors; became in 1817 a contributor to *Le Censeur européen*, edited by Comte, and afterward to the *Courrier français*, in which he first published in 1820 his remarkable *Lettres sur l'Histoire de la France*, but concentrated himself more and more on the study of history, especially that of France and England, and published in 1825 his *Histoire de la Conquête de l'Angleterre par les Normands* (4 vols., 1860), which attracted great attention, and has been often republished, and translated twice into English (1825 and 1847). In 1826 he became nearly blind, and could continue his studies only by the aid of secretaries and of his friends, among whom were Armand Carrel and Fauriel. A most precious assistance he received from his wife, JULIE DE QUERANGAL, known from several spirited essays in the *Revue des Deux Mondes*; they were married in 1831, but she died in 1844. Subsequently he lived mostly in his brother's house, and d. in Paris May 22, 1856. To the latter period of his life belong *Dix Ans d'Études historiques* (1834), a collection of minor essays, and *Récits des Temps mérovingiens* (1840), both translated into English. By Guizot he was appointed to edit one part of the *Collection des Monuments inédits de l'Histoire de France*—namely, the *Recueil des Monuments inédits de l'Histoire du Tiers État* (3 vols., 1849–56), which led him to write his *Essai sur l'Histoire de la Formation et des Progrès du Tiers État* (1853; translated into English by Francis B. Wells, 1855).—His brother, AMEDÉE SIMON DOMINIQUE THIERRY, b. at Blois Aug. 2, 1797, was appointed professor of history in Besançon in 1828, prefect of the department of Haute-Saône in 1830, member of the council of state in 1838, senator in 1860, and d. in Paris Mar. 26, 1873. His writings, advocating the same principles as those of his brother, but less brilliant in execution, comprise *Histoire des Gaulois jusqu'à la Domination romaine* (3 vols., 1828), *Histoire de la Gaule sous l'Administration romaine* (3 vols., 1840–47), *Histoire d'Attila* (2 vols., 1856), *Récits de l'Histoire romaine* (1860), *Tableau de l'Empire romain* (1862), *Saint-Jérôme* (2 vols., 1867), *Saint-Chrysostome* (1872).

Thiers, town of France, department of Puy-de-Dôme, on the Durolle, manufactures candles, paper, leather, and copper, brass, and iron goods, especially knives. P. 16,635.

Thiers′ (LOUIS ADOLPHE), b. at Marseilles Apr. 16, 1797; studied law at Aix; was admitted to the bar in 1818, and began to practise as an advocate, but was drawn by his ambition as well as by his talents to politics and literature, and removed in 1821 to Paris. Here he became a contributor to the *Constitutionnel*, and his articles, comprising criticisms on literature, politics, and art, historical essays, and miscellaneous sketches, soon brought him into intimate connection with the leaders of the party in opposition; as,

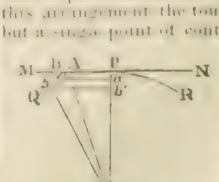
for instance, with Lafitte. Some of the articles—*De la Monarchie française, Salon de 1822, Les Pyrénées, ou le Midi de la France pendant les Mois de Novembre et de Décembre*, etc.—were also published separately, and attracted a wide attention. In 1823 he began to publish his *Histoire de la Révolution française*, finished in 1827 in 10 vols., translated into English by F. Shoberl (1838); and this book at once gave him rank among the great historians and made his name popular throughout France. In 1830 he founded the *National* in connection with Mignet and Armand Carrel, drew up the protest against the *ordonnances* of July 26, and took an active part in the revolution which effected the change of dynasty in France. In August he entered the civil service of the new government, receiving office in the department of finances, and shortly after was elected a member of the Chamber of Deputies. On Oct. 11, 1832, he was made minister of the interior; changed this department for that of commerce and public works in December; returned to it 1834; resigned with all his colleagues in Jan., 1836, but was made prime minister and minister of foreign affairs in February; in August, however, he retired from the government altogether. The most prominent features of his administration were the arrest of the duchess of Berri Nov. 6, 1832, and the pacification of the Vendée; the completion of a number of public buildings and monuments, such as Arc de l'Étoile, the Madeleine, the palace of the Quai d'Orsay, etc., and a great activity in the construction of canals, roads, etc.; the prompt suppression of the insurrections in Lyons and Paris in 1834; the adoption of restrictive laws, the so-called "September laws," on the press and jury, on account of the attempt by Fieschi on the life of the king, July 28, 1835, etc. The reason of his withdrawal from the government was the king's opposition to his plan of an armed intervention in the affairs of Spain. Once more, however, he returned to power during the reign of Louis Philippe. On Mar. 1, 1840, he was made prime minister, but he resigned in October. In the controversy between Mehemet Ali and the Porte, France was Mehemet Ali's only friend, but the question was suddenly found to have been settled by Russia, England, Austria, and Prussia, without any regard to the views of France. Thiers now demanded money for extensive armaments, proposed to fortify Paris, meditated a descent on Italy, etc., but was checked in his warlike aspirations by the absolute unwillingness of the king to enter into his plans. He now retired from public life for several years; visited England, Spain, Italy, and Germany, studying battlefields, ransacking archives, and making other preparations for his great work, *Histoire du Consulat et de l'Empire* (20 vols., 1845–62; translated into English by D. F. Campbell). But in the last years of the reign of Louis Philippe he resumed his work in the Chamber of Deputies, and made vehement opposition to the government of Guizot, especially to its foreign policy. In the banquets which preceded the revolution of Feb., 1848, he took no part, but the popularity which he had partly lost during his own administration he fully regained when he came into opposition; and when the revolution actually broke out, he was one of the men on whom many eyes rested. As a member of the Constituent and Legislative Assemblies he accepted the Republic, but advocated very restrictive measures. He voted for the presidency of Louis Napoleon, and when Bixio accused him in the Legislative Assembly of having said that the election of Louis Napoleon as president would be a shame to France, he denied it, and fought a duel with his accuser. Nevertheless, when the Empire began to develop from the policy of the president, Thiers immediately went into opposition, and on Dec. 2, 1852, he was arrested, and shortly after banished from France. He returned, however, in August, but lived in retirement until 1863, when he was elected a member of the Representative Assembly by Paris. His criticism of the policy of the emperor, the Italian and Mexican wars, the rebuilding of Paris, etc., was often very severe, though generally not very effective; he was almost the only member of the Assembly who opposed and condemned the declaration of war against Prussia. But after the downfall of the Empire, he developed an astonishing energy to save his country from utter ruin. On Sept. 17, 1870, he started on a tour to London, St. Petersburg, Vienna, and Florence in order to procure foreign intervention, and on his return in the last days of October he opened negotiations with Bismarck concerning an armistice. After the capitulation of Paris and the conclusion of the armistice, he was elected a member of the National Assembly by 26 departments, Feb. 8, 1871, and on Feb. 17 the Assembly chose him chief of the executive. On Aug. 31 his term of office was fixed at three years, and his title "president of the republic." He was very successful in negotiating the peace; he saved Belfort and one milliard for France. And he was still more successful in procuring the means of fulfilling the conditions of peace; the payment of the indemnification and the liberation of French soil from German occupation were effected in a surprisingly short time. The insurrection of the Commune was promptly put down, and order and regularity established in the administration. But his attempt at consolidating the "conservative republic" by legislative enactment failed, May 24, 1873, and he resigned. D. at St. Germain Sept. 3, 1877. Among his other works are *Histoire de Law, De la Propriété* (1848), *L'Homme et la Matière* (1875). CLEMENS PETERSEN.

Thiersch (FRIEDRICH WILHELM), b. at Kirchscheidungen, Prussian province of Saxony, June 17, 1784; studied theology, and afterward philology, at Leipsic and Göttingen; was appointed professor in 1809 at the gymnasium of Munich, and in 1812 at the university of the same city; visited Italy, and wrote *Reisen in Italien*, 1826; resided for two years in Greece, and wrote *De l'État actuel de la Grèce* (1833); founded the philological institute of Munich; edited the *Acta Philologorum Monacensium* (1811–29); published a Greek grammar (1826), and contributed much to encourage the study of classical languages and literatures in Bavaria. D. at Munich Feb. 25, 1860. His son, HEINRICH WILHELM JOSIAS THIERSCH, b. at Munich Nov. 5, 1817; studied theology at Erlangen, and became professor at Marburg in 1843, but resigned this office in 1849, and lived subsequently at Munich. He is the representative in Germany of the ideas of Edward Irving. He wrote *Grammatik der hebräischen Sprache* (1846), *Katholicismus und Protestantismus* (1848), *Geschichte der Kirche im apostolischen Zeitalter* (1857), *Ueber christlichen Familienleben* (1859), etc.

Thinocor'idæ [from *Thinocorus*—Gr. θίς, θινός, a "heap of sand" or "plain," and χορεύω, to "leap"—the generic name of the type], a family of birds of uncertain affinities peculiar to South America. The general aspect is somewhat quail like; the bill rather short, somewhat slender, broad at the base, and compressed forward, and with the upper mandible slightly decurved over the lower; nostrils basal and lateral, and partly covered by a horny membrane; wings long and pointed; tail moderate and produced straight backward; tarsi stout or moderate, and with the investing scales more or less small; toes four, the three anterior moderately long and free, the posterior small and elevated. The family was proposed (by Prince Bonaparte in 1850) and has been adopted (by Kaup, Gray, etc.) for a group of birds confined to the temperate and colder regions of South America. They are generally supposed to be most nearly related to the sheathbills (Chionididæ), but this remains to be verified. They go about generally in pairs or small coveys. Their flight somewhat resembles that of grouse. Open plains seem to be their chief resorts. Eight species are known, belonging to the genera *Thinocorus* and *Attagis*. THEODORE GILL.

Thin Plates, Colors of. When any naturally colorless transparent substance is observed in extremely thin laminæ by means either of reflected or of transmitted light, it exhibits vivid prismatic tints which vary with the thickness of the lamina and with the obliquity of the incident light. Such colors are beautifully seen in soap bubbles resting on the surface of the liquid of which they are formed. In consequence of the subsidence of the material, the thickness gradually and uniformly increases down to the base. The tints therefore appear in parallel and horizontal zones or rings, and in the order in which they are seen in the rainbow, the violet being uppermost. In this case the film is more dense than the surrounding medium (the air); but similar colors occur in films of liquid compressed between glass plates and in the fissures of transparent minerals, and inasmuch as they appear in such fissures *in vacuo*, it is evident that the presence of a material substance between the bounding surfaces of the fissure is not essential to their formation.

The conditions under which these colors are produced were investigated by Newton. He employed in his experiments two lenses of long focus, a double convex and a plano-convex, the latter having its plane surface pressed down upon the former by means of binding [illegible] this arrangement the touching surfaces have [illegible] but a single point of contact, which is the [illegible]



Thin Plates.

cluded thin [illegible] plate regul[illegible] direction [illegible] ing to [illegible] thi[illegible] of [illegible]

the figure annexed M N [illegible] the superior lens, [illegible] Q P R the convex upper surface of

the inferior, P being the point of contact. Then, if C P, the radius of curvature, $= r$, Pa' or Pb', the abscissa $= x$, and $a\,a'$ or $b\,b'$, the ordinate $= y$, we have, by the equation of the circle, $2rx - x^2 = y^2$.

Supposing r very great in respect to y, the abscissa x is so minute that its square may be neglected; whence,

$$2rx = y^2 \text{: or } x \text{ varies as } y^2.$$

It was observed by Newton that in proceeding outward from the centre, which is quite black, the same tints recur periodically, so that there are as many as seven distinct series, called by him orders of colors. Of these, the second and third are the most vivid; the more distant rapidly fading out, and the first being diluted with white. The orders are—

1. Black, blue, white, yellow, red.
2. Violet, blue, green, yellow, red.
3. Purple, blue, green, yellow, red.
4. Green, red.
5. Greenish-blue, red.
6. Greenish-blue, pale-red.
7. Greenish-blue, reddish-white.

The cause of the fading with increase of distance from the centre may be made manifest by employing homogeneous or monochromatic light, obtained by isolating a portion of the rays of the prismatic spectrum whose refrangibility and color are sensibly the same. Then very many more bright rings will be observed, separated by intermediate rings entirely dark. It will also be seen that the rings of the least refrangible rays are larger than any others, and that the diameters of rings of the same order regularly diminish as the refrangibility increases. This difference of magnitude between the rings of different tints occasions the overlapping, when white light is used, of one color upon another; so that the colors observed are not simple, but resultant colors, determined in their character by the blending of the several simple tints which happen to be present in different proportions at the point of observation. This blending, moreover, to a certain extent produces white light, which dilutes or enfeebles the color formed by the combination of the predominant tints. The truth of this explanation is demonstrated by viewing the rings through a prism. This more completely superposes the rings on one side, and separates them on the other. They appear, therefore, more numerous and better defined on the side of the greatest refraction, while on the other they become nearly indistinguishable.

From a careful measurement of the diameters of all the rings, Newton ascertained that the squares of these diameters form a regular arithmetical progression proportional to the natural series of numbers, 1, 2, 3, etc., those of the bright rings corresponding to the odd terms of the series, and those of the dark to the even terms. From the law, x varies as y^2, it therefore follows that where the bright rings appear the thickness of the plate is *once, thrice, five times*, etc. some determinate dimension; and that where the dark rings are seen it is *twice, four times, six times*, etc. the same quantity. In order to ascertain this constant, Newton made a very careful measurement of the absolute diameter of a single ring. He selected the fifth dark ring for this purpose. With this measurement, and the known value of r, he computed the thickness of the plate at the point observed, which being the fifth term of the series 2, 4, 6, etc., is ten times the constant desired. The value of the constant is thus found to be $\frac{1}{178000}$th of an English inch, or, decimally, $= 0.0000056$ inch. For the violet it is about 0.0000039 inch, and for the red 0.0000069 inch.

These results illustrate still more clearly the cause already pointed out, of the unequal vividness of the colors of the different orders. In the first order the thicknesses vary slowly; and as there is a certain range of variation within which each color may appear, though its greatest intensity is in the middle of this range, it happens that the colors of this order, in larger proportion than those of the orders next succeeding, mingle to form white. In the fourth, fifth, and higher orders an opposite cause—*i. e.* the rapid variation of thickness—produces a similar effect: for here the rings are so crowded together that the tints of different orders become mingled, and the resultant is sensibly colorless.

If water or any other liquid is introduced between the glasses, the rings become smaller, the squares of the diameters being inversely as the indices of refraction of the media thus introduced—a law which is of general application.

When the system of lenses above described is held between the eye and the light, another set of rings makes its appearance, formed by the light transmitted. Of these it is remarkable that the diameters are intermediate between those seen by reflected light: that is, the bright rings seen by transmission correspond to the dark rings seen by reflection, and *vice versâ*. The tints are also much feebler than those of the reflected rings, being diluted by the intermixture of a great deal of white light which has nothing to do with their formation. Moreover, the transmitted tints at any given point are complementary to those reflected from the same point, or are such as, united with them, will produce white. The centre in the transmitted system is therefore white, as in the reflected it is black.

The measurements given above are those which correspond to rings formed by light perpendicularly incident. But when the rings are observed obliquely, their diameters are rapidly increased with increase of obliquity. The law of this increase may be stated thus: The squares of the diameters of the rings of the same order observed under different obliquities are inversely as the cosines of the angles of incidence of the light producing them.

Colors resembling those of thin plates may be produced under certain arrangements by means of thick plates. A silvered glass concave mirror receiving a very small beam of light in a dark room, through a minute aperture in the window-shutter, will exhibit colored rings when the reflection is thrown upon a card held near the centre of curvature. Two thick plates having a difference of thickness comparable to the absolute thickness which will produce color in thin plates will produce color also. The causes of all these phenomena are considered under the title UNDULATORY THEORY OF LIGHT (which see). F. A. P. BARNARD.

Thionville′ [anc. *Theodonis Villa*; Ger. *Diedenhofen*], town of the present German province of Alsace-Lorraine, on the Moselle, 19 miles N. of Metz, and in the midst of the broad level plain which the valley here exhibits. It is a walled city of the old school of fortification, ranking under that system as a third-class fortress. After the disaster of Forbach and retreat to Metz of the French, Thionville annoyed the Prussians before the latter place a good deal, and orders were given to carry it by a *coup-de-main* in August, but the attempt was abandoned; orders to take it were also issued in September and again in October, but after reconnaissances it was determined that the force necessary to accomplish its capture could not then be spared, and the attempt was postponed until after the fall of Metz. Bombarding batteries were commenced by the Prussians Nov. 16, and Thionville was bombarded by 85 guns from 7 A.M. Nov. 22 until the evening of Nov. 24, 1870, when it capitulated with 4000 men, 187 guns, and large stores of supplies. Although many buildings in the town were destroyed, the defences were left almost intact. P. about 8000.

Third, in music, an interval comprising two degrees of the diatonic scale. (See INTERVAL.)

Third, tp., Richland co., S. C. P. 1815.

Third Creek, p.-v. and tp., Gasconade co., Mo. P. of v. 200; of tp. 1228.

Third Estate. See ESTATES, THE THREE.

Third Orders. See TERTIARIES.

Thirl′wall (CONNOP), D. D., b. at Stepney, Middlesex, England, Feb. 11, 1797; displayed such extraordinary precocity that at the age of eleven years his father printed a volume of his compositions under the title *Primitiæ, or Essays and Poems on Various Subjects*, etc. (1809); took the Craven and Bell scholarships at Trinity College, Cambridge, 1815; graduated as senior chancellor's medallist 1818; became fellow and tutor there; studied law, and was called to the bar at Lincoln's Inn 1825; published a translation of Schleiermacher's *Critical Essay on the Gospel of St. Luke* (1825); took orders in the Church of England 1828; became rector of Kirby Underdale, Yorkshire; assisted Rev. Julius Charles Hare in translating Niebuhr's *History of Rome* (2 vols., 1828); was for several years examiner for the classical tripos at Cambridge, classical examiner in the University of London, and visitor of St. David's College, Lampeter; wrote for Lardner's *Cabinet Cyclopædia* a popular *History of Greece* (8 vols., 1835–40), afterward revised and enlarged in a library edition (8 vols., 1845–52); was one of the editors of the Cambridge *Philological Museum*; and became bishop of St. David's 1840, which post he resigned June, 1874. D. July 27, 1875. He published a number of sermons, charges, letters, addresses, and essays, which, with other writings, were issued under the title *Literary and Theological Remains* (3 vols., 1875–76), edited by Canon J. J. S. Perowne.

Thirsk, town of England, county of York, on the Codbeck, an affluent of the Swale, manufactures coarse linen, leather, and saddlery. P. 5735.

Thirst, a sensation normally caused by the need of water in the animal system, and consequently relieved by drinking. The great thirst of cholera and diabetes is also caused by a deficiency of water. But thirst also accompanies febrile excitement. This is only temporarily relieved by drinking, and unless contra-indicated by the symptoms small lumps of ice will usually relieve the thirst, and reduce the excessive heat with efficiency and without danger. The use of too much salt is another familiar cause of thirst.

Thirty-nine Articles of Religion. When the Reformation was fairly introduced into England under Edward VI. (1547–53), Archbishop Cranmer at first entertained the noble but premature project of framing an evangelical catholic creed in which all the Reformed churches could agree in opposition to the Church of Rome, then holding the Council of Trent, and invited the surviving continental Reformers, Melanchthon, Calvin, and Bullinger, to London for the purpose. Failing in this scheme, he framed, with the aid of his fellow-Reformers, Ridley and Latimer, the royal chaplains, and the foreign divines, Bucer, Peter Martyr, and John à Lasco, whom he had drawn to England, the *Forty-two Articles of Religion* for the English Reformed Church. After passing through several revisions they were completed in Nov., 1552, and published in 1553 by "royal authority" and with the approval of convocation. The re-establishment of the papacy under the short but bloody reign of Mary (1553–58) set them aside, together with the Edwardine Book of Common Prayer. Under Elizabeth (1558–1603) the Articles were revised and permanently restored. They were reduced to *thirty-nine*, and brought into that shape and form which they have ever retained since in the Church of England. The Latin edition was prepared under the supervision of Archbishop Parker, with the aid of Bishop Cox of Ely (one of the Marian exiles) and Bishop Guest of Rochester, approved by convocation, and published by the royal press 1563. The English edition, which is of equal authority, though slightly differing from the Latin, was adopted by convocation in 1571, and issued under the editorial care of Bishop Jewel of Salisbury 1571. They were made binding on all ministers and teachers of religion and students in the universities, but subscription was not always enforced with equal rigor, and bitterly complained of by nonconformists, who had scrupulous objections to the political articles. The Act of Uniformity under Charles II. imposed greater stringency than ever. But the Toleration act of William and Mary gave some relief by exempting dissenting ministers from subscribing Articles XXXIV. to XXXVI. and a portion of Article XXVII. Subsequent attempts to relax or abolish subscription resulted at last in the University Tests act of 1871, which exempts all students and graduates in the universities of Oxford, Cambridge, and Durham, except divinity students, fellows, professors, and heads of colleges, from subscription, and throws these institutions open to dissenters.

The Thirty-nine Articles are among the most important doctrinal formulas of the Reformation period. They cover nearly all the heads of the Christian faith, especially those which were then under dispute with the Roman Catholics. They affirm the old orthodox doctrines of the Trinity and incarnation, the Augustinian views on free-will, total depravity, divine grace, faith, good works, election, and the Protestant doctrines on the Church, purgatory, and the sacraments of baptism and the Lord's Supper. They are borrowed in part from Lutheran standards—namely, the Augsburg Confession of Melanchthon (1530) and the Würtemberg Confession of Brentius (1552), but on the sacraments, especially the much-disputed doctrine of the real presence in the Eucharist, they follow the Swiss Reformers, Bullinger and Calvin. In the political sections they are purely English, and teach the Erastian doctrine of the spiritual as well as temporal supremacy of the sovereign as the supreme governor of the Church of England. They have therefore an eclectic and comprehensive character, which distinguishes the Anglican Church from the Lutheran and the strictly Calvinistic churches of the Continent and Scotland, and from the dissenting denominations of England. They have often been interpreted and misinterpreted in the interest of particular schools and parties, while all claim them as favoring themselves. They must be understood in their plain grammatical sense; and when this is doubtful, the Prayer Book, the two books of Homilies, the Catechism, and the private writings of the English Reformers and the Elizabethan divines must be called to aid. The doctrinal decisions in the Gorham, Bennet, and other recent controversies favor great latitude in their interpretation.

The Protestant Episcopal Church in the U. S., after effecting an independent organization and episcopate in consequence of the American Revolution, formally adopted the Thirty-nine Articles of the mother Church at the General Convention held in Trenton, N. J., Sept. 12, 1801, but with sundry alterations and omissions in the political articles (Art. XXI. and XXXVII.), which the separation of Church and State made necessary. The only doctrinal difference is the omission of all allusion to the Athanasian Creed (Art. VIII.), which is also excluded from the American editions of the Prayer Book.

The following is the text of the American revision of the Articles:

ART. I. *Of Faith in the Holy Trinity.*—There is but one living and true God, everlasting, without body, parts, or passions; of infinite power, wisdom, and goodness; the Maker and Preserver of all things both visible and invisible. And in unity of this Godhead there be three Persons of one substance, power, and eternity—the Father, the Son, and the Holy Ghost.

ART. II. *Of the Word or Son of God, which was made very Man.*—The Son, which is the Word of the Father, begotten from everlasting of the Father, the very and eternal God, and of one substance with the Father, took man's nature in the womb of the blessed Virgin, of her substance; so that two whole and perfect natures, that is to say, the Godhead and manhood, were joined together in one person, never to be divided, whereof is one Christ, very God, and very man; who truly suffered, was crucified, dead, and buried, to reconcile his Father to us, and to be a sacrifice, not only for original guilt, but also for actual sins of men.

ART. III. *Of the going down of Christ into Hell.*—As Christ died for us, and was buried; so also is it to be believed, that he went down into hell.

ART. IV. *Of the Resurrection of Christ.*—Christ did truly rise again from death, and took again his body, with flesh, bones, and all things appertaining to the perfection of man's nature; wherewith he ascended into heaven, and there sitteth, until he return to judge all men at the last day.

ART. V. *Of the Holy Ghost.*—The Holy Ghost, proceeding from the Father and the Son, is of one substance, majesty, and glory, with the Father and the Son, very and eternal God.

ART. VI. *Of the Sufficiency of the Holy Scriptures for Salvation.*—Holy Scripture containeth all things necessary to salvation; so that whatsoever is not read therein, nor may be proved thereby, is not to be required of any man that it should be believed as an article of the faith, or be thought requisite or necessary to salvation. In the name of the holy Scripture we do understand those canonical books of the Old and New Testament, of whose authority was never any doubt in the Church. *Of the Names and Number of the Canonical Books.* Genesis, Exodus, Leviticus, Numbers, Deuteronomy, Joshua, Judges, Ruth, The First Book of Samuel, The Second Book of Samuel, The First Book of Kings, The Second Book of Kings, The First Book of Chronicles, The Second Book of Chronicles, The First Book of Esdras, The Second Book of Esdras, the Book of Esther, The Book of Job, The Psalms, The Proverbs, Ecclesiastes or Preacher, Cantica, or Songs of Solomon, Four Prophets the greater, Twelve Prophets the less. And the other books (as *Hierome* saith) the Church doth read for example of life and instruction of manners; but yet doth it not apply them to establish any doctrine: such are these following: The Third Book of Esdras, The Fourth Book of Esdras, The Book of Tobias, The Book of Judith, The rest of the Book of Esther, The Book of Wisdom, Jesus the Son of Sirach, Baruch the Prophet, The Song of the Three Children, The Story of Susanna, Of Bel and the Dragon, The Prayer of Manasses, The First Book of Maccabees, The Second Book of Maccabees. All the books of the New Testament, as they are commonly received, we do receive, and account them canonical.

ART. VII. *Of the Old Testament.*—The Old Testament is not contrary to the New: for both in the Old and New Testament everlasting life is offered to mankind by Christ, who is the only Mediator between God and man, being both God and man. Wherefore they are not to be heard, which feign that the old fathers did look only for transitory promises. Although the law given from God by Moses, as touching ceremonies and rites, do not bind Christian men, nor the civil precepts thereof ought of necessity to be received in any commonwealth; yet notwithstanding, no Christian man whatsoever is free from the obedience of the Commandments which are called moral.

ART. VIII. *Of the Creeds.*—The *Nicene* Creed, and that which is commonly called the *Apostles'* Creed, [illegible] thoroughly to be received and believed; for they [illegible] proved by most certain warrants of holy Scripture.

ART. IX. *Of Original or Birth Sin.*—Original [illegible] eth not in the following of *Adam* (as the [illegible] vainly talk); but it is the fault and co[illegible] ture of every man, that naturally is e[illegible] spring of *Adam*; whereby man i[illegible] original righteousness, and is of h[illegible] evil, so that the flesh lusteth al[illegible] and therefore in every pers[illegible] serveth God's wrath and [illegible] of nature doth remain, y[illegible] whereby the lust of the [illegible] (which some do exp[illegible] some the affection, [illegible] the flesh, [illegible]

ject to the Law of God. And although there is no condemnation for them that believe and are baptized; yet the Apostle doth confess, that concupiscence and lust hath of itself the nature of sin.

Art. X. *Of Free-Will.*—The condition of man after the fall of *Adam* is such, that he cannot turn and prepare himself, by his own natural strength and good works, to faith, and calling upon God. Wherefore we have no power to do good works pleasant and acceptable to God, without the grace of God by Christ preventing us, that we may have a good will, and working with us, when we have that good will.

Art. XI.—*Of the Justification of Man.*—We are accounted righteous before God, only for the merit of our Lord and Saviour Jesus Christ by faith, and not for our own works or deservings. Wherefore, that we are justified by faith only, is a most wholesome doctrine, and very full of comfort, as more largely is expressed in the Homily of Justification.

Art. XII. *Of Good Works.*—Albeit that good works, which are the fruits of faith, and follow after justification, cannot put away our sins, and endure the severity of God's judgment; yet are they pleasing and acceptable to God in Christ, and do spring out necessarily of a true and lively faith; insomuch that by them a lively faith may be as evidently known as a tree discerned by the fruit.

Art. XIII. *Of Works before Justification.*—Works done before the grace of Christ, and the inspiration of his Spirit, are not pleasant to God, forasmuch as they spring not of faith in Jesus Christ; neither do they make men meet to receive grace, or (as the school-authors say) deserve grace of congruity: yea rather, for that they are not done as God hath willed and commanded them to be done, we doubt not but they have the nature of sin.

Art. XIV. *Of Works of Supererogation.*—Voluntary works besides, over and above, God's commandments, which they call works of supererogation, cannot be taught without arrogancy and impiety: for by them men declare, that they do not only render unto God as much as they are bound to do, but that they do more for his sake, than of bounden duty is required: whereas Christ saith plainly, When ye have done all that are commanded to you, say, We are unprofitable servants.

Art. XV. *Of Christ alone without Sin.*—Christ in the truth of our nature was made like unto us in all things, sin only except, from which he was clearly void, both in his flesh, and in his spirit. He came to be the Lamb without spot, who, by sacrifice of himself once made, should take away the sins of the world: and sin (as Saint *John* saith) was not in him. But all we the rest, although baptized, and born again in Christ, yet offend in many things; and if we say we have no sin, we deceive ourselves, and the truth is not in us.

Art. XVI. *Of Sin after Baptism.*—Not every deadly sin willingly committed after baptism is sin against the Holy Ghost, and unpardonable. Wherefore the grant of repentance is not to be denied to such as fall into sin after baptism. After we have received the Holy Ghost, we may depart from grace given, and fall into sin, and by the grace of God we may arise again, and amend our lives. And therefore they are to be condemned, which say, they can no more sin as long as they live here, or deny the place of forgiveness to such as truly repent.

Art. XVII. *Of Predestination and Election.*—Predestination to life is the everlasting purpose of God, whereby (before the foundations of the world were laid) he hath constantly decreed by his counsel secret to us, to deliver from curse and damnation those whom he hath chosen in Christ out of mankind, and to bring them by Christ to everlasting salvation, as vessels made to honor. Wherefore, they which be endued with so excellent a benefit of God, be called according to God's purpose by his Spirit working in due season: they through grace obey the calling: they be justified freely: they be made sons of God by adoption: they be made like the image of his only-begotten Son Jesus Christ: they walk religiously in good works, and at length, by God's mercy, they attain to everlasting felicity.

As the godly consideration of predestination, and our election in Christ, is full of sweet, pleasant, and unspeakable comfort to godly persons, and such as feel in themselves the working of the Spirit of Christ, mortifying the works of the flesh, and their earthly members, and drawing up their mind to high and heavenly things, as well because it doth greatly establish and confirm their faith of eternal salvation to be enjoyed through Christ, as because it doth fervently kindle their love towards God: So, for curious and carnal persons, lacking the Spirit of Christ, to have continually before their eyes the sentence of God's predestination, is a most dangerous downfall, whereby the devil doth thrust them either into desperation, or into wretchedness of most unclean living, no less perilous than desperation.

Furthermore, we must receive God's promises in such wise, as they be generally set forth to us in holy Scripture: and, in our doings, that will of God is to be followed, which we have expressly declared unto us in the Word of God.

Art. XVIII. *Of obtaining eternal Salvation only by the Name of Christ.*—They also are to be had accursed that presume to say, That every man shall be saved by the law or sect which he professeth, so that he be diligent to frame his life according to that law, and the light of nature. For Holy Scripture doth set out unto us only the name of Jesus Christ, whereby men must be saved.

Art. XIX. *Of the Church.*—The visible Church of Christ is a congregation of faithful men, in the which the pure Word of God is preached, and the sacraments be duly ministered according to Christ's ordinance, in all those things that of necessity are requisite to the same.

As the Church of *Jerusalem*, *Alexandria*, and *Antioch*, have erred; so also the Church of *Rome* hath erred, not only in their living and manner of ceremonies, but also in matters of faith.

Art. XX. *Of the Authority of the Church.*—The Church hath power to decree rites or ceremonies, and authority in controversies of faith: and yet it is not lawful for the Church to ordain anything that is contrary to God's Word written, neither may it so expound one place of Scripture, that it be repugnant to another. Wherefore, although the Church be a witness and a keeper of Holy Writ, yet, as it ought not to decree anything against the same, so besides the same ought it not to enforce anything to be believed for necessity of salvation.

Art. XXI. *Of the Authority of General Councils.**—

Art. XXII. *Of Purgatory.*—The Romish doctrine concerning purgatory, pardons, worshipping and adoration, as well of images as of relics, and also invocation of saints, is a fond thing, vainly invented, and grounded upon no warranty of Scripture, but rather repugnant to the Word of God.

Art. XXIII. *Of Ministering in the Congregation.*—It is not lawful for any man to take upon him the office of public preaching, or ministering the sacraments in the congregation, before he be lawfully called, and sent to execute the same. And those we ought to judge lawfully called and sent, which be chosen and called to this work by men who have public authority given unto them in the congregation, to call and send ministers into the Lord's vineyard.

Art. XXIV. *Of Speaking in the Congregation in such a Tongue as the People understandeth.*—It is a thing plainly repugnant to the Word of God, and the custom of the primitive Church, to have public prayer in the church, or to minister the sacraments, in a tongue not understanded of the people.

Art. XXV. *Of the Sacraments.*—Sacraments ordained of Christ be not only badges or tokens of Christian men's profession, but rather they be certain sure witnesses, and effectual signs of grace, and God's good will towards us, by the which he doth work invisibly in us, and doth not only quicken, but also strengthen and confirm our faith in him.

There are two sacraments ordained of Christ our Lord in the Gospel, that is to say, baptism, and the supper of the Lord.

Those five commonly called sacraments, that is to say, confirmation, penance, orders, matrimony, and extreme unction, are not to be counted for sacraments of the Gospel, being such as have grown partly of the corrupt following of the Apostles, partly are states of life allowed in the Scriptures; but yet have not like nature of sacraments with baptism, and the Lord's Supper, for that they have not any visible sign or ceremony ordained of God.

The sacraments were not ordained of Christ to be gazed upon, or to be carried about, but that we should duly use them. And in such only as worthily receive the same, they have a wholesome effect or operation; but they that receive them unworthily, purchase to themselves damnation, as Saint *Paul* saith.

Art. XXVI. *Of the Unworthiness of the Ministers, which hinders not the effect of the Sacraments.*—Although in the visible Church the evil be ever mingled with the good, and sometimes the evil have chief authority in the ministration of the Word and sacraments, yet forasmuch as they do not the same in their own name, but in Christ's, and do minister by his commission and authority, we may use their ministry, both in hearing the Word of God, and in receiving the sacraments. Neither is the effect of Christ's ordinance taken away by their wickedness, nor the grace of

* The Twenty-first of the former Articles is omitted; because it is partly of a local and civil nature, and is provided for, as to the remaining parts of it, in other Articles.

God's gifts diminished from such as by faith, and rightly, do receive the sacraments ministered unto them; which be effectual, because of Christ's institution and promise, although they be ministered by evil men.

Nevertheless, it appertaineth to the discipline of the Church, that inquiry be made of evil ministers, and that they be accused by those that have knowledge of their offences; and finally, being found guilty, by just judgment be deposed.

ART. XXVII. *Of Baptism.*—Baptism is not only a sign of profession, and mark of difference, whereby Christian men are discerned from others that be not christened, but it is also a sign of regeneration or new-birth, whereby, as by an instrument, they that receive baptism rightly are grafted into the Church; the promises of the forgiveness of sin, and of our adoption to be the sons of God by the Holy Ghost, are visibly signed and sealed; faith is confirmed, and grace increased by virtue of prayer unto God.

The baptism of young children is in any wise to be retained in the Church, as most agreeable with the institution of Christ.

ART. XXVIII. *Of the Lord's Supper.*—The supper of the Lord is not only a sign of the love that Christians ought to have among themselves one to another; but rather it is a sacrament of our redemption by Christ's death: insomuch that to such as rightly, worthily, and with faith, receive the same, the bread which we break is a partaking of the body of Christ: and likewise the cup of blessing is a partaking of the blood of Christ.

Transubstantiation (or the change of the substance of bread and wine) in the supper of the Lord, cannot be proved by holy Writ; but is repugnant to the plain words of Scripture, overthroweth the nature of a sacrament, and hath given occasion to many superstitions.

The body of Christ is given, taken, and eaten, in the Supper, only after an heavenly and spiritual manner. And the mean whereby the body of Christ is received and eaten in the Supper, is faith.

The sacrament of the Lord's Supper was not by Christ's ordinance reserved, carried about, lifted up, or worshipped.

ART. XXIX. *Of the Wicked, which eat not the Body of Christ in the use of the Lord's Supper.*—The wicked, and such as be void of a lively faith, although they do carnally and visibly press with their teeth (as Saint *Augustine* saith) the sacrament of the body and blood of Christ; yet in no wise are they partakers of Christ; but rather, to their condemnation, do eat and drink the sign or sacrament of so great a thing.

ART. XXX. *Of both Kinds.*—The cup of the Lord is not to be denied to the lay-people: for both the parts of the Lord's sacrament, by Christ's ordinance and commandment, ought to be ministered to all Christian men alike.

ART. XXXI. *Of the one Oblation of Christ finished upon the Cross.*—The offering of Christ once made is that perfect redemption, propitiation, and satisfaction, for all the sins of the whole world, both original and actual; and there is none other satisfaction for sin, but that alone. Wherefore the sacrifices of masses, in the which it was commonly said, that the priest did offer Christ for the quick and the dead, to have remission of pain or guilt, were blasphemous fables, and dangerous deceits.

ART. XXXII. *Of the Marriage of Priests.*—Bishops, priests, and deacons, are not commanded by God's law, either to vow the estate of single life, or to abstain from marriage: therefore it is lawful for them, as for all other Christian men, to marry at their own discretion, as they shall judge the same to serve better to godliness.

ART. XXXIII. *Of excommunicate Persons, how they are to be avoided.*—That person which by open denunciation of the Church is rightly cut off from the unity of the Church, and excommunicated, ought to be taken of the whole multitude of the faithful, as an heathen and publican, until he be openly reconciled by penance, and received into the Church by a judge that hath authority thereunto.

ART. XXXIV. *Of the Traditions of the Church.*—It is not necessary that traditions and ceremonies be in all places one, or utterly like; for at all times they have been divers, and may be changed according to the diversity of countries, times, and men's manners, so that nothing be ordained against God's Word. Whosoever, through his private judgment, willingly and purposely, doth openly break the traditions and ceremonies of the Church, which be not repugnant to the Word of God, and be ordained and approved by common authority, ought to be rebuked openly (that others may fear to do the like), as he that offendeth against the common order of the Church, and hurteth the authority of the magistrate, and woundeth the consciences of the weak brethren.

Every particular or national church hath authority to ordain, change, and abolish, ceremonies or rites of the Church ordained only by man's authority, so that all things be done to edifying.

ART. XXXV. *Of the Homilies.*—The Second Book of Homilies, the several titles whereof we have joined under this article, doth contain a godly and wholesome doctrine, and necessary for these times, as doth the former Book of Homilies, which were set forth in the time of *Edward the Sixth*; and therefore we judge them to be read in churches by the ministers, diligently and distinctly, that they may be understanded of the people.

Of the Names of the Homilies. 1. Of the right use of the church. 2. Against peril of idolatry. 3. Of repairing and keeping clean of churches. 4. Of good works: first of fasting. 5. Against gluttony and drunkenness. 6. Against excess of apparel. 7. Of prayer. 8. Of the place and time of prayer. 9. That common prayers and sacraments ought to be ministered in a known tongue. 10. Of the reverend estimation of God's Word. 11. Of almsdoing. 12. Of the nativity of Christ. 13. Of the passion of Christ. 14. Of the resurrection of Christ. 15. Of the worthy receiving of the sacrament of the body and blood of Christ. 16. Of the gifts of the Holy Ghost. 17. For the rogation days. 18. Of the state of matrimony. 19. Of repentance. 20. Against idleness. 21. Against rebellion.

[This article is received in this Church, so far as it declares the Books of Homilies to be an explication of Christian doctrine, and instructive in piety and morals. But all references to the constitution and laws of England are considered as inapplicable to the circumstances of this Church; which also suspends the order for the reading of said homilies in churches, until a revision of them may be conveniently made, for the clearing of them, as well from obsolete words and phrases, as from the local references.]

ART. XXXVI. *Of Consecration of Bishops and Ministers.*—The Book of Consecration of Bishops, and Ordering of Priests and Deacons, as set forth by the General Convention of this Church in 1792, doth contain all things necessary to such consecration and ordering; neither hath it any thing that, of itself, is superstitious and ungodly. And, therefore, whosoever are consecrated or ordered according to said form, we decree all such to be rightly, orderly, and lawfully consecrated and ordered.

ART. XXXVII. *Of the Power of the Civil Magistrates.*—The power of the civil magistrate extendeth to all men, as well clergy as laity, in all things temporal; but hath no authority in things purely spiritual. And we hold it to be the duty of all men who are professors of the Gospel, to pay respectful obedience to the civil authority, regularly and legitimately constituted.

ART. XXXVIII. *Of Christian Men's Goods, which are not common.*—The riches and goods of Christians are not common, as touching the right, title, and possession of the same; as certain Anabaptists do falsely boast. Notwithstanding, every man ought, of such things as he possesseth, liberally to give alms to the poor, according to his ability.

ART. XXXIX. *Of a Christian Man's Oath.*—As we confess that vain and rash swearing is forbidden Christian men by our Lord Jesus Christ, and *James* his Apostle, so we judge, that Christian religion doth not prohibit, but that a man may swear when the magistrate requireth, in a cause of faith and charity, so it be done according to the prophet's teaching, in justice, judgment, and truth.

Literature.—Hardwick, *History of the Articles of Religion* (Cambridge, 2d ed., 1859); Thomas Rogers, *Exposition of the Thirty-nine Articles* (London, 1579; new ed., Cambridge, 1854); Burnet, *History of the Reformation* (many eds.) and *Exposition of the Thirty-nine Articles* (Oxf., 1814, and other eds.); Laurence, *Bampton Lectures* for 1804 (Oxf., 3d ed., 1838); Browne (now bishop of Winchester), *Exposition of the Thirty-nine Articles* (London, 1850; 9th ed., 1871; Am. ed. by Bishop Williams); [illegible] *Exposition of the Thirty-nine Articles* (Lond., 1867); Bishop White, *Memoirs of the Prot. Episc. Ch.*; Perry, [illegible] *of the General Convention of the Prot. Episc. Ch. in the U. S.*, 1785–18[illegible], vol. i. pp. 279 sqq.; Schaff, [illegible] *Creeds of Christendom* (New York, 187[illegible]) [illegible]

Ph[illegible]

Thirty Tyrants, a body of thirty [illegible] Athens 404–403 B.C. They were [illegible] oligarchic party by the Spartans [illegible] Peloponnesian war. The tyrants were [illegible] and shameless acts, and after [illegible] by Thrasybulus.

Thirty Tyrants of Rome [illegible] adventurers who from 2[illegible] their own power in [illegible] reigns of Valerian [illegible] is borrowed from [illegible] Athenian [illegible]

The names of only nineteen of these adventurers have come down to us.

Thirty Years' War, The (1618–48), originated as a contest between the Protestant and Roman Catholic parties in Germany. By the Peace of Augsburg (1555) it was left to each state to prescribe the form of worship within its own boundaries (*cujus regio, ejus religio*), and all subjects were allowed to move from those states in which their worship was forbidden to those in which it was not. But, although a basis of religious liberty was thus established, the treaty failed to settle, even in principle, the many social and political questions involved in the religious controversy. Perpetual chicaneries kept the hostile feelings alive, and bitter strifes arose in one place before they had died out in another. During the reign of Maximilian II. (1564–76) Protestantism was spreading not only in Bohemia, where two thirds of the population belonged to this creed, but also in Hungary, and even in Austria proper, and the Roman Catholics were made to feel that the enemy was victorious. But under his successor, Rudolf II. (1576–1612), a heavy reaction set in. The Jesuits were everywhere at work, and the Roman Catholic princes used their right of prescribing the form of worship in an outrageous manner. Alarmed by the violence and arbitrariness of the emperor's measures, the Protestant princes of the German empire formed the Evangelical Union at Ahausen, a monastery in the margraviate of Anspach, Franconia, May 4, 1608, under the lead of the elector-palatine, Frederick IV., and as a counterbalance the Roman Catholic princes formed next year (July 10, 1609) the Holy League at Munich, under the leadership of Maximilian, duke of Bavaria. Thus the materials for a great conflagration were ready, only the spark was wanting; and so far all the points at issue were purely religious or of religious origin. But when, subsequently, the contest actually took place, the interference of foreign powers brought many non-religious interests into play. Sweden intended to conquer provinces, France to crush or curb the house of Austria, etc.; and in the final results of the long and terrible war the social and political consequences were of much greater importance to Germany and Europe than the religious. On the one side, during the whole struggle, stood Austria, supported by Spain and Bavaria; on the other side the parties changed—first, Bohemia and the Palatinate, next a combination of North German princes under the leadership of Denmark, then Sweden, and finally Sweden and France; and in accordance with these changes the course of the war falls into four distinct periods.

The Bohemians had compelled Rudolf II. to issue the so-called *Majestätsbrief*, July 11, 1609, which guarantied their religious liberty, and his successor, Matthias (1612–19), had also signed it on his accession to the throne. But, having no children of his own, Matthias appointed his cousin, Ferdinand of Styria, his heir, and Ferdinand, who had been educated by the Jesuits and was a fanatic, had made an oath while still a young man to extirpate Protestantism from his countries. In 1617 he was crowned king of Bohemia, and the persecutions immediately began. In Klostergraben and Braunau, two small Bohemian towns, the Protestants had built two new churches. The archbishop of Prague and the abbot of Braunau, under whose jurisdiction the places belonged, closed the churches, and finally pulled them down. A lawsuit was instituted, and the courts decided in favor of the Roman Catholic authorities. A petition was sent to the emperor, and a very harsh answer was returned. Then the Protestants, under the leadership of Count Thurn, penetrated into the castle of Prague (May 23, 1618), threw the imperial councillors, Martinitz and Slavata, out of the windows from a height of about 60 feet, organized a general rising throughout the country, established a connection with Bethlen Gabor, prince of Transylvania, and invoked the aid of the Evangelical Union in Germany. The negotiations which the emperor Matthias opened led to nothing; the Union sent an auxiliary army of 4000 men under the count of Mansfeld; the Austrian forces proved utterly insufficient; and when Matthias died (Mar. 20, 1619) the Bohemians declared their throne vacant, and offered the crown to the young elector-palatine, Frederick V., the son-in-law of James I. of England, who accepted it. The situation of Ferdinand was very critical. The insurrection spread into Austria proper, and Bethlen Gabor approached Vienna through Hungary. Ferdinand, nevertheless, succeeded in being elected emperor of Germany Aug. 28, 1619, and secured the active support of Maximilian of Bavaria and the Holy League. An army of 30,000 men was organized and placed under the command of the Bavarian field-marshal Tilly, who speedily restored order in Austria, and thence penetrated into Bohemia, reinforced by Spanish and Austrian troops. Johann Georg, elector of Saxony, who, although a Lutheran, had never joined the Union, probably because the elector-palatine was a Calvinist, now declared against Frederick, and entered Lusatia, while a Spanish army under Spinola invaded the Lower Palatinate. The Protestant army stood before the walls of Prague on the White Mountain, but on Nov. 8, 1620, it was completely routed, and the young king—the "winter king," as he was called—fled to Holland. In a short time the whole of Bohemia was reduced to submission, and Ferdinand treated it with barbarous vengeance. The *Majestätsbrief* he tore to pieces with his own hands; the Protestant worship was absolutely forbidden; the property of all the leaders, worth more than 40,000,000 crowns, was confiscated; over 30,000 families of the Lutheran and Reformed creeds fled or were driven from the country, and the Jesuits were reinstated in full power. Immediately after the reduction of Bohemia, the Evangelical Union dissolved, and the emperor was now at liberty to turn his whole force against the elector-palatine. The margrave of Baden-Durlach was the only prince who protested against the invasion of the Palatinate by Spanish and Austrian troops and took up arms in defence of the unfortunate Frederick V.; even his own father-in-law left him to shift for himself. Nevertheless, for a moment the issue seemed doubtful. Frederick returned from Holland with an army, and Tilly was defeated at Wiesloch Apr. 27, 1622. On the dissolution of the Union, Mansfeld had not dissolved his army. He was a man who had adopted war as his business, and his army was his capital. Gifted with a great military talent, with infinite shrewdness in negotiation, with a brilliant eloquence, swift, audacious, and entirely unscrupulous, he easily gathered around himself a multitude of young men who were attracted by the adventures, the plunder, and the gross pleasures which the life of the "free soldiers" offered. He then hired himself, his talent, and his army to the highest bidder, England, France, or whosoever could furnish the largest "subsidies," and in the mean time, in the empty hours between two subsidies, he maintained himself by plunder and robbery. After the battle of the White Mountain this man had led his army to the regions of the Rhine, and he now fought here desperately against the imperial soldiers, together with Christian of Brunswick, an adventurer of the same kind, but of a lower grade. Nevertheless, Tilly defeated the margrave at Wimpfen (May 6) and Christian of Brunswick at Höchst (June 20), and Mansfeld he drove into Holland. Frederick now gave up his case in despair, and through the intervention of his father-in-law opened negotiations with Ferdinand. But Ferdinand knew no other feeling than vengeance, and when Frederick in foolish confidence dissolved his army, Tilly rapidly overran the whole Palatinate, plundering and devastating, and at the diet at Regensburg (Mar. 6, 1623) Frederick was placed in ban, bereft of all his possessions, and the Palatinate was given to Maximilian of Bavaria.

At this point the war might have ended but for the imprudence and stubbornness of the emperor. The discontent which his violent measures caused contributed much more than the exertions of the emigrants and the intrigues of the English and French courts to the formation of a union of the North German princes under the leadership of Denmark. The Danish king, Christian IV., was a man of much ability, though not of any superior talent. There was a romantic turn in his character, which made him the finest architect Denmark ever had; but in actual life, where events and circumstances will not remain standing, like brick and mortar, in the place assigned to them by the builder, he generally became lost among the details, and seldom achieved anything great. Although he entered the scene in 1625 with a well-appointed army, subsidized by England and Holland, joined by Mansfeld and Christian of Brunswick, and, at least in the beginning, tolerably well supported by his allies, he was not very dangerous, and the emperor was well prepared. Besides the army of the League under the command of Tilly, he had now a second army at his disposal, an independent Austrian army under the command of Wallenstein. Wallenstein was a most peculiar but most powerful character, possessed of brilliant talents both in the council-room and on the battle-field, and the mystical streak which pervaded his intellect, and afterward made his goal wavering and his means uncertain, appeared as yet only as an additional charm of his mind. In his own name, but for Austrian money and under the authority of Ferdinand, he had organized an army of about 40,000 men, nearly on the same principle as Mansfeld, though in a different style. He did not hire single men for the rank and file by the promise of plunder, but he hired commanders of whole regiments or army corps by the promise of independent principalities, or perhaps crowns; and so great was his success in creating and organizing an army on this principle that not only the League, but even the emperor himself, soon became jealous of him—yea, afraid of him. These two armies, Wallen-

stein to the E., Tilly to the W., now moved northward against Christian IV. Mansfeld made a diversion against Wallenstein, but was defeated at Dessau Apr. 25, 1626. He then drifted like a swift stormcloud into Hungary, where Bethlen Gabor once more had taken up arms against Austria, and Wallenstein was compelled to follow him. Bethlen Gabor, however, was induced to make peace before Mansfeld could join him. Mansfeld himself fell sick, his army dissolved, and on Nov. 30, 1626, he died at Zara, standing erect and full armed, supported by two of his adjutants. Wallenstein was now at liberty to return to Germany, but he had sustained great losses both of men and material. In the mean time, Tilly had defeated Christian IV. at Lutter am Barenberge, Aug. 27, 1626, and the two generals now agreed on a common plan of operation, Tilly drawing to the W., toward Holland, Wallenstein to the N., toward Denmark. He conquered Pomerania and Mecklenburg, and expelled the princes who had revolted against the emperor. He then penetrated into the Danish peninsula, and compelled Christian IV. by the Peace of Lubeck (May 22, 1629) to withdraw altogether from any interference in the affairs of Germany. In reward he was made duke of Mecklenburg by the emperor. Here, again, a point was reached at which the war might have ended, and many circumstances pointed toward peace. Alarmed by the independent and imperious manner in which Wallenstein conducted affairs, the League demanded that the emperor should dismiss him and disband the army, and the emperor was found willing to do so. But on Mar. 6, 1629, Ferdinand issued the "edict of restitution," ordering that all ecclesiastical estates secularized since 1552 should be returned to the Church, and all immediate sees held by Protestants transferred to Roman Catholic prelates, etc.; and in spite of the protest of Brandenburg, Saxony, Hesse, Magdeburg, and other states, the edict was carried out by force in all the free imperial cities, such as Augsburg, Ulm, Regensburg, etc., and Tilly was ordered to move northward and crush every attempt at resistance. At this critical moment Gustavus Adolphus stepped forward, and the third phase of the war began.

Various considerations brought the Swedish hero to Germany. During his war in Poland the emperor and Wallenstein had supported the Poles. The victory of Romanism in Germany would endanger his own position in Sweden, where there still was a Roman Catholic party. The whole Swedish nation was at this moment moved by an impulse of expansion, and as Sweden ruled over by far the largest part of the countries around the Baltic, it seemed the natural goal of an aggressive policy to conquer the rest and make the Baltic a Swedish sea. But beneath these and other similar considerations an enthusiastic conviction of the justice of the Protestant cause, and a deep indignation at the mass of lies and fraud with which the popes had filled Europe, were acting in his mind. In the latter part of June, 1630, he landed in the island of Usedom, drove away the imperial garrisons from Pomerania and Mecklenburg, where he reinstated the expelled princes, and formed alliances with Hesse, Saxe-Weimar, Magdeburg, and France. But he proceeded with great caution, moving only on the basis of solid alliances guarantied by the surrender of important fortresses and actual support of troops. While difficult negotiations with the electors of Brandenburg and Saxony detained him, Tilly pushed forward and took Magdeburg by storm, May 20, 1631. The city was given up to plunder and massacre, and such horrors were perpetrated that the soldiers themselves, awakening from their delirium, asked the general to put an end to the carnage; but Tilly, a monster, both bodily and mentally, a dwarf with a fiendish eye which delighted in looking at destruction, a demon rich in talents, but destitute of enthusiasm, even of ambition, wished to see the city destroyed, and after the lapse of three days over 130,000 of the inhabitants had been killed or drowned, and of the houses only 130 were left standing. The electors of Brandenburg and Saxony now joined Gustavus Adolphus, and on Sept. 17, 1631, they met Tilly at Breitenfeld, near Leipsic, where in a murderous battle his army was nearly annihilated. The two electors then passed into Bohemia, while Gustavus Adolphus pushed onward into the Palatinate. On Apr. 15, 1632, Tilly was defeated a second time in the battle on the Lech; he himself was mortally wounded, and his proud army, the whole force of the League, was dispersed. On May 17, Gustavus Adolphus and Frederick V. entered Munich. In this emergency the emperor recalled Wallenstein, and commissioned him a second time to organize an army. The situation was extremely dangerous. Not only had Gustavus Adolphus proved a general of the very first rank, but the superiority of his army was so strikingly apparent that it impressed even the superstition of people. Since the days of Alba, Don Juan, and Farnese the Spanish army had been celebrated in Europe for its discipline, its quickness in moving, its reliability in fighting. But here appeared an army whose discipline was not the product of the rod, but a simple consequence of the natural nobleness of the soldiers, and to whose perfect training in all military exercises were added personal valor and genuine warlike enthusiasm. The artillery of Gustavus Adolphus was also novel and very powerful. Wallenstein, however, did not hesitate to meet this new foe, but he saw the difficulties of the emperor, and exacted very humiliating conditions. With an army as yet only half organized he cleared Bohemia in less than a month, and he then entered the Palatinate and took up a position at Nuremberg opposite the camp of Gustavus Adolphus. For three months the two armies stood facing each other without stirring. At last, Wallenstein moved into Saxony; Gustavus Adolphus followed. At Lutzen (Nov. 16, 1632) the battle took place. Gustavus Adolphus fell, but Wallenstein was defeated, and retreated into Bohemia.

With the death of the Swedish king the war changed character entirely. The religious motives disappeared, and gave place to merely political interests. Instead of broad plans, large armies, definite movements, and decisive battles, the scene became filled with an inextricable maze of intrigues, often of the meanest egotism, and a whirl of small armies led to campaigns of robbery and devastation by adventurers more or less brilliant. Sweden, now governed by the great chancellor, Axel Oxenstiern, thought only of retaining as much as possible of its conquests; and although the military valor of its army continued the same under the leadership of Banér, Horn, Torstenson, and Wrangel, its moral character sank, and the striking difference which in 1630 distinguished it from the loose and multifarious rabble gathered together under Mansfeld, Tilly, or Wallenstein, disappeared before 1645. Wallenstein remained inactive in Bohemia for more than a year, carrying on treacherous negotiations with the Swedes and the German Protestants, though, as it seems, without any fixed goal. The emperor suspected him, but dared not dismiss him at the head of a large army which clung enthusiastically to him; he was assassinated at Eger Feb. 25, 1634. The imperial army, under the leadership of Archduke Ferdinand, Gallas, and Piccolomini, then marched up the Danube, and at Nordlingen the Protestant army, under Duke Bernhard of Saxe Weimar and Horn, suffered a very severe defeat, Sept. 6, 1634. Immediately after, the electors of Brandenburg and Saxony deserted their allies, made peace with the emperor, and even turned against the Swedes. But at the same time, Richelieu, who had subsidized Sweden from the beginning, and who considered the humiliation of the house of Hapsburg as the principal aim of his foreign policy, took Duke Bernhard and his army into the French service and declared war against Austria. The most brilliant chapter of this last part of the war was Torstenson's campaigns from 1641 to 1646. The emperor induced Christian IV. of Denmark to join him against Sweden, and the plan was to crush the Swedish army in Germany between an Austrian army from the S. and a Danish from the N.; but before the plan was ripe and could be carried out, Sweden was informed of it, and with a most astonishing rapidity of movement, and an almost uninterrupted success under the most difficult circumstances, Torstenson now defeated Piccolomini at Breitenfeld, Nov. 2, 1642, penetrated into Jutland, which he completely subdued, returned to Germany and drove Gallas before him into Bohemia, defeated a third Austrian army under Hatzfeld and Götz at Jankow, Mar. 6, 1645, and approached Vienna, which he proposed to surround and besiege in connection with Prince Rakoczy of Transylvania. But Rakoczy made peace with the emperor, and Torstenson was compelled by the gout to resign his command. The most horrible chapter formed the French participation in the war. Duke Bernhard made a successful campaign into Bavaria, but, like Wallenstein, he seems to have fought simply in order to obtain a crown for himself, and suddenly (July 18, 16[illegible]) he died under very singular circumstances; his conquest fell to France. During the subsequent [illegible] campaigns in Bavaria and Hesse these countries were [illegible] fully devastated. In 1646 over 100 villages were [illegible] Bavaria, and the inhabitants driven away. In [illegible] towns, 17 castles, and 400 villages had been [illegible] ing the war. The last contest took pl[illegible] where the Swedish general, Count K[illegible] quered one part of Prague, and w[illegible] other when news came that the P[illegible] been concluded at Munster [illegible] of peace were first attempted [illegible] the powers were to treat under [illegible] and the Protestant under [illegible] these first negotiations [illegible] tions of etiquette. The [illegible] was due to the complete [illegible] Austria [illegible]

peror gave up not his title, but the greatest part of his authority as head of the German empire, while the power of the princes was so considerably extended that the empire became nearly dissolved. Holland and Switzerland were declared independent; Alsace was given to France, Pomerania to Sweden. In the interior still greater changes took place. Only the religious affairs were now found comparatively easy to settle; the Peace of Passau (1655) was taken as a basis for the order established.

The materials for the study of this war, now very ample, are furnished by Schiller (1802), Menzel (1835), Flathe (1840), Mebold (1840), Sölte (1840), Barthold (1842), Heilmann (1851), Klopp (1861), Hauser (1862), Gindely (1869), Ranke (1869), Stieve (1875). (See also Sir Edward Cust, *Lives of the Warriors of the Thirty Years' War*, London, 1865.) CLEMENS PETERSEN.

This'tle [Ang.-Sax. *thistel*], a name given to many stout spinous herbs of the order Compositæ and of the genera *Cirsium, Carduus, Centaurea, Onopordon.* A few have medicinal qualities, and some have fine flowers. The roots and leaves of some species were once eaten as food. The Canada thistle (*Cirsium arvense*) is a noxious weed of European origin, now naturalized extensively in America.

This'tle-Bird, a name given to the *Chrysomitris tristis*, generally designated as the YELLOW-BIRD (which see).

Thistle, Order of the. See ANDREW, SAINT.

Tho'luck (FRIEDRICH AUGUST GOTTREU), b. at Breslau Mar. 30, 1799; studied theology and Oriental languages at the universities of Breslau and Berlin; visited England in 1825 and Rome in 1828; was appointed professor of theology at Berlin in 1824, and removed to Halle in 1826. His works, most of which have been often reprinted in Germany and translated into English both in England and America, were published in a collected edition in 11 vols. 1863–72, and treat Oriental subjects—*Sufismus, sive Theosophia Persarum pantheistica* (1821), *Blütensammlung aus der morgenländischen Mystik* (1825), *Speculativ Trinitätslehre des späteren Orients* (1826); exegetical—*The Epistle to the Romans* (1824; twice translated into English), *The Gospel of John* (1827; translated into English by Kaufmann, 1836), *The Sermon on the Mount* (1833; translated into English by R. L. Brown, Edinburgh, 1860), etc.; historical—*Vorgeschichte des Rationalismus* (4 vols., 1853–62), *Geschichte des Rationalismus* (1865, etc.); ethical and dogmatical—*Wahre Weihe des Zweiflers* (1824; translated into English by Ryland under the title of *Guido and Julius, the Doctrine of Sin and the Propitiator*), *Stunden der Andacht* (2 vols., 1840). D. at Halle, Prussia, June 10, 1877.

Thom (JOHN HAMILTON), b. probably in Scotland about 1810; became a distinguished minister of the Unitarian Church, and was many years pastor of the congregation worshipping in Renshaw chapel, Liverpool. Author of *St. Paul's Epistles to the Corinthians* (London, 1851; Boston, 1852), *The Revelation of God and Man in the Son of God and the Son of Man* (1859), a *Memoir of Rev. John James Tayler* (1872), and other works, and edited *The Life of the Rev. Joseph Blanco White, written by himself, with Portions of his Correspondence* (3 vols., 1845).

Thom'as, county of South-western Georgia, bordering on Florida, drained by Ocklockonee River, and traversed by Atlantic and Gulf R. R.; surface level, soil productive. Staples, cotton, Indian corn, oats, sweet potatoes, and livestock. Cap. Thomasville. Area, 920 sq. m. P. 14,523.

Thomas, unorganized county of Western Kansas, intersected by several streams; surface rolling, and well adapted for stock-raising.

Thomas, tp., Butler co., Mo. P. 654.

Thomas, tp., Darlington co., S. C. P. 1558.

Thomas, or **Didymus** ("the twin"), SAINT, one of the twelve apostles, of whose personal character and history nothing is known except by two or three allusions in the Gospel of John. The most important of these is his refusal to believe in the resurrection of Jesus until convinced by tangible proof. He figures largely in the apocryphal Gospels, one of which (the *Evangelium Infantiæ Christi*) was ascribed to him; was represented by later so-called "tradition" as having preached in Ethiopia, Egypt, Parthia, or India, and in the latter country the CHRISTIANS OF ST. THOMAS (which see), found by the Portuguese on the Malabar coast in the sixteenth century, claimed to originate from his preaching. This, however, is probably due to a confusion with a Nestorian or Manichæan missionary. Great efforts have been made by several Spanish, Mexican, and South American theologians to make it appear that the apostle evangelized America, and traces of his presence are pointed out in sacred caves and other sites from Paraguay to Mexico, in which latter country he has been formally identified by several native antiquarians with the Aztec divinity QUETZALCOATL (which see).

Thomas (ABEL CHARLES), b. in Exeter township, Pa., July 11, 1807, and educated at Lancaster, Pa. He has been Universalist pastor in Lowell, Mass., Brooklyn, N. Y., and Cincinnati, O.; published *Centenary of Universalism* (1872).

Thomas (BENJAMIN FRANKLIN), LL.D., grandson of Isaiah, b. at Boston Feb. 12, 1813; removed to Worcester 1819; graduated at Brown University 1830; admitted to the bar 1833; judge of probate for Worcester county 1844–48; judge of Massachusetts supreme court 1853–59; resumed legal practice at Boston 1860, and member of Congress 1861–63. Author of *Law of Towns and Town Officers* (1845) and *Suggestions upon the Personal Liberty Law* (1861). D. at Salem, Mass., Sept. 27, 1878.

Thomas (CHARLES LOUIS AMBROISE), b. at Metz Aug. 5, 1811; studied music at the Conservatory of Paris 1828–32, in Italy and Vienna 1832–36; settled in Paris in 1836, and composed his first opera, *La Double Échelle*, in 1837. The most remarkable of his compositions are—*Le Caïd*, a comic opera (1849), *Le Songe d'une Nuit d'Été* (1850), *Mignon* (1866), and *Hamlet* (1868).

Thomas (DAVID), b. in Montgomery co., Pa., in 1776; settled near Aurora, Cayuga co., N. Y., 1805; published *Travels through the Western Country in 1816* (Auburn, 1819); was chief engineer of the Erie Canal W. of Rochester, and subsequently one of the principal engineers of the Welland Canal, Canada; was eminent as a florist and pomologist, and by his writings in the *Genesee Farmer* rendered great services to scientific agriculture. D. in 1859.

Thomas (EBENEZER SMITH), b. at West Cambridge, Mass., in 1775; learned the printing trade at Worcester in the office of his uncle, Isaiah Thomas; became a bookseller and editor at Charleston, S. C., 1795; resided at Baltimore, Md., 1816–29; removed to Cincinnati, O., 1829; edited the *Daily Advertiser* 1829–35, and the *Evening Post* 1835–39. D. at Cincinnati Oct. 22, 1845. Author of *Reminiscences of the Last Sixty-five Years* (2 vols., 1840).

Thomas (EDWARD), F. R. A. S., b. in London, England, in Dec., 1813; received a careful education; entered the civil service of the East India Company at an early age, and rose to posts of great responsibility, having been for several years British resident at Delhi; was distinguished for historical, antiquarian, and philological researches on Oriental subjects, and became on his return to England professor in the East India College at Haileybury. Author of *The Coins of the Patan Sultans of Hindustan* (London, 1847) and *Supplementary Contributions* to the same (Delhi, 1852; new ed., London, 1870), *The Epoch of the Sah Kings of Surashtra* (1848), *Coins of the Kings of Ghazni* (1848–59), *The Numismatic History of the Early Mohammedan Arabs in Persia* (1849), *Catalogue of Bactrian Coins* (1857), *Coins of the Sassanidæ*, *The Hindu Kings of Kabul*, *Miscellaneous Essays on Oriental Subjects* (1868), *Early Sassanian Inscriptions, etc.* (1868), and *Pehlevi Inscriptions, etc.* (1871), and other works of a similar character; edited James Prinsep's *Essays on Indian Antiquities* (2 vols., 1872), and contributed largely to the *Oriental* and *Numismatic Reviews*.

Thomas (FRANCIS), b. in Frederick co., Md., Feb. 3, 1799; educated at St. John's College; was admitted to the bar 1820; was a member of the house of delegates 1822, 1827, and 1829, being chosen Speaker in the latter year; member of Congress 1831–41, and again 1861–69; governor of Maryland 1841–44; was president of the Chesapeake and Ohio Canal Company 1839; member of the State constitutional convention 1850; was an active Union man during the civil war, and raised a brigade of 3000 volunteers, but declined a military command; was a delegate to the Philadelphia "Loyalists' Convention" 1866, and U. S. minister to Peru 1872–75. He was killed by a railway accident at Frankville, Md., Jan. 22, 1876.

Thomas (FREDERICK WILLIAM), son of Ebenezer Smith, b. at Providence, R. I., Oct. 25, 1808; became a cripple at the age of four years; was educated at Baltimore, Md., where he was admitted to the bar 1828; removed to Cincinnati 1830; assisted his father in editing the *Advertiser*, in which he printed his well-known song, "'Tis said that absence conquers love;" was editorially connected with the *Democratic Intelligencer* (1834) and *Evening Post* (1835); wrote also for the magazines; published his most successful novel, *Clinton Bradshaw* (1835), followed by *East and West* (1836), *Howard Pinckney* (1840), *John Randolph of Roanoke, and other Public Characters* (1853); was clerk in the treasury department at Washington, D. C., 1841–50; was for a short time a preacher of the M. E. Church in Cincinnati (1850); afterward professor of rhetoric and English literature in Alabama University; resumed the practice of law at Cambridge, Md., 1858; took charge of the literary department of the *Richmond Enquirer* 1860, and was subsequently engaged upon

the staff of the *South Carolinian* at Columbia; travelled extensively, especially in the Southern States; was a successful lecturer, and occasionally figured in politics. D. at Washington, D. C., Sept. 30, 1866.

Thomas (GEORGE HENRY), b. in Southampton co., Va., July 31, 1816, of parents who were of Welsh descent on his father's side and of French origin on his mother's side. Both branches of his family were among the early settlers of S. E. Virginia, where they devoted themselves to the pursuits of agriculture. In 1836 young Thomas was appointed a cadet at the U. S. Military Academy, where he graduated July 1, 1840, and promoted in the army to second lieutenant 3d Artillery. After a brief service in garrison in New York harbor, he was sent to Florida with his company, where he served against the Indians for two years, participating in Major Wade's capture of 70 Seminoles, Nov. 6, 1841, and brevetted first lieutenant for gallantry. Again in garrison in the South and South west until 1845, his regiment in that year was ordered to Texas with the army of occupation. In the war with Mexico, which soon followed, Thomas was engaged in the gallant defence of Fort Brown, in the battle of Monterey and in that of Buena Vista; in all of which he was distinguished, and brevetted captain and major for gallantry in the last-named battles. Subsequent to Buena Vista he continued in garrison at the mouth of the Rio Grande until the close of the war, when again for a year in Florida. Transferred to West Point in 1851, he served as instructor of cavalry and artillery at the Military Academy until 1854, when ordered to California with his regiment, in which he had attained a captaincy Dec. 24, 1853. In May, 1855, Thomas was appointed major of the newly organized 2d Cavalry, with which he served continuously in Texas for upward of five years. In Aug., 1860, in a skirmish with Indians near the head-waters of the Brazos River, he received a wound in the face, and in November following came East on a leave of absence. Born and reared in a Southern State, he was held in high esteem in the aristocratic community to which his family belonged, and his native State had made him the recipient of a splendid sword in token of its appreciation of his services in the war with Mexico. Moreover, for five years preceding he had served on our Southern borders, removed from other associations than those of his brother-officers. A. S. Johnston was colonel, R. E. Lee lieutenant-colonel, and W. J. Hardee was the senior major of his regiment. Among the younger officers were Van Dorn, Kirby Smith, Fitz Hugh Lee, Hood, and others, all of whom resigned to enter the cause of the South, and bore conspicuous parts in the Confederate armies. "We have no reason to doubt that he (Thomas) shared in the general sentiments of Virginia, and deprecated any agitation which would disturb her social institutions; . . . and he regarded the growing political strife as a measureless outrage, in which both contestants were wrong, but in which Northern agitators were the first aggressors. . . . While the contest was confined to the politicians, and found expression only in constitutional theories and legal subtleties, the wisest might well be perplexed. But the flash of the first gun revealed to the clear intellect of Thomas the whole character and spirit of the controversy, and his choice was made in an instant." (*Garfield's Oration*, 1870.) Hastening at once to Carlisle barracks, Pa., where his regiment had now arrived in a disorganized condition and shorn of its equipments through the treachery of Twiggs, he reported for duty Apr. 14, and at once set about the work of reorganizing his command. Three days later, Virginia in convention was hurried into passing a resolution of secession; two months later, Thomas crossed the Potomac at the head of his command, and entered his native State to aid in the maintenance of the Union. Referring to a conversation at this date (June 16) with Thomas, Gen. Sherman says that in response to questioning him as to his feelings regarding the events then transpiring, Thomas replied, "I have thought it all over, and I shall stand firm in the service of the government." Nobly did he maintain his decision. [illegible] stood on many future battlefields where [illegible] alone prevented disaster. In the latter part of April, Thomas was promoted to be lieutenant-colonel 2d Cavalry, and colonel May 3, 1861. (The designation of this regiment was changed in August to 5th Cavalry.) Transferred to the field of active operations in the Shenandoah Valley, he commanded a brigade at the action of Falling Waters, July 2, at Martinsburg, July 3, and at Bunker Hill, July 15. Promoted to be brigadier-general of volunteers in August, and transferred to the department of the Cumberland, he was for a time engaged in mustering and organizing the 1st brigade, which formed the nucleus of the 14th corps (Army of the Ohio), to the command of which he attained upon Gen. Buell's succession to the command of the department (newly designated as that of the Ohio) in November, and Dec. 31 moved against the enemy, then threatening the flank and rear of Buell's army. The battle of Mill Spring (Jan. 19–20, 1862), resulting in the defeat of [illegible], was the most important victory yet gained in the West. The effect was to bring Thomas into general notice, and to lay the foundation of the greater fame he was yet to achieve. Continuing in command of his division until Sept. 30, 1862 (except during the advance upon and siege of Corinth, Apr. 9–May 30, when he commanded the right wing of the Army of the Tennessee), he was engaged in the movement on Nashville (Feb.–Mar.); in the Tennessee and Mississippi campaign (Mar.–Apr.); in the march on Pittsburg Landing, where held in reserve; in command at Corinth June 5–22; and in operations in Alabama, Tennessee, and Kentucky. On the advance into Kentucky he was appointed second in command of the Army of the Ohio, commanded the right wing at the battle of Perryville (Oct. 8) and subsequent pursuit of the enemy. In the latter part of October the department of the Cumberland was revived, with Gen. Rosecrans in command, the troops under him to constitute the 14th army corps, which Rosecrans organized into three grand divisions: Thomas was assigned to the centre, and in the battle of MURFREESBORO' (which see) withstood the furious assaults of the enemy. By orders of the war department the Army of the Cumberland was now (Jan. 9, 1863) divided into three army corps, and Thomas assigned to command of the 14th, with which he was engaged in the campaign of Middle Tennessee, the passage of the Elk and Tennessee rivers (July–Sept.). At the battle of CHICKAMAUGA (which see) he commanded the right and centre, where the great struggle took place for the repossession of Chattanooga, out of which the enemy had been manœuvred. The Rossville road—the road to Chattanooga, and for the possession of which the battle was fought—was successfully held by Thomas during the first day's fighting. The history of the second day's battle—the record of Thomas's wonderful resistance for upward of five hours against the concentrated efforts of the enemy after our right was routed—furnishes one of the most remarkable pages in the history of the war, and justly entitles him to be called the "Rock of Chickamauga." He now retired upon Chattanooga, which he proceeded to fortify, and here (Oct. 19) orders reached him placing him in command of the Army of the Cumberland; a week later (Oct. 27) he received the commission of brigadier-general in the regular army. The armies of Sherman and [illegible] were soon after assembled at Chattanooga, with Gen. Grant in chief command, the Army of the Cumberland forming the centre of the grand army; which position it held at the storming of Missionary Ridge, and [illegible] the campaign of 1864 during the almost daily engagements from May to September, resulting in the capture of Atlanta (Sept. 1). On Sept. 27, Thomas was detached from the main army in Georgia, and placed in chief command in Tennessee with large discretionary powers, it being at this time a matter of doubt what were the real intentions of the Confederate general Hood, who was moving [illegible] in the hope of causing Sherman's withdrawal from Georgia. Sherman, having determined to cut loose from his communications and strike to the coast, detached the 4th and 23d corps to Thomas's support, leaving the latter to look out for Hood and drive him out of Tennessee should he attempt invasion, or follow him closely in case of his turning on Sherman. By Nov. [illegible], Hood was encamped along the banks of the Tennessee with a force of some 50,000 men of all arms. The 4th and 23d corps were on their way back to Thomas, whose [illegible] of Nashville was now less than [illegible], but [illegible] were coming in, and [illegible]. The advance of Hood was [illegible] at Duck River and Spring Hill; the battle of [illegible] (which see) occurred Nov. 30, in which Hood suffered a severe defeat, checking his [illegible] enable the two corps, by which the battle was fought, to unite with Thomas at Nashville. The next day, however, the undaunted Hood appeared before the lines by which that city was [illegible] strongly fortified. Although Thomas was now [illegible] equal to his opponent, his cavalry was [illegible] mounted, and the great demand was for time [illegible] complete their necessary outfit and the [illegible] newly received troops. The period was [illegible] to the country, and the government [illegible] at what was deemed at Washington [illegible] the invaders. By Dec. [illegible] the battle, but a storm of [illegible] an attack at that time impossible [illegible] started from City Point [illegible] enemy, but was met at W[illegible] first day's (Dec. 15) [illegible] country knew of the [illegible] was further supple[illegible]

suit beyond the Tennessee and utter destruction as an army. Gen. Grant was among the first to record that the defeat of Hood was the vindication of Thomas's judgment. The appointment of major-general in the regular army was now bestowed upon him, and Congress at its next meeting tendered him a vote of thanks. The legislature of Tennessee voted him a magnificent gold medal, and everywhere his name was mentioned with enthusiasm and affection. During the remaining months of the war he contributed materially to the overthrow of the rebellion by organizing raiding expeditions (resulting in the capture of Jefferson Davis in May, 1865) and by timely aid to other departments. He commanded the military division of the Tennessee (1865–66); the department of the Tennessee (1866–67); the 3d military district (Georgia, Florida, and Alabama), and the department of the Cumberland (1867–69). In Mar., 1866, he was a member of a board to recommend brevets to general officers, and from Nov., 1868, to May 15, 1869, was president of a court of inquiry in the case of Gen. Dyer, chief of ordnance. From the latter date he commanded the military division of the Pacific, with headquarters at San Francisco, where his death occurred Mar. 28, 1870. Congress passed resolutions of sympathy, and military honors were paid him at Troy, N. Y., where his remains are interred. GEORGE C. SIMMONS.

Thomas (GEORGE HOUSMAN), b. in London, England, Dec. 7, 1824; served an apprenticeship to a wood-engraver; practised that art in Paris, giving his chief attention to the illustration of books, in which he gained such popularity that his services were engaged to go to the U. S. to illustrate a newspaper; resided at New York 1846–47; furnished designs for a number of bank-notes; returned to England on account of ill-health; became one of the principal draftsmen for the *Illustrated London News;* visited Italy in the employ of that paper; produced vivid sketches of the siege of Rome, which attracted the attention of Queen Victoria, and led to his being thenceforth frequently employed by her or at her suggestion in depicting scenes of interest in which members of the royal family were engaged; produced several large oil-paintings of this character, and an album of water-color sketches belonging to the queen. His best pictures were *The Queen giving the Medals to the Crimean Heroes* and *The Queen and Prince Albert at Aldershott.* His illustrations to Thomson's *Seasons* (1858) and *Uncle Tom's Cabin* were much admired. D. at Boulogne, France, July 21, 1868.

Thomas (ISAIAH), LL.D., b. at Boston, Mass., Jan. 19, 1749; lost his father in childhood; was apprenticed when six years old to a printer, with whom he remained eleven years; commenced business at Newburyport 1767; was a partner with his former master in establishing the *Massachusetts Spy,* of which the first number appeared July 17, 1771; became obnoxious to the British authorities on account of the support given by his paper to the movements preparatory to the Revolution; transferred his printing-office to Worcester 1774; published a long series of reprints of popular English works, displaying good judgment in their selection; set up an additional bookstore and publishing-house at Boston 1788, under the firm-name of Thomas & Andrews; issued the *Massachusetts Magazine* (8 vols., 1789–96); was a partner of Carlisle in his printing-office at Walpole, N. H.; had business connections in many directions; conducted for twenty-six years (1775–1801) the celebrated *New England Almanac;* was author of a carefully-prepared *History of Printing in America* (2 vols., 1810; new ed., Albany, 1876), and was founder and first president (1812) of the American Antiquarian Society, for which he erected a building, gave a valuable library, and bequeathed a fund for its maintenance. D. at Worcester Apr. 4, 1831.

Thomas (JOHN), M. D., b. at Marshfield, Mass., in 1725; became an eminent physician in his native town and at Kingston; was surgeon to a regiment sent to Annapolis, N. S., 1746, and on the medical staff of Gov. Shirley's regiment 1747, but exchanged that post for the rank of lieutenant; attained the grade of colonel 1759; commanded a regiment under Amherst at Crown Point 1760, and took part in the capture of Montreal the same year; enrolled himself at an early date among the "Sons of Liberty;" was a delegate in 1774–75 to the Massachusetts provincial congress, by which he was appointed brigadier-general Feb. 9, 1775; received the same rank from the Continental Congress June 22, and was promoted to major-general Mar. 6, 1776; was in charge of the fortification of Dorchester Heights Mar. 4, 1776, which led to the speedy evacuation of Boston by the British; succeeded at Montgomery's death to the command of the remains of the army then besieging Quebec, where he arrived May 1, found the smallpox prevalent in camp, the forces reduced to less than 1000 effective men, and was consequently forced to raise the siege and retreat, but was attacked by the epidemic near the river Sorel, and d. at Chambly June 2, 1776.

Thomas (JOHN), b. at Chalford, England, in 1813; served an apprenticeship to a stonecutter; taught himself to paint sign-boards and engrave door-plates in order to earn a few shillings out of working hours; engaged in business with his brother; was an architect at Birmingham, and later at Leamington; was entrusted with the stone carvings for the grammar-school edifice at Birmingham, under the superintendence of Sir Charles Barry, who, when he became architect of the new Houses of Parliament, employed him in the same capacity for a series of years; executed a great number of commissions for architectural and decorative sculpture, and ultimately undertook with great success the execution of works of sculpture of the highest class, among which were *Musidora, Boadicea, Lady Godiva, Una and the Lion,* and several portrait-statues, including a colossal memorial of Shakspeare, and the famous majolica fountain exhibited at the Universal Exposition of 1862. He was also the architect of the seats of several noblemen. D. at Maida Hill, London, Apr. 9, 1862.

Thomas (JOHN A.), b. in Tennessee 1811; graduated at the U. S. Military Academy July, 1833, when commissioned second lieutenant in the 3d Artillery; captain 1843. After serving a brief term in garrison, he was recalled to West Point, where employed as instructor of infantry tactics 1834–37, as assistant professor of geography, history, and ethics 1837–41, as commandant of cadets 1842–45. In May, 1846, he resigned from the army to enter upon the practice of law in New York City; was chief engineer of the State of New York 1853–54; was advocate at London on the part of the U. S. Apr., 1853–Jan., 1854, for settlement of claims under terms of convention of Feb. 8, 1853; assistant secretary of state of the U. S. Nov., 1855–Apr., 1857. D. in Paris, France, Mar. 26, 1858.

Thomas (JOHN J.), son of David, b. near Aurora, Cayuga co., N. Y., in 1810; became, like his father, a distinguished writer on agriculture and pomology; was assistant editor of the *Genesee Farmer* 1834–39, horticultural editor of the *Albany Cultivator* 1841–53, assistant editor of the same and of the *Country Gentleman* for many years from 1853; contributed to the *Transactions* of the New York State Agricultural Society 1841–47 and to *The Farm* (New York, 1858); conducted the *Illustrated Annual Register of Rural Affairs* (Albany, 1857–65), and was author of *The American Fruit Culturist* (Auburn, 1849), *Farm Implements, and the Principles of their Construction and Use* (New York, 1854), and *Farm Implements and Farm Machinery* (New York, 1869).

Thomas (JOHN WESLEY), b. in Exeter, England, in 1798; became a Methodist Wesleyan preacher 1822; was a man of remarkable attainments as a linguist; was a good painter; author of several volumes of poems and theological essays, and executed a creditable poetical version of Dante—the *Inferno* having appeared in 1859, the *Purgatorio* in 1862, and the *Paradiso* in 1866. He was engaged in preparing a second edition at the time of his death, which occurred at Dumfries, Scotland, Feb. 7, 1872.

Thomas (JOSEPH), M. D., LL.D., b. in Cayuga co., N. Y., about 1811; educated at the Rensselaer Institute, at Yale College, and in medicine at Philadelphia; resided in India 1857–58, engaged in the study of Oriental languages; spent some months in Egypt with a similar object; was professor of Latin and Greek at Haverford College, Pa., and gave private lessons in the classics at Philadelphia. He was co-editor with Thomas Baldwin of a *Pronouncing Gazetteer* (Philadelphia, 1845), which in a revised edition was entitled *A Complete Pronouncing Gazetteer and Geographical Dictionary of the World* (1855; revised 1861, 1866), and of *A New and Complete Gazetteer of the United States* (1854); published *A First Book of Etymology* (1851–52), a volume of *Travels in Egypt and Palestine* (1853), *A Comprehensive Medical Dictionary* (1864), and *Universal Pronouncing Dictionary of Biography and Mythology* (1870–71); contributed geographical and biographical pronouncing vocabularies to Webster's Dictionaries, wrote the sections on muscular action and the mechanism of locomotion in Dr. S. G. Morton's treatise on *Anatomy,* and published an edition of Oswald's *Etymological Dictionary.* Has made pronunciation and etymology a special feature in all the works of reference published by him.

Thomas (LORENZO), b. in Newcastle, Del., Oct. 26, 1804; graduated from the U. S. Military Academy in 1823, when appointed second lieutenant of 4th Infantry, serving with that regiment in Florida until 1831; as adjutant 1828–31. After two years of recruiting service, he was on duty in the adjutant-general's office at Washington from June, 1833, to Sept., 1836; on quartermaster duty in the Florida war 1836–37, and at Washington 1837–38. Upon the organization of the adjutant-general's department he was com-

missioned major and assistant adjutant-general, and served as chief of staff of the army in Florida 1839-40; at Washington, D. C., 1840-46; in the war with Mexico he served as chief of staff to Major-Gen. Butler, both while in command of a division of volunteers and after his succession to the command of the army. In 1852 he became lieutenant-colonel, and served as chief of staff to Lieut.-Gen. Scott from Mar., 1853, to Mar. 7, 1861, when promoted to be colonel and placed in charge of the adjutant-general's office at Washington. Brigadier-general and adjutant-general of the army Aug. 3, 1861, but from 1863 employed on special duty in organizing colored troops, inspection tours, etc., until Feb., 1869, when retired from active service. At the time of Pres. Johnson's controversy with Congress he appointed Gen. Thomas (Feb. 21, 1868) secretary of war *ad interim*, but Secretary STANTON (which see) refused to vacate. D. at Washington, D. C., Mar. 2, 1875.

Thomas (MARY F. MYERS), M. D., b. in Maryland Oct. 28, 1816, daughter of Samuel Myers, a Quaker associated with Benjamin Lundy in the first anti-slavery meeting held in Washington, D. C.; married to Owen Thomas in 1839; kept house, had three children, studied medicine, and graduated from Penn Medical College in Philadelphia, Pa., in 1854; was assistant physician in hospitals during the war; has been city physician, and physician for the Home for Friendless Women in Richmond, Ind.; was admitted to membership in the Indiana State Medical Society in 1876; has been an earnest advocate of temperance for over forty years; in 1851 helped to organize the first women's rights society in Indiana; addressed the Indiana legislature in 1859, and held responsible offices in the movement, State and national, to the present. Her youngest daughter won the first Greek prize at the intercollegiate contest at New York Dec., 1875. SUSAN B. ANTHONY.

Thomas (PHILEMON), b. in North Carolina in 1764; served in the war of the Revolution; resided some years in Kentucky, where he was chosen to the legislature; afterward settled in Louisiana; headed the insurrection in West Florida against the Spanish government 1810-11; was major-general of Louisiana militia in the U. S. service 1814-15, and member of Congress 1831-35. D. at Baton Rouge, La., Nov. 18, 1847.

Thomas (PHILIP FRANCIS), b. in Talbot co., Md., Sept. 12, 1810; educated at Dickinson College; was admitted to the bar 1831; was elected to the State constitutional convention 1836; was a member of the legislature 1838 and 1843-45; member of Congress 1839-41; subsequently judge of the land-office court of the Eastern Shore of Maryland; was governor of Maryland 1848-51; became U. S. commissioner of patents 1860; succeeded Howell Cobb as secretary of the treasury in Pres. Buchanan's cabinet, acting as such from Dec., 1860, to Jan. 11, 1861; was elected U. S. Senator Mar., 1867, but not admitted to a seat on the ground of having "given aid and comfort to the rebellion," and was elected a Representative in Congress 1874.

Thomas (RALPH), b. in England Aug. 18, 1840; is well known as a zealous and accurate bibliographer. Author of *A Martyr to Bibliography, a Notice of the Life and Works of Joseph Marie Quérard* (1867), and of a useful *Handbook of Fictitious Names* (1868), both published over the anagram of "Olphar Hamst." In 1866 he issued the prospectus of a *Bibliotheca of English Law Literature*, which has not yet (1876) appeared.

Thomas (THEODORE), b. in the kingdom of Hanover in 1835; received his musical education from his father, and when only six years of age played the violin in public concerts; in 1845 accompanied his family to America, where, still a mere lad, he joined the orchestra of the Italian Opera in New York City, and played first violin in the orchestra which accompanied Jenny Lind in her first American concerts; in 1861 established the orchestra which became famous under his management, and in 1864 gave his first symphony concerts in New York City. He began his summer-night concerts in the same city two years later, and in 1869 started on his first annual tour of the principal American cities; director of College of Music, Cincinnati, O., 1877, but resigned in 1880. J. B. BISHOP.

Thomas (THEODORE GAILLARD), A. M., M. D., b. in South Carolina in 1831; graduated M. D. at the Medical College of South Carolina; elected prof. of obstetrics and diseases of women in the College of Physicians and Surgeons, New York City, 1862; visiting physician to Bellevue Hospital; attending surgeon to Women's Hospital of the State of New York; physician to Roosevelt Hospital, etc.; has contributed largely to current medical literature. His chief work is *Diseases of Women*, which has been translated into French, German, and Italian. PAUL F. LAY.

Thomas (WILLIAM MOY), b. at Homerton, near London, England, in 1828; studied law, but abandoned it for a literary career; became one of Dickens's staff of writers on *Household Words* 1850; was subsequently connected with the *Athenæum* and the *Daily News*; wrote for many other periodicals, and was the original editor of *Cassell's Magazine*. Author of *When the Snow Falls* (2 vols., 1859), *Pictures in a Mirror* (1861), *A Fight for Life* (3 vols., 1868), and other novels; translated Victor Hugo's *Toilers of the Sea* (1866); edited the *Poetical Works of William Collins* (1858) and the *Letters and Works of Lady Mary Wortley Montagu* (2 vols., 1861).

Thomas à Kempis. See KEMPIS.

Thomas Aquinas. See AQUINAS (THOMAS).

Thomas, Christians of St. See CHRISTIANS OF ST. THOMAS.

Thoma'sius (CHRISTIAN), b. at Leipsic Jan. 1, 1655; studied jurisprudence and philosophy at Frankfort-on-the-Oder 1675-79; settled in his native city, and began to lecture at the university; adopted in 1687 the German language instead of the Latin in his lectures; published from 1688 to 1690 a monthly paper, in which he criticised with much witticism and good common sense the extravagances of the scholastic method in theology and philosophy; was driven away from Leipsic in 1790 by the chicaneries and open attacks of the orthodox theologians, whom he much offended by his sympathy for Francke, and settled at Halle, where he attracted much attention by his lectures; contributed much to the foundation of the university; published, among other works, his *Geschichte der Weisheit und Thorheit* (3 vols., 1693). D. Sept. 3, 1728. There is an interesting biography of him by Luden (1805).

Thomasius (GOTTFRIED), b. at Egenhausen, Bavaria, in 1802; studied theology at Erlangen, Halle, and Berlin 1821-26; was appointed a Lutheran minister at Nuremberg in 1829, and professor of dogmatics at Erlangen in 1842. D. in 1875. His principal works are *Origenes* (1837), *Kirchliche Christologie* (1845), *Christi Person und Werk* (3 vols., 1856). He was also one of the founders of the *Zeitschrift für Protestantismus und Kirche*.

Thomas the Rhymer. See RHYMER, THE.

Thom'aston, p.-v., Litchfield co., Conn.

Thomaston, p.-v., cap. of Upson co., Ga., the terminus of Upson County R. R., 70 miles S. E. of Atlanta, contains 5 churches (2 colored), an excellent mixed school, 1 newspaper, and 2 colored schools. P. about 1000.
J. C. MCMICHAEL, ED. "HERALD."

Thomaston, p.-v. and tp., Knox co., Me., on St. George River and on Knox and Lincoln R. R., is specially noted for its large shipments of lime, is the site of the Maine State prison, and has 2 national banks. P. 3092.

Thom'astown, tp., Saginaw co., Mich. P. 697.

Thom'asville, p.-v. and tp., cap. of Thomas co., Ga., on Atlantic and Gulf R. R., and centre of trade for a productive region, has a bank and weekly newspaper. P. 1651.

Thomasville, p.-v., Oregon co., Mo., on Eleven Points River, 150 miles S. of St. Louis, contains 1 church, 1 academy, a newspaper, saw and grist mills, 1 hotel, and fair-ground. Principal business, farming and stock-raising. P. about 200. J. W. BUCKLEY, ED. "SOUTH MISSOURIAN."

Thomasville, p.-v. and tp., Davidson co., N. C., on Richmond and Danville R. R. P. of v. 214; of tp. 2417.

Thomists. See AQUINAS (THOMAS).

Thomp'son, new county in S. Central Dakota, on both sides of Dakota River, and drained by Snake River, has a rolling prairie surface. Area, about 925 sq. m.

Thompson, tp., Pike co., Ark. P. 868.

Thompson, p.-v. and tp., Windham co., Conn., has a national bank. P. 5804.

Thompson, tp., Columbia co., Ga. P. 369.

Thompson, tp., Jo Daviess co., Ill. P. 800.

Thompson, tp., Guthrie co., Ia. P. 671.

Thompson, tp., Carlton co., Minn. P. 163.

Thompson, tp., Sullivan co., N. Y. P. 3511.

Thompson, tp., Delaware co., O. P. [illegible]

Thompson, p.-v. and tp., Geauga co., O. P. [illegible]

Thompson, tp., Seneca co., O. P. [illegible]

Thompson, tp., Fulton co., Pa. P. [illegible]

Thompson (AUGUSTUS CHARLES [illegible]), b. at [illegible], Conn., Apr. 30, 1812; educated [illegible] graduate; studied theology [illegible] at the University of Berlin [illegible] Congregational church, Roxbury [illegible] and accompanied Rev. Dr. Anderson [illegible] American missions in [illegible] devotional books.

Thompson (Benjamin). See Rumford, Count.

Thompson (Cephas G.), b. at Middleborough, Mass., about 1812, son of a portrait-painter, by whom he was trained to the same business; went at the age of 18 to Plymouth, where he painted portraits, chiefly of sea-captains and their families, for a couple of years; practised drawing at Boston under D. C. Johnson, and copied casts from the antique in the Athenæum; was afterward professionally employed at Providence, R. I., until 1837, when he opened a studio in the University Building, New York City; soon became one of the leading portrait-painters of New York, being employed by scores of prominent citizens; gained also much reputation by his ideal pictures; went to New Bedford 1847; soon afterward returned to Boston; married a sister of Mrs. A. M. Ritchie; spent seven years (1852-59) in Italy; made nearly unique copies of the Staffa *Madonna* of Raphael and the famous *Beatrice Cenci*, now so familiar to all artists, and has again resided in New York since 1860, enjoying a large practice and high consideration in literary and artistic circles.—His brother, Jerome, is also a painter, chiefly known by his rustic landscapes.

Thompson (Daniel Pierce), b. at Charlestown, Mass., Oct. 1, 1795; removed to Berlin, Vt., in childhood; taught district schools 1815–16; graduated at Middlebury College 1820; was for some time a private tutor in Virginia, where he studied law and was admitted to the bar; settled at Montpelier, Vt., 1824; became register of probate; was clerk of the legislature 1830–33; compiled a volume of statutes (1835); was county judge of probate 1837–40; clerk of the county 1843–45; afterward clerk of the supreme court and secretary of state 1853. D. at Montpelier June 6, 1868. Author of several novels, chiefly illustrative of Vermont life and of Revolutionary history, among which were *May Martin* (1835), *The Green Mountain Boys* (1840), *Locke Amsden, or the Schoolmaster* (1847), *Lucy Hosmer* (1848), *The Rangers* (1850), *Gaut Gurley* (1857), and published a *History of Montpelier* (1860).

Thompson (Elizabeth), b. in England about 1850; acquired sudden celebrity from her painting of *The Roll-Call*, exhibited at the Royal Academy, London, 1874, highly admired by the Prince of Wales, and in consequence purchased by the queen; visited Italy 1875; has painted a *Vintage Sketch in Tuscany* and one or two military pictures, and is now (1876) commissioned to execute a picture of *The Battle of Balaklava*.

Thompson (George), b. in Liverpool, England, June 18, 1804. In 1831 he was lecturing-agent of the London Anti-Slavery Society, and by his commanding eloquence greatly aided in the abolition of slavery in the British colonies. He visited the U. S. in 1834 at the invitation of Wm. Lloyd Garrison, to assist in the abolition of slavery there, but mob-violence compelled him to return to England Dec., 1835. He engaged successfully in various reforms in England and India, and greatly aided in preventing the recognition of the independence of the Southern Confederacy by the British government. D. Oct. 7, 1878.

Thompson (George W.), b. in Ohio in 1806; graduated at Jefferson College, Pa., 1826; was admitted to the bar; settled in Western Virginia, where he became U. S. district attorney 1849; was member of Congress 1851–52, and was subsequently judge in West Virginia. Author of *A Dissertation on the Historical Right of Virginia to the Territory North-west of the Ohio*, *A Life of Hon. Linn Boyd*, *The Living Forces of the Universe* (1866), and several legal, political, and educational addresses. He was a contributor to the Boston *Quarterly Review* 1839–42.

Thompson (Henry), b. in England in 1797; graduated at St. John's College, Cambridge, 1822; took orders in the Church of England; was for some years curate of Wrington, Somersetshire, and became in 1853 vicar of Chard. Author of a *Life of Hannah More* (1838), *A History of Roman Literature*, and a part of the *History of Greek Literature*, in the *Encyclopædia Metropolitana*, to which work he was a large contributor; translated Schiller's *Maid of Orleans and William Tell* (1845), and *Original Ballads by Living Authors* (1850); wrote for the *Lyra Messianica* and its companion volume; edited *The Complete Works of Horace from the Text of Orellius, with 250 Illustrations, and Introductory Dissertation on the Life and Poetry of Horace* (1853), and *The Complete Works of Virgil, from the Text of Heyne and Wagner, with 250 Illustrations and Memoir* (1854); contributed to a work on *Occult Sciences* (1855), and published several theological and devotional books. D. at Chard, Somersetshire, Eng., Dec., 1878.

Thompson (Sir Henry), M. D., F. R. C. S., b. at Framlingham, England, Aug. 6, 1820; educated at University College, London; studied medicine; gained the Jacksonian prize at the Royal College of Surgeons 1852, and again 1860; became professor of clinical surgery at University College Hospital 1866; was appointed surgeon to the late king of the Belgians 1863, and to the present king 1866; was knighted 1867; is an honorary member of several foreign academies, and author of a treatise on *Practical Lithotomy and Lithotrity* (1863). His writings in the *Contemporary Review* for 1873 gave rise to the movement of that year in favor of cremation.

Thompson (Jacob), b. in Caswell co., N. C., May 15, 1810; graduated at the University of North Carolina 1831; was admitted to the bar 1834; settled in the Chickasaw country, Miss., 1835; was a Democratic member of Congress 1839–51; chairman of the committee on Indian affairs; opposed the Compromises of 1850; secretary of the interior under Pres. Buchanan from Mar., 1857, to Jan. 7, 1861, when he resigned in consequence of the order to reinforce Fort Sumter; governor of Mississippi 1862–64, and subsequently aide-de-camp to Gen. Beauregard and inspector-general for the department of Mississippi.

Thompson (James), b. at Middlesex, Berks co., Pa., Oct. 1, 1806; became a practical printer; studied law; was admitted to the bar 1828; sat in the Pennsylvania legislature 1832–34; was Speaker of the house 1834, judge of the district court 1836–42; a Democratic member of Congress 1845–51, and judge of the supreme court of Pennsylvania 1857–72, serving as chief-justice during the latter part of his term. He was defeated as a candidate for re-election Oct., 1872; subsequently practised at the bar, and fell dead in the supreme court-room at Philadelphia Jan. 28, 1874.

Thompson (John B.), b. in Kentucky in 1810; was a Whig member of Congress 1841–43 and 1847–51; afterward lieutenant-governor, and was U. S. Senator 1853–59. D. at Harrisonburg, Ky., Jan. 7, 1874.

Thompson (John R.), b. in Richmond, Va., Oct. 23, 1823; studied at East Haven, Conn.; graduated at the University of Virginia 1843; studied law in the office of James A. Seddon and in the law school of the university, where he took the degree of bachelor of laws 1845, and from 1847 to its suspension at the outbreak of the civil war edited the *Southern Literary Messenger*, the ablest, most successful, and longest-lived of the Southern monthlies. During the war he edited the *Record* (1863), went to England 1864, and defended the Confederate cause in the columns of *Blackwood*, the *Cornhill Magazine*, and other periodicals; was connected with the editorial staff of the *Morning Herald*, and subsequently resided in New York, where he wrote for the *Evening Post*. He wrote many essays and poems for his own and other magazines, and was a lecturer. D. at New York Apr. 30, 1873.

Thompson (Joseph Parrish), D. D., LL.D., b. at Philadelphia, Pa., Aug. 7, 1819; graduated at Yale College 1838; studied theology at Andover and at New Haven; became pastor of the Chapel street Congregational church, New Haven, Nov., 1840; was minister of the Broadway Tabernacle, New York, 1845–72; was one of the founders of the *New Englander*, a quarterly theological organ of the Congregational Church, and of the New York *Independent*; was a manager of the American Congregational Union and of the Home Missionary Society; originated in 1852 the plan of the Albany Congregationalist convention; visited Egypt, Palestine, and other Oriental countries 1852–53; afterward devoted much research to Oriental subjects, especially Egyptology, on which he wrote for biblical cyclopædias and reviews. He resided since 1873 several years in Berlin, Germany. Author of a *Memoir of Timothy Dwight* (1844), *Lectures to Young Men* (1846), *Memoir of David Hale* (1850), *Egypt, Past and Present* (1856), *Memoir of Rev. David T. Stoddard* (1858), *The Believer's Refuge* (1857), *Christianity and Emancipation* (1863), *Man in Genesis and Geology* (1869), *Theology of Christ from his own Words* (1870), *Church and State in the United States* (1874), *Life of Christ* (1875). D. at Berlin, Germany, Sept. 20, 1879.

Thompson (Launt), b. in Queen's co., Ireland, in 1833; came with his widowed mother to Albany, N. Y., 1847; began the study of medicine in the office of Dr. Ormsby; learned drawing in the mean time; was pupil and assistant of Erastus D. Palmer, the sculptor, nine years; developed a remarkable talent for medallion portraits; settled in New York Nov., 1858, and became a prominent member and officer of the Academy of Design. Among his works are busts of Edwin Booth as Hamlet, Bryant, and Gen. Dix, and a colossal statue of Napoleon. He now (1876) resides at Florence, Italy.

Thompson (Mortimer M.), b. at Riga, N. Y., in 1831; studied for a time at Michigan University, but left before graduating; was for some time connected with a travelling theatrical company; became about 1852 a clerk in a jewelry

store in New York; wrote some humorous letters in the Detroit *Advertiser*, which procured him employment on the New York press, and subsequently published several humorous volumes which had a wide circulation. D. in New York City June 26, 1865. Among his books were ***Doesticks—What he Says*** **(1855),** ***Pluribustah*** **(1856),** ***History and Records of the Elephant Club*** (1857), and *Nothing to Say* (1857).

Thompson (Robert Anchor), b. at Durham, England, in 1821; educated at Durham School and as an engineer student of Durham University; graduated at Catharine Hall, Cambridge, 1844; was for some years connected with the astronomical observatory at Durham, a volume of his observations having been published in 1849; took orders in the Church of England; became curate of Louth and (1854) of Binbrooke, Lincolnshire, and in 1868 was chosen master of the hospital of St. Mary the Virgin at Newcastle-upon-Tyne. Author of a volume of *Sermons* (1853), of *Christian Theism, the Testimony of Reason and Revelation to the Existence and Character of the Supreme Being* (London, 2 vols., 1855), which gained the first Burnett premium (£1800) among 208 competitors; *An Essay on the Principles of Natural Theology* (1857), *Christ the Light of the World* (1859), *The Oxford Declaration*, etc. (1864).

Thompson (Robert Ellis), b. near Lurgan, Ireland, in 1844; emigrated to America in 1857; settled in Philadelphia; graduated at the University of Pennsylvania in 1865 and at the Theological Seminary of the Reformed Presbyterian Church (N. S.) in 1867; became assistant editor of the *American Presbyterian*, and remained such till its extinction by the Presbyterian union of 1870. He was called to the University of Pennsylvania as instructor in mathematics and Latin in 1868; became assistant professor of mathematics in 1870, and professor of social science in 1874. In Oct., 1873, he was ordained to the ministry by the Reformed presbytery of Philadelphia. In 1875 he published *Social Science and National Economy*. He has been always the principal, and sometimes the sole, editor of the *Penn Monthly*, now (1876) in its seventh year, and is a member of the American Philosophical Society and of the Historical Society of Pennsylvania.

Thompson (Smith), LL.D., b. at Amenia, N. Y., in 1767; graduated at Princeton College 1788; studied law with Chancellor Kent; became district attorney in the middle district of New York 1801; was judge of the New York supreme court 1802–14, chief justice 1814–18; secretary of the navy in the cabinet of Pres. Monroe 1818–23, and associate justice of the U. S. Supreme Court from 1823 to his death, at Poughkeepsie Dec. 18, 1834.

Thompson (Thomas Perronet), b. in Hull, England, Mar. 15, 1783; graduated at Queen's College 1802; entered the navy as a midshipman 1803, and the army as second-lieutenant 1806; took part in the campaign against Buenos Ayres 1807; governor of Sierra Leone 1808; issued a proclamation for the suppression of the slave trade in the colony; recalled to England 1810 through the exertions of the slave-traders; served in the army in the Peninsular campaign 1813, in France 1814, and in the Pindaree campaign in India; accompanied Sir William Keir Grant as Arabic interpreter in his expedition up the Persian Gulf 1819, assisting in negotiating a treaty with the Arab tribes by which the slave-trade was declared piracy; published numerous pamphlets against the corn laws and upon other questions of political economy, on music, the Greek revolution, etc.; was one of the founders of and principal contributors to the *Westminster Review* (1824), and became one of its proprietors 1829; sat frequently in Parliament between 1835 and 1857; published his collected essays in 6 vols., 1842, and attained the rank of major general 1854. D. Sept. 6, 1869.

Thompson (Waddy), b. at Pickensville, S. C., Sept. 8, 1798; graduated at South Carolina College 1814; was admitted to the bar 1819; was a member of the legislature 1826–30; served as solicitor for the western circuit 1830; was appointed brigadier-general of militia; sat in Congress 1835–41 as a Whig; was prominent in debate, and in 1840 chairman of the committee on military affairs; was minister to Mexico 1842–44; negotiated two important treaties with that country; obtained the release of more than 200 Texan prisoners confined in the castle of [illegible] and other military prisons, and published a very readable book, *Recollections of Mexico* (1846). He afterward resided alternately at Greenville, S. C., and at Tallahassee, Fla., where he d. Nov. 23, 1868.

Thompson (William), b. in Ireland about 1730, emigrated to Pennsylvania; served as captain of [illegible] militia in the French war 1758–60; settled at [illegible] and was one of the purchasers of the lands [illegible]; was colonel of the regiment of Pennsylvania riflemen which marched to Cambridge June, 1775; had a [illegible] with the British at Lechmere Point Nov. 10; was appointed brigadier-general Mar. 1, 1776; succeeded Gen. Lee in command at New York Mar. 19; proceeded to the [illegible] in Canada in April; commanded the attacking force at Three Rivers June 6, when he was taken prisoner, and [illegible] to Philadelphia on parole in August, but was not exchanged until 1778. He resided during his later years near Carlisle, Pa., where he d. Sept. 4, 1781.

Thompson (William), b. at Belfast, Ireland, Nov. 2, 1805; was a distinguished promoter of science, of the fine arts, and of research in every department of natural history; was long president of the Natural History and Philosophical Society of Belfast; accompanied Prof. Edward Forbes to the Ægean Archipelago 1841, and contributed more than 70 papers on botany, zoology, and especially ornithology, to the *Transactions* of [illegible]. D. in London Feb. 17, 1852. His great work was *The Natural History of Ireland* (vols. i., ii., and iii., 1849–51), of which the concluding volume on *Mammalia* appeared in 1856.

Thompson (William Hepworth), D. D., b. at York, England, Mar. 27, 1810; educated at Trinity College, Cambridge, where he became a scholar 1830, fellow 1834, assistant tutor 1837, and tutor 1844; was [illegible] elected regius professor of Greek in Cambridge University; became a canon of Ely 1853, and on the death of Dr. Whewell in 1866 was chosen master of Trinity College. He edited William Archer Butler's *Lectures on Ancient Philosophy*, also two of Plato's *Dialogues*, with critical apparatus; is author of various papers read before learned societies, and of published addresses and sermons.

Thompson (Zadock), b. at Bridgewater, Vt., May 23, 1796; graduated at the University of Vermont 1823; was tutor there 1825; published a *Gazetteer of Vermont* (Montpelier, 1824), an *Arithmetic* (1826), and a *History of the State of Vermont* (Burlington, 1833); edited the [illegible] and the *Green Mountain Repository* (1832); removed to Hatley, Canada East, 1833; was engaged as a teacher there and at Sherbrooke; published a *Geography of Canada*; studied theology, and took deacons' orders in the Protestant Episcopal Church May 27, 1836; returned to Burlington, Vt., 1837; became a professor in the Vermont Episcopal Institute; published his chief work, *The History of Vermont, Natural, Civil, and Statistical* (1842; [illegible] 1853); issued a *Guide to Lake George, Lake Champlain, Montreal, and Quebec* (1845) and *The Geography and Geology of Vermont* (1848); was State [illegible]; collected a valuable cabinet of the [illegible] of Vermont; was professor of chemistry and natural [illegible] University of Vermont 1851–[illegible]; visited [illegible] as Vermont commissioner to the Universal Exposition, and published a *Journal* of his trip (1851); was appointed State naturalist 1853, and while preparing [illegible] of the State, d. at Burlington Jan. 19, 1856. He had issued an *Almanac* as early as 1819, made [illegible] the astronomical calculations for [illegible], and for some years those for the [illegible]. A brief biography was published by [illegible].

Thompson's, tp., Alamance co., N. C. P. [illegible].

Thompson's, tp., Robeson co., N. C. P. 1799.

Thompson's Creek, tp., [illegible] co., Ky. P. 444.

Thompson's Creek, v., Perry co., Miss. P. [illegible].

Thomp'sontown, p.-b., Juniata co., Pa. P. 280.

Thomp'sonville, p.-v., Hartford co., Conn., on New York New Haven and Hartford R. R., [illegible] latter place, has [illegible], 1 newspaper, a savings bank, and banking company. [illegible] an extensive carpet manufactory, [illegible] the works of the Hartford Carpet Co., [illegible].
L. H. Pease.

Thoms (William John), F. S. A., b. at Westminster, England, Nov. 16, [illegible] the office of the secretary of Chelsea Hospital, [illegible] to the *Foreign Quarterly Review* and other [illegible] long clerk of the printed paper department [illegible] of Lords; became in 1863 deputy librarian [illegible] of Lords; was for many years one of the [illegible] members of the Society of Antiquaries [illegible] the Camden Society 1838–[illegible], and [illegible] and *Queries*, a periodical of [illegible] until 1872. Among his pub[illegible] *Early Prose Romances* [illegible] and *Traditions* [illegible] and *Lamentable* [illegible] Worsaae's *Primeval* [illegible] *Notes on Nursery* [illegible] *The Longevity of Man* [illegible] genuine character of [illegible] unavailing."

Thom'son, p.-v., cap. of McDuffie co., Ga., on Georgia R. R., 37 miles W. of Augusta, contains 4 churches (2 colored), 2 flourishing high schools, an efficient fire company, 1 newspaper, 1 mill, and Odd Fellow and Templar lodges. Principal business, cotton-growing. P. about 1500.

WHITE & HUDSON, EDS. "MCDUFFIE JOURNAL."

Thomson, p.-v., Carroll co., Ill., on Mississippi River and Western Union R. R., has a weekly newspaper.

Thomson, p.-v. and tp., cap. of Carlton co., Minn. P. 163.

Thomson (ANDREW), b. at Sanquhar, Dumfriesshire, Scotland, July 11, 1779; studied theology at the University of Edinburgh, and was appointed minister of Spronston, Roxburghshire, in 1802, of the East church of Perth in 1808, of the New Grey Friars' church, Edinburgh, in 1810, of St. George's church, Edinburgh, in 1814. D. in Edinburgh Feb. 9, 1831. He was a man of great energy and considerable eloquence, and published *Lectures, Expository and Practical, on Select Portions of Scripture* (2 vols., Edinburgh, 1816), *Sermons on Infidelity* (1831; several times reprinted), *Sermons on Hearing the Word* (1825), *The Scripture History* (1826), *The Scripture History of the New Testament* (1827), *Sermons on Various Subjects* (1829), *The Doctrine of Universal Pardon* (1830), besides educational and religious works for children, etc. After his death appeared *Sermons and Sacramental Exhortations*, with memoir (Edinburgh, 1831; Boston, 1832). He also contributed to the *Edinburgh Encyclopædia*, and founded and edited *The Edinburgh Christian Instructor* (1810 *seq.*).

Thomson (ANTHONY TODD), M. D., F. L. S., b. at Edinburgh, Scotland, Jan. 7, 1778, son of the British postmaster-general of Georgia and collector of customs at Savannah; studied at the Edinburgh high school; graduated in medicine at Edinburgh University 1799; became a physician at London 1800; was a voluminous writer in periodicals on medical and literary subjects; edited the *Medical Repository*; became professor of materia medica in London University, and of medical jurisprudence 1832, holding both posts until his death at Ealing, near London, July 3, 1849. Among his works were—*The London Dispensatory* (1811), *An Authentic Medical Statement of the Case of H. R. H., the late Princess Charlotte of Wales* (1817), *Thoughts on Medical Education, and a Plan for its Improvement* (1826), *Elements of Materia Medica and Therapeutics* (2 vols., 1832–33), *Domestic Management of the Sick-room* (1841), and a posthumous *Practical Treatise of Diseases affecting the Skin* (1850), completed by Dr. E. A. Parkes, who prefixed a biographical notice. Dr. Thomson also edited Dr. Thomas Bateman's *Practical Synopsis of Cutaneous Diseases* (7th ed. 1829), to which he added an illustrative *Atlas of Delineations* (1829), and edited, with copious illustrative notes, Eusèbe Salverte's *Philosophy of Magic, Prodigies, and Apparent Miracles* (2 vols., 1846; New York, 1847) and James Thomson's *Seasons* (1847).

Thomson (CHARLES), LL.D., b. at Maghera, Derry, Ireland, Nov. 29, 1729; came to America at the age of eleven, landing in 1741 at Newcastle, Del., with three brothers, his father having died on the voyage; was enabled by an elder brother to enter an academy taught by Rev. Dr. Francis Alison, at Thunder Hill, Md., where he obtained a good classical and mathematical training; became a teacher in the Friends' academy at Newcastle; removed to Philadelphia, where he became an efficient teacher and obtained the friendship of Dr. Franklin; served in 1758 on a commission to treat with the Iroquois Indians at Oswego, N. Y.; was also concerned in negotiations with the Delaware Indians, who conferred upon him the honor of adoption into their tribe under the name of the "Truth-teller;" married Hannah Harrison, aunt of Pres. Harrison; was for some years engaged in mercantile business; was secretary of the American Society, and prominent in literary and patriotic associations; was chosen secretary of the first Continental Congress on the day of its assembling at Carpenters' Hall, Philadelphia, Sept. 5, 1774; filled the same post to the successive Congresses until 1789, being considered as "the Sam Adams of Philadelphia, the life of the cause of liberty;" was chosen to inform Washington at Mount Vernon of his election to the Presidency, and resided during his later years at Lower Merion, Montgomery co., Pa., where, at the venerable age of ninety-five, he d. Aug. 16, 1824. Author of *An Enquiry into the Causes of the Alienation of the Delaware and Shawanese Indians* (London, 1759), of a valuable translation of the whole Bible, the Old Testament portion being from the Septuagint (4 vols., Philadelphia, 1808), and of *A Synopsis of the Four Evangelists, or a Regular History of the Conception, Birth, Doctrine, Miracles, Death, Resurrection, and Ascension of Jesus Christ, in the Words of the Evangelists* (Philadelphia, 1815), in the language of his own version.

Thomson (EDWARD), D. D., LL.D., b. at Portsea, near Portsmouth, England, in Oct., 1810; came with his parents to the U. S. in 1819, and settled at Wooster, O.; received a good classical education; graduated in medicine at the University of Pennsylvania 1829; commenced practice as a physician at Wooster, but, experiencing a change in his religious views, became in 1833 a minister of the Methodist Episcopal Church; preached at Detroit, Mich., 1836; was principal of the Methodist Seminary at Norwalk, O., 1837–44; editor of the *Ladies' Repository* at Cincinnati 1844–46; first president of the Ohio Wesleyan University at Delaware, O., 1846–60; editor of the *Christian Advocate* at New York from 1860 to 1864, when he was chosen a bishop; made a missionary voyage around the world, visiting the Methodist missions in Germany, Bulgaria, India, and China, organizing in India an annual conference; visited the churches of the Pacific States and Territories, and was subsequently actively engaged in home episcopal work until his death, at Wheeling, Va., Mar. 22, 1870. Author of *Educational Essays* (1856), *Moral and Religious Essays*, *Biographical Sketches*, and *Letters from Europe*.

Thomson (JAMES), b. in Roxburghshire, Scotland, Sept. 11, 1700; studied for six years at the University of Edinburgh, with the design of entering the Church, but, abandoning this intention, went to London in 1724, where he was for several months tutor in a nobleman's family. In 1726 appeared his poem *Winter*, which speedily became popular; *Summer* followed in 1727, *Spring* in 1728, and *Autumn* in 1730, completing *The Seasons*. In the interval he had published a *Poem Sacred to the Memory of Sir Isaac Newton* (1727), and written *Sophonisba*, a tragedy, acted in 1729. He then travelled for two years as tutor to the son of Lord Chancellor Talbot, by whom he was rewarded with the post of secretary of briefs, and wrote a poem on *Liberty* (5 parts, 1735–36), which met with a very unfavorable reception, and was subsequently considerably abridged. The lord chancellor dying in 1737, the secretaryship was lost by Thomson, but he received from the prince of Wales a pension of £100, and some years later was rendered independent by the appointment of surveyor-general of the Leeward Isles, which, after paying the deputy who performed all the duties, brought him £300 a year. His works, besides those already mentioned, are—*Agamemnon*, a tragedy; *Edward and Eleanora*, a drama; *Alfred*, a masque; *Tancred and Sigismunda*, a successful tragedy; *The Castle of Indolence*, a poem in the Spenserian stanza, upon which he had labored many years, and which is his best work, though far less popular than *The Seasons*; and *Coriolanus*, a tragedy, not produced until after his death. D. at Kew Lane, near Richmond, Aug. 27, 1748.

Thomson (JAMES), brother of Sir William and son of James Thomson, LL.D., professor of mathematics in the University of Glasgow, b. at Belfast, Ireland, about 1816; educated there and at Glasgow, where he graduated about 1837; became a pupil in the Horseley ironworks at Tipton, Staffordshire; was employed by Sir William Fairbairn, the eminent civil engineer; settled at Belfast; was appointed professor of civil engineering in Queen's College, Belfast, 1857, and in the University of Glasgow 1872; has been extensively engaged as an agricultural engineer, especially with reference to irrigation and water-supply; invented the vortex turbine and the jet-pump and intermittent reservoir for draining swamp-lands, and solved the problem of glacial action by a series of investigations upon the lowering by pressure of the freezing temperature of water. He has contributed to the *Transactions* of the leading scientific associations over 40 papers on physics, mathematics, and mechanics.

Thomson (JAMES BATES), LL.D., b. in Springfield, Vt., May 21, 1803. His early life was spent on his father's farm, and he enjoyed the advantages of district-school training during the winter seasons; attended a neighboring academy for a few weeks, and commenced teaching a winter district school in his own town at the age of sixteen; was for some years alternately a farm-hand, a teacher, and a student in Chester and Kimball Union academies. A severe affection of the eyes compelled him to suspend study for four years, but he was able to teach a part of the time in Boston and Brighton, Mass. He entered Yale College in 1830, graduated in 1834, and in 1835–42 took charge of a newly-founded academy at Nantucket, Mass.; his health having become impaired by his excessive labor, he resigned and removed to Auburn, N. Y., and soon after, at the request of Pres. Day of Yale College, commenced the abridgment and adaptation of his *Algebra* for the use of schools and academies. In 1843 he conducted the mathematical exercises in the first teachers' institutes held in this country, and for four or five years was actively engaged in attending teachers' institutes and promoting their efficiency. In

1845 he assisted in the organization of the New York State Teachers' Association, and in 1864 was elected its president. He returned to New York City in 1846, and afterward to Brooklyn. He has since his removal to New York been occupied with mathematical and scientific pursuits, and has published a first series of mathematical textbooks of 10 vols., from mental arithmetic to algebra and geometry; a second series, of which 3 vols., *New Mental Arithmetic*, *New Rudiments of Arithmetic*, and *New Practical Arithmetic and Key*, have already been issued, and the higher mathematics are in preparation. He has also written on the metric system, oral instruction, free schools, etc. He has been for many years a student of natural history, and is distinguished as a conchologist. In 1853 he received the degree of LL.D. from Hamilton College, N. Y.

L. P. Brockett.

Thomson (Katharine **Byerley**), b. at Etruria, Staffordshire, England, in 1800; married Dr. Anthony T. Thomson (which see), a medical writer; was authoress of several novels and of many works of biography and anecdotical literature, of which the later volumes, in which she was assisted by her son, John Cockburn Thomson (b. about 1825; d. at Tenby, Wales, 1860), have appeared under the pseudonyms of "Grace" and "Philip Wharton." D. at Dover Dec. 17, 1862. Among her works were—*Memoirs of the Court of Henry VIII.* (2 vols., 1826), *Memoirs of Sir Walter Raleigh* (1830), *Memoirs of Sarah, Duchess of Marlborough, and of the Court of Queen Anne* (2 vols., 1838), *Memoirs of the Jacobites of 1715 and 1745* (3 vols., 1845–46), *Recollections of Literary Characters and Celebrated Places* (2 vols., 1854), *Life and Times of George Villiers, Duke of Buckingham* (3 vols., 1860), *Queens of Society* (2 vols., 1860), and *Wits and Beaux of Society* (2 vols., 1860).

Thomson (Richard), b. in England about 1795; was a distinguished antiquary and bibliographer, and for thirty years librarian of the London Institution. D. at London Jan. 2, 1865. Author of *Chronicles of London Bridge* (1827), *Illustrations of British History* (2 vols., 1828), *Tales of an Antiquary* (3 vols., 1828), *An Historical Essay on the Magna Charta of King John* (1829), *Legends of London* (1832), and an elaborate *Catalogue of the Library of the London Institution systematically classed*, etc. (4 vols. royal 8vo, 1835–51), one of the best works of its kind, including several extensive reference tables, classifications, and indexes.

Thomson (Robert Dundas), M. D., F. R. S., nephew of Dr. Thomas (1773–1852), b. in Scotland in 1811; educated in medicine at the universities of Edinburgh and Glasgow; made a voyage to India and China as assistant surgeon in the navy of the East India Company; was for eight years a physician at London, where he was instrumental in establishing the Blenheim Free Dispensary, acting gratuitously as one of its physicians; assisted in editing the *Annals of Medicine*, and conducted a monthly periodical, *The Records of General Science* (4 vols., 1835–36), in which he had the assistance of his uncle, Dr. Thomas Thomson, whose daughter he married, and of whom he became the assistant (1841) and successor (1846) in the professorship of chemistry at the University of Glasgow; was also editor of the *British Annual Epitome of the Progress of Science* (3 vols., 1837–39); became president of the Meteorological Society and fellow of the Royal Society; contributed largely to their publications; became professor of chemistry in St. Thomas's Hospital, London, medical officer of health and analyst for St. Marylebone (1856), and subsequently chemical member of the council of the University of London. D. at Richmond-on-Thames Aug. 17, 1864. Author of *Experimental Researches on the Food of Animals and the Fattening of Cattle, with Remarks on the Food of Man* (1846), *A School of Chemistry* (1847), and *The Cyclopædia of Chemistry, with its Applications to Mineralogy, Physiology, and the Arts* (1854).

Thomson (Samuel), M. D., b. at Alstead, N. H., Feb. 9, 1769; was the originator of the "Thomsonian system" of medical practice. D. at Boston, Mass., in 1843. Author of *Materia Medica and Family Physician*, *New Guide to Health*, and *Life and Medical Discoveries, written by himself* (Boston, 1825).

Thomson (Thomas), b. at Dailly, Ayrshire, Scotland, in 1768; educated at the University of Glasgow; became an advocate 1793, deputy clerk [illegible] of Scotland [illegible] principal clerk of session 1828, and [illegible] the Bannatyne Club 1832; was one of the [illegible] of the *Edinburgh Review*, and occasionally [illegible]; was esteemed the most learned antiquary in Scotland, and as such is frequently referred to in the [illegible] of Sir Walter Scott. D. at Shrubhill, between [illegible] and [illegible], Oct. 2, 1852. He edited for the Bannatyne Club [illegible] of the works of Sir Thomas Hope, John Lesley, Sir George Mackenzie, Sir James Melville, Lady Grisell Murray, Sir James Turner, and other old Scottish writers, and superintended for the Maitland Club and the [illegible] commission other reprints of the same character. [illegible] (1855) was prepared for the Bannatyne Club by [illegible] Innes.—His brother John, b. at Dailly in 1778, was minister of Dailly 1800–05, and of Duddington 1805–40, wrote on physical science for the *Edinburgh Review*, and was so distinguished as a landscape painter as to be called the "Scottish Claude Lorraine." D. at Duddington Oct. 27, 1840.

Thomson (Thomas), M. D., b. at Crieff, Perthshire, Scotland, Apr. 12, 1773; educated at Stirling and at the University of St. Andrew's; succeeded his brother, James Thomson, D. D. (1768–1855), as editor of the 3d edition of the *Encyclopædia Britannica*, Nov., 1796–1800; graduated in medicine at Edinburgh 1799; was for some years from 1802 the scientific editor of James Mill's *Literary Journal*; was the first to introduce the use of symbols in chemistry in articles for the *Supplement* to the *Encyclopædia*, written 1798–99, and which became the basis of his *System of Chemistry* (4 vols., 1802); first announced to the world Dr. Dalton's atomic theory, which had been privately communicated to him in 1804, in the 3d ed. of the same work (5 vols., 1807); was for many years a lecturer on chemistry, and conducted a laboratory for students; edited at London the *Annals of Philosophy* (1813–22); became in 1818 professor of chemistry in the University of Edinburgh. D. at Kilmun, Argyleshire, July 2, 1852. Among his other works were—*The Elements of Chemistry* (1810), *The History of the Royal Society of London* (1812), *Travels in Sweden and Lapland* (1813), *An Attempt to establish the First Principles of Chemistry by Experiment* (2 vols., 1825), [illegible] *of the Sciences of Heat and Electricity* (1830), *The History of Chemistry* (2 vols., 1830), *Outlines of Mineralogy, Geology, and Mineral Analysis* (2 vols., 1836), and a recast of his earlier work on chemistry in three separate treatises—*The Chemistry of Inorganic Bodies* (2 vols., 1831), *Chemistry of Organic Bodies, Vegetables* (1838), and *The Chemistry of Animal Bodies* (1842). His son Thomas was an assistant surgeon in the Bengal army, superintendent of the East India Company's botanic gardens at Calcutta, and author of *Western Himalaya and Thibet, the Narrative of a Journey through the Mountains of Northern India* (1852).

Thomson (Thomas), b. in Scotland about 1810; received a careful education; became a minister of the Scottish Church; wrote for the Messrs. W. & R. Chambers the supplementary vol. (v.) of their elaborate *Biographical Dictionary of Eminent Scotsmen* (1855), and [illegible] Charles Macfarlane, *The Comprehensive History of England, Civil and Military*, etc., *from the Earliest Period to the Suppression of the Sepoy Revolt* (4 vols., 1858–61).

Thomson (William), LL.D., b. in Perthshire, Scotland, in 1746; educated at St. Andrew's [illegible]; was for some time librarian to the earl of Kinnoul [illegible] of the Scottish church at Monivaird; taught [illegible] at London, and passed his later years as a professional author, editing several magazines and writing "history, biography, voyages, travels and memoirs, novels and romances, pamphlets and periodicals, largely and well." D. at Kensington, London, Mar. 16, 1817. Among his works were—*The Man in the Moon, a Novel* (1782), [illegible] *Novel* (1789), and [illegible] (1788); completed Watson's *History of Philip III.* (1783), and wrote several works published in the names of others, among which was the well-known [illegible] (2 vols., London, 1791), usually ascribed to Stedman.

Thomson (William), D. D., F. R. S., b. at Whitehaven, Cumberland, England, Feb. 11, 1819; educated at Shrewsbury School; was successively scholar, fellow, tutor, and provost of Queen's College, Oxford, where he graduated 1840; was ordained deacon 1842 and priest 1843; was incumbent of the parishes of [illegible] and [illegible]; appointed [illegible] preacher at Oxford 1848, and [illegible] preached the Bampton lectures on [illegible] [illegible] of All Souls', Marylebone, 18[illegible] [illegible] and to [illegible] [illegible] (1858); was [illegible] Inn 1858–61; was appointed [illegible] bishop of Gloucester [illegible] archbishop of York 1862 [illegible] a member of [illegible] and church [illegible] at Oxford [illegible] Royal Geographical [illegible] the Palestine [illegible] at Oxford [illegible] governor of the [illegible]

don: wrote the *Life of Christ* and other articles for Dr. Smith's *Dictionary of the Bible;* has written much for the reviews; edited the *Aid to Faith* (1862); has published sermons, pastoral letters, and lectures, and is author of *An Outline of the Necessary Laws of Thought* (1842; 9th ed. 1868), a textbook in several British and American universities, *Sermons preached in Lincoln's Inn Chapel* (1861), and *The Limits of Philosophical Inquiry* (1869).

Thomson (Sir William), F. R. S., LL.D., son of Prof. James, LL.D., b. at Belfast, Ireland, in June, 1824; educated at the University of Glasgow and at Peterhouse, Cambridge, where he graduated in 1845 as second wrangler, and was elected fellow; became in 1846 professor of natural philosophy at the University of Glasgow, a post he still occupies (1876); was editor from 1846 to 1853 of the *Cambridge and Dublin Mathematical Journal*, in which he published his researches on the mathematical theory of electricity, especially the notable paper on *The Distribution of Electricity on Spherical Conductors* (1848); invented quadrant and portable electrometers of extreme delicacy and accuracy, the former having been employed at Kew Observatory for the automatic registration of the electric state of the atmosphere; was also the inventor of the mirror galvanometer and the siphon recorder, instruments of great value in submarine telegraphy; made important experiments in magnetism, and especially in heat, among which were those upon the conversion of water at the freezing-point into ice without the expenditure of force; the specific heat of substances, the heating of india-rubber by sudden stretching, and the relation between the force expended and the heat produced in the compression of a gas. His extraordinary and fruitful generalization concerning the universal tendency in nature to the dissipation of mechanical energy was given to the world in the *Philosophical Magazine* in 1852, and many other remarkable papers have since appeared in that and in other scientific periodicals or in the *Transactions* of learned societies. He delivered in 1855 the Bakerian lecture on *The Electro-Dynamic Properties of Metals;* received for his researches the royal medal of the London Royal Society and the Keith prize of the Edinburgh Royal Society; delivered the Rede lecture in 1866, in which year he was knighted and received the freedom of the city of Glasgow on the completion of the Atlantic cable, which was rendered practicable by his discoveries; was president of the British Association at its Edinburgh session of 1871; elected president of the Geological Society of Glasgow 1872, and chosen fellow of St. Peter's College, Cambridge, in recognition of scientific eminence, Oct. 29, 1872. With Prof. Peter G. Tait he published in 1867 the first volume of an *Elementary Treatise on Natural Philosophy*, which immediately became the standard work of reference on the subject; wrote the article "Telegraph" in the 8th ed. of the *Encyclopædia Britannica* (1868), and in 1872 issued a volume of his papers on electro-statics and magnetism. Engaged in 1876 in perfecting a tide-calculating machine, in which year he visited Canada and the U. S. Porter C. Bliss.

Thomson (William M.), D. D.: graduated in 1828 at Miami University, Oxford, O.; was sent by the American Board of Commissioners for Foreign Missions to Syria and Palestine; worked there for about twenty-five years, and published *The Land and the Book, Biblical Illustrations drawn from the Manners and Customs, the Scenes and the Sceneries of the Holy Land* (2 vols., New York, 1859; London, 1860), *The Land of Promise, or Travels in Modern Palestine, illustrative of Biblical History, Manners, and Customs* (New York, 1865), besides a number of minor essays.

Thomson's Galvanometer. See Electricity, by Pres. H. Morton, Ph. D.

Thonon′, town of France, department of Haute-Savoie, on Lake Geneva, has some hot springs and a few manufactures. P. 5080.

Thor, the wild god of strength and the terrible enemy of all evil spirits, was the most characteristic and the most conspicuous figure in the Scandinavian Mythology (which see), and expressed by his character and in his adventures the very nature of the Scandinavian people, as Apollo, with whom he in other respects has no resemblance at all, expressed that of the Greek people. The principal attributes with which he was furnished by the mythical imagination are—the belt which doubles his strength when he fastens it around his waist; the hammer, Mjölnir, with which he can crush mountains, and which always returns to his hand when he throws it; and the chariot in which he rides across the heavens, thereby producing thunder and lightning.

Thorac′ic Duct, the principal lymphatic vessel in the human body, runs upward on the left side of the spinal column from the receptaculum chyli, and terminates near the junction of the left internal jugular and the left subclavian veins. It discharges into the blood-current the chyle and most of the lymph of the body. It is often represented in the lower animals by a congeries of lymphatic vessels. Birds have two thoracic ducts, one on each side. Its outlet is provided with valves which prevent the ingress of blood, and the duct has other valves which allow the contents to pass upward, but not downward.

Thorax. See Chest.

Thor′burn (Grant), b. near Dalkeith, Scotland, Feb. 18, 1773; was in early life a nailmaker; was engaged in some political movements which involved him in difficulties, on account of which he emigrated to the U. S., settling at New York, June, 1794, where he passed through a checkered career subsequently depicted by John Galt in his novel of *Lawrie Todd* (1830), and by himself in his autobiographies; became a successful seedsman and a prolific writer for periodicals over the signature of "Lawrie Todd," and was noted for benevolence and practical religious philosophy. He resided many years at Astoria, L. I., settled at Winsted, Conn., 1854, and d. at New Haven Jan. 21, 1863. Author of *Forty Years' Residence in America* (1834), *Men and Manners in Great Britain* (1834), *Fifty Years' Reminiscences of New York* (1845), *Life and Writings of Grant Thorburn, prepared by himself* (1852), and various other works.

Thor′da, or **Thorenburg,** town of Transylvania, on the Aranyos, is beautifully situated among vineclad hills, and has extensive saltworks, from which nearly 100,000 cwts. of salt are annually produced. P. 8302.

Thor′eau (Henry David), b. July 12, 1817—according to some authorities in Boston, according to others in Concord, Mass.—son of a maker of lead-pencils at Concord; graduated at Harvard 1837; taught school until 1840; afterward turned his hand to various occasional employments, such as land-surveying, carpentering, and other mechanical handicrafts, for which he had a natural facility; determined, however, to work no more than necessary to provide for his extremely limited wants, devoting the rest of his time to study and the contemplation of nature; was much influenced by the transcendental doctrines of his friend and neighbor, Ralph W. Emerson; spent two years from Mar., 1845, as a hermit in Concord on the shore of Walden Pond, living in a house built by himself, and subsisting at an annual expense of about $70; was noted for many eccentricities of thought and action, never voting or attending church, paying no taxes, rarely using flesh as food, and never employing a gun, though an ardent naturalist. As a matter of course, he was never married. His favorite studies were the classics, especially Homer, old English literature, and Oriental poetry and philosophy. He wrote occasionally for the *Dial* and other periodicals, but allowed more than the Horatian "nine years" to elapse between the composition and the publication of his first book, *A Week on the Concord and Merrimack Rivers* (1849), being an account of a boat-journey made along with his brother in 1839 from Concord to the head of Merrimack River, and back again, the minute narrative of the incidents being supplemented by observations in botany and natural history, descriptions of scenery, and much "transcendental philosophy." His second book, *Walden, or Life in the Woods* (1854), appeared after a similarly long interval, and is interesting for its descriptions of natural scenery and of the habits of birds, insects, and wild animals. D. at Concord May 6, 1862. Mr. Emerson published an interesting account of his life in the *Atlantic Monthly*, in which several of his sketches also appeared, and several volumes were subsequently prepared from his MSS., *Excursions in Field and Forest* (1863), *The Maine Woods* (1864), *Cape Cod* (1865), *Letters to Various Persons* (1865), with nine poems, and *A Yankee in Canada, with Anti-Slavery and Reform Papers* (1866). (See *Thoreau, the Poet-Naturalist*, by W. E. Channing, 1873.) Porter C. Bliss.

Thores′by (Ralph), F. R. S., b. at Leeds, England, Aug. 16, 1658; educated at Leeds School; resided some years at Rotterdam, qualifying himself for the mercantile business, which he afterward successfully conducted, devoting, however, much of his time to antiquarian pursuits. D. in 1725. Author of *Ducatus Leodiensis, or the Topography of Leeds* (London, folio, 1715), of which a new edition was brought out by Dr. T. D. Whitaker (1816); *Museum Thoresbianum, or a Collection of Antiquities in the possession of Ralph Thoresby*, and *Vicaria Leodiensis, or the History of the Church of Leeds* (1724); all which are highly appreciated by topographers. He contributed to Gibson's edition of Camden's *Britannia*, Collins's *Peerage*, Calamy's *Memoirs of Divines*, and other works, and wrote much in the *Philosophical Transactions*. His *Diary* (2 vols., 1830) and *Correspondence* (2 vols., 1832) were edited by Rev. Joseph Hunter.

Thori'idæ [*Thorius*—Gr. θορόεις, "undeveloped"—the name of the only known genus], a family of salamanders (Gradentia), distinguished by Prof. Cope for a species found in Mexico exhibiting the "lowest grade of ossific deposit found among the tailed batrachians (whence the name), accompanied by characters of full development in other respects. The parietal and palatine bones are represented mostly by cartilage and membrane; the posterior nares are therefore not separated from the orbit, the palatine bones are not prolonged over the parasphenoid; there is no postorbital arch; teeth are developed on plates on the parasphenoid bone; the tongue is boletoid and free in front; the carpus and tarsus are ossified; the vertebræ concave behind. The single known species has been named *Thorius pennatulus*, and is terrestrial in habits." (See Cope in *Proc. Acad. Nat. Sc. Phila.*, 1869, pp. 110–112.)

THEODORE GILL.

Tho'rium, also **Thorinum,** one of the rare metals, discovered by Berzelius in 1828 in a Norwegian mineral which he called *thorite*, from the mythical being *Thor*. Thorite is a hydric silicate of thoria, or oxide of thorium, consisting of $ThO.SiO_2.2H_2O$. Berzelius and Chydenius both obtained metallic thorium of densities 7.657 and 7.795 by treating the chloride $ThCl_2$ with sodium. It is a gray metallic powder, which burns with great brilliancy to snow-white infusible *thoria* or *thorina*, ThO. Water does not act upon it, and nitric and sulphuric acids with difficulty, though muriatic acid attacks and dissolves it powerfully. This is the statement of Berzelius, but Chydenius makes it easily soluble in nitric and difficultly in muriatic acid. It therefore, no doubt, has different allotropic forms. Its equivalent weight is as yet uncertain, some adopting 115.7, others 118.4. Thorium occurs also in other minerals besides thorite, as *orangite* (a heavier allotrope of thorite itself), as columbate in some *pyrochlores*, as phosphate in *monazite*, and according to Chydenius in *euxenite*, as columbate and tantalate.

HENRY WURTZ.

Thorn. See CRATÆGUS.

Thorn, town of Prussia, province of Prussia, on the Vistula, is strongly fortified, surrounded with walls, and defended by forts; has some manufactures of cloth, linen, soap, tobacco, and gingerbread, and carries on an active trade in corn and cattle. Copernicus was born here, and a fine monument in his honor has been erected in the market-place. P. 16,619.

Thorn-Apple. See DATURA.

Thorn'apple, tp., Barry co., Mich. P. 1795.

Thorn'back [*i. e.* "back with prickles" or "thorns"], the name given in some parts of England to the *Raia clavata*. This is a short-snouted ray, whose dorsal surface, especially about the snout and interorbital space, is covered with small spines, and along the middle of the back and tail with a row of large spines, resembling somewhat the thorns of a rose-bush; the male has further still larger thorns on the sides of the head and pectoral fins, and the female has numerous spines, each arising from a large roundish base. It is very abundant along some parts of the English coast, and is the most esteemed as a table fish of any member of the genus. It comes into the shallow water in spring and summer, and is then taken in the greatest numbers.

THEODORE GILL.

Thorn'borough (Sir EDWARD), b. in 1756; entered the British navy; was first lieutenant of the Falcon, one of the vessels which participated in the attack on Bunker Hill, 1775; took an active part in subsequent naval actions during the war of the American Revolution, and distinguished himself on various occasions in the war with France, rising to the rank of admiral of the white and receiving the thanks of Parliament. D. Apr. 3, 1834.

Thorn'bury, p.-v., Grey co., Ont., on the S. side of Nottawasaga Bay, Lake Huron, and on Northern Railway, has a trade in grain and lumber, and 1 weekly newspaper. P. about 400.

Thornbury, p.-v and tp., Chester co., Pa. P. 255.

Thornbury, tp., Delaware co., Pa. P. 990.

Thornbury (GEORGE WALTER), b. at London, England, in 1828; became contributor to periodicals at the age of seventeen; was connected with the *Athenæum* 1851; studied art and occasionally practised painting, but devoted himself to periodical literature, including essays, poems, novels, travels, and biographies. D. at London Jan. 7, 18[illegible]. Author of *Lays and Legends, or Ballads of the New World* (1851), *The Buccaneers, or the Monarchs of the Main* (3 vols., 1855), *Shakespeare's England*, [illegible] *Social History during the Reign of* [illegible] (2 vols., 18[illegible]), *Art and Nature at Home and Abroad* (2 vols., 18[illegible]), *Songs of the Cavaliers and Roundheads* (18[illegible]), *[illegible] Trumpeter* (3 vols., 18[illegible]), *Life in Spain* (2 vols., 18[illegible]), *Turkish Life and Character* (2 vols., 1860), *British Artists from Hogarth to Turner* (2 vols., 1860), *Ice Bound* (1861), *Cross Country* (1861), *Life of J. M. W. Turner, R. A.* (2 vols., 1861), *True as Steel* (1863), *Wildfire* (1865), *Haunted London* (1865), *Two Centuries of Song* (1866), *Old Stories Re-told* (1869), *A Tour round England* (1870), *Old and New London* (2 vols., 1873–74), *Criss-Cross Journeys*, and *Historical and Legendary Ballads and Songs* (1876).

Thorn Creek, tp., Whitley co., Ind. P. 1343.

Thorn'dike, p.-v. and tp., Waldo co., Me. P. 730.

Thorndike, p.-v., Hampden co., Mass.

Thorndike (GEORGE QUINCY), b. in Boston about 1825; graduated at Harvard 1847; studied art in Paris, settled at Newport, R. I., and devoted himself to landscape painting. Among his best known productions are *Scenes in Central Park* and *The Wayside Inn*.

Thorndike (ISRAEL), b. at Beverly, Mass., in 1757; received a common school education; was commissioned captain of the privateer Warren Oct. 30, 1776, subsequently acquired wealth by commerce with China and the East Indies and by manufactures; was a member of the convention that framed the Federal Constitution, settled at Boston 1810, and in 1818 presented to Harvard University the valuable library of Prof. Ebeling of Hamburg. D. at Boston May 10, 1832.

Thorne, tp., Perry co., O. P. 729.

Thorn'ton, p.-v. and tp., Cook co., Ill. P. of v. 301; of tp. 2222.

Thornton, p.-v. and tp., Grafton co., N. H. P. [illegible].

Thornton (EDWARD), b. at Clapham, Surrey, England, in 1810; entered the civil service of the East India Company at an early age; spent many years in the India House, London, from which he retired 18[illegible] with the decoration of commander of the Bath. Author of *India, its State and Prospects* (1835), *Chapters of the Modern History of British India* (1840), *History of the British Empire in India* (6 vols., 1841–45; 3d ed. 1862), *A Gazetteer of the Countries adjacent to India on the North-west* (2 vols., 18[illegible]), and *A Gazetteer of India* (4 vols., 1854; 2d ed. 1[illegible]). He edited William Milburn's *Oriental Commerce* (2d ed. 1825), and wrote most of the articles upon India in the 8th ed. (1853–60) of the *Encyclopædia Britannica*.

Thornton (Sir EDWARD), LL.D., K. C. B., b. [illegible] 18[illegible], son of Hon. Edward Thornton, British [illegible] in Portugal, who for services rendered the government [illegible] was created count of Cassilhas in the Portuguese [illegible]; entered the diplomatic service in 18[illegible]; [illegible] became paid attaché in Mexico 18[illegible], [illegible] legation there 18[illegible]; rendered valuable [illegible] in facilitating the negotiation of the treaty of Guadalupe Hidalgo 1848; was secretary of legation at Buenos Ayres 1852–53; appointed chargé d'affaires to [illegible]; also commissioned to Paraguay, which [illegible] officially visited; minister to the Argentine Republic [illegible]; envoy to Brazil 186[illegible]–67, and in Dec., 1867, [illegible] to the U. S., where he still remains (1876); [illegible] 9, 1870; a member of the joint high commission on the Alabama claims 1871; a privy councillor 18[illegible]; [illegible] of the Mexican and American [illegible] commission [illegible], and participated in the Centennial ceremonies at Philadelphia July 4, 1876.

Thornton (HARRY I.), b. in Virginia; removed early in life to Kentucky. He removed to Huntsville, Ala., and became a judge of the supreme court [illegible] in M[illegible] in [illegible], Ala., and [illegible] M[illegible] appointed [illegible] 18[illegible], a few years after, which he died. His brother, JAMES O. THORNTON of Tuscaloosa, was secretary of state of Alabama 182[illegible]–34.

Thornton (JAMES S.), U. S. N., b. Feb. 25, 1827, in New Hampshire, entered the navy as a midshipman Jan. 15, 1841; became a lieutenant in 18[illegible]; [illegible] captain in 187[illegible]; was executive officer of the [illegible] at the capture of New Orleans and the [illegible] there, and executive officer of the Kearsarge [illegible] with the Alabama. D. May 14, 187[illegible]. [illegible] gallantry and [illegible] [illegible], and the [illegible] in his official report of June 20, 18[illegible] [illegible] Lieut.-Com. Thornton [illegible] the Kearsarge [illegible] an example [illegible] when [illegible] success of the action." [illegible]

Thornton (JOHN W[illegible]), [illegible] 1818; graduated at [illegible] of the founders of the [illegible] Society, vice-president [illegible]

ation and of the Prince Publication Society; contributed to the *Historical Magazine* and other periodicals upon antiquarian subjects, and was the orator before the Genealogical Society Nov. 21, 1870, on the 250th anniversary of the signing of the compacts in the cabin of the Mayflower. Author of *Genealogical Memoir of the Gilbert Family* (1850), *Lives of Isaac Heath, John Bowles, and Rev. John Eliot, Jr.* (1850), *The Landing at Cape Anne* (1854), *Ancient Pemaquid* (Portland, 1857), *Pulpit of the American Revolution* (1860), etc. D. June 6, 1878.

Thornton (MATTHEW), b. in Ireland in 1714; came to Wiscasset, Me., in youth; received an academic education at Worcester, Mass., and studied medicine; accompanied Pepperell's expedition against Louisburg as a surgeon 1745; became a physician at Londonderry, N. H., and a colonel of militia; was president of the convention which in 1775 assumed the government of New Hampshire; took his seat as a delegate to the Continental Congress Nov. 4, 1776; signed the Declaration of Independence, though he had not been a member at the time of its adoption; was afterward chief-justice of Hillsborough county, judge of the New Hampshire supreme court, and member of both branches of the legislature and of the council (1785). D. at Newburyport, Mass., June 24, 1803.

Thornton (ROBERT JOHN), M. D., b. in London, England, about 1758, son of Bonnell (1724–68), an author of some note; was educated at Cambridge; studied medicine at Guy's Hospital, London, and on the Continent; became physician to the Marylebone Dispensary and lecturer on botany at Guy's Hospital. D. at London Jan. 21, 1837. Author of *The Philosophy of Medicine* (4 vols., 1796; 5th ed., 5 vols., 1807), in favor of the Brunonian system; *New Illustrations of the Sexual System of Linnæus* (atlas folio, 1799–1807), with 314 colored plates, also known as *The Temple of Flora*; and many other works, chiefly botanical.

Thornton (THOMAS), b. in England about 1787; became connected with the London *Times* in 1825; was reporter of the proceedings of the ecclesiastical and maritime courts, having drawn up for forty years the famous law-reports headed "Notes of Cases," and for twenty years prepared the summaries of the debates in the House of Commons; was a high authority on East Indian affairs, and a contributor to the *Edinburgh* and other reviews. D. in London Mar. 25, 1866. Author of a *History of China* (1844), a *History of the Punjaub and of the Sikhs* (3 vols., 1846), and other works.

Thornton (THOMAS C.), D. D., b. in Dumfries, Va., Oct. 12, 1794. His grandfather, Thomas Thornton, was a clergyman of the Church of England, who emigrated to America before the Revolutionary war, and became a firm friend of Washington; he devoted his property to the cause of independence. He graduated in Dumfries, and began to preach when only sixteen years of age. His father, being a High Churchman, at first opposed his preaching, but finally consented, and furnished him a horse and saddle-bags, and in 1813 he entered the Baltimore conference of the M. E. Church, and in 1841 was transferred to the Mississippi conference to take charge of Old Centenary College. From some misunderstanding, in 1845 he left the Methodist and joined the Protestant Episcopal Church, continuing to preach, but not submitting to reordination, as he did not believe in the uninterrupted apostolical succession. In 1850 he renewed his connection with the Methodist Church, and in 1853 with the Mississippi conference, in communion with which he died (Mar. 23, 1860). His principal works are *Theological Colloquies* and *Slavery as it is in the United States*, in reply to Dr. Channing.

T. O. SUMMERS.

Thornton (Sir WILLIAM), b. in England about 1775; entered the British army as ensign 1796; became major 1806; was appointed military secretary and aide-de-camp to the governor-general of Canada Aug., 1807; returned to England 1811; took part in the Peninsular war and Wellington's campaign in Southern France 1813–14; commanded the light brigade and advance of Gen. Ross's expedition up the Chesapeake May, 1814; was severely wounded and made prisoner at Bladensburg; was exchanged for Commodore Barney; commanded the advance of the British army sent against New Orleans in October, and the detached corps which operated on the right bank of the Mississippi in the battle of New Orleans, Jan. 8, 1815, when he was again severely wounded; and rose to the rank of lieutenant-general 1838. D. at Stanhope Lodge, near Hanwell, England, Apr. 6, 1840.

Thornton (WILLIAM THOMAS), b. at Burnham, Buckinghamshire, England, Feb. 14, 1813, son of Thomas Thornton, president of the Levant Company's establishment at Constantinople, by his wife, an Armenian lady; educated in the Moravian settlement at Ockbrook, near Derby; resided with a cousin who was auditor-general at Malta 1827–30; was secretary to the British consul-general at Constantinople 1830–35; was a clerk in the India House, London, from 1836 to 1856, when he was placed in charge of the public works department of that office, and in 1858 became secretary for public works in the India Office, a post he still (1876) holds. Author of *Over-Population and its Remedy* (1845), *A Plea for Peasant Proprietors* (1848; 2d ed. 1873), *Zohrab, and other Poems* (1854), *The Siege of Silistria, a Poem* (1854), *Modern Manichæism, and other Poems* (1856), *Old-Fashioned Ethics and Common-Sense Metaphysics*, and *On Labor, its Rightful Dues and Wrongful Claims* (2d ed. 1869).

Thorn'town, tp., Blackford co., Ind. P. 1526.

Thorntown, p.-v., Boone co., Ind., has a national bank and a weekly newspaper.

Thorn'well (JAMES HENLEY), D. D., LL.D., b. in Marlborough district, S. C., Dec. 9, 1812; graduated at South Carolina College, Columbia, 1831; studied and taught till the summer of 1834, when he spent some weeks at Harvard University, Cambridge, Mass.; was settled over a small Presbyterian church in Lancaster, S. C., June 12, 1835; took the professorship of logic and belles lettres in South Carolina College in Jan., 1838; resigned to take the pastorate of the Presbyterian church in Columbia in 1840; in 1841 went back to the college as chaplain and professor of sacred literature and the evidences of Christianity; from July to Dec., 1851, was pastor of the Glebe street church in Charleston; went back once more to the college, this time to be its president, in Jan., 1852; in 1855 accepted the professorship of didactic and polemic theology in the Theological Seminary at Columbia. D. at Charlotte, N. C., Aug. 1, 1862. He visited Europe for health in 1841, and again in 1860, returning to take a prominent and influential part in the struggle then just beginning between the North and the South. He was a man of fine scholarship, of rare critical acumen, and of great personal magnetism. Besides many review articles he published—*Arguments of Romanists Discussed and Refuted* (1845), *Discourses on Truth* (1854), *Our Danger and our Duty* (1861), and *On the State of the Country* (1861). The *Southern Quarterly Review*, founded (1855) and edited by him, lived not quite two years. His *Collected Writings* were edited by Rev. John B. Adger (2 vols., 1874), and his *Life and Letters* by Rev. B. M. Palmer, D.D., LL.D. (1875). R. D. HITCHCOCK.

Thor'nycroft (MARY **Francis**), b. at Thornham, Norfolk, England, in 1814; was a pupil of her father, John Francis, an eminent sculptor of portrait-statues; married, in 1840, Mr. Thornycroft, also a sculptor, and pupil of her father; accompanied him to Rome 1842; attracted the notice and enjoyed the advice of Thorwaldsen, who recommended her to Queen Victoria when the latter was in quest of an artist who should make portrait-statues of the royal children—a task which she accomplished with great success, representing them in the character of the *Four Seasons*. Among her best-known works are *Penelope*, *Ulysses and his Dog*, *The Flower-Girl*, *Sappho*, *The Sleeping Child*, and a *Girl Skipping*, the latter having been much admired in the Paris Exposition of 1855.

Thor'old, p.-v., Welland co., Ont., Canada, on Welland Canal and Great Western and Welland railways, 4 miles S. of St. Catharine's. It is built on a hill, and commands a fine view of Lake Ontario and of a rich and beautiful region. It has important quarries, good water-power, extensive manufactures, an active trade, and a weekly newspaper. P. of v. 1635; of tp., exclusive of v., 2501.

Thor'ough-Bass, in music, the mode or art of expressing chords by means of figures placed over or under a given bass. These figures indicate the harmony *through* all the other parts, and hence the name. Thorough-bass may be considered as the first department in the study of harmony. The term is sometimes taken in a larger sense, as equivalent to musical science. (See FIGURED BASS, HARMONY, and MUSIC.) WILLIAM STAUNTON.

Thorpe (BENJAMIN), b. in England in 1808; devoted himself at an early age to the study of the Anglo-Saxon and Scandinavian languages and literatures; made a complete translation of the Edda (unpublished), and received a pension from the British government. D. at Chiswick July 18, 1870. He translated Rask's *Grammar of the Anglo-Saxon Tongue* (Copenhagen, 1830; new ed. 1865); published Cædmon's *Metrical Paraphrase of Parts of the Holy Scriptures, in Anglo-Saxon, with an English Translation, Notes, and a Verbal Index* (1832); *The Anglo-Saxon Version of the Story of Apollonius of Tyre, upon which is founded the Play of Pericles, with a Translation and Glossary* (1834); *Analecta Anglo-Saxonica, a Selection in Prose and Verse from Anglo-Saxon Authors of Various Ages, with a Glossary* (Oxford, 1834; 3d ed. 1868); *Libri Psalmorum*

Versio Antiqua Latina, cum Paraphrasi Anglo-Saxonica, etc. (1835); *Ancient Laws and Institutes of England, enacted under the Anglo Saxon Kings from Ethelbert to Canut, with an English Translation of the Saxon* (London, folio, 1840); *The Holy Gospels in Anglo-Saxon, edited from the Original MS.* (Oxford, 1842; new ed. 1848; New York, 1846); *Codex Exoniensis, a Collection of Anglo-Saxon Poetry, etc., with English Translation and Notes* (1842); *The Homilies of the Anglo Saxon Church, etc., with an English Version* (2 vols., 1843–46); *The History of England under the Anglo-Saxon Kings, translated from the German of Dr. J. M. Lappenberg, with Additions and Corrections by the Author and Translator* (2 vols., 1845; new ed. 1857); *Florentii Wigorniensis Chronicon* (2 vols., 1848–49); *Northern Mythology, etc., compiled from Original and other Sources* (3 vols., 1851; new ed. 1863); *Yule Tide Stories, a Collection of Scandinavian Tales and Traditions* (1853); *Pauli's Life of Alfred the Great* (1854); *The Anglo-Saxon Poems of Beowulf, with a Literal Translation, Notes, and Glossary* (Oxford, 1855); *Lappenberg's History of England under the Norman Kings* (1857); *The Anglo-Saxon Chronicle, according to the several Original Authorities* (London, 2 vols., 1861); *Diplomatarium Anglicum Ævi Saxonici, a Collection of English Charters, etc.* (1865).

Thorpe (John), b. in England about 1510; was the chief introducer, if not the inventor, of what is known as the "Elizabethan" style of domestic architecture, having built Kirby House, Northamptonshire, 1570, Burleigh, Holdenby, Audley End, Giddy Hall, Ampthill, the Strand front of Somerset House, Longford Castle, Ireland, Holland House (1607), and many others. The particulars of his life and date of his death are unknown.

Thorpe (Thomas Bangs), b. at Westfield, Mass., Mar. 1, 1815; educated at the Wesleyan University, Middletown, Conn.; studied art; travelled in the South-west, and resided at New Orleans, La., from 1836 to 1853; edited a Whig paper there several years; raised volunteers for the Mexican war, and proceeded to Northern Mexico as bearer of despatches to Gen. Taylor after the capture of Matamoras; was the writer of the first newspaper correspondence narrating military events on the frontier; published *Our Army on the Rio Grande* (1846) and *Our Army at Monterey* (1847); was an active political speaker in the campaign of 1848; became known, under the pseudonym of "Tom Owen, the Bee-Hunter," as the writer of a series of tales of Western life, including *Mysteries of the Backwoods* (1846) and *The Hive of the Bee-Hunter* (New York, 1853); settled in New York in 1853, devoting himself alternately to literary and artistic pursuits; has contributed to *Harper's* and *Blackwood's Magazines*; was editor of the *Spirit of the Times* and other periodicals; published *Linda Weiss, an Autobiography* (1854), *A Voice to America* (1855), and other works, and was writing (1876) a series of biographical sketches of American artists. His best-known painting, *Niagara as it Is*, was produced in 1860. He was city surveyor of New Orleans during the administration of Gen. Butler (1862–63). D. in New York Sept. 20, 1878.

Thorpe (William), b. in England about 1350; received a good education; became a priest; preached the doctrines of Wycliffe for twenty years from 1386; was imprisoned in Saltwood Castle, Kent, as a "Lollard," 1407, and examined before Archbishop Arundel, then lord chancellor, July 3 of that year. He wrote an account of his *Examination*, which was widely circulated, and was condemned by an assembly of the clergy so late as 1530. The subsequent history of Thorpe is unknown. His *Examination*, which may be found in Foxe's *Book of Martyrs* and in Dr. C. Wordsworth's *Ecclesiastical Biographies*, is elegantly written, and is of great value as a picture of English society and manners in the time of Chaucer and Gower, and especially as a trustworthy summary of Lollard doctrines.

Thorwald'sen (Albert [Berthel]), b. at Copenhagen Nov. 19, 1770. His father, Gottschalk Thorwaldsen, a native of Iceland, was a wood-carver and poor, but his ancestry, there is reason to believe, was of the noblest, running back to the old Danish kings. He followed his father's calling, having no taste for any other, though with little enthusiasm for that, and soon excelled him in his humble art. His schooling was short and unprofitable until he was sent to the free school of the Academy of Arts at Copenhagen. There, at the age of seventeen, a bas-relief of Cupid reposing gained the silver medal; at twenty a sketch of *Heliodorus driven from the Temple* gained the small gold medal; two years later he drew the grand prize, which entitled him to receive the royal pension, available for five years, beginning in 1796. In Mar., 1797, he arrived in Rome. The first years there were disappointing. The country was disturbed by war, and his unaided resources were unequal to his support. He was about returning home when his model of *Jason*, which Canova praised, attracted the admiration of an English connoisseur, Thomas Hope, who gave the artist a commission to execute it in marble. This was the beginning of a great career. Other pieces followed; his fame increased; the crown prince of Denmark held out brilliant inducements to return to his native city, which, but for pressing engagements, he would have yielded to. The *Adonis*, begun in 1808, was not finished until 1832. It is the only one of Thorwaldsen's statues which was entirely carved by his own hands. It is one of the finest statues of modern times, and a triumphant answer to the charge brought against Thorwaldsen in his lifetime, that he could not work in marble. "Not work in marble!" he said. "Tie my hands behind my back, and I will hew out a statue with my teeth!" The famous bas-relief, *The Triumphal Entry of Alexander into Babylon*, which has been twice executed in marble and engraved in a series of plates, celebrated Napoleon's entry into Rome in 1812. The familiar bas-reliefs *Night* and *Morning* were modelled in 1815, it is said in a single day of mental depression, to which the artist was subject. The *Venus Victrix* (1813–16), and the *Mercury* (1818) are, with the *Adonis* just mentioned, his most perfect works. In 1819, Thorwaldsen revisited Copenhagen; was received with demonstrations of wild joy; was lodged in the palace of Charlottenborg, and welcomed in triumph by the chief cities of Prussia, Saxony, and Austria as he visited them on his way back to Rome. The well known groups of *Christ and the Twelve Apostles* and *John the Baptist preaching* were completed in 1838 for the church of Notre Dame at Copenhagen. Another visit to his native city, where he meant to make his home for the rest of his life, delightful and honorable as his position was, was cut short by the uncongenial climate. In 1841 he went back to Italy, stayed a year, then went to Copenhagen, intending to remain for a short time only, but died suddenly of disease of the heart Mar. 24, 1844. He was buried with royal honors in the cathedral church. Funeral honors were paid him in Rome and Berlin; tributes of respect were rendered throughout Europe. Thorwaldsen died rich. He was never married, but by a Roman girl he had one daughter, who was respectably married and handsomely provided for. The chief part of his fortune was left as a perpetual endowment for the museum at Copenhagen, which is raised around his grave, and contains all his works. Thorwaldsen's fame in his own land and abroad, while he lived, was immense. It was aided by attractive private gifts—great personal beauty, charm of manner, sweetness, simplicity and heartiness of disposition, accompanied by generosity to the poor. The best and most accessible works on Thorwaldsen are Thiele's, J. M., *Thorwaldsens Biographie* (4 vols., Copenhagen, 1851–56; Am. ed., translated by Prof. Paul C. Sinding, New York, I. G. Unnevehr, 1869); *Thorwaldsen, sa Vie et son Œuvre*, par Eugène Plon, with two etchings and thirty-five wood cuts (Paris, 1867; Am. ed. Boston, 1874, with the wood cuts of the Paris ed.). Thorwaldsen's works are very numerous—295 as mentioned by Thiele, the chief authority. They are of all dimensions and of every variety of theme, secular and religious, classical and Christian. Nearly every great city from Rome to Copenhagen contains something—statues, single or in groups, bas-reliefs of nearly every description, monuments funereal or commemorative, equestrian statues, pieces for the gallery and the public square.

O. B. Frothingham.

Thoth. See Hermes Trismegistus.

Thou, de (Jacques Auguste), b. at Paris Oct. 8, 1553; studied law at Orléans, afterward under Cujacius at Valence, where he made the acquaintance of Scaliger; travelled in Italy, Germany, and Holland, returned to Paris in 1574, and was made councillor to the Parliament in 1578, councillor of state in 1588, vice-president of the Parliament and keeper of the Royal Library in 1594. Henry III. and Henry IV. showed him great confidence, and entrusted him in many difficult diplomatic and political negotiations; but under the regency of Maria de' Medici [illegible] slighted and retired from public life. D. May [illegible] Of his great work, *Historia sui Temporis*, [illegible] period from 1543 to 1607, and divided into [illegible] first part was published in 1604, the second [illegible] third in 1614, reaching to the 80th book [illegible] in 1620, edited by Dupuy and Rigault [illegible] added a continuation or conclusion [illegible] author; complete edition in 7 [illegible] French translation in 16 vols. [illegible] autobiography, edited by M[illegible] poems. (See John Collin[illegible] *Account of his Writings* [illegible] cois Auguste de Thou [illegible] Royal Library, was [illegible] Mars, and executed Sept. [illegible] 1642.

Thouar (Pietro), b. at Florence in 1809; labored earnestly with Lambruschini to promote popular and elementary instruction in Tuscany, and he was himself a model teacher as well as an attractive writer for children. D. in 1861. Among his works the following are still read in the Italian schools: *Il Libro del Fanciulletto, Letture Graduali, La Casa sul Mare, Saggio di Racconti, Nuovi Racconti per la Gioventù, Racconti Popolari, Letture di Famiglia*, and others with similar titles.

Thouars. See Dupetit-Thouars.

Thousand and One Nights. See Arabian Nights, by J. Thomas, M. D., LL.D.

Thousand Islands, The, are in St. Lawrence River, and are all included in the 40 miles next below Lake Ontario. The islands are partly in Canada and partly in Jefferson and St. Lawrence cos., N. Y. Their number is reported to exceed 1800. The Thousand Islands have become a favorite summer resort, and are remarkable for their great and diversified beauty.

Thought, Train of. See Association of Ideas, by C. P. Krauth, S. T. D., LL.D.

Thra'ce was in ancient geography the name of that part of modern Turkey which lies between the Black Sea, the Sea of Marmora, the Struma, and the Danube. It was inhabited by a race of unknown descent, whose savage and barbarous character was proverbial; one king put out the eyes of his six sons for disobedience, and another transfixed his prisoners of war. The Thracians bought their wives and sold their children. When a man died, his wives contested with one another as to which had been best beloved by him, and she in whose favor the case was decided was with great congratulations slain by her nearest male kinsman on her husband's grave. They lived exclusively by plunder and robbery. Along the coasts the Greeks had planted several colonies—as, for instance, Byzantium, Callipolis, and Abdera—and during the Peloponnesian war the Thracians began to mix in the affairs of Greece, but without exercising any great influence. They were conquered by Philip of Macedon, and Thrace passed from Macedonia into the hands of the Romans. The old myths said that Orpheus and the Muses came from Thrace, and some ingenuity and much stupidity have been at work to solve the question how the originators of the Greek civilization could have come from the most barbarous nation of the ancient world.

Thrale. See Piozzi.

Thrash'er, a name applied in different parts of the U. S. to the species of Turdidæ or thrush-like birds belonging to the genera *Oreoscoptes* and *Harporhynchus*. These have a more or less long and decurved bill, which is scarcely or not at all notched near the tip, rather short and concave wings, and the tarsi scutellate anteriorly. *Oreoscoptes* is distinguished by its wings, which are decidedly longer than the tail, the nearly even tail, and the slightly-notched moderate bill. *Harporhynchus* has the wings decidedly shorter than the tail, the tail long and graduated, and the bill not notched and diversiform, but generally quite elongated and decurved. The color is rather plain, generally brownish or ash above, whitish or spotted on the breast. The species are the sage thrasher or mountain mocker (*O. montanus*), the brown thrasher (*H. rufus*), Cape St. Lucas thrasher (*H. cinereus*), gray curve-bill thrasher (*H. curvirostris*), California thrasher (*H. redivivus*), and red-vented thrasher (*H. crissalis*).

Thrashing. See Threshing Machinery.

Thrasybu'lus, one of the prominent leaders of the democratic party in Athens during the latter part of the Peloponnesian war, was a celebrated general, but after the surrender of Athens to Lysander and the establishment of the thirty tyrants he was banished, and took up his residence at Thebes. The violent measures, however, instituted in Athens by the oligarchical government provoked him so much that with a small band he invaded Attica and seized the fortress of Phyle, where he was speedily reinforced by other exiles and by the discontented democrats. Four days afterward he descended into the Piræus and took a strong position on the hill of Munychia, whence neither the thirty tyrants, nor the ten who succeeded them, were able to expel him. The oligarchs now called on Lysander to blockade the Piræus and attack it from the sea, but the exiles were saved from this danger by the rivalry between Lysander and Pausanias. The latter brought about a reconciliation between the two parties in Athens. Thrasybulus and the exiles entered the city, a general amnesty was granted, and a democratic government established again, though in a modified form (403 B. C.). In 390, Thrasybulus was killed by the inhabitants of Aspendus, in Cilicia, who fell upon him in his tent during the night.

Thrasymenus Lacus. See Perugia, Lake of.

Thread-Worm, the English name for the Nematoids. See Nematelmia.

Threatening Letters. See Threats.

Threats, in law, are oral or written menaces of injury to the property, character, person, or life of one individual, made by another under such circumstances that they become criminal. A threat made with a special evil intent, aggravated in its nature and form, and tending to produce mental disquietude, is an offence, at least a misdemeanor, and sometimes a felony. If, however, the menace be simply an outbreak of anger without a special evil intent, and with no evidence of malice—such as a mere threat to assault or to commit some other breach of the peace—the person making it will be bound over with sureties to keep the peace. A common example of the former class is a threatening letter, message, or other communication sent or made with an intent to extort money, ordinarily known as "black-mailing." The threat itself may be to expose a prior wrong, real or simulated, to sue, and the like. If the purpose be to extort money by holding the menace over the victim's head, the offence is committed. This whole subject, including the nature and form of the threat itself, its intent and circumstances, in order that it shall be an indictable offence, is now minutely regulated by statutes both in the U. S. and in England. In all cases, however, the menace must be of a nature calculated to affect a man of ordinary prudence and firmness, but the criterion thus stated has reference to the general character of the wrong menaced, and not to its probable effect upon the particular individual against whom it is directed.

John Norton Pomeroy.

Three Bodies, Problem of. The discovery of the law of universal gravitation by Newton reduced the question of the motion of the planets to one of almost pure mathematics. Newton himself was able to show, by a rigorous but intricate geometrical demonstration, that if two bodies like the sun and a planet attracted each other with a force inversely as the square of their mutual distance, they would each describe a conic section around their common centre of gravity. The planet being very small relatively to the sun, this common centre of gravity would be very near the centre of the sun, and the planet might therefore be said to describe a conic section around the sun. It was thus shown that, considering only the attraction of the sun upon the planets, each planet would revolve in an ellipse having the sun in one of its foci, which was Kepler's first law of planetary motion. But since each planet is attracted by all the other planets, as well as by the sun, this motion in an ellipse represents not the mathematical truth, but only an approximation to the real motion. Hence, mathematicians were led to propound the problem, more general than that solved by Newton: *Three bodies being projected in space with any velocity and in any direction whatever, and then left to their mutual attraction, to find the motion of each of them during all time.* The general and complete solution of this problem was found to be beyond the power of mathematical analysis, for the reason that the curves described by the several bodies would be so irregular, subject to such constant variation, and changing so greatly according to the masses of the bodies, that it would be impossible to express them by any mathematical formula. It was, however, possible to find certain general laws to which the motion would be subject. The centre of gravity of the three bodies would always move in a straight line with a uniform velocity. Certain relations were found to subsist between the masses of the bodies, their distance apart, and their velocities, and certain great principles established relating to secular changes as well as to the real permanence and stability of the solar system. (See Lagrange.)

But all this did not suffice to determine completely the motion of any one body. In consequence of the impossibility of the general solution, the efforts of mathematicians have generally been directed, not to the general problem, but to two special cases of it which occur in the solar system. The first of these cases is that of the motion of two planets around the sun, in which the masses of the bodies are very small compared with that of the sun, while their motion takes place in nearly circular orbits. The deviations of each planet from the average ellipse in which it would move if not attracted by the other, then admit of being determined with any required degree of accuracy, though not with mathematical rigor. The actual problem of planetary motion is, however, not simply that of three bodies, or two planets, but of nine bodies, there being eight large planets. But the solution of the problem of any number of planets involves no greater mathematical difficulties than are encountered in the case of two, though the labor of the numerical solution is immensely greater. The other special

case is that of the motion of the moon around the earth, under the influence of the attraction of the sun as well as of that of the earth. This is a more complicated case than that of planetary motion, because while the moon revolves round the earth, both the earth and moon revolve together around the sun. But by the researches of Hansen and Delaunay this difficult problem of the moon's motion has been solved with the same degree of accuracy as that of planetary motion.

The efforts of several generations of mathematicians since the middle of the last century have resulted in the general problems of planetary and lunar motion being rendered comparatively simple from a purely mathematical point of view. But the problem of actually calculating the formulæ necessary to determine the motion of any one planet is one of immense labor, the increased accuracy demanded by modern astronomy having more than made up for the greater simplicity of the methods now used. The reader may form an idea of the labor involved from the simple statement that the algebraic formulæ by which Delaunay represents the position of the moon occupy 120 4to pages.

S. NEWCOMB.

Three Kings. See EPIPHANY.

Three Mile, tp., Barnwell co., S. C. P. 1087.

Three Mile Bay, p.-v., Jefferson co., N. Y.

Three Oaks, p.-v. and tp., Berrien co., Mich., on Michigan Central R. R. P. of v. 499; of tp. 1316.

Three Rivers [Fr. *Trois Rivières*], city and port of entry, cap. of St. Maurice co. and of the district of Three Rivers, province of Quebec, Canada, on the N. W. bank of the river St. Lawrence, 90 miles above Quebec and 90 miles below Montreal, at the mouth of the river St. Maurice, from which vast amounts of lumber are afforded to the commerce of Three Rivers. It is the seat of a Roman Catholic bishop, has a splendid cathedral, a college, an academy, 2 convents, a hospital, a tri-weekly, a semi-weekly, and 3 weekly newspapers, 5 churches, a court-house, jail, gasworks, and 5 fire companies. Lumber, iron, and brick are largely manufactured and exported. A branch of Grand Trunk Railway terminates at Doucett's, on the opposite side of the St. Lawrence, with which point ferryboats ply regularly. P. 8414.

Three Rivers, p.-v., St. Joseph co., Mich., 28 miles S. of Kalamazoo, at the crossing of Kalamazoo division of Michigan Southern and Air-line division of Michigan Central R. R., on St. Joseph River, has 6 churches, 2 union schools, 3 flouring-mills, 4 pump-factories, 2 foundries, 1 threshing-machine factory, 1 paper-mill, 2 planing mills and lumber-factories, 2 cigar factories, 2 newspaper and job printing offices, 4 hotels, magnetic bath-house, 2 national banks, domestic, British, and German money-order post-office; in all, 175 places of miscellaneous business and stores. Buildings mainly brick, and new; deals largely in peppermint oil and wheat, the products of the country. The town and surroundings are beautiful, and population and business increasing. P. 1189.

WILBER H. CLUTE, PUB. "THREE RIVERS REPORTER."

Three Rivers Point, v., Onondaga co., N. Y. P. 43.

Three Springs, p.-v. and b., Huntingdon co., Pa. P. 189.

Thresher, a name frequently given to the *Alopias vulpes*, otherwise called FOX SHARK (which see).

Thresh'ing Machinery. Threshing is the separation of grain from the straw, as winnowing is the separation of threshed grain from the chaff. There are two methods of threshing—one by blows which beat out the grain; the other by a kind of trituration which breaks its hold on the straw. The former appears to have been developed from the latter. The earliest method of threshing was doubtless that of treading the grain to and fro by horses or oxen—a method still in common use on the small farms in our own country and elsewhere, especially for buckwheat, and notably for clover. Another ancient method still in use in the Orient, but probably nowhere else, is that of drawing a sled back and forth over the unthreshed straw. The primitive method of beating out the grain was by means of a flail, an implement comprising a staff wielded by the thresher, and having at one end a swingle shorter, thicker, and heavier than the staff, to which it is connected by a flexible thong. The flail is uniformly used to this day where only small quantities of grain are to be threshed. The best flails have staves made of ash and swingles of hickory; the staff in each case being provided with a wooden bow swivelled at its upper end in order that the swingle may be free to swing around the line of the staff, the swingle being attached to the bow by a looped thong made preferably of eel skin, which best resists the great and continual strain and friction brought upon it. In threshing grain with straight straw, such as oats, wheat, [illegible], etc., the sheaves are laid in double rows with [illegible] inward and slightly overlapping. The [illegible] thresher down the middle, [illegible] out the [illegible] bands upon the sheaves are then broken, and [illegible] uniformly again turned over. It is then [illegible] vested and flailed again. If the weather is [illegible] straw is tougher and [illegible] the grain more firmly [illegible] such cases the [illegible] with a pitchfork [illegible] more as may be [illegible] and repeatedly [illegible] the flail. With [illegible] which the sheaves [illegible] are of conical form, the [illegible] are placed [illegible] whole mass is beaten down [illegible] upon the tops of the stocks, the [illegible] being [illegible] and taken up as often as may be required, and repeatedly threshed until the grain is [illegible] beans, peas, etc., are [illegible] on the threshing floor and turned and beaten until [illegible] These last, however, are readily threshed by horses [illegible] ling upon them, an attendant turning the [illegible] part of the floor while the horses are tramping at another.

These primitive methods, from the very earliest times until a very recent period, were the only ones by which grain was separated from the straw, unless we except the rude method sometimes used by [illegible] burning the straw and gathering the [illegible] behind; also that other method in which we may detect the faintest glimmer of the principle of [illegible] the hurdles made of planks or [illegible] with flints or hard pegs, to rub the grain out between them; for we have simply to curve one of these [illegible] the arc of a circle, and bend the other to [illegible] der revolving within the concave, to have [illegible] representation of the two essential parts of [illegible] threshing machine. It is to such [illegible] ples of improved machinery may [illegible] and the threshing machine of to-day [illegible] the pegged hurdles of the ancient [illegible] harvester had its beginning in the [illegible] mounted on wheels mentioned by Pliny [illegible] the Gauls. When or where the first [illegible] machines were attempted is not known, [illegible] cribes their first suggestion in Britain [illegible] Holland. The first threshing machine that [illegible] sense be considered a practical success, and [illegible] the prototype of those that led to the [illegible] the hand-flail, was that invented by Michael Menzies of East Lothian in Scotland, who used [illegible] attached to a revolving shaft driven by [illegible] This machine succeeded in the [illegible] high velocity required soon [illegible] and the mechanical resources of that [illegible] to the task of constructing an apparatus [illegible] which would successfully stand the [illegible] use. Afterward, in the year 17[illegible] Michael Stirling in Perthshire [illegible] er, which appears to have [illegible] This had a vertical shaft [illegible] a cylinder, the shaft being [illegible] sheaves were thrown in at the top [illegible] beaten by the [illegible] arms. [illegible] little utility, and [illegible] machine, in which [illegible] an indented drum, the [illegible] rubbing out the grain. [illegible] as were also [illegible] another Scotchman, Andrew Meikle [illegible] which rollers and [illegible] ing was substituted [illegible] kind was made in 1786 [illegible] best threshing machine [illegible] tended out [illegible] to the drum, and [illegible] straw. At [illegible] the grain from the [illegible] straw in [illegible] of these [illegible] rated from the straw, was [illegible] was [illegible] had [illegible] But this [illegible] tinued it, were [illegible] and chaff, and the grain from [illegible] that time, when [illegible] least three times what it is [illegible] one man to do the [illegible] cent more of winnowed [illegible] than was possible [illegible] remarked: "It [illegible]

it is as great a gain to the public as if the national territories were increased one-seventh." Notwithstanding the comparative excellence of these early British machines, they have of course been much changed, and in fact nearly metamorphosed, and the steam threshing-machines exhibited at the annual agricultural shows in Great Britain are in fact triumphs of mechanical engineering.

In this country threshing-machines were early invented, but for the reason that most of the farms were those newly cleared from the wilderness, divided into small fields and almost necessitating hand-labor in all the different departments of agriculture, it is only within a comparatively recent period—say, twenty-five or thirty years—that this class of machinery has been brought to any perfection. Among those earlier invented, the plan of rotary beaters or flails attached to a revolving shaft was the subject of much experiment. But a revolving cylinder provided with radial teeth or spikes, and working with a concave or section of a cylinder provided with similar but inwardly-projecting teeth, comprised the beating mechanism first found uniformly successful, and which continues in use to this day. The changes and improvements have related for the most part to the mode of giving motion to this cylinder, and to accessories for securing safety and convenience in the operation of the machine. Those which first came into common and satisfactory use had the cylinder actuated by intermediate gearing from a vertical driving-shaft, from the upper end of which extended radial arms. To the outer end of these arms was attached a whippletree, on which draught was exerted by a single horse. The four horses walked in a circular path, and thus gave rotatory movement to the vertical driving-shaft and rapid rotation to the cylinder. The sheaves, unbound, were fed with the heads first into the space between the cylinder and its concave. In some of the first of these machines shaking screens were so applied as to sift the grain and chaff from the straw, the latter being carried and deposited by itself, while the former passed to the hopper of a fanning-mill, which cleaned or separated the grain from the chaff, while a graduated system of sieves separated the small seeds, pigeon-weed, devil's-gut, etc. Many attempts were made to supersede this clumsy mode of driving the cylinder by an inclined endless belt constructed with transverse wooden lugs, and driven after the manner of a treadwheel by horses. This plan has been adopted with success for small dog-power machines for churning. Many experiments were made to apply the same principle in various forms to the heavier work of driving a thresher. The writer has had from the lips of the late Charles H. Metcalf an account of the first attempts of this kind made at a foundry in the village of Fly Creek, N. Y. A gentleman of that place had succeeded in making a horse-power on the plan just mentioned, which theoretically appeared to be perfect, but with which no steadiness of motion could be given to the cylinder. When the sheaves were not passing to the machine, the apparatus ran too fast for the horses; when the sheaves were applied, the apparatus choked. This, it appears, was about forty years ago; the apparatus was laid aside; and shortly after, a projector from the State of Maine came to the same foundry and had constructed a far ruder apparatus, which on trial gave a perfectly satisfactory motion to the cylinder. The constructor of the first-named device was not long in discovering that this was due to a balance-wheel placed on the main shaft of the horse-power. He added this useful appliance to the shaft of the previous machine, and from this was developed the Badger railroad horse-power, which for many years held its own as the most efficient power for driving threshing-machines. It is difficult to explain the construction of this apparatus without elaborate diagrams. It consisted, in brief, of a framework carrying at each side two endless cast-iron tracks situate in vertical planes. The endless belt was composed of two systems of iron links arranged around the two tracks, and connected by the transverse lugs or wooden bars which composed the travelling floor of the apparatus. Each link carried a broad-faced wheel resting upon the upper part of the adjacent endless track. The endless belt thus constructed and arranged was of course in an inclined position, the weight of the horse walking thereon as upon a treadmill giving a motion to the endless belt, the wheels of which travelled upon and around the endless tracks, from which operation the designation "railroad" was derived. A large broad-faced wheel constituted at once the balance-wheel to give steadiness of motion and the driving-wheel from which, by means of a belt, power was transmitted to the threshing-cylinder. At a later date the construction was much simplified, and what are now termed railroad horse-powers differ materially in construction from the first representatives of the class. In the use of this class of machinery much difficulty was at first experienced from the breaking or slipping of the driving-belt, which by relieving the horse-power from the resistance of the thresher was liable to throw the horses back out of the machine, with consequent injury and loss. This was remedied a number of years ago by an ingenious application of a lever arranged in such relation with the belt that the breaking of the belt lets fall the lever, and this in its turn actuates a brake that, coming in contact with the driving-wheel, stops the motion of the endless platform.

The ordinary threshing-machine in use in the Eastern States comprises a railroad horse-power, commonly for two horses, and a thresher composed essentially of the toothed cylinder acting in conjunction with the toothed concave. An endless shaker formed with transverse wires, and operated like an endless belt, conveys the straw some distance in the rear of the thresher, a vibrating motion given to the belt shaking out the chaff and grain, these latter being passed to a fanning-mill which separates the chaff, small seeds, etc., from the winnowed grain. These machines are commonly owned by some enterprising farmer, who, aside from the threshing of his own farm, journeys from farm to farm by appointment, and threshes either for a stated cash price per bushel or for a percentage of the grain itself, commonly one-tenth. The large farms of the West and the immense quantities of grain produced have called into existence far more elaborate apparatus, in which, however, the principle of operation is substantially unchanged. The following is a sketch, made some time since by the writer, of a thresher in use during the past few years in the Western States, and which may be taken as a type of the improved threshing-machine in use in the Prairie States. In this the threshing-cylinder "is made of skeleton form, having cast-iron heads, and the central annular brace of the same material; wrought-iron bars are arranged on these parts, and form the circumferential parts of the cylinder, being held in position by the external wrought-iron rings. The bars carry the teeth, the shanks of which pass through holes in the bars, and are held by nuts firmly screwed upon their inner ends; the uniformity in shape and size of the teeth arises from their being made by machinery properly shaped in dies under a drop-hammer. The concave is of cast iron, with slots in it which allow the grain to pass through to separate from the straw at the earliest possible stage of the threshing operation. The straw as it leaves the cylinder is flung back over several transverse series of inclined rods, which permit whatever grain may yet remain in the straw to drop upon a laterally vibrating shaker, arranged below at a slight angle to the horizontal, and serving to conduct the grain to the fan-mill, the rotating fan of the latter being placed under the centre of the threshing-cylinder, and securing far greater compactness of structure than was formerly obtained."

In the Pacific States the peculiar dryness of the atmosphere greatly facilitates not only the threshing, but the reaping, of grain; the standing grain, instead of crinkling down when ripe, as is the case in the Eastern States, stands straight for many weeks; and this without the shaking out of the kernels incident to ripe grain in other portions of the country. It is, however, dry enough to thresh immediately; the threshers are driven by portable steam-engines, and the threshing is carried on in the open field. The latest attempted improvement upon the ordinary thresher in California lies in the utilization of the straw for fuel in the portable engines. And there is no reason why the immense piles of straw which ordinarily are wasted should not be made useful to this end. Straw-burning furnaces have been used in Hungary during a long period, and for many years the straw of the Southern rice-fields in this country has been utilized in the same manner. The most advanced step, however, is found in the combined reaper and thresher, an example of which was examined by the writer in San Francisco some five years since. This was calculated for threshing and sacking grain in the field. My memorandum at the time describes it as follows: A large grain frame is supported on two heavy driving-wheels, and has two lighter ones in front arranged as guiding-wheels. Projecting from the side of this frame is a platform like that of an ordinary reaper, but about 12 feet long. This runs at such height that the reciprocating sickle at the front will cut off the heads from the standing grain; the heads fall on an endless apron running longitudinally upon the platform, and are carried by this to a hopper that conducts them to a threshing-cylinder having a fanning-mill and straw-separator arranged behind it. The threshed and winnowed grain is thrown out from the fan-mill through a spout at the side directly into the mouth of a sack suspended under the spout. An attendant riding upon the platform ties the sacks when full, and throws them off upon the ground to be collected at leisure. The driving parts receive their motion from the large or driving-wheel by means of suitable bands and gearing. This apparatus was designed to be drawn by ten horses, the management of which would constitute the greatest difficulty in the operation of the

apparatus. Something similar to this has been projected in Australia, where the peculiarities of the climate permit the immediate threshing of the grain as soon as cut. It is somewhat doubtful whether so complex an apparatus will meet with perfect success in practice. But it is not impossible that an apparatus itself drawn by horses, but with the sickle and threshing-cylinder driven by a steam-engine closely boxed on the wheeled frame, might harvest and thresh the grain much more cheaply than by present methods. The plan would not be more audacious than that experimentally carried into effect a half century since in Devonshire, England, of connecting a threshing and winnowing apparatus with a run of mill stones, so that the grain was stripped from the straw, separated from the chaff, ground, and bolted at one continuous operation.

JAMES A. WHITNEY.

Thrift, the *Armeria vulgaris*, a European sea-side and mountain plant, found also on British American shores, and often grown in gardens as an edging for flower-borders. It has diuretic powers. *A. latifolia* is a fine ornamental plant from Portugal. They are of the order Plumbaginaceæ.

Thrips [Gr. θρίψ], a genus of insects which gives name to the family Thripidæ, an interesting group of degraded organisms, generally considered to be hemipterous, although their position is not quite established. The Thripidæ are destructive to grain, flowers, and the bark of growing plants. *Thrips cerealium* is one of the most destructive species. It is a very minute insect, with long fringed wings, but it appears to leap rather than to fly.

Throat, Diseases of. Although the specialty of the study and treatment of throat diseases is designated "laryngology," it includes diseases of the posterior nares, the fauces, pharynx, and larynx. Exceptionally, some of these diseases may be suspected or even diagnosticated from symptoms only, as laryngitis from hoarseness, stridulus, and aphonia; chronic tonsillitis from muffled voice and habitual snoring; elongated uvula and papular pharynx from habitual spasmodic pharyngeal cough. But physical exploration, the direct examination of the oral cavity and the passages to the posterior nares and larynx, is essential both to diagnosis and to correct treatment. Simple examination—the depression of the tongue by a spoon or tongue spatula—will suffice in many cases, exhibiting the tonsils, soft palate, uvula, posterior wall of the pharynx, and the top of the epiglottis. To discover the root of the tongue, the entire epiglottis, the true and false vocal cords, the chink of the glottis, and even the upper rings of the trachea and division of the bronchia, the laryngoscopic mirror must be employed. Laryngoscopy may be performed by the use of either bright sunlight or a concentration of artificial light. Specialists employ lamps with condensing prisms, and where very bright light is desired the oxyhydrogen light is used; with such methods of illumination the examination is conducted in a dark room. A good light, whether the sun's rays or artificial, is reflected, by a concave mirror held by the physician or worn upon a head band, into the patient's opened mouth. The patient's tongue being drawn forward and [illegible] held, a small circular or oval laryngeal mirror [illegible]. There are several sizes of mirrors, varying in diameter from one quarter to one inch in diameter; they are attached to delicate handles at an angle, so that when passed to the back

FIG. 1.

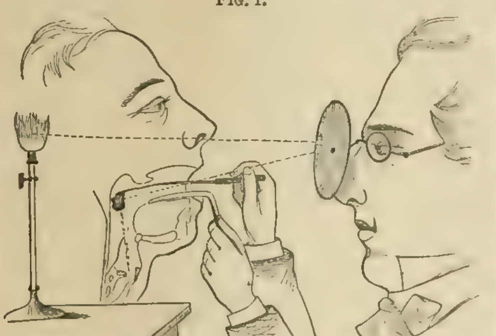


FIG. 2.

Healthy Larynx.

of the throat they catch the rays thrown into the mouth by the concave mirror, and reflect them [illegible] illuminating the larynx. The parts thus rendered [illegible] present a distinct picture in the small laryngeal [illegible] above them; and this is seen by the observer through the perforated centre of the concave mirror, since the axes of light return by reflection to the reflecting surface from which they started.

The laryngoscopic examination is easily accomplished after a brief period of practice. More difficult is the exploration of the upper pharynx and the posterior nares, termed rhinoscopy. The uvula has to be drawn forward, and the reflecting laryngeal mirror passed well back and turned upward. When correctly held, a distinct image of the septum between the nostrils, and of the extensive corrugated surfaces of the naso-pharyngeal space, is transmitted to the eye (Fig. 3). Patients are easily trained to permit the presence of the throat mirror, and even to explore their own throats (auto-laryngoscopy). The movements of the vocal cords are displayed best by phonating *a* [illegible]. All of these several constituting parts of the throat are richly supplied with blood vessels, lined by a mucous membrane, secreting mucus. They are therefore liable to hypersecretion of mucus, or catarrh, which may be acute, subacute, or chronic; to active and passive congestions, inducing redness, heat, and swelling; to active inflammations, with formation of submucous abscess, erosion of the epithelial covering of the mucous membrane, or ulceration and sloughing of its deeper layers. Such destruction of soft tissue may induce necrosis of the underlying hard structures, the nasal and laryngeal cartilages. Inflammation may terminate in an exudation, developing organized membranes, as those of croup and diphtheria. Repeated congestions and inflammations tend to engorge and hypertrophy the structures of the mucous membrane and glandular bodies embedded in it. The papillæ of the back of the throat and of the columns of the fauces are very often thus enlarged. The surface is seen to be studded with prominent ovoid papules or tubercles, a condition known as "clergyman's sore throat," and technically as "papular pharyngitis." Polypoid growths of variable size develop in the nares, pharynx, and on and around the vocal cords—products of papular growth and of granulation process.

FIG. 3.

A most alarming and critical condition is acute œdema of the glottis. The secretion of the region of the larynx being suddenly checked, as by cold, or the seat of sudden determination of blood, serum transudes from the overloaded blood vessels into the loose submucous connective tissue, and creates a sudden dropsy and tumefaction. The distended, swollen structures overlap the opening of the glottis and occupy the ventricles of the larynx, preventing inspiration, and threaten immediate death by suffocation. The laryngoscopic mirror definitely locates the seat of these dropsical sacs, and is the sure guide to efficient scarification and evacuation of their contained fluid. The vocal cords may be affected by spasms, producing hoarseness, aphonia, and labored respiration, in which case the mirror detects the unusual approximation and irregularity of the cords, and excludes the presence of more serious inorganic disease. One of the vocal cords may be found paralyzed, inactive, and relaxed, while the other remains normal. Such paralysis of a cord may be due to vocal inflammation or abnormal growth, or may depend upon lesions of the recurrent nerves in the neck, or again, coexisting with paralysis of one half of the body, depend on a lesion of the brain—softening, embolism, apoplexy. [illegible] or inflammation may so seriously damage the vocal cords that cicatricial or scar-like tissues are formed, [illegible] contraction, in time the chink of the glottis becomes contracted and narrow—termed "stenosis of the larynx." The aperture being no longer adequate [illegible] ingress or egress of air, gradual suffocation [illegible] unless surgical relief is afforded. [illegible] of the vocal cords often occurs from [illegible] bal cancer.

The more accurate diagnosis of [illegible] study and classification [illegible] have led to corresponding [illegible] tions are no longer applied [illegible] tain of the cond tion th [illegible] reached. Remedies [illegible] methods, with definite [illegible] case. Astringents [illegible]

of iron, and solutions of nitrate of silver—are employed to contract blood-vessels, lessen congestions and relaxations of surfaces. Caustics are used to remove papular and granular developments, and induce absorption of hypertrophied structure. Local applications are made to heal ulcers. Inflammation is checked, limited, and cured by warm solutions and vapors impregnated with salts of soda, ammonia, and potash, or in other cases by cold gargles or spray. The salines tend to increase and liquefy the secretions of the throat: resin oil and astringent agents lessen them; carbolic acid, chlorine, etc., disinfect them when septic. Anodynes are given to allay pain, either by the stomach or locally. Electricity is applicable directly to the paralyzed vocal cord. The knife is constantly of service in treating throat diseases, for the excision of the tonsils and uvula, opening abscesses, the incision of hard papules, preceding use of caustics, removal of polypi, the scarification of œdema of the glottis, and for the operations of tracheotomy and laryngo-tracheotomy, whenever, by congestion, inflammation, ulceration, stenosis, tumors, cancer, sudden œdema, croupous or diphtheritic membrane, or whatsoever obstruction, the larynx is closed to the passage of air and death is imminent by suffocation.

E. Darwin Hudson, Jr. Revised by Willard Parker.

Throck'morton, county of N. W. Texas, drained by Brazos River and its affluents; surface is generally broken and hilly, and suited to grazing.

Throcmorton (Sir Nicholas), b. in England about 1513; became a page to the duke of Richmond; was afterward a member of the households of Henry VIII. and of the queen-dowager; was engaged in the French campaign 1544–47; was appointed under-treasurer of the mint by Edward VI., to whom he was, as an earnest Protestant, much attached; was present at the death of Edward 1553; was concerned in Wyatt's rebellion 1554, for which he was imprisoned in the Tower and tried for treason, but acquitted; resided on the Continent during the reign of Mary; appointed by Elizabeth chief butler of England, and subsequently chamberlain of the exchequer; ambassador to France 1559–63; afterward sent on a mission to Mary Queen of Scots, and entered into the scheme for her marriage to the duke of Norfolk, for which he was disgraced and committed to the Tower 1569. D. Feb. 12, 1571.

Throm'bus [Gr. θρόμβος, a "clot"], in pathology, designates the fixed venous blood-clot. Thrombus often accompanies phlebitis. It is conceded that dilatation or contraction of a vessel, or great weakness of the heart's action, may favor the formation of thrombus, but whether a special miasmatic influence may have the same result is not settled. Thrombi are liable to putrefactive changes, whence follow metastatic abscesses and a long train of deplorable consequences. When thrombus exists, a rich diet, tonics, and pure air afford the only prospect of recovery.

Throop, tp., Cayuga co., N. Y. P. 1302.

Throop (Enos Thompson), b. at Johnstown, Montgomery co., N. Y., Aug. 21, 1784; studied law; was admitted to the bar in 1806, and removed to Auburn, N. Y.; was appointed clerk of Cayuga co. by Gov. Tompkins; elected to Congress in 1814; appointed circuit judge of the 7th district of New York by Gov. Yates; in 1828 was elected lieutenant-governor of New York, with Martin Van Buren as governor, and became acting governor on the latter's retirement from the governorship to accept a place in Pres. Jackson's cabinet; renominated and re-elected in 1830 at the head of the ticket; declining a third term, removed to Michigan, where he conducted extensive improvements in that sparsely-settled Territory. Returning to New York, he ended his days amid the scenes of his early life, his death occurring Nov. 1, 1875, at Willow Brook, on the shore of Owasco Lake, his former home.

Throops'ville, p.-v., Throop tp., Cayuga co., N. Y. P. 126.

Thrupp (Francis Joseph), b. in England in 1827; educated at Winchester School and at Trinity College, Cambridge, where he obtained a fellowship; took orders in the Church of England; travelled in the East; became vicar of Barrington, Cambridgeshire; d. there Sept. 24, 1867. Author of *Ancient Jerusalem, a New Investigation into the History, Topography, and Plan of the City, Environs, and Temple* (1855), *An Introduction to the Study and Use of the Psalms* (2 vols., 1860), *The Song of Songs, a New Translation* (1862), and other works; contributed to Dr. William Smith's *Dictionary of the Bible,* and prepared part of the commentary on the Pentateuch in the *Speaker's Commentary.*

Thrush, the English name applied to various species of the family Turdidæ, and especially to those of the genus *Turdus.* As understood by American authors, this genus embraces the species of which the bill is conical, subulate, and shorter than the head, the tip of the upper mandible slightly decurved, the rictus provided with moderate bristles, the wings rather long and pointed, and with the first primary small, the tail nearly even, and the tarsi with continuous plates. The genus thus understood has, however, been subdivided into five sub-genera (considered by some as genera), which exhibit differences in the relations of the sexes, the size and shape of the bill, etc. It includes some of the finest songsters and most familiar birds of the northern hemisphere. Most of the American species belong to the section Hylocichla, and among these is the wood thrush, or *T. mustelinus,* famous for its song. To the section Planesticus belongs our familiar robin (*T. migratorius*). Baird, Brewer, and Ridgway admit 8 species as inhabitants or visitants of North America and the U. S. Theo. Gill.

Thrush, an abscess in the sensitive frog of the horse's foot. Cleanliness and the paring away of loose pieces of the frog are useful toward a cure. Carbolic-acid lotions or occasional sprinkling with calomel will materially hasten the recovery. This disease is generally the result of neglect.

Thucyd'ides, generally considered the greatest historian the Greek people ever produced, was b. at Athens 471 b. c. He descended from a princely family in Thrace, and was connected with the families of Miltiades, Cimon, and Pisistratus. He was also rich; he owned those gold-mines on the coast of Thrace, opposite the island of Thasos, which later were worked with so great profit by Philip of Macedon. He received the instruction of the philosopher Anaxagoras and the rhetorician Antiphon. In the eighth year of the Peloponnesian war (424 b. c.) he commanded an Athenian fleet of seven ships destined to defend the Athenian settlements along the coast of Thrace, especially the city of Amphipolis. The Spartan general, Brasidas, attacked this city at a moment when Thucydides and the fleet happened to be absent, and offered it very alluring terms of capitulation. It accepted them, and capitulated before Thucydides could reach it, and as a punishment for this misfortune or neglect he was driven into exile, and lived for twenty years in foreign countries—in Thrace, Peloponnesus, and Sicily. In 403 he returned to Athens, but two years after he was assassinated, whether in Athens or in Thrace is uncertain. His great work on the Peloponnesian war is unfinished. It reaches only to the year 411 b. c.; and the eighth book, which differs considerably from the preceding books, is said to have been written by his daughter. Although he is only thirteen years younger than Herodotus, the difference between them is very striking. It always remains the honor of Herodotus to have invented the art of history, but from him to Thucydides this art has made great progress both in style and method. Herodotus tells everything interesting, and tells it simply because he finds it interesting, but this prolixity sometimes becomes diffuse and garrulous. Thucydides tells only that which has a direct bearing on his subject, and tells it solely on account of this relation. This iron consistency makes him sometimes obscure, but his style belongs, nevertheless, to a much more advanced civilization; it has reduced the volume of the expression one-half. Herodotus arranges his materials so as to make them all enter into a general view. With Thucydides there is very little arrangement. He takes the phenomena as they show themselves, and his labor consists in finding out the motive of the acting person and the cause of the visible effect; but this method belongs to a higher stand-point of historical art, as it is a deeper world it describes. His work has been edited by Poppo (Leipsic, 1821 *seq.*, 11 vols.), Bekker (1832), Böhme (1856), Krüger (1846), and translated into English by Rev. S. T. Bloomfield (3 vols., 1829), Rev. Thomas Dale (1856), and Richard Crawley (1874). Clemens Petersen.

Thugs [from the Hindoo *thugna,* to "deceive"], a religious association, worshippers of the goddess Kali, who in bands of from 30 to 300 roamed all over India, and had established connections everywhere. They decoyed persons into their company, allured them to distant places, murdered and plundered them. But their motive was not so much lust of plunder as certain religious ideas, and of the spoil one-third was given to the goddess. Between 1829 and 1837 the British Indian government succeeded in breaking up these bands entirely. (See *Ramaseeana, or a Vocabulary of the Peculiar Language used by the Thugs* (1836), by Capt. Sleeman, and *The Confessions of a Thug,* by Meadows Taylor (London, 1858).)

Thu'le, the name which Pytheas (at the time of Alexander the Great) gave to a land which he discovered after sailing six days in a northerly direction from the Orkney Islands. Later, the Romans used the name as a general signification for the northernmost parts of the habitable earth—*ultima Thule.* What island Pytheas meant by his Thule is unknown.

Thumb'screw, or **Thumb'kin,** an instrument of judicial torture formerly used in various parts of Europe,

but particularly in Scotland. The thumb was compressed by means of a screw. Its last official use was in the trial and on the person of Principal Carstairs in 1682, after the Rye-house Plot.

Thun'berg (CARL PETER), b. at Jönköping, Sweden, Nov. 11, 1743; studied at Upsal under Linnæus; resided at the Cape of Good Hope 1771–73, and in Japan 1775–79; returned in 1779 to Sweden; succeeded Linnæus in 1784 as professor of botany at the University of Upsal; d. there Aug. 8, 1828. His principal works are—*Flora Japonica* (1784), *Prodromus Plantarum Capensium* (1794–1800), *Icones Plantarum Japonicarum* (1794–1805), *Flora Capensis* (1807–13), and *Resa uti Europa, Africa och Asia* (4 vols., 1788–91).

Thunder. See LIGHTNING, by J. HENRY.

Thun, Lake of, in the canton of Berne, Switzerland, at an elevation of 1775 feet above the level of the sea, is 10 miles long and 2 miles broad. On its eastern shore stands Interlaken, and on its north-western—or, properly speaking, on the Aar, about 1 mile from its exit from the lake—the town of Thun. Both these towns are every season visited by a great number of tourists journeying to the Bernese Oberland. Steamers ply on the lake.

Thur'ber (GEORGE), M. D., b. in Providence, R. I., in 1821; became professor of mathematics, medicine, and botany in the New York College of Pharmacy, and is co-editor of the *American Agriculturist*. He has edited *American Weeds and Useful Plants*, being a second and illustrated edition of Darlington's *Agricultural Botany*, and has contributed largely upon botanical subjects to the *American Cyclopædia*.

Thur'gau, canton of Switzerland, bordering N. on the Rhine and the Lake of Constance, comprises an area of 384 sq. m., with 93,300 inhabitants, of whom 69,231 are Protestants and 23,454 Roman Catholics. The surface is undulating, but not mountainous, except in the southernmost districts. The soil is very fertile, and agriculture is the main branch of industry pursued; several cotton and linen spinning and weaving factories are in operation. Cap. Frauenfeld.

Thu'rible [Lat. *thuribulum*, from *thus*, "incense"], or **Cen'ser,** in the Roman Catholic Church service, a vessel of silver suspended by four short chains. It is charged with burning charcoal, upon which incense is placed. The thurible is borne by an acolyte called the *thurifer*.

Thü'ringerwald ["the forest of Thuringia"], a mountain-range in Central Germany, extends along the right bank of the Werra, from the influx of the Horsel, for about 60 miles, and joins the Frankenwald in Northern Bavaria. Its highest point is Schneekopf, 3400 feet high. It is covered with pine forests, and consists mostly of granite, porphyry, and slate, interspersed with rich veins of iron ore. The country it occupies was formerly called Thuringia, but is now parcelled into many petty states.

Thurin'gia [Ger. *Thüringen*], the general name for that region of Central Germany which lies between the Hartz and the Thuringian Forest, the Saale and the Werra, and which comprises parts of the Prussian province of Saxony and the Saxon duchies. The name originated from the Thuringii, who settled here, but since the fifteenth century it has had no definite political signification.

Thurles', town of Ireland, county of Tipperary, Munster, on the Suir, contains several fine buildings and carries on an active general trade. P. 5332.

Thur'loe (JOHN), b. in Essex, England, in 1616; studied law; was called to the bar at Lincoln's Inn 1647; enjoyed the favor of Oliver St. John, through whom he obtained the post of secretary to the council of state 1652; was secretary of state 1653–60; sat in Parliament; was chief postmaster, privy councillor, governor of the Charterhouse, chancellor of Glasgow University, and suffered a short imprisonment at the Restoration. D. in London Feb. 21, 1668. His collection of *State Papers* was edited by Dr. Birch (7 vols., 1742).

Thur'low (EDWARD), BARON THURLOW, b. at Ashfield, near Stowmarket, Suffolk (according to others at Little Bracon-Ash, Norfolk), England, about 1732, his father, Rev. Thomas Thurlow, being rector of that parish; studied the classics at a school in Canterbury; entered Caius College, Cambridge, Oct., 1748; left the university without a degree on account of some breach of discipline 1751; became fellow-pupil, in a solicitor's office, with the poet Cowper; also studied law at the Inner Temple, where he was called to the bar Nov., 1754; became accidentally acquainted with one of the Scotch solicitors employed in the great Douglas case; was in consequence employed as junior counsel, gaining great distinction and the powerful patronage of the house of Douglas, one of whose members, the duchess of Queensberry, obtained for him the rank of king's counsel 1761; was elected to Parliament for Tamworth 1768; was a zealous supporter of Lord North; became solicitor-general Mar., 1770, attorney-general Jan., 1771, and lord chancellor and Baron Thurlow June 3, 1778, in reward for his powerful advocacy of the American war; retained the chancellorship by express command of the king through the succeeding administrations of Lords Rockingham and Shelburne, whose policy he vigorously and successfully opposed in the House of Lords; was excluded from the coalition ministry on its formation Apr. 9, 1783, but returned to office on the accession of the younger Pitt Dec. 23, 1783; retained the great seal eight years longer, in reliance upon the personal favor of the king, while frequently venturing to oppose the policy of the ministry; was dismissed from office on the demand of Pitt June 15, 1792, after which he became a bitter enemy of the government, but lived in comparative obscurity. He opposed the abolition of the slave trade, and was a warm partisan of Warren Hastings. D. at Brighton Sept. 12, 1806. He was possessed of an overbearing [illegible], which did duty for eloquence in Parliament, and had a great contemporary reputation for ability, which later generations have not confirmed. Neither his [illegible] nor judicial record exhibits any traces of a master mind. He had no children, but by a new patent of peerage, executed 1792, his title was made heritable by his nephews, one of whom, EDWARD HOVELL THURLOW, second baron (b. 1781; d. 1829), was a poet of some distinction.

PORTER C. BLISS.

Thur'man, p.-v. and tp., Warren co., N. Y., on Adirondack R. R., the starting point for tourists in the Adirondacks. P. 1084.

Thurman (ALLEN G.), b. at Lynchburg, Va., Nov. 13, 1813; removed to Ohio in 1819; received an academic education; studied law, and was admitted to the bar in 1835; was Representative from Ohio in the 29th Congress; elected judge of the supreme court of Ohio in 1851, and chief-justice from 1854 to 1856; Democratic candidate for governor of Ohio in 1867; elected to the U. S. Senate, in place of Benjamin F. Wade, Mar. 4, 1869, and re-elected in 1874. His term of service will expire Mar. 3, 1881; was prominent among the candidates for the Democratic nomination for President at St. Louis in 1876.

Thurs'day ["Thor's day;" Ger. *Donnerstag*], the fifth day of the week. The name seems to have originated among the later Roman pagans, who adopted the week of seven days, and named the fifth day *Jovis dies*, "Jove's Day" (Fr. *Jeudi*).

Thurs'ton, south western county of Washington Territory, lying E. of the Coast Range, drained by Des Chutes River and traversed by Northern Pacific R. R., is rather mountainous, but with several fertile valleys. Staples, wheat, oats, potatoes, wool, and lumber. Cap. Olympia, also the capital of the Territory. Area, 672 sq. m. P. 2246.

Thurston, tp., Steuben co., N. Y. P. 1216.

Thurston (ROBERT HENRY), son of Robert Lawton Thurston, b. in Providence, R. I., Oct. 25, 1839, was trained in the workshop of his father, and graduated at Brown University in 1859. He was engaged in the business firm of which his father was senior partner until 1861, when he entered the navy as an officer of engineers, served during the civil war on various vessels; was present at the battle of Port Royal and at the siege of Charleston; was attached to the North and South Atlantic squadrons until the close of 1865, when he was detailed as assistant professor of natural and experimental philosophy at the U. S. Naval Academy at Annapolis, where he also acted as lecturer in chemistry and physics. In 1870 he visited Europe for the purpose of studying the British iron manufacturing districts, and in 1871 was appointed professor of mechanical engineering at the Stevens Institute of Technology. In this year he conducted, in behalf of a committee of the American Institute, a series of experiments on steam boilers, in which for the first time all [illegible] heat were noted, and by condensing all the [illegible] rated the quantity of water entrained by [illegible] accurately noted. In 1873 he was appointed [illegible] the U. S. scientific commission to the Vienna [illegible] served upon the international jury, edited [illegible] commissioners, and published his own [illegible] and Manufactures, in 5 vols. (187[illegible] [illegible] sequently he conducted at the Stevens Inst[illegible] researches on the efficiency of [illegible] and upon the strength and [illegible] materials of construction. [illegible] member of the U. S. [illegible] explosions, and of the [illegible] construction. He [illegible] cations in the U. S., G[illegible], France and Germany.

and has written numerous papers on technical subjects, which have appeared in scientific journals in Europe and America, and prepared articles upon similar topics for this CYCLOPÆDIA. Some of his more important papers are the following: *On Losses of Propelling Power in the Paddle-Wheel* (1868), *Steam Engines of the French Navy* (1868), *H. B. M. Iron-clad Monarch* (1870), *Iron Manufactures in Great Britain* (1870), *Experimental Steam-Boiler Explosions* (1871), *Report on Test-Trials of Steam-Boilers* (1872), *Traction-Engines and Road Locomotives* (1871), *Report on the Stevens Iron-clad Battery* (1874), *Efficiency of Furnaces burning Wet Fuel* (1874), *The Mechanical Engineer, his Preparation and his Work* (1875), and a number of papers embodying accounts of original investigations of the strength and other properties of materials of construction. Among his numerous inventions are—the magnesium-ribbon lamp, a magnesium-burning signal apparatus, an autographic recording testing-machine, a new form of steam-engine governor, and an apparatus for determining the value of lubricants.

Thurston (ROBERT LAWTON), b. at Portsmouth, R. I., Dec. 13, 1800; was engaged as early as 1821 in building steamers and machinery; founded the Providence Steam Engine Co. and the firms of R. L. Thurston & Co., Thurston, Greene & Co., and Thurston, Gardner & Co., which were the first to build and introduce the "drop cut-off" expansive steam-engine, invented by F. E. Sickles and N. T. Greene. D. at Providence, R. I., in 1873.

Thy'ine Wood [ξύλον θύϊνον, the "wood of the *Thuja*, or yew" improperly so called], a kind of wood mentioned in the Bible, is probably the arar or sandarach wood, the wood of *Callitris quadrivalvis*, a large tree of Barbary. This tree affords the resin called gum-sandarach, and its timber is considered imperishable by the Turks, who floor their mosques with its planks.

Thylacine. See THYLACINIDÆ.

Thylacin'idæ [from *Thylacinus*—θύλακος, "pouch"—the name of one of the genera], or **Dasyuridæ** [from *Dasyurus*—δασύς, "hairy," and οὐρά, "tail"—the name of another genus], a family of mammals of the order Marsupialia and sub-order Dasyuromorphia, including the chief carnivorous mammals of Australasia. The form is diversiform in the several genera, the larger species much resembling a dog externally, others an opossum, and the small species simulating mice in appearance, although anatomically they differ but little from each other; the snout is dog like or acutely pointed; the ears moderate or large; the tail is generally more or less long, and the feet have separate toes, four or five in number. The teeth are well developed, and simulate those of the placental carnivores (dogs, etc.), and are in considerable number—viz. M. $\frac{4}{4}$, P. M. $\frac{2}{2}$ or $\frac{3}{3}$, C. $\frac{1}{1}$, I. $\frac{4}{3}$ = 42–46; there is no such distinction between molars and premolars as in placental carnivores, only the last premolars (P. M. 3d) having deciduous predecessors; the molars have cusps connected more or less by sectorial ridges; the premolars are compressed, conical; the canines generally well developed and typical in form, and the incisors cylindroid and curved, and moderate or rather large. The skull superficially has much resemblance to that of a dog, but is of course radically different, and exhibits the typical marsupial modifications of the mammalian skeleton, and the small size of the cerebral cavity is indicated externally by the absence of inflation; the palate has a pair of large longitudinal vacuities between the true molar teeth of the respective sides. The stomach is simple, and there is no intestinal cæcum. The family is peculiar to the Australasian region, and its representatives there take the place in the economy of nature held by the placental carnivores and insectivores in other parts of the world. The species are quite numerous. They are primarily divisible into three groups, which may be provisionally considered as sub-families. These are (1) Thylacininæ, represented by one genus (*Thylacinus*) and two species in Van Diemen's Land; (2) Dasyurinæ, represented by two genera, *Dasyurus* and *Diabolus* (or *Sarcophilus*); and (3) Phascogalinæ, including the small insectivorous animals, represented, according to Krefft, by five genera and fourteen species—viz. *Phascogale*, with 2 species; *Antechinus*, with 6; *Podabrus*, with 4; *Antechinomys*, with 1; and *Chætocercus*, with 1. The most notable of all these are the *Thylacini* (*T. cynocephalus* and *T. breviceps*), which are called "tigers" by the colonists of Tasmania, and the *Diabolus ursinus*, which rejoices, among the same people, in the significant name "devil:" the *Thylacini* are about the size of a large dog or a wolf, and are very powerful and savage animals; the *Diabolus* is little larger than a terrier dog, but much stouter about the head and shoulders, and has enormous strength in its jaws. The several large animals of the family are very destructive to the sheep of the Tasmanian colonists. THEODORE GILL.

Thyme [Gr. θύμος], the name of certain non-American labiate half-shrubby plants of the genus *Thymus*. Two kinds are cultivated in gardens, the common, *T. vulgaris*, and the lemon-scented, a variety of *T. serpyllum* or wild thyme. Both plants afford good bee-pasture. The leaves are used for flavoring soups and forcemeats; the volatile oil is sold for oil of origanum, which it closely resembles.

Thyme, Oil of, a volatile oil obtained by the distillation of the herb *Thymus vulgaris* with water. It usually has a brownish-red color and a thickish consistency, although when freshly prepared it is nearly colorless and is mobile. It possesses a pleasant pungent odor and an aromatic taste, has a sp. gr. of about 0.9, and is but slightly soluble in water, although it dissolves in alcohol and in ether. Oil of thyme contains two hydrocarbons, a *terpene* ($C_{10}H_{16}$) and *cymene* ($C_{10}H_{14}$), and an oxygenated camphor, THYMOL (which see). These compounds are separated by submitting the oil to fractional distillation. When oil of thyme is distilled with a mixture of 8 parts of chloride of lime and 24 parts of water, chloroform is formed.

J. P. BATTERSHALL.

Thym'ol (*Thymylic Hydrate, Thymylic Alcohol, Thymylic Acid*), ($C_{10}H_{14}O$), is a homologue of phenol and an isomere of cymylic alcohol. It is obtained from the OIL OF THYME (see above), of which it is the oxygenated camphor or stearoptene, by distillation. Thymol forms crystalline rhomboidal plates, which have a weak odor and a peppery taste. It fuses at about 111° F. to a colorless liquid, which has a boiling-point of 446° F., and dissolves with difficulty in water, but easily in alcohol and in ether. By the action of chlorine, bromine, and nitric acid upon thymol, series of derivatives are formed.

J. P. BATTERSHALL.

Thy'mus [Gr. θυμός, "soul"] **Gland,** a ductless gland, with no known function, located in the neck below the thyroid gland, and in the chest beneath the sternum, in the mediastinal space, as low as the fourth costal cartilage. It develops at the third month of fœtal life, weighs half an ounce at birth, grows until the second year, attaining a length of two inches. Thereafter it atrophies, and at the fourteenth or sixteenth year is obliterated, or its site marked only by a few fibres and a small deposition of fat. It has abundant blood-vessels, nerves, and lymphatics, but endless research has failed to disclose its use in either the fœtal state or during childhood.

E. DARWIN HUDSON, JR. REVISED BY WILLARD PARKER.

Thy'roid Gland, a glandular structure consisting of two lateral lobes, with a connecting band or isthmus, situated on the anterior surface of the neck (hence its name, from Gr. θυρεός, a "shield," and εἶδος, "like") and attached to the sides of the larynx. The gland moves with the larynx in respiration and deglutition. The isthmus bridges across from the lower or basic portion of the lobules, and covers in its transit the front of the second and third tracheal rings. By this relation and its great vascularity it has an important surgical relation to the operation of tracheotomy. The gland is ductless, and its function is as yet unknown. It has an external fibrous coat, which gives off numerous internal partitions and bands, so that the gland consists of communicating cavities like a sponge. This sponge is the seat of the peculiar disease termed GOITRE (which see).

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Thysanu'ra [from θύσανος, "fringe," and οὐρά, "tail"], a group of insects by some considered as a peculiar order or orders of the class, and by others as a sub-order of either the order Orthoptera or the order Neuroptera. They are wingless insects, with a hairy or scaly body, with the parts of the mouth variously and peculiarly developed, and generally more or less rudimentary, and which do not undergo a regular metamorphosis. The group embraces small insects, some of which are remarkable for the sculpture of the scales, which are common objects of microscopical examination. The formerly commonly-admitted families were Lepismidæ and Poduridæ, and to it was also later added a family, Campodeidæ or Campodeæ. Recently, however, Sir John Lubbock has completely remodelled the group, and divides it into two orders—viz. (I.) Thysanura (restricted), with three families, Lepismidæ, Campodeidæ, and Japygidæ; and (II.) Collembola (nearly coequal with the old family Poduridæ), with the families Anuridæ, Lipuridæ, Poduridæ, Degeeriidæ, Smynthuridæ, and Papiriidæ. (Consult Lubbock's *Monograph of the Collembola and Thysanura*, London, 1873. See also PODURA.)

THEODORE GILL.

Ti, a liliaceous tree-like plant, *Cordyline Ti*, found in the Pacific Islands and in parts of Asia. Its leaves afford roofing for houses, food for cattle, and fibre for cloth. The sap yields sugar and a stimulating drink, while the roots, when baked, afford a valuable supply of food.

Tiahuanu'co, a group of interesting ruins in Bolivia, 12 miles from the shore of Lake Titicaca, on an eminence which may have once been an island in that lake. The elevation is 12,930 feet, and the surrounding country is a desolate and sterile plain. The ruins at this point are confessedly much older than the age of the Incas, but there seems to be no possible clue to their date. A marked character of the ruins is the use of enormous and finely-wrought stone blocks, in some instances clamped together with bronze. Mr. Squier believes that Tiahuanuco was never a city, but a shrine or sacred place of some pre-historic race of men. The whole area is, however, very considerable.

Tia'ra [Gr. τιάρα, a Persian head-dress], the papal crown, a cap of cloth of gold having three golden circlets, two silken embroidered pendants, and at the top a golden cross. It was at first a plain round cap (worn first by Damasus II.); the first crown or fillet was added by Nicholas I. (or by Benedict VIII.); the second by Boniface VIII. (or, according to others, by Benedict XII.), the third by Urban V. or by John XXIII. Others date the wearing of the tiara from Constantine's or Clovis's time, and say that Pope Hormisdas added the first circlet.

Ti'ber [Lat. *Tiberis*], the most celebrated of Italian rivers, rises at the foot of Mount Aquilone, a spur projecting from the S. W. flank of the Apennines, in N. lat. 43° 45', W. lon. 12°, at the height of 1600 feet above the sea, drains a basin of about 6500 sq. m., and after a course of 220 miles, generally in a S. direction, though with many sinuosities, empties into the Mediterranean near Ostia, 27 miles below Rome, in N. lat. 41° 45'. The mean delivery of the Tiber is about 400 cubic yards per second; its smallest observed delivery is 215 cubic yards. It is navigable from the sea to Rome for vessels of 140 tons and with some difficulty 60 or 70 miles farther for vessels of 60 tons. The Romans kept the channel of the Tiber above Rome, up to the outlet of the Nera, about 100 miles from the sea, as well as those of the lower course of the Nera, the Chiana, and the Anio, always in a boatable condition, and employed them very largely for transportation; but at present those channels are little used for any form of navigation, except, on a small scale, for flotation of firewood and lumber. Up to Rome the bed of the Tiber may be considered an estuary, for at various points below Ponte Sisto the bottom of the river is from 30 to 20 feet *below* the level of the sea. The sedimentary deposits of the river have both raised its bed and lengthened its lower course since the days of ancient Rome, and hence it is not difficult to understand that, though there is now generally depth of water only for small vessels, it was possible under the Empire for a ship to transport an obelisk weighing 400 tons from Egypt to a landing-place on the Tiber 3 miles below Rome. For the upper half of its course the current of the Tiber, though not torrential, is too rapid for navigation, and it is worth mentioning that above Rome it is not divided by a single noticeable island. Its waters are scarcely anywhere utilized as a motive-power or for irrigation, though they might be made largely available for both purposes. The epithet *flavus* ("yellow") applied to the Tiber by the Romans referred, no doubt, to the turbid appearance of its waters due to the quantity of sediment then, as now, borne down by them. Rozet calculated that the quantity of sediment annually deposited by the Tiber at its outlet had been for many centuries approximately constant, and sufficient to extend the coast seaward at the rate of a little less than 13 feet per year. Later observations show that at some points, at least, the rate of advance is greater. In general, we may say that there is no satisfactory proof of any considerable changes in the physical conditions of the Tiber, except those produced in its lower course by this accumulation of sedimentary deposit and by the creation or removal of artificial obstructions in its bed. We may add, however, that, according to the testimony of old writers, the Tiber was more frequently partially or completely frozen over in ancient than in modern times. The effects of the deposit of mineral and vegetable matter in the river-bed have been the same as similar causes have produced near the outlets of other rivers. The estuary, which originally formed the harbor of Rome, was so reduced in depth by the silt let fall by the river, as well as by sand rolled in from the sea, that it was found necessary in the days of the Empire to cut an emissary from a point considerably above Ostia to serve as a ship-canal to the sea; and this is still the only navigable channel from the Mediterranean to Rome. Beside this, an artificial harbor, known as the port of Trajan, was filled up in the same way, and the river silt united with the sea sand both to form shoals in what had been deep water, and to build up along the coast a vast range of banks rising above the water, behind which the overflow from the river spread out into shallow morasses of great extent, the miasmata from which not only render their immediate vicinity uninhabitable, but, as is commonly thought, are among the chief causes of the present insalubrity of Rome and the whole Campagna. The regulation of the Tiber involves the draining of these pestiferous marshes or the filling of them with the sediment brought down by the river, which some able engineers think sufficient in quantity to accomplish the great work in a relatively short period of time. To restore the Tiber to its ancient function as the great maritime approach to the capital of Italy the construction of an artificial harbor at or near its mouth is a necessity; and this, as recent works of the like sort elsewhere have shown, is not to be regarded as an undertaking technically formidable or extravagantly costly.

Aside from historical associations, into which we cannot enter, the special interest of the Tiber arises from certain peculiarities in its *régime*, and from its importance as a source of danger to the city of Rome. Of these peculiarities the most remarkable is the provision made by nature for the disposal of the precipitation in its basin. The mean annual delivery of the river is computed to equal [illegible] of the downfall in its valley, the proportion being above the mean in dry, below it in humid years. Comparatively little of the precipitation is conveyed to the channel of the Tiber by direct superficial conduction, but a vast amount of the water of rains and snows is received into subterranean cavities or absorbed by the bibulous earth which covers much of the surface, and slowly conveyed by underground conduits into the channel of the river, or possibly, to some extent, into the sea. Lombardini estimates "the subterranean discharge of the Tiber" at not less than three fourths of the total delivery. The result of this natural arrangement is that this river has no true *low-water* stage, and at Rome, as well as far above the city, it flows always with a strong full current, its lowest known discharge being, as we have already seen, 215 [illegible] per second, or more than one half its mean volume. Its [illegible] *imum*, therefore, is little inferior to that of the Po, though the *mean* discharge of the latter river is more than [illegible] times as great as the average delivery of the Tiber. The renewed importance of Rome as the social and political capital of a great nation, now happily restored to no small share of its ancient dignity and power, is drawing greatly increased attention to the dangers which threaten the city from the inundations of the Tiber, and to the means by which those dangers may possibly be averted. Great floods have occurred in the Tiber at frequent intervals through the whole historic period, and some of the most ancient seem to have been almost as overwhelming and destructive as the most violent of modern times, but in general the data we possess respecting them are too vague to enable us to arrive at precise comparative results. Under the first emperors the diversion of some of the principal tributaries, and even of the main channel of the Tiber itself, was suggested as a remedy for the evil, and similar measures form a feature of several of the plans now under consideration. To this there are grave objections, and, so far as we know, there is but a single point in which all engineers agree; we mean the expediency of widening and straightening the channel at various points within and near the limits of the city, where by human encroachment or other causes it has been narrowed and made tortuous—and of removing the numerous artificial obstructions, chiefly piers and piles of old bridges, by which the flow of the current is retarded and the deposit of sedimentary matter greatly promoted. There is much difference of opinion in regard to the extent of the relief to be obtained by this measure, but it could hardly fail to be considerable, and some are of opinion that the increased velocity of the current would suffice to sweep out the accumulated deposits of many centuries, lower the bed of the river to its ancient level, and render the construction of dikes or river walls upon the banks, which most of the projects contemplate, quite superfluous. The question is complicated by doubts which have been suggested as to the stability of the [illegible] level at the outlet of the Tiber, and some geologists believe that not only the immediate shores of the [illegible] but the whole Campagna far into the interior, are [illegible] going a secular elevation.

Contrary to the general rule, the overflows of [illegible] tributaries of the Tiber are contemporaneous [illegible] but their flood waves reach Rome [illegible] intervals of some hours, and [illegible] The approach of these waters [illegible] telegraph, and consequently [illegible]

There is another point [illegible] the lower part of [illegible] floods the waters of the [illegible] investigated. We [illegible] W[illegible] materially retarded [illegible] the stream, by [illegible]

upon its surface, or in raising waves in the sea at the mouth, which operate as a barrier to the escape of the river-water, or even, as some think, drive it upward with a refluent current, like a tidal wave. This effect, or at least the amount of it, is matter of dispute. Probably, it is scarcely felt as high up as Rome, but, admitting the fact, the possibility of a remedy by constructing breakwaters in the sea in front of the mouth or otherwise does not appear to have been yet much studied.

The rise of the Tiber in its great floods is very considerable. It is measured from the zero of the hydrometer at the stairs of the Ripetta at Rome, which is usually taken as the sea-level, though Possenti states that in May, 1871, the royal commission of that year found its true level to be 1.17 mètres, or 3.84 feet above the sea at low water. The lowest known surface of the Tiber at this point is 5.3 m. or 5.4 m., or 17.7 feet above this zero, its mean height 6.7 m., or 22 feet. In the highest recorded flood, that of Dec., 1598, the river rose to 19.56 m., or 63.22 feet (according to some authorities, to 20.15 mètres) above zero. In the inundation of Dec., 1870, it rose to 17.22 m., or 56.48 feet, above zero. Between 1530 and 1637 there were four floods higher than that of 1870, but in the following 233 years, from 1637 to 1870, not one of equal height. Possenti ascribes the diminished violence of the inundations during this latter period to the removal of mills, piers, and other obstructions in the bed of the river within the city, but he thinks, from various circumstances, that though the level of the surface at the Ripetta in the flood of 1598 was higher by 2.34 m. than in that of 1870, the actual quantity of water discharged by the river was not greater in the former than in the latter inundation. The pavement of the Ripetta is at 13.50 m. above the zero of the hydrometer, and the other streets near the river are but little above that level. The inundation of 1870 rose to 17.22 m.—or 3.72 m., equal to 12⅕ feet, above the pavement—and overflowed the whole N. W. quarter of the city, including the Corso and other important business streets, filling the cellars, flooding the ground-floors, and letting fall great quantities of sediment. The direct and indirect damage from such a visitation can hardly be overestimated. The mere mechanical inconvenience from the flooding of the lower parts of the city and its environs, though sufficiently serious, is not the only evil resulting from the inundations of the Tiber. The sewers are not merely checked in their flow by the water-wall which the rise of the river opposes to their discharge, but partially choked by sediment let fall by the inflowing current, and this of course interferes very seriously with the sanitary arrangements of the city. The construction of dikes on the banks would not remedy the evil; and on the contrary, might augment it from increasing the height to which the current so confined would rise. A system of great collecting sewers, with occasional siphons, is proposed, but it is not easy to find a suitable point of discharge for the accumulated sewerage of so large a city. There can, indeed, be no doubt that the obstruction to the drainage of the city at high water is deleterious to its health, but practically this temporary check of the outflow from the drains, the submerging of the streets, and the filling of the cellars in the lower part of the town, have not been shown to be so active and immediate causes of disease as would be expected. The winter of 1870–71 was not marked by any epidemic or any aggravation of endemic maladies, nor have other great inundations been always followed in a perceptible degree by such effects.

The literature of our subject is very voluminous. We have space to refer only to Lombardini, *Esame degli Studi nel Tevere* (1871) and other papers; Carcani, *Il Tevere e le sue Inondazioni* (1875); Possenti, *Piano di Sistemazione del Fiume Tevere* (1871); Possenti, *Sulle Piene del Tevere* (1872); Canevari, *Cenni sulle Condizioni altimetriche ed idrauliche dell Agro Romano* (official report, 1874); Baccarini, *Sull' Altezza di Piena massima nel Tevere urbano* (1875); Cialdi, *Nozioni sulla Costruzione dei Porti nel Mediterraneo* (1874); Dausse, *Lettre au Sujet de l'Endiguement du Tibre* (pamphlet, 1876); *Studi sulla Geographia naturale e civile dell' Italia* (Soc. Geog. Italiana, 1875). GEORGE P. MARSH.

Tiberias. See GENNESARET, LAKE OF, by PROF. R. D. HITCHCOCK, S. T. D., LL.D.

Tibe'rius, whose full name was TIBERIUS CLAUDIUS NERO CÆSAR, Roman emperor 14–37, b. Nov. 16, 42 B. C., a son of Claudius Tiberius Nero and Livia Drusilla. In 38 B. C., Livia was divorced from Claudius and married to Augustus, who thus became the step-father of Tiberius. In the imperial household he received a careful education, and he seems at one time to have been a favorite with the emperor. He was large and strong of body, with handsome features, a man of simple habits and reserved manners, and not altogether without literary taste. For military affairs he even seems to have had a talent. He commanded successively in Cantabria, Armenia, Rhætia, Dalmatia, and Germany; and although the enemies he had to encounter were not very dangerous, yet he finished the wars promptly and with honor. From Germany, where he commanded after the death of his brother Drusus, he returned in 7 B. C. to Rome, celebrated his second triumph, was chosen consul for the second time, and was the following year invested with the *potestas tribunitia* for five years. Meanwhile, the good relations between him and Augustus had become utterly disturbed. Livia seems from the very first to have striven to clear the way to the throne for her own children, and it was no doubt for this purpose that Tiberius was compelled to divorce his first wife, Vipsania Agrippina, whom he loved and who had borne him a son, Drusus, and marry Augustus's daughter, the dissolute Julia. After the lapse of one year the marriage proved equally disgusting to both parties. In these impure domestic relations, with an ambitious, scheming mother and a profligate, dishonorable wife, the bad elements of Tiberius's character came into rank growth—his jealousy, suspiciousness, hypocrisy, etc. Augustus saw and understood the development of this strange character, and Tiberius spent seven years in Rhodes in retirement, occupied with the study of astronomy. By his mother's exertions he was recalled to the court in 2 A. D., and in 4, all the male heirs of Augustus having died one after the other, he was adopted by the emperor and appointed his successor. The next ten years he spent mostly in wars on the frontiers, and in 14 he finally succeeded to the throne. His long reign of twenty-three years is by itself not very remarkable. Its most prominent feature is the monstrous development of his own character. His avarice, suspiciousness, and hypocrisy became fiendish and malicious; a feeling of hatred and vengeance filled his heart, and by degrees he sank into brutish sensuality and cruelty. A new crime was invented, *crimen læsæ majestatis*, and defined in such a manner that it might be construed into an offence to the *princeps* if anybody spoke well of anybody else. A new method of proceeding, the *delatores* (informers), was instituted, and the senate showed itself zealous in divining and fulfilling the despot's wishes before they were uttered. No man was safe if he had a name, talent, a fortune, a wife, or anything which excited the emperor's fear or his appetite, and the manner in which men belonging to the noblest families of Rome were prosecuted and put to death was often as incredible as the wildest freaks of a farce. The emperor himself, however, seems to have been the most miserable victim of his own evil passions. In 26 he retired to Capreæ, where he lived not only in retirement, but in seclusion, leaving the government mostly to Sejanus, and after his death to Macro. He was afraid of being seen. At last he was capable only of sensations of the coarsest description, while an indefinable terror seized his mind and drove him nearly mad. On a journey in Campania he fell sick at Astura, and died in the villa of Lucullus at Misenum Mar. 16, 37—it was said in an untimely way. He fell into a fainting-fit, and was believed to be dead. Caius Caligula was hailed as emperor, and all the people rejoiced. But he recovered, and asked for something to eat. Fright and confusion fell at once upon all; only Macro remained cool; he drew the bed-clothes over the old man and suffocated him. CLEMENS PETERSEN.

Tibet. See THIBET, by E. SCHLAGINTWEIT.

Tibul'lus (ALBIUS), was descended from an equestrian family of good standing in Roman society; accompanied Messala in 31 B. C. to Aquitania, and subsequently to the East, but returned to Rome on account of his health, and lived on his estates near Rome, devoting himself to poetry and literary occupation. D. very young, probably in 18 B. C. Four books of elegies ascribed to him have come down to us, but the authenticity of the third and fourth is disputed. They were edited by Dissen (1835, 2 vols.), Rossbach (1866), and Müller (1873), and translated into English by Dr. Grainger (1752). On account of the genuineness and simplicity of their feeling, these poems belong to the best the Latin literature contains.

Tibur. See TIVOLI.

Tic Douloureux. See NEURALGIA, by E. C. SEGUIN, M. D.

Tich'borne Trial, a noted English *cause célèbre.* Roger Charles Tichborne, b. Jan. 5, 1829, was the son of James Tichborne, presumptive heir to the titles and great landed estates of his brother, Sir Edward Tichborne-Doughty. Roger was educated in France, and afterward at the Roman Catholic college of Stonyhurst, England, and in 1849 received a commission in the army. In 1852 he proposed marriage to his cousin Kate, daughter of Sir Edward, and the proposal having been declined by her

parents, he threw up his commission, went to sea as a sailor, made a voyage to South America, and in Apr., 1854, sailed from Rio Janeiro for New York on board a vessel which was supposed to have been lost at sea with all on board. Sir Edward died in Mar., 1853, and was succeeded by the father of Roger, who died in 1862, and was succeeded by his second son, Alfred, who died in Feb., 1866, and was succeeded by a posthumous son, born in the following May. Lady Tichborne, the widow of Sir James, had come to be on ill terms with her family, and had taken up the idea that her son Roger might still be living, and in 1865 advertised in newspapers at home and abroad for intelligence respecting him. In the following year a butcher at Wagga Wagga, Australia, where he was known as Thomas Castro, gave out that he was no other than the missing Roger Tichborne. After some correspondence with Lady Tichborne, he sailed for Europe, met her in Paris in Jan., 1867, was acknowledged by her as her son, and furnished with some money. All the other members of the family treated him as an impostor. In Mar., 1867, he filed a bill in chancery, the real issue of which was to enable him to prove himself to be Roger Tichborne and the rightful owner of the title and estates. He also succeeded in raising large sums of money upon bonds payable when he should come into possession of his property. For various reasons the case did not come to trial for nearly four years, and in the mean time Lady Tichborne, whose testimony might have been of great importance, died Mar., 1868. The cause came on before the court of common pleas May 11, 1871, for the recovery of estates valued at £24,000 a year; it was twice adjourned, and was closed Mar. 6, 1872, the actual proceedings occupying 103 days. The real issue was whether the claimant was or was not Roger Charles Tichborne. He showed himself to be cognizant of many things which could hardly have been known by an impostor, while of others which must have been known by the real Roger he was wholly ignorant. His physical appearance differed from that of Roger Tichborne in a manner not to be accounted for by the lapse of less than twenty years. Roger, when he disappeared, was a tall, slender young man, with small head, straight hair, his ears adhering closely to the head; the claimant was an inch taller, enormously obese, with a large head and curly hair, the ears free, with large lobes. Roger had had his initials tatooed on one of his arms, while nothing of the kind appeared on the claimant. Roger had been well educated, and spoke French with perfect fluency; the claimant was grossly illiterate, and wholly unacquainted with French. The jury found that the claimant was not Roger Charles Tichborne, and he was nonsuited. He was taken into custody to be tried for perjury. The trial came on before the court of queen's bench Apr. 23, 1873, and after several adjournments was concluded Feb. 28, 1874, having occupied in all 188 days. In the course of the two trials it was established beyond reasonable doubt that the real name of the claimant was Arthur Orton, a native of London, who emigrated to Australia, where, for reasons growing out of some misconduct, he assumed the name of Thomas Castro. By what means and by whose assistance he gained the information which enabled him to make such show as he did of being the missing Roger Tichborne is an unsolved mystery. So great were the expenses of these protracted suits that the trustees of the infant owner of the Tichborne estates were obliged to mortgage them in order to obtain money to defend his title. In spite of the verdicts of the courts, there were many, especially among the lower and middle classes in England, who still believed that Castro or Orton was really Roger Charles Tichborne. So strong was this feeling that Mr. Kenealy, his leading counsel in both cases, who subsequently established a newspaper, *The Englishman*, which acquired an immense circulation in consequence of its attacks upon these verdicts, was in 1875 elected, mainly upon this account, to the House of Commons. (See KENEALY, EDWARD V. H.) A. H. GUERNSEY.

Tiche'nor (ISAAC), LL.D., b. at Newark, N. J., Feb. 8, 1754; graduated at Princeton 1775; began the study of law at Schenectady; accepted in 1777 an appointment as assistant commissary-general at Bennington, Vt., where he took up his residence; became prominent in Vermont politics; was judge of the supreme court 1791-94; chief justice 1795-96; commissioner for adjusting the boundary dispute with New York 1791; U. S. Senator 1796-97; governor 1797-1807 and 1808-09, and again U. S. Senator 1815-21. D. at Bennington Dec. 11, 1838.

Tichvin. See TIKHVIN.

Tici'no, the southernmost canton of Switzerland, on the Italian side of the Alps and on both sides of the river Ticino, borders on Lago Maggiore. Its northern frontier toward Uri and Grisons is formed by a range of the Lepontine Alps 12,000 feet high, branches of which cover the whole northern part of the canton. In the southern part the ground becomes low and the surface level. Dairy farming and cattle breeding are the principal occupations in the Alpine regions, and agriculture and the cultivation of grapes, olives, figs, almonds, and melons in the southern part. Area, 1082 sq. m. P. 112,619, most of whom speak Italian and are Roman Catholics. Cap. Bellinzona.

Tick. (1) The common name of Arachnids of the group Acarina and the family Ixodidæ. They "are mites of gigantic size, with bodies of a leathery consistence." (*Packard*.) The wood ticks, dog ticks, cattle ticks, etc. (*Ixodes*) are well known examples of these intolerable parasites, which often bury themselves beneath the skin and give rise to severe pain and inflammation. Still others of the larger parasitic Acarina are called ticks. (2) Many degraded forms of dipterous parasitical insects are called ticks. Several of these are of the family Hippoboscidæ. Such is the well known sheep tick, *Melophagus ovinus*; such are the horse ticks and bird ticks (*Hippobosca*, *Lipoptena*, *Ornithomyia*, etc.). The bat ticks are spider like dipterous insects of the family Nycteribiidæ.

Tick'ell (THOMAS), b. at Bridekirk in Cumberland in 1686; was educated at Queen's College, Oxford, of which he became a fellow in 1710; became a friend of Addison, through whose influence he was in 1717 appointed under-secretary of state, and in 1725 was made secretary to the lords justices of Ireland, a post which he retained until his death. His principal works are *The Prospect of Peace*, a poem; *The Royal Progress*, verses celebrating the arrival of George I.; a translation of the first book of the *Iliad*; and an *Elegy on Addison*, besides which he contributed papers to the *Spectator* and *Guardian*. D. at Bath Apr. 23, 1740.

Ticket of Leave, originally designated a "permit," given to British convicts transported to penal settlements, by which they were allowed a certain amount of liberty within certain territorial limits. At present the term designates an order remitting a portion of the sentence of a convict as a reward for his good behavior.

Tick'nor (GEORGE), LL.D., b. at Boston, Mass., Aug. 1, 1791; received at home a careful training in the classics; entered Dartmouth College at the age of twelve; graduated there 1807; pursued for three years a post graduate course of studies at Boston under the direction of Rev. Dr. J. S. J. Gardiner, with whom William H. Prescott was then preparing for college; was one of the members of the Anthology Club; studied jurisprudence in the office of an eminent lawyer at Boston; was admitted to the bar 1813, but soon resolved to devote himself to a literary career, favored by the possession of an ample fortune; sailed for Europe 1815, resided two years at the University of Göttingen, chiefly occupied with classical philology and the modern literatures of Europe; spent two years more in travel, visiting most of the European capitals and forming the acquaintance of many of the chief literary and political celebrities; gave especial attention to the Spanish language, for the study of which he formed an extensive library, including many rare works; was chosen in 1817 to the Smith professorship of modern languages at Harvard; filled that post from 1820 to 1835, when he resigned; spent three years in Europe, chiefly engaged in preparatory researches for his principal work, to which he devoted several more years of assiduous labor; published in 1849 in London and New York his *History of Spanish Literature* (3 vols.), which was translated into French, German, and Spanish, and speedily became classical, even in Spain; printed some occasional essays, chiefly on education [illegible] and several biographical sketches (of La Fayette 1825, Nathan A. White 1827, Daniel Webster 1831, the Buckminsters 1849, and Edward Everett 1865); wrote an elaborate *Life of William Hickling Prescott* (1864), who had been his most intimate friend and fellow laborer in the field of Spanish literature; contributed to various magazines and reviews, and took an interest in several public enterprises, especially in the Boston Public Library, to which he was a munificent benefactor, presenting it with 2000 volumes in 18[illegible] [illegible] a member of the leading literary societies of [illegible] America, and a correspondent of many [illegible] Europe. D. at Boston Jan. 26, 1871. [illegible] *Spanish Literature* appeared shortly after [illegible] the editorship of Mr. G. S. Hillard [illegible] *Life and Correspondence* (1876) [illegible] and successful of American men [illegible]

Tick'nor (WILLIAM D.), [illegible] N. H. [illegible] 1810; became in 1832 a bookseller [illegible] a publishing business, wh[illegible] under the firm name of [illegible] Osgood & Co., founded [illegible] his office a centre [illegible] with that magazine. [illegible] Holmes, W[illegible]

tier, Lowell, and Saxe, whose poems were issued by the firm. D. at Philadelphia, Pa., Apr. 10, 1864.

Ticondero'ga. p.-v. and tp., Essex co., N. Y., at the junction of Addison R. R. with the Champlain division of Delaware and Hudson Canal Co.'s lines. The town occupies a lofty promontory lying between Lakes George and Champlain, the outlet being 4 miles in length, with a fall of 220 feet, affording excellent water-power. In the township are veins of graphite, utilized for the manufacture of lead-pencils and crucibles, valuable deposits of iron ore, manufactories of lumber, an extensive cotton-factory, 2 woollen-mills, 2 foundries, 5 churches, 15 schools, and a weekly newspaper. It was nearly destroyed by fire Mar. 31, 1875, but has been handsomely rebuilt. P. in 1875, 3401. Ticonderoga was prominent in colonial and Revolutionary history from its celebrated fortress, built by the French in 1755, and originally named Carillon ("chime of bells") from the music of the neighboring waterfall. It was the head-quarters of Montcalm 1757; was unsuccessfully assaulted by Gen. Abercrombie July 8, 1758; occupied after a siege by Gen. Amherst July 30, 1759; captured by Ethan Allen May 10, 1775; retaken by Burgoyne July 5, 1777, and again by Gen. Haldeman 1780, but soon abandoned on each of the two latter occasions. There is a *History of Ticonderoga*, by Rev. Joseph Cook (Keeseville, 1858).

Tid'ball (JOHN C.), b. in Virginia 1828; graduated at the U. S. Military Academy 1848, when appointed brevet second lieutenant 3d Artillery; served in Florida war 1849–50, in garrison 1850–53, on Whipple's exploration to California 1853–54, on Coast Survey duty 1854–59; thence in garrison and on frontier duty until the outbreak of civil war (Apr., 1861), when ordered to the defence of Fort Pickens. Promoted to be captain 2d Artillery May 14, 1861, he served with his battery at Bull Run (July 21), in the operations of the Virginia Peninsular campaign of 1862, the battles of Antietam, Chancellorsville, Gettysburg, etc. In Aug., 1863, he was appointed colonel of the 4th New York Heavy Artillery, which he commanded in the Richmond campaign of 1864 from the Wilderness to Petersburg. Commandant of cadets at West Point July–Sept., 1864, when, returning to the Army of the Potomac, was in command of the artillery of the 9th corps till the close of the war. Brevetted major, lieutenant-colonel, colonel, brigadier and major-general for gallantry in battle. In Sept., 1865, he returned to duty with his company; promoted major 2d Artillery Feb., 1867.

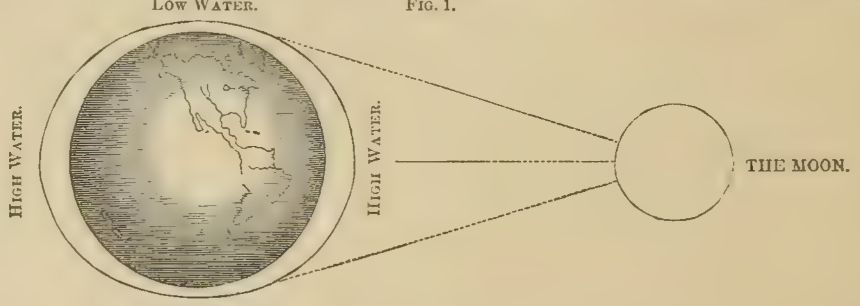
Tide'-Mill, an apparatus for the utilization of the water-power of the tide. In some cases, as at the old London Bridge tide-mills, the water-wheels, mill and all, were afloat, so that no adjustment of the wheels to the height of the water was necessary, and the tide was utilized both on its ebb and flow. In other cases dams are constructed which shut the water at high tide, and its outflow through a raceway gives motion to the mill; and during the return of the tide through the sluice its power may again be utilized.

Tides, Oceanic Waves, and Currents. The waters of the ocean are subjected to various movements, the effect either of atmospheric or astronomical causes. The principal kinds of movements are known as waves, tides, and marine currents. (For currents, see under CURRENTS, MARINE.)

Waves are produced by the action of the winds, and vary in their height, form, velocity, and extent, from the gentle ripple to enormous waves of great height, breadth, and volume, which break with violence against any opposing obstacle. These diversities depend upon the force of the wind, the depth of the sea, and the size of its basin, the waves in the open ocean being much larger and moving more swiftly than in the inland seas. After the wind which has disturbed the surface of the water has subsided, the ocean, with acquired momentum, continues to undulate with a movement called the *swell*, which seldom ceases entirely until a fresh storm arouses the waves again to action.

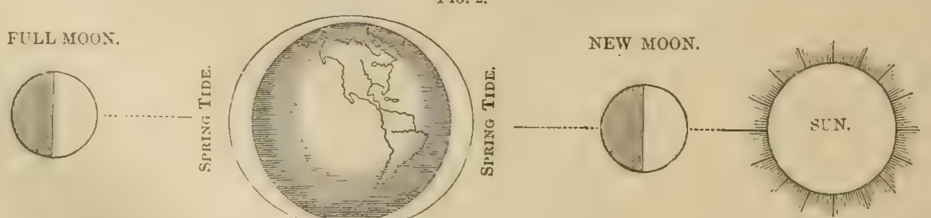
Tides.—Those living on the shores of the ocean see its bosom rise and fall regularly twice every day, as by a mighty process of respiration. These movements are tides. For six hours the water rises, or *flows*; then, remaining stationary for a short time, it gradually recedes or *ebbs* for another six hours; after a short lull, called *slack water*, it again rises and falls as before. The rising sea is called the *flood tide*; the receding sea, the *ebb tide*. When the water is at its greatest height, it is *high water*; when at its lowest point, *low water*. There are thus daily two high tides and two low tides. The time of high water and low water, at the same place, however, is gradually changing. The interval of time between two consecutive high tides or low tides being really twelve hours and twenty-six minutes, the hour of the day at which high water or low water occurs is later every day by about fifty-two minutes.

FIG. 1.



Cause of the Tides.—Though the dependence of the tides upon the course of the moon seemed to point out their source, the real cause of these mysterious movements was not understood before the discovery of the law of gravitation by Sir Isaac Newton. Applying here this new principle, Newton showed that the rise of the waters was due to the attraction of the moon and the sun upon the revolving globe of the earth. As the moon, on account of its proximity, and notwithstanding its smaller mass, has an influence more than double that of the sun (100 to 38), let us consider first its action, which is illustrated by the preceding diagram (Fig. 1). Land and water alike experience this attraction, but the particles of the latter, being free to move, are lifted up toward the attracting luminary beyond the normal curve of the surface of the ocean. Thus is formed a vast swell, toward the crest of which the most distant and heavier waters are gathered from both sides, causing there a depression of the surface, or low water. On the opposite side of the globe, the waters being less attracted than its solid mass, on account of their greater distance from the attracting body, are left somewhat behind, as if the solid globe were drawn farther from the surface of the ocean. Another swell is thus produced, directly opposite the first, and occupying, like it, half the surface of the globe. There are thus always simultaneously and directly under the moon two high waters opposite each other, and two low waters at equal distances between them. Owing

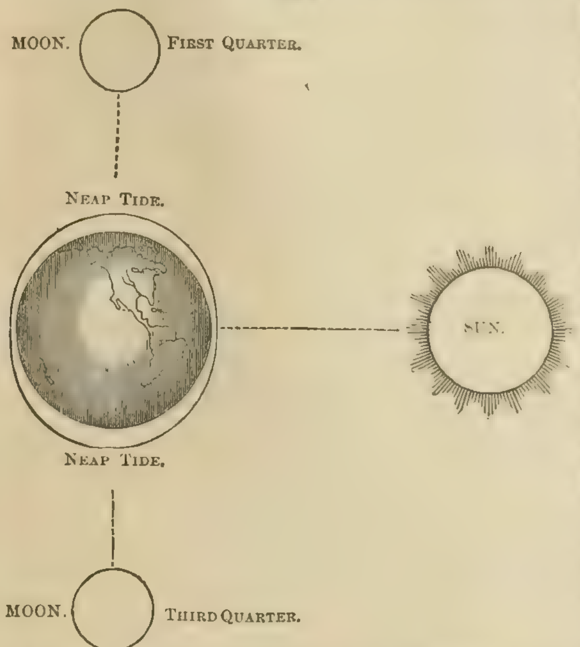
FIG. 2.



to the rotation of the earth, this permanent system of swells and troughs travels from E. to W. over every part of the ocean and of its coast, and explains the regular succession of rising and falling waters, at equal intervals of time, which we call the tides.

Spring Tides and Neap Tides.—The sun also asserts its attractive power on the ocean, and causes a similar system of four daily tides. Owing, however, to the great distance of the sun, the solar tides are much smaller, and mostly merged in, or masked by, the lunar tides. As the relative position of the moon and sun is constantly changing, the solar and lunar tides seldom coincide. But twice a month, at new moon and full moon, the sun and moon being on a line with the earth, as shown in Fig. 2, act together, and cause an unusually high water, which is the sum of the lunar and solar tides. These are the *spring tides*. High water is then highest, and low water lowest. When the sun is placed 90° from the moon (Fig. 3)—that is, at the time of the first and third quarter of the moon—its attraction acts against that of the moon, diminishing the height of the high tide and increasing that of low water. These are the *neap tides*. High water is then lowest, and low water highest. The proportion of the rise and fall in the spring tides and neap tides is nearly as 7 to 3. The highest spring tides occur in March, a little before the vernal equinox, and in September, a little after the autumnal equinox, because the sun is then at the equator and nearest to the earth. The lowest neap tides are those occurring at the time of the solstices, in June and December, because the sun is then in a higher latitude and farther from the earth.

FIG. 3.



Course of the Tidal Wave.—If the ocean covered the whole earth with a uniform depth of water, the tidal wave, with its long crest extending from N. to S., would follow the apparent course of the moon, and travel from E. to W. around the globe in twenty-four hours. It would be greatest in the equatorial regions, and move there with a velocity of over 1000 miles an hour. But the continents which divide the ocean into several large basins oppose its passage, and in each of these basins the course of the tidal wave is subjected to great modifications. The regularity and velocity of the tidal wave depend upon the size of the basin, the depth of the water, and freedom from all obstacles opposing its progress. Nowhere are these conditions better fulfilled than in the southern half of the Pacific Ocean. There is formed what might be called the parent tidal wave, which, advancing rapidly westward, enters the Indian and Atlantic oceans, and seems to control their tides.

Co-tidal Lines. (See CO-TIDAL LINES.)

Tides in the Pacific Ocean. In the middle and equatorial part of the Pacific Ocean the advance of the tidal wave is gradually slackened, and becomes very irregular when broken up by the numberless islands of the East Indian Archipelago. The influence of shallow water, and of friction on the bottom and on the coasts of the ocean, is evident in the slow progress of the tide wave between New Guinea and Australia, and in the Chinese Sea. Its rapid motion, on the contrary, toward the N. W. in the middle of the North Pacific, shows the influence of deep and open water. Thence, however, the tidal wave ceases to be direct, and assumes the shape of a free reflected wave, which turns N. and E. toward the western coast of the North American continent. In the southern Pacific, while the main tidal wave seems to start on its westward course from the 90th meridian, it sends a reflected wave eastward along the western coast of South America, from which this coast seems to derive its tides. This meets, at Cape Horn, the Atlantic tide coming from the E.

Tides in the Indian and Atlantic Oceans. The tidal wave in both the Indian and Atlantic oceans seems to be but a continuation of the great parent wave from the Pacific. The tides raised directly in these two basins are overpowered by, or merged into, it. Here, also, the course of the wave is mostly determined by the depth of the water and the form of the [illegible] somewhat retarded along the

FIG. 4.

southern coast of Australia, it turns N. with considerable velocity into the deep channel leading to the peninsula of India. Approaching the coast, these waves accumulate, producing high tides in the Gulf of Bengal and the Arabian Sea. Reaching the entrance of the Atlantic Ocean, it passes into that long channel, and moves, at the rate of almost 600 miles an hour, toward the N. W. in the deep trough, 20,000 to 30,000 feet, which runs parallel to the coast of the New World, until it strikes the eastern shores of North America. Thence bending toward the N. E., it gradually lessens its speed to 300 and 200 miles an hour, sweeps over the coasts of Europe, and, turning around the continent, loses itself in the Arctic Ocean.

The course of the tides on the coast of England, in the Channel, and the German Sea, as shown in the map of co-tidal lines in that region, here annexed (Fig. 4), illustrates in a forcible manner the retardation of the tidal wave in shallow and narrow seas. The main tide wave in the broad Atlantic moves on, unobstructed, around the British Isles, reaching the Orkneys in four hours, and descends southward along the eastern coast of Scotland before the slackened tide-wave has forced its way through the Channel to Dover Straits. Each wave then continues its course, the first along the English coast, that from the Channel along the coast of Holland, causing high water and low water at different hours on the opposite shores.

The Age of the Tide.—This course of the tidal wave shows that the tides of the Indian and Atlantic oceans are not generated in these basins, but are mainly derived from those of the Pacific Ocean. But the tide-wave takes some time to travel over this vast extent. The map shows that in twelve hours the Pacific wave reaches Tasmania; in twelve hours more, the coast of India; another twelve or thirty-six hours brings it to the coast of North America; a few hours more, to the shores of Europe. Therefore the tide on our shores is not the one caused by the last passage of the moon over us, but the one which had its origin thirty-six hours before in the Pacific Ocean, and is, therefore, one day and a half old. It is two days old in London.

The Height of the Tide.—The height of the tide depends very much upon local circumstances. In the midst of the Pacific it is scarcely more than from 2 to 5 feet, which may be considered as the natural height of the tide. But when dashing against the land and forced into deep gulfs and estuaries, the accumulating tide-waters sometimes reach a very great height. On the eastern coast of North America, which is directly in the path of the great Atlantic wave, the tide rises on an average from 9 to 12 feet. In the Bay of Fundy, which opens its bosom to receive the full wave, the tide, which, at the entrance, is 18 feet, rushes with great fury into that long and narrow channel, and swells to the enormous height of 60 feet, and even to 70 feet in the highest spring tides. In the Bay of Bristol, on the coast of England, the spring tides rise to 40 feet, and swell to 50 in the English Channel at St. Malo, on the coast of France. It is obvious that differences so considerable in the level of the water will cause strong currents, constantly varying in force and direction with the tide, such as those witnessed in Hell Gate, at the outlet of Long Island Sound into New York harbor. To the same cause may be traced the dangerous whirlpools which have long been celebrated on various coasts. The famous Maelstrom off the Norwegian coast is but a tidal current rushing with great violence between two of the Lofoden Islands, causing a whirling motion, which is reversed at every new tide. So, in the Straits of Messina, are the ill-fated Scylla and Charybdis, so much dreaded by the navigators of old, and many other whirlpools of less celebrity.

Bore.—In estuaries into which large rivers flow the struggle between the ascending tidal wave and the opposing current of the stream produces the imposing phenomenon of a huge wave, which, like a moving wall of water, advances with great rapidity and a deep roaring noise up the river, often for hundreds of miles, to the limit of tide-water. This is called the *bore*. In the Hoogly River, one of the main mouths of the Ganges, the bore rushes up the river with great impetuosity. In the Chinese river Tein-Tang it rises to 30 feet in height, and travels at the rate of 25 miles an hour, sweeping everything before it. In the Amazon River, at the time of the equinoxes, bores of 15 feet in height follow each other in quick succession, and within the space of 200 miles five such mighty waves may be seen travelling simultaneously up the river. The Indians, imitating the roaring sound of the bore, call it *pororoca*. (See further CURRENTS, MARINE.) A. GUYOT.

Tides, Theory of. See APPENDIX.

Tidioute′, p.-b., Warren co., Pa., on Oil Creek and Allegheny River R. R., 160 miles from Pittsburg, has 6 churches, good schools, 1 banking-house, 2 savings banks, and 1 newspaper. The principal industry is petroleum, though the lumber interest is large. Allegheny River is spanned here by a fine suspension bridge. P. 1638.

CHARLES E. WHITE, ED. "NEWS."

Tieck (LUDWIG), b. at Berlin May 31, 1773; studied philosophy, philology, and literature at Halle, Göttingen, and Erlangen; returned in 1794 to his native city, and opened his long and brilliant literary career with a number of romances, novels, and fantastic tales, which at once revealed the peculiar romantic cast of his own genius: *Abdallah* (1795), *William Lovell* (3 vols., 1795), *Peter Lebrecht* (2 vols., 1795–96), *Peter Lebrecht's Volksmärchen* (3 vols., 1797); and his contempt for the literature of enlightenment, which was the pride of the eighteenth century: *Blaubart, Der gestiefelte Kater, Franz Sternbald's Wanderungen* (2 vols., 1798), *Phantasien über die Kunst* (1799). From 1799 to 1819 he alternately resided in various German cities—Jena, Munich, Vienna, Frankfort-on-the-Oder, etc.; visited Italy in 1805, and England in 1817; lived in intimate connection with A. W. Schlegel, Novalis, Solger, Rumohr, Steffens, etc., and occupied a very prominent position in the German literature as one of the chief leaders of the romantic school. From 1819 to 1840 he lived in Dresden, where he exercised a considerable and still noticeable influence on the development of the theatre. In 1840, Frederick William III. invited him to Berlin, and gave him a high title and a large pension; and in Berlin he d. Apr. 28, 1853. His works, which as he grew older became deeper and clearer, and entirely free of that mystic excitement and confusion of form which characterized his earlier attempts, comprise a few lyric poems, which are rather weak; several huge dramas, *Genoveva* (1800), *Octavianus* (1804), etc., which are unenjoyable on account of the vagueness of their dramatical form; 12 volumes of novels (Berlin, 1853), which contain some of the most exquisite pictures from present life and history, drawn sometimes with humor, sometimes with positive enthusiasm; one of them, *Dichterleben*, is a sort of biography of Shakspeare. But he exercised, no doubt, the greatest influence by his excellent translations—*Don Quixote* (1799–1801), *Altenglische Theater* (2 vols., 1811), *Shakespeare's Vorschule* (2 vols., 1823–29), etc.; by his editions of Solger's, Novalis's, Kleist's, and others' works, accompanied with critical and historical introductions, and by his *Kritische Schriften* (4 vols., 1848–52), which for range of view, completeness of knowledge, and acuteness of argument rarely find their equals.—His brother, CHRISTIAN FRIEDRICH TIECK (b. at Berlin Aug. 14, 1776; d. there May 14, 1851), acquired a name as a sculptor, and executed several of the busts in the Walhalla.

Tie′demann (FRIEDRICH), b. at Cassel, Germany, Aug. 23, 1781; studied medicine, especially anatomy, physiology, and chemistry, at the University of Marburg, and in Bamberg, Würzburg, and Paris; was appointed professor of zoology and anatomy at the University of Landshut in 1806, and in 1816 at Heidelberg, whence he retired in 1849. D. at Munich Jan. 22, 1861. His *Anatomie des Fischherzens* (1809), *Anatomie und Bildungsgeschichte des Gehirns* (1816), *Das Hirn des Negers verglichen mit dem des Europäers* (1837), attracted much attention. He also wrote *Zoologie* (3 vols., 1808–10) and *Physiologie des Menschen* (3 vols., 1830–36).

Ti′el, town of the Netherlands, province of Geldern, on the Waal, has several tanneries and breweries and an active general trade. P. 7748.

Tien-Tsin′, town of China, province of Pe-Chee-Le, at the confluence of Peking and Yuen-Ling rivers, forms the port of Peking, and was opened to foreign traffic by the Treaty of Peking (1860). It is surrounded with a wall, and although most of its houses are built of mud or sun-dried brick, its streets are well paved, broad, and straight. As the port of Peking it carries on a considerable trade. In 1873 the value of exports amounted to $12,240,602; that of imports to $27,602,314. The population is variously estimated at from 400,000 to 900,000.

Tierce [Fr.], a stop in the organ, tuned a seventeenth (or two octaves and a third) above the diapasons.

Tier′ney (GEORGE), b. at Gibraltar Mar. 20, 1761, son of a London merchant; educated at Eton and at Peterhouse, Cambridge, where he graduated in law 1784; became a lawyer in London; published a treatise on *The Real Situation of the East India Company, considered with reference to their Rights and Privileges* (1787); entered Parliament 1789; became a leader of the Whigs, and acquired celebrity as a debater and satirist; fought a duel with Pitt May 27, 1798; opposed the war with France; brought forward annually a series of resolutions in opposition to those of the chancellor of the exchequer; was treasurer of the navy 1803–04; secretary of state for Ireland 1806; president of the board of control 1806–07; was the head of the opposition after the death of Mr. Ponsonby in 1817, and was master of the mint

in the administration of Canning 1827–28. D. in London Jan. 25, 1830.

Tierney (Mark Aloysius), F. R. S., F. S. A., b. at Brighton, England, in Sept., 1795; educated in the school conducted by the Franciscan Fathers at Baddesley Green, Warwickshire, and at the college of St. Edmund, near Ware; was ordained a Roman Catholic priest 1818. D. at Arundel Feb. 19, 1862. Author of *The History and Antiquities of the Castle and Town of Arundel*, (2 vols., 1834); began an edition of Charles Dodd's *Church History of England, with Notes, Additions, and Continuations*, intended to extend to 14 vols., but left incomplete (5 vols., 1839–43); wrote a memoir of his friend Dr. Lingard, prefixed to vol. x. of that author's *History of England* (1854); wrote for several theological publications; contributed to and edited the volumes issued by the Sussex Archæological Society, of which he was the local secretary.

Tierra del Fuego. See Terra del Fuego.

Tiers État. See Estates, The Three.

Tif'fin, tp., Adams co., O. P. 1858.

Tiffin, tp., Defiance co., O. P. 1080.

Tiffin, city and cap. of Seneca co., O., on Baltimore Pittsburg and Chicago, Cleveland Sandusky and Cincinnati, and Toledo Tiffin and Eastern R. Rs., and on Sandusky River, 50 miles from its mouth. It contains 13 churches, Heidelberg College, and an excellent system of schools, 3 banks, 4 weekly newspapers, an orphan asylum, several woollen-mills and foundries, stone and tile works, machine-shops, and an agricultural implement factory. P. 5648. John M. Myers, Ed. "Seneca Advertiser."

Tiffin (Edward), M. D., b. at Carlisle, England, June 19, 1766; emigrated to the U. S. 1786, settling at Charlestown, Va.; became a Methodist preacher, acting also as a physician; married Mary, sister of Gov. Thomas Worthington, 1789; removed to Chillicothe, O., 1798; was Speaker of the Territorial legislature 1799; president of the Ohio constitutional convention 1802; first governor of the State of Ohio 1803–07; U. S. Senator 1807–09; commissioner of the U. S. land-office 1812–15, and subsequently surveyor-general of the North-west Territory. D. at Chillicothe, O., Aug. 9, 1829. Three of his *Sermons*, preached in 1817, were published in the *Ohio Conference Offering* (1851). A thriving city in Northern Ohio bears his name.

Tif'lis, government of Russia, bounded N. by the Caucasian Mountains and S. by Asiatic Turkey. Area, 18,296 sq. m. P. 606,584, consisting of Georgians, Armenians, Tartars, and Russians, who belong partly to the Christian, partly to the Mohammedan religion. The surface is mountainous, covered with branches both from the Caucasian and from the Ararat mountains, several peaks of which rise to 12,000 feet. The soil, of which only a very limited portion is under cultivation, is very fertile in the valleys, and tobacco, cotton, and indigo, wheat and other cereals, grapes, peaches, and all S. European fruits, grow abundantly. Numerous forests of oak, elm, chestnut, and maple yield excellent timber.

Tiflis, town of Russia, capital of the government of Tiflis and the centre of the whole Russian territory S. of the Caucasian Mountains, on both sides of the Koor, has some manufactures and carries on an active trade with Persia. In its vicinity are naphtha springs, and thermal springs which are much frequented. P. 60,937.

Ti'ger [Gr. τίγρις], the name, derived through the learned tongues, applied to certain quadrupeds. (1) Primarily and of right only it belongs to the *Felis tigris*, one of the largest of living Felidæ, about equal in size and superior in strength to the largest lions, and more destructive and far more dangerous to man. It is peculiar in the development of spreading thick, whisker like hairs on the sides of the head; its tail is elongate and smooth haired, and the color is a tawny yellow transversely striped with black. It ranges N. into Southern Siberia, and S. as far as Ceylon and the Spice Islands. E. and W. its habitat extends from Persia to the Pacific. It prefers forests and jungles near river-banks for its abode. It is much dreaded by man, especially in parts of India. The tiger has been frequently induced to hybridize with the lion in captivity. Old tigers sometimes acquire a great fondness for human flesh, and are then called "man eaters." The hunting of the tiger is a favorite though perilous amusement in Oriental lands. (2) The name is also sometimes applied by hunters to the American Jaguar (*Felis onca*), which see. (3) It is further transferred in Van Diemen's Land to the striped *Thylacinus cynocephalus*, a carnivorous marsupial. (See Thylacinidæ.)

Tiger-Beetle, a name given to the species of coleopterous insects of the family Cicindelidæ, on account of their active, bold, and carnivorous nature. They are distinguished by their large and broad heads, and the very long and formidable falcate jaws, as well as by their long and slender legs. They chiefly affect sunny and sandy places, especially by the shores of streams and lakes. They are unusually swift in their movements, and are therefore difficult to capture. The larva is also characterized by large head and formidable jaws. They live mostly concealed in holes near the borders of water, and there lie in wait for their prey, weaker insects which come near. Theodore Gill.

Tiger-Cat is a name applied to quite a large number of striped and spotted wild cats, mostly rather small tropical animals, often arboreal in their habits.

Tiger-Flower, the *Tigridia pavonia*, a superb garden flower of the order Iridaceæ. It is a native of Mexico, and is cultivated for its splendid flowers, each of which endures but for a day, a fresh one sometimes following for many days in succession. The flowers are without perfume.

Tiger's Fork, tp., Shelby co., Mo. P. [illegible].

Tighe (Mary Blachford), b. in Dublin, Ireland, in 1773; married in 1793 her cousin, Henry Tighe, of county Wicklow, a member of the Irish Parliament; published in 1805 for private circulation her *Psyche*, a poem of remarkable excellence, based on the well known story of Apuleius. D. of consumption at Woodstock, county Kilkenny, Ireland, Mar. 24, 1810. Her *Works*, which appeared in 1811, have passed through several editions.

Tiglath-Pileser. See Assyria, by W. Jacobs, A. M.

Tigra'nes the Great, king of Armenia [illegible] B. C., conquered in his wars with Parthia, Mesopotamia, Assyria proper, and Media Atropatene, and in his wars with the Seleucidæ, Cilicia, Syria, and Phœnicia. But having been involved in war with Rome through his father in law, Mithridates the Great, king of Pontus, he was defeated first by Lucullus, who took and sacked his capital, Tigranocerta, and subsequently by Pompey, to whom he had to pay an enormous sum in order to remain in possession of Armenia proper, while Lesser Armenia was given to Deiotarus, and all his foreign conquests either returned to their old masters or were incorporated with the Roman province of Asia. He was succeeded by his son, Artavasdes or Ardavast.

Tigré, province of Abyssinia, between lat. 12° and 16° N. and lon. 37° and 40° E., was formerly an independent state until conquered in 1855 by Theodore. Its capital is Adowa, one of the principal stations on the caravan route between Massorah and Gondar.

Ti'gris, river of Asiatic Turkey, rises in the mountains of Koordistan, and after a winding but generally south eastern course of about 1000 miles, it joins the Euphrates at Korna, and forms the Shatt el Arab, which enters the Persian Gulf after a course of about 100 miles. The principal places on its banks are Diarbekir, Mosul, and Bagdad, and the ruins of Nineveh, Seleucia, Ctesiphon, and Opis. Along its upper course its banks are lined with fine pastures, visited by the nomadic tribes of the neighborhood. From Diarbekir, where it becomes navigable for rafts and small vessels, to Mosul, its banks are highly cultivated, but a few miles below Mosul, and down to Bagdad, almost all vegetation ceases, and the land on both sides of the river becomes a mere desert. From Bagdad to Korna the banks are steep and overgrown with high reeds and brushwood, which form the haunts of lions and other beasts of prey. The average breadth of the Tigris between Mosul and Bagdad is 200 yards, but its depth, velocity, and breadth vary very much according to season.

Tikhvin', or **Tichvin**, town of Russia, government of Novgorod, on the Tikhvinka, which by a canal is connected with the Volga. P. about [illegible].

Til'burg, town of the Netherlands, province of North Brabant, is the seat of a [illegible] industry. Several thousand persons are engaged in this business, but each family has a house of its own, to which belongs a strip of land for the cultivation of [illegible]. Printworks, breweries, and soap factories are [illegible]. P. 24,[illegible].

Til'den (Samuel Jones), b. in New [illegible], N. Y., Feb. 9, 1814; graduated from Yale [illegible] the bar [illegible] New York, and was [illegible] the [illegible] that city. He entered [illegible] for fifteen years was chairman [illegible] committee of New York. He was [illegible] national conventions in 18[illegible] two terms in the lower house [illegible] in 1846, and second in 18[illegible] the overthrow of the [illegible] elected by the Dem[illegible] New York. Nominated by the [illegible] St. Louis, Mo., June [illegible] dency. [illegible]

Tile [Fr. *tuile;* Lat. *tegula*], a flat plate of baked clay, used for roofing, for flooring, and for various ornamental purposes in architecture. The more highly-ornamental varieties are called ENCAUSTIC TILES (which see). The earthenware pipes used in the drainage of land are also called tiles. They are of various patterns and sizes, are extensively manufactured by machinery, and are burned in the same way as bricks.

Tilgh'man (LLOYD), b. in Maryland 1816; was graduated from the U. S. Military Academy July 1, 1836, when commissioned brevet second lieutenant 1st Dragoons, receiving his full commission to that grade July 4: but without service resigned Sept. 30, 1836, to become a civil engineer, and in that capacity was engaged in the construction of railroads in various sections and of works of public improvement in Baltimore. In the war with Mexico he served as volunteer aide to Gen. Twiggs at the battles of Palo Alto and Resaca de la Palma; commanded a volunteer company Oct., 1846; superintended the construction of the defences at Matamoras in June, 1846; and in command of company of light artillery (Maryland and District of Columbia Vols.) 1847–48. Returning to his profession at the close of the war, he was principal assistant engineer of the western division of the Panama R. R. and chief engineer of several Western railroads in the U. S. He became a general in the Confederate army in 1862, and in Feb., 1862, surrendered at Fort Henry, giving himself up rather than abandon his command: exchanged in July, he served afterward in the South-west, and was killed in the battle of Baker's Creek, Miss., May 16, 1863.

Tilghman (TENCH), b. in Talbot co., Md., Mar. 25, 1810; graduated at the U. S. Military Academy in 1832, when appointed brevet second lieutenant 4th Artillery; resigned Nov. 30, 1833. Locating upon the family estate at Oxford, though thenceforward actively engaged otherwise, he devoted his spare time to agricultural pursuits. From 1841 to 1851 was commissioner of State public works, president Talbot Insurance Co. 1846–49, superintendent of military department of Maryland Military Academy 1847–57, U. S. consul at Turk's Island 1849, and same year at Mayaguez; was president (1855–61) of Maryland and Delaware R. R., projected and carried to successful completion by him; also U. S. collector of customs at Oxford 1857–61; was brigadier-general of State militia 1837–60, and major-general 1860–61, when he entered the service of the Southern Confederacy. For many years he was president of the Society of the Cincinnati of Maryland, and treasurer-general of the Society of the U. S. D. at Baltimore Dec. 22, 1874.

Tilghman (WILLIAM), LL.D., b. in Talbot co., Md., Aug. 12, 1756, son of James, secretary of the proprietary land-office; removed to Philadelphia in childhood; studied law under Benjamin Chew; practised at the Maryland bar 1783–93, and was a member of the legislature several years; was chief-justice of the U. S. circuit court 1801–02; became president of the court of common pleas July, 1805, and chief-justice of the supreme court of Pennsylvania Feb., 1806; was president of the American Philosophical Society 1824, and published several occasional addresses. D. at Philadelphia Apr. 30, 1827.

Tilghman's Sand-Blast. See SAND-BLAST, by G. F. BARKER, M. D.

Tilgh'manton, tp., Washington co., Md. P. 1489.

Tilia'ceæ [from *Tilia*, one of the genera], a natural order of exogenous trees, shrubs, and herbs, mostly tropical, and allied to Malvaceæ. The well-known basswood and linden trees belong to this order, as do the jute-plant and a number of timber and fruit trees of tropical regions.

Til'lamook, county of N. W. Oregon, bordering on Pacific Ocean, and bounded E. by the Coast Mountains, abundantly watered, and having the good harbor of Tillamook Bay; surface mountainous, and covered mostly with spruce forests, but with some small fertile valleys. The rivers abound with fish, and coal and iron have been found. Staples, live-stock, with small quantities of wheat, oats, and potatoes. Cap. Tillamook. Area, 1400 sq. m. P. 408.

Tillamook, p.-v., cap. of Tillamook co., Or.

Tilland'sia [named by Linnæus in honor of Dr. Elias Tillands, a Finnish botanist], a genus of epiphytic air-plants of the order Bromeliaceæ. There are many species, eight of which are natives of the Southern U. S. Of these, *T. usneoides*, the long or Spanish moss (so called), is the best known. It is abundant in the more humid districts of the South, where it hangs in long festoons from the trees. Its central fibre is extensively used in stuffing mattresses. The plant is used in making an ointment asserted to be a cure for hæmorrhoids, and in winter it is eaten by cattle.

Tillemont', de (LOUIS SÉBASTIEN LE NAIN), b. at Paris Nov. 30, 1637; was educated by the Jansenists of Port Royal; studied theology at the seminary of Beauvais; took holy orders in 1672, and became subdeacon at the St. Lambert; retired in 1677 to the monastery of Port Royal, and, when the government closed this institution in 1679, to his estate of Tillemont, between Vincennes and Montreuil, where he d. Jan. 10, 1698. He wrote *Mémoires pour servir a l'Histoire ecclésiastique des six premiers Siècles* (16 vols., 1693–1712), *Histoire des Empereurs et des autres Princes qui ont régné durant les six premiers Siècles de l'Église* (6 vols., 1692–1738). His *Vie de St. Louis* was first published by the French Historical Society (6 vols., 1847–51).

Til'ley (SAMUEL LEONARD), C. B., b. in Queen's co., New Brunswick, May 8, 1818, descended from a loyalist family of Massachusetts; received a good English education; settled at St. John's; took an active part in organizing temperance associations; engaged in politics on the temperance issue; was elected to the provincial assembly 1851; became a member of the cabinet and provincial secretary Nov., 1854; resigned May, 1855; again held the same office from July, 1857, to Mar., 1861; was leader of the government 1861–65; was a commissioner to confer with the governments of Canada and Nova Scotia on intercolonial trade and railways 1861, and on the project of confederation 1864; was a delegate to the British government on the railway question 1861–62, and on that of confederation 1866–67; was prominent in effecting the settlement of the latter question, and for several years from the organization of the Dominion government in 1867 was minister of customs in the Dominion cabinet.

Tillico, tp., St. Francis co., Ark. P. 733.

Til'linghast (JOSEPH LEONARD), b. at Taunton, Mass., in 1791; graduated at Brown University 1819; became a lawyer at Providence; was many years a member of the State assembly, and often Speaker of that body; was chiefly instrumental in promoting improvements in the judiciary and common-school systems, and was a member of Congress 1837–43. D. at Providence, R. I., Dec. 30, 1844. Author of *An Oration on Gen. Greene* (1813), *A Eulogy on Adams and Jefferson* (1826), and other published speeches on political subjects.

Til'loch (ALEXANDER), LL.D., b. in Glasgow Feb. 28, 1759; was a practical mechanic, and in 1781 conceived the idea of the production of stereotype plates for printing, and for that purpose entered into partnership with Mr. Foulis, a noted printer in Glasgow, and patents for his invention were taken out. His father was a tobacconist, and for a short time he was engaged with his brothers in that business; but he soon returned to printing, and in 1787 went to London, where he purchased *The Star*, an evening newspaper, which he conducted for more than thirty years. In 1790 he formed a plan for producing bank-notes which could not be counterfeited, but it was not carried into effect. In 1797 he established the *Philosophical Magazine*, which he edited with great success, and just before his death commenced the publication of the *Mechanic's Oracle*, a weekly journal. He was a minister of the sect known as Sandemanians, devoted much attention to the study of the prophecies, and published a volume of *Dissertations introductory to the Study of the Apocalypse* (1823). D. at Islington Jan. 26, 1825.

Tillodon'tia [Gr. τίλλειν, to "tear," and ὀδούς, "tooth"], an extinct group of Tertiary mammals, now regarded as forming a distinct order, possessing characters intermediate between carnivores, rodents, and ungulates. In *Tillotherium*, the typical and best-known genus, the skull resembles in shape that of the bear. It is expanded by air-cavities in the frontal region. The orbits are confluent with the large temporal fossæ, which are separated at the middle line of the skull by an obtuse sagittal crest. The nasals are stout, and expanded behind. The dental formula in the adult is incisors, $\frac{2-2}{2-2}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{2-2}$; molars, $\frac{3-3}{3-3}$. The anterior incisors both above and below are large, curved, scalpriform, and faced in front with enamel. They grow from persistent pulps, and strongly resemble the corresponding teeth of rodents. The canines are quite small. The upper molars are peculiar, and the lower are of the palæotherium type. The brain-cavity is small. As in most if not all Eocene mammals, the hemispheres were small, and extended but slightly over the cerebellum or over the olfactory lobes. The latter were large and projected well forward. The hemispheres were evidently somewhat convoluted. The cerebellar fossa is large, expanded transversely, and extends above the cerebral cavity. The vertebræ resemble those of some carnivores: the cervicals were short, the lumbars quite large. The radius and ulna were separate and of nearly equal size. The scaphoid and lunar bones were dis-

tinct. The feet were plantigrade, apparently fitted for digging, and each had five toes. There was a well marked third trochanter on the femur, and the tibia and fibula were distinct. The best-known species (*T. fodiens*, Marsh) was about two-thirds the size of a tapir. The first known remains of this order were found in Monmouth co., N. J., and described under the name *Anchippodus riparius* by Dr. Leidy. This genus, and even species, is now regarded as identical with *Trogosus castoridens* of the same author, from the Eocene of Wyoming. It is easily distinguished from *Tillotherium* by the presence of a small pair of incisors in the lower jaw between the large scalpriform ones. The systematic relations of these genera were not known until the discovery of *Tillotherium*. A second family of this order is represented by *Stylinodon*, in which the molars are rootless, subquadrate in transverse section, and faced with enamel within and without. *S. mirus*, Marsh, was about as large as a capybara. O. C. MARSH.

Til'lotson (JOHN), D. D., b. at Sowerby, Yorkshire, in 1630; was educated at Clare Hall, Cambridge, where he was made a fellow in 1651. He was originally a rigid Puritan, and in 1657 became tutor in the family of Cromwell's attorney-general, but at the Restoration went over to the Established Church, in which he took orders, and became in succession curate of Cheshunt, rector of Keddington, preacher at Lincoln's Inn, dean of Canterbury, prebend of St. Paul's, and finally, in 1691, archbishop of Canterbury, having in the mean while served as clerk of the closet to William III. and as member of the commission appointed in 1689 to revise the English liturgy. He took an active part in measures in opposition to popery, opposed the declaration of Charles II. in favor of liberty of conscience, and was an earnest advocate of the exclusion of the duke of York from the succession. He ranks among the foremost of English preachers; published during his lifetime several volumes of sermons, and left many more in manuscript, and for the copyright of these his widow received 2500 guineas. Several editions of his *Sermons*, in 12 and 14 volumes, were published. His complete works have been published (3 vols. fol., 1707–12, and 10 vols. 8vo, 1820), and many of his sermons have been translated into French and German. D. in London Nov. 22, 1694.

Til'ly, von (JOHANN TSERCLAES), COUNT, b. in the castle of Tilly, near Gemblours, province of Brabant, Belgium, in Feb., 1559; was destined for the Church, being a younger son, and educated by the Jesuits, but preferred the military profession; served under Farnese in the Netherlands, and under Duke Philip Emanuel of Lorraine in Hungary, and was in 1610 appointed field-marshal by Duke Maximilian of Bavaria. When the Thirty Years' war broke out, he was made commander-in-chief of the army of the Holy League; suppressed the insurrection in Bohemia after the battle of Prague, Nov. 8, 1620; conquered the Palatinate; defeated Christian IV. at Lutter-am-Barenberg Aug. 27, 1626; was made commander-in-chief also of the Austrian army after the dismissal of Wallenstein in 1630; stormed Magdeburg May 20, 1630, but was utterly defeated by Gustavus Adolphus at Breitenfeld, Sept. 17, 1631, and again on the Lech, Apr. 15, 1632, in which battle he was mortally wounded. D. at Ingolstadt Apr. 30, 1632.

Til'sit, town of Prussia, province of Prussia, on the Niemen, is regularly built, and in a fertile and well-cultivated district. It manufactures cloth, hosiery, oil, paper, chemicals, has several sugar-refineries and important eel and salmon fisheries, and carries on a considerable trade in grain, hemp, flax, wool, and horses. P. 20,251.

Til'sonburg, p.-v., Oxford co., Ont., Canada, on Big Otter Creek, 16 miles N. of Port Burwell. It has good water-power, large lumbering interests, and a weekly newspaper. P. about 1000.

Tilt Cove, port of entry on White Bay, Newfoundland, 230 miles by steamer N. W. of St. John. It is a picturesque village, and owes its importance to a rich copper-mine which is actively worked. There is also a vein of nickel, occurring in a regular lode; the copper, however, is in pockets or bunches. The harbor is not very good. P. 770.

Til'ton, tp., Fleming co., Ky. P. 125.

Tilton, p.-v. and tp., Belknap co., N. H., on Boston Concord and Montreal R. R., has a national bank. P. 1117.

Tilton (JAMES), M. D., b. in Kent co., Del., June 1, 1745; educated at Nottingham Academy and at Philadelphia Medical School; practised at Dover, Del., until 1776, when he became surgeon to a Delaware regiment, with which he was present at the battles of Long Island and White Plains; was hospital surgeon from 1777 to the end of the war; resumed practice at Dover 1783; served many years in the legislature; was a member of the Continental Congress 1783–85; commissioner of loans 1785–1801; was appointed physician and surgeon general to the U. S. army 1812; was many years president of the Medical Society of Delaware; published papers on agricultural subjects, on fruit-growing and the curculio, and was author of *Economical Observations on Military Hospitals* (Wilmington, 1813). D. near Wilmington May 14, 1822.

Tilton (THEODORE), b. in New York Oct. 2, 1835; was educated at the New York Free Academy; entered upon journalism at an early age, and in 1856 was employed upon the New York *Independent*, a weekly religious journal edited by Rev. Henry Ward Beecher; married Elizabeth Richards, himself and his wife becoming active members of Plymouth church, Brooklyn, of which Mr. Beecher was pastor. Mr. Beecher resigning the editorship of the *Independent* in 1863, was succeeded by Mr. Tilton, who in 1871 also became editor of the Brooklyn *Union*, a daily newspaper, both being owned by Mr. Henry C. Bowen. In 1872, in consequence of some disputes, his connection with these journals was discontinued, and he established *The Golden Age*, a weekly journal, which he conducted till 1874. In that year he brought suit against Mr. Beecher, whom he charged with criminal intimacy with his wife, claiming damages of $100,000. The suit lasted six months, and the jury were unable to agree upon a verdict, nine being for the defendant and three for the plaintiff. He was a popular public lecturer, and has published *The American Board and Slavery* (1860), *Memorial of Mrs. Browning* (1862), *The Fly* (1865), *Golden Haired Gertrude* (1865), *The Two Hungry Kittens* (1865), *The King's Ring* (1866), *The True Church* (1867), *The Sexton's Tale, and other Poems* (1867), *Sanctum Sanctorum, or Proof-Sheets from an Editor's Table* (1871), *Life of Victoria C. Woodhull* (1871), and *Tempest Tossed*, a novel (1875).

Tim'ber, tp., Peoria co., Ill. P. 1707.

Timber and Timber Trees. See APPENDIX.

Timber Creek, p.-v. and tp., Marshall co., Ia. P. 886.

Timber Creek, tp., Cowley co., Kan. P. 97.

Timber Hill, tp., Bourbon co., Kan. P. [illegible]

Timber, Preservation of. See PRESERVATION OF TIMBER, by H. WURTZ, A. M.

Timber Ridge, tp., Morgan co., West Va. P. 657.

Timber Trees, Culture of. See ARBORICULTURE, by J. J. THOMAS.

Timbre, of the voice. See VOICE, by R. R. RAYMOND.

Timbre, of tones. See ACOUSTICS, by PROF. O. N. ROOD, A. M.

Timbs (JOHN), b. at Clerkenwell, London, England, Aug. 17, 1801; was for some time amanuensis to Sir Richard Phillips, publisher of the *Monthly Magazine*, in which he made his first appearance as a writer; was editor of the *Mirror*, a cheap and popular literary weekly, 1827–38, of the *Literary World* 1839–40, and one of the editors of the *Illustrated London News* 1842–58. D. in London Mar. [illegible], 1875. Author, among other works, of *Laconics* (1825–26), *The Arcana of Science and Art* (41 vols., 1828–58), *Knowledge for the People* (4 vols., 1831–32), *Year-Book of Facts in Science and Art* (31 vols., 1839–69), *The Illustrated Year Book* (2 vols., 1850–51), *Things not Generally Known* (7 vols., 1856–57), *School Days of Eminent Men* (1858), *Anecdotic Biography* (2 vols., 1859–60), *Lives of Wits and Humorists* (2 vols., 1862), *Walks and Talks about London* (1864), *Romance of London* (3 vols., 1865), *Club Life of London* (2 vols., 1865), *English Eccentrics and Eccentricities* (2 vols., 1866), *Nooks and Corners of English Life* (1866), *Wonderful Inventions* (1867), *London and Westminster, City and Suburb* (2 vols., 1867), *Notable Things of our own Time* (1868), *Ancestral Stories and Traditions of Great Britain* (1869), *Abbeys, Castles, and Ancient Halls of England and Wales* (2 vols., 1870), and [illegible] (1872).

Timbuc'too, town of Soudan, Central Africa, on a branch of the Niger, near the desert of Sahara, in lat. [illegible] N., lon. 1° 45′ W. It is in an unhealthy and unproductive district; provisions have to be brought from distant places. But for the traffic between N[illegible] tral Africa it is of great importance, and [illegible] repeatedly suffered severely from being [illegible] ed by the Moors and by neighbo[illegible] rises again, and is still [illegible] manufactures, firearms, gun[illegible] are brought here through S[illegible] ostrich feathers, gold dust [illegible] dance to a rapid develo[illegible] ent, the rivalry and [illegible] French merchants [illegible] mainly of mud huts [illegible] tiering. It is surrounded [illegible] walls, but the walls are [illegible]

bad repair; it has no manufactures. Its inhabitants, numbering about 13,000, are negroes.

Time [Sax. *tima*] has been characterized as that wherein there is room for *events* to *happen*, as in *space* there is room for *things* to be *placed*. "For times and spaces," says Sir Isaac Newton, "are, as it were, the places as well of themselves as of all other things. All things are placed in time as to order of succession, and in space as to order of situation." (*Principia*, Scholium to Def. vii.) So space and duration (out of which latter time is parcelled out) are to be regarded, in accordance with all experience, as *existing relations* of things actual. The limit which occurs *when*, and not *where*, one part or portion of duration ends and another begins, but which does not occupy any portion of duration (does not *last* at all), such a limit is an *instant*. It differs from a moment, which is itself a small but indefinite portion of duration. (The busy and hurried man says, "Wait a moment, and I will attend to you.") The analogy, and yet contrast, in this case being thus perfect, it is not strange that an instant should be designated as "a point of time." The instant is that which marks the present, the *veritable now*; which thus does not last, does not endure. It seems to be in consistency with this that some of the ancient languages have no present tense.

The *practical now* has the characteristic of the moment, enduring while some specific consideration can be held before the mind; as now we are reading and comprehending this sentence. Yet this same practical now must be a sensible fraction of the life of an ephemera, which lasts only for a single day. And it is then quite conceivable that in the case of beings of a far higher order than ourselves the practical now should include a sensible fraction of a whole human life; while to the infinitely supreme Being all that has taken place in history, and all that is anticipated in the future, will be one vast, comprehensive, ever-during *now* ("the Eternal Now").

Of the Infinity of Space and of Time.—Space cannot bound or limit itself. It is therefore continuous on all sides, and presents in all directions, as far as it is itself concerned, an inexhaustible emptiness; and thus (viewing the matter from the physical side) we arrive at the *induction* that space is veritably boundless, *absolutely infinite*. In comparison, and also in contrast with this, we must (whatever form of belief we may otherwise cherish) accept the conclusion that *something always was*, since the zero of existence (non-existence) has in itself no energy to produce aught. The great pre-existent must then have been "from everlasting," and in that is *Eternity Past*. Then, as all our experience shows, there will be room for the successive occurrence of events in the duration to come, or in that duration parcelled out or measured—that is, in time to come—to go on or continue always, and that "*for ever and ever*;" and in that we have the characteristic of the *Eternity Future*. Now, it is the combination of both these—of the Eternity that was "from everlasting," and that which is to be "to everlasting"—nothing less than that combination, nothing short of it, that there is constituted for us the *absolute infinite of duration*.

Comparison of Finites with Infinites.—If a point P be assumed in a straight line, interminable in both directions (toward A and toward B, Fig. 1),

Fig. 1.

B — — ——————P′——————P—————— — — — A,

then all that division of the interminable line from P in the direction of A must, in effect, be regarded as being neither greater nor less than the other division of the line extended from P in the direction of B; the two divisions being both in effect terminated at P, but interminable otherwise, though in opposite directions; each division being thus *in effect the half* of the original interminable line. But if a new point P′ be assumed in the same line with P, and at a finite distance from P, *either great or small*, then, reasoning as before, the division toward one side of P′, but interminable in the direction of A, must, as before, be regarded as being equivalent to the division interminable in the direction of B; and so each division, as before, be *in effect the half* of the original line interminable both ways. And yet to one half thus obtained, in comparison with that which begins at P, has been added the distance P′P in the direction of A, and from another has been subtracted that same distance P P′ in the direction of B. It appears, then, that the characteristic of a line terminated in one direction, but interminable in the other, as being in *effect the half* of the line interminable both ways, is not affected by the addition or the subtraction of any *finite* portion of the *so designated half*, be that finite portion *either great or small*. So the finite portion is a *relative zero* in comparison with a line interminable in only one direction, being utterly worthless in the comparison. That it ought to be so will moreover appear from the consideration that a terminated line, *either great or small*, made use of as a measure of the line interminable in only one direction, must, in every instance, be *worthless* for such a purpose, since the continued application of the measure must ever fail to approach (and so never reach) the termination of that which, in the very direction of the advance, is itself interminable.

So in comparison again, and in contrast, the abstraction of either a thousand years or one day from the Eternity Future, to be added to the Eternity Past, will still leave either in effect the half of the absolute infinite of duration extending "from everlasting to everlasting," and thus either a thousand years or one day be alike worthless as a measure of either the past without beginning or the future without end; and thus, at least, "a thousand years be as one day, and one day as a thousand years."

Of Absolute and Relative Time, and the Measure of Time.—Says Sir Isaac Newton, "Absolute, true, and mathematical time, of itself, and from its own nature, flows equably, without regard to any thing external" (*Principia*, Scholium to Def. vii. of book i.); and he would make duration to be but "another name" for that; and of duration absolute time is indeed a portion. All experience, moreover, confirms us in the belief that there is room for the like succession of events within the same extent of duration; and that, in accordance with the figurative description already quoted, through the instantaneous present, the Eternity Future, moment by moment (if we estimate it), passes over into the Eternity Past. We recognize this, to some extent at least, in our ordinary language when we say, "When to-morrow comes"—not when we come into to-morrow, time being sometimes regarded as being, even in its mathematical aspect, the only *independent variable*.

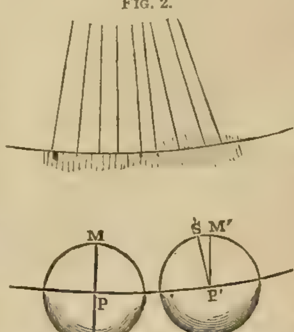
"Relative, apparent, and common time" (continues the same great author already quoted) "is some sensible and external (whether accurate or unequable) measure of duration by means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year." In its applications, such relative time, when now used, is almost always corrected by an *equation of time*; of which more hereafter.

Next, with regard to the *measures of time*, whether variable or accurate. A suitable measure of time, and withal a natural one, is to be found in the earth's rotation about its axis; which measure will be found to possess the *three requisites* which must belong to every good measure—viz. (1) It must be of suitable size or magnitude; (2) it must be readily accessible, and admit of an easy application; (3) it must, if possible, be invariable.

(1) The *sidereal day* (see Moon) which is completed in the time occupied by the rotation of the earth about its axis will be found to have in itself all these requisites, though our limits will not admit of the exposition of that.

But, admitting what has just been stated, we ought next to ascertain how we are to determine when a globe rotating about its axis, and at the same time transferred in space, has just completed one entire rotation. For this purpose, suppose two entirely similar globes to be placed as in Fig. 2, with the meridian P M of the one parallel to the P′ M′ of the other. Then, if the respective angular velocities of rotation of the globes be equal, the plane P′ M′ of the one will continue parallel to P M, and so at the end of one complete rotation P′ M′ will be found to be parallel to P M in the original position of the latter. Now, if instead of *two* globes, we suppose *one* globe, turning still with the same angular velocity, to have advanced during one rotation from the first of the two positions in the figure to the second, then the meridian P M will be in the position P′ M′, and *itself be parallel* to the position which it had at first.

Fig. 2.



Now, if the plane of P M passed through or coincided with the direction of a fixed star, P′ M′ would also sensibly coincide with the same, since the directions, such as P M and P′ M′, extending to the same fixed star, would be sensibly parallel. And so between two successive transits of the same fixed star would be accurately accomplished one complete rotation and also one *sidereal day*.

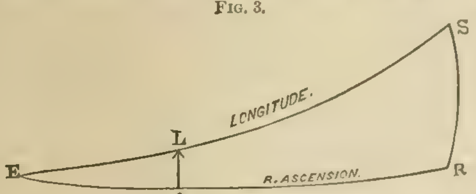
The sidereal day of astronomers begins when the vernal

equinox is on the meridian of the place of observation. As the position of the vernal equinox is affected by the very slow change due to the precession, this practical sidereal day is the veriest trifle less than the true. Moreover, the position of every terrestrial meridian is also very slowly changed, and the precession not quite that due to a uniform change. But all would make a difference in the observed time of but little more than one second in nineteen years, and therefore no correction is made for it, the whole being understood. The apparent rotation of the heavens being due to the actual rotation of the earth, it will, like the latter, be isochronous in the whole and in all its parts, which all the observations of *sidereal* time justify.

Of Solar Time, Mean Solar Time, Apparent Solar Time, and the Equation of Time.—If, as in Fig. 2, P M be, at any instant, the meridian, the plane of which passes through the visible place of the sun (affected by aberration), then to all places of which P M is the meridian, to which the sun is visible, the time will be that of *apparent* noon. Between that and the next succeeding noon the earth will have moved from P to P′ (the extent of the motion being here exaggerated). Before this (in accordance with what has been heretofore demonstrated), a sidereal day will have been accomplished, the meridian having in that period arrived at the position P′ M, *parallel* to its first position, P M. But in order that the plane of the same meridian should a second time pass through the apparent place of the sun, P′ M′ must rotate still farther until it arrives at the position P′ S, and then, and not before, will be completed the *apparent solar day*. The time meted out by these motions is *apparent solar time*. Now, the arc M′ S in the plane of the earth's equator is (on a small scale) an arc of *right ascension*, and P P′, in the same plane, measures, on the large scale, the motion of the earth in its orbit, also in *right ascension;* and the angle at the sun measured by P P′ is the alternate angle to M′ P S. Hence the angular excess of motion M′ P S above a whole rotation, between one noon and the next, is itself equal to the angular motion of the earth (orbital motion, that is) in *right ascension* in the same interval. Now, as will be demonstrated, the angular motion of the earth in right ascension from day to day is *variable*. Hence, although the earth's rotation is isochronous, the solar days must be unequal. But by combining a great number of them (comparing them with sidereal time), and then dividing by the whole number, we obtain the average or *mean solar day*.

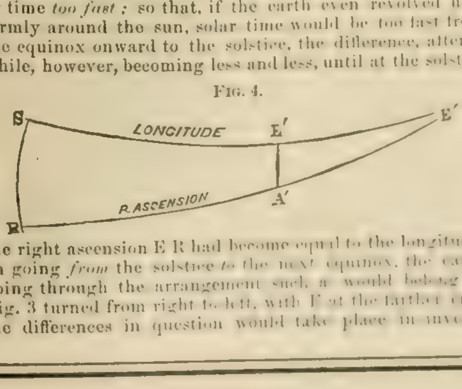
There are two principal causes of the variation in the daily increment of the earth's right ascension. One of these is obliquity of the ecliptic (earth's orbit) to the equinoctial. Did the earth's motion around the sun take place in a circle, and if that motion itself were uniform, even then the motion in right ascension would be variable; for

FIG. 3.



then, although the motion in longitude from the equinox E (Fig. 3) would in one quarter of a year amount to 90° or E S, and the motion in right ascension, E R, be also 90°, yet as respects any intermediate point L the right ascension E A would be *less* than the longitude E L. The effect of this from day to day (the gain in right ascension being less than the average) would be to make the *excess* above a whole rotation to make out a solar day *less* than the *average*, and so the solar day be made *too short* for the average, or time *too fast;* so that, if the earth even revolved uniformly around the sun, solar time would be too fast from the equinox onward to the solstice, the difference, after a while, however, becoming less and less, until at the solstice

FIG. 4.



the right ascension E R had become equal to the longitude. In going *from* the solstice *to* the next equinox, the earth going through the arrangement such a would belong to Fig. 3 turned from right to left, with E at the farther end, the differences in question would take place in inverse order: and (as in Fig. 4) the arc E′ A′ of right ascension being *less* than E′ L′, that of longitude, it [illegible] subtracted from 90°, we shall have R A′ *greater* [illegible] or the motion in right ascension, in going *from* the [illegible] *toward* the equinox, will be *greater* than the [illegible] longitude, instead of *less*, as was true in the [illegible] the equinox toward the solstice; though 90° will [illegible] pleted in longitude as well as at right ascension at the equinoctial point E′.

The summing up of this is, that in consequence of the motion of the earth in an orbit *oblique* to the plane of the earth's equator and therefore also to the equinoctial, solar time would be made *too fast*, as the earth was going from *the equinox toward the solstice*, this variation being, however, exactly overcome at the end of the one quarter of the year, when the earth would arrive at the solstice. But in going from the solstice toward the next equinox, the effect of the earth's oblique motion would be to make solar time at first *too slow*, as the earth was *going* [illegible] *toward the next equinox; this* variation also to be overcome at the end of the one quarter of a year, when the earth would arrive at the next equinox; and the right ascension of the earth thus be the same *at the equinoxes and at the solstices* as it would be if the earth had moved [illegible] in the plane of the equinoctial, and so had kept mean time. Solar time would thus be *right* when the earth was at either of the equinoxes or of the solstices, while *between* [illegible] *nox and the succeeding solstice* solar time would be [illegible] but between any solstice and the succeeding equinox solar time would be *too slow*, there being four *instants* (viz. at the equinoxes and at the solstices) in the course of the year at which solar time, kept by the earth's motion, would be right, with four intervening intervals within which time thus kept would be alternately *too fast* and [illegible] intervals for the second half of the year would repeat the effects of the first.

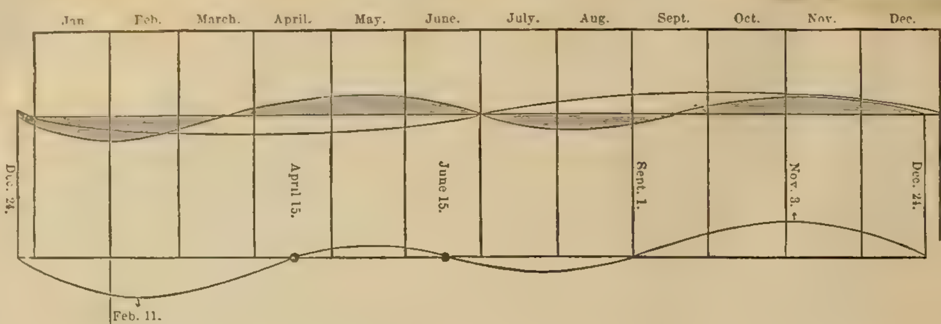
But the earth does not revolve around the sun uniformly in a circle, but in an ellipse, with a variable angular motion. (See PLANET.) Yet the *one half* of the revolution in the ellipse, from the perihelion P (or place *nearest the sun*) to the aphelion A (or place *farthest from the sun*), is accomplished in the same time with the other half revolution (from A to P); and either the same time in which a body moving in a circle at the distance C A (*i.e.*, one half of A P) would describe its half circumference. In going, then, from P to A, the earth at first moves *faster* than the average, and so makes the arc M′ S in Fig. 2 [illegible] to complete the solar day (*too large;* the day is thus made *too long*, and solar time thereby *too slow*, through the [illegible] *year* while the earth is passing from P to A [illegible] the 1st of January to about the 1st of July [illegible] being true, time made *too fast*, from the beginning of July to January (*i.e.*, for the *other half* of the year), the positions at P and A, notwithstanding, being those at which the earth would be if it revolved in a circle [illegible] at the mean distance A C, which is the one half of P A. We have, then, from this cause (considered by itself), [illegible] *instants* at which the irregularity of solar time [illegible] and those *half a year* asunder, instead of [illegible] *year*, as in the instance of irregularity due to [illegible] and the half year periods beginning and ending at [illegible] different from any of the *four dates* [illegible] *obliquity*.

Other small irregularities in the earth's elliptical motion, arising from her connection with the [illegible] and [illegible] the perturbations of the planets, slightly modify the results of that motion as to solar time here described.

In Fig. 5 the variations from both causes now described are artificially represented, the bolder curve representing the effect of the obliquity, with the wave *above* the horizontal line when time is *too fast*, the height of the wave at any date indicating proportionally how much too fast. The *hollows* of the waves at those several dates indicate time too slow, the depth of the depression indicating, proportionally, how far too slow; the four dates at which time would be neither too fast nor too slow [illegible] being at the points of intersection at the [illegible] solstices, as heretofore shown. The [illegible] like fashion, indicates the effect of the [illegible] the earth's orbit, time being represented [illegible] too slow by the hollow of the wave extending [illegible] ginning of January to the beginning [illegible] sum or the difference, as the case [illegible] dicular heights and depressions [illegible] *denotes*—*i.e.*, the combined [illegible] by means of the third curve [illegible] On this it will be seen that [illegible] too fast due to the [illegible] anced by the effect of [illegible] and so time then [illegible] time too fast from [illegible]

slow of the other cause, on the *15th of June*. Between these two dates there is everywhere manifest no very great **excess** of time too fast. From the *15th of June* to the *1st of September* the outstanding difference apparent is everywhere small, but it is that of time too slow. From the 1st of September to the 24th of December the two causes com-

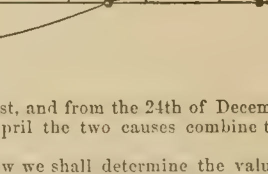
FIG. 5.



bine to render time too fast, and from the 24th of December to the next 15th of April the two causes combine to render time too slow.

It remains to be seen how we shall determine the value of these results; that is, the *extent* of variation from *mean time*—*i. e.* the *equation of time*—and with this, and in order to it, from what limits mean time is to be reckoned. If, as in Fig. 2, M′ S represent the excess above a whole revolution required to complete a mean solar day—which angular excess is measured, *on the large scale*, by the arc P P′ with its centre at the sun—then in the 24th part of a mean solar day this excess so measured by the earth's motion in right ascension will be the 24th part of P P′, or, in arc, also the 24th part of M′ S. As, then, a whole mean solar day will consist of the time required to describe an entire rotation, + the time of describing M′ S, so in 1 *mean solar hour* the time required will be that of describing $\frac{1}{24}$th of a whole rotation (*i. e.* $\frac{1}{24}$th of a *sidereal* day), together with the *sidereal time* required to describe $\frac{1}{24}$th of M′ S. If, then, a terrestrial meridian such as P m' (Fig. 6) be 15° of terrestrial longitude to the W. of P m, and the plane of P m pass through the apparent position of the sun, then in the $\frac{1}{24}$th part of a mean solar day (1 mean solar hour) the rotation of the earth will not only transfer P m' through the 15° belonging to 1 *sidereal* hour, and bring the western meridian to the position P m'' (parallel to the original position of P m), but also (in the completion of the 1 hour of mean solar hour) the arc of excess due to the earth's motion meanwhile in right ascension, and which (on the large scale) is measured by P P′; so that at the end of the entire 1 hour of *mean solar time* the 2d meridian will have arrived at the P′ m' in a direction *then* passing *through the sun*, as did the meridian P m at first. It appears, then, that a *difference of 15° in terrestrial longitude will require a difference of 1 hour in time*, whether the time in question be *mean solar* or it be *sidereal time*.

FIG. 6.



Having thus ascertained in what measure as to time angular difference of position of meridians is to be interpreted, and having ascertained what would at any given time be the angular position of a given meridian with regard to the sun if the earth moved uniformly in right ascension in the plane of the equinoctial, and the actual angular position of the same meridian with regard to the sun in consequence of the earth's veritable motions (reckoned like the other in right ascension), the difference between these two, transformed into time measurement, at the rate of 15° to an hour, will be the *equation of time*.

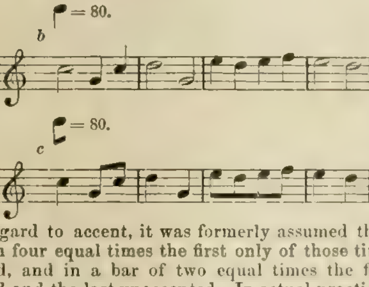
Fig. 5, in its third curve, represents the relative value of the equation of time at any date during the year, as well as the character of the equation as either fast or slow, or else zero, in comparison with mean time. The greatest equation of time fast (by the combination of the two causes of variation), as the figure indicates, occurs about the 2d of November, the sun being then too fast by almost 16m. 20s.; and the greatest equation of time slow about the 12th of February, when the sun is very nearly 14½ minutes too slow. The dates of no equation are about the 15th of April, 15th of June, 1st of September, and the 24th of December, as heretofore explained.

Of Local Time, and the Day of the Week correspondent to the same.—These may be best illustrated by an example in the determination of an answer to what has been esteemed a puzzling problem—viz. if we could advance westward so rapidly as to keep it always noon, when should we pass from one day of the week into another (suppose from Wednesday into Thursday)? With regard to this, it seems to have been usually forgotten, or else overlooked, that before it can be accurately determined *where* Wednesday will *end* we ought to find out where Wednesday is to *begin*. To determine this, it will be necessary to *fix upon* some meridian. And then reckoning from that meridian continuously *westward*, the local time will be found more and more *behind* that of the first meridian, until at last, in lon. 180° W., the local time will be found to be 12 hours behind that of the first meridian. But reckoning from the same first meridian continuously *eastward*, the local time will be found to be more *in advance* of that of the first meridian, until at last, in lon. 180° E., the local time will be found to be 12 hours *in advance* of that of the first meridian. In passing across the meridian in lon. 180° from the first meridian, we should therefore pass from the region of time *behind* that of the first meridian to time *in advance* of the same, or *vice versâ* when proceeding in the opposite direction. In the case supposed it would therefore be on passing lon. 180° from the W. that we should pass from Wednesday into Thursday, and in no other longitude whatsoever. (See also YEAR.) S. ALEXANDER.

Time. In music, every sound, and every rest or intermission of sound, necessarily occupies some portion of time. The duration of such sound or rest is not absolute, but relative—*i. e.* it is not measured by clock-time, but depends upon the rate or speed assigned to any piece of music by the composer or performer. When that rate is once determined, then the duration of each individual note or sound is also determined, as would be the case with the minutes and seconds of a clock if its rate of motion were subject to change. Notes and rests represent portions of time in the order of 1, ½, ¼, ⅛, etc. If the duration of the semibreve should be equal to 8 seconds of time, then the minim would occupy 4 seconds, the crotchet 2, the quaver 1, and so on. And if the duration of the semibreve should be arbitrarily fixed at more or less than 8 seconds, the shorter notes must all conform and preserve their relative proportions. This is the simplest and most elementary office of time in music. (See LARGE and NOTATION.) Notes written in a continued series, without any regular divisions or periodical accent, would be unmeaning and unfit for the expression of musical sentiment and beauty, except in very rudimentary forms. Regularity of time, accent, and rhythm is at the foundation of all excellence in modern music, and its absence is one chief cause of the dreary and formless character of the music of the ancients. All regular music is therefore now written in regular periods, phrases, etc., with smaller divisions into measures or bars. These measures are of several kinds, representing various styles of movement and peculiarities of accent, the leading idea being that musical sounds have a natural tendency to fall into rhythmical groups of equal duration, and that these groups may be reduced into two classes, the one consisting of two or four times in a bar, and the other of three. (Of the nature, origin, and object of these divisions or bars much explanatory matter has already been given in the article MEASURE, to which the reader is referred.) We proceed to notice some further points necessary to a full comprehension of the subject. Regularity of time is an essential element in all grades of musical composition. There is a certain degree of interest created in the mind even by the repeated strokes of a drum when marked off into groups by a periodical accent. In such a case there is no diversity of musical sound, but yet the mind receives pleasure from

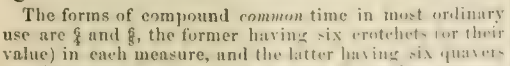
the mere marking and recurrence of equal times. A succession of such equal times will (as said above) naturally fall into groups of twos or threes, or, in technical language, it will be duple or triple, binary or ternary. Other distinctions, as imagined by musicians of the last century, are unreal and have no philosophical basis. The reduction of all musical times into the two genera of duple and triple, says a writer, "would long ago have been recognized had music made advances equal to other arts and sciences." Duple or *common* time (embracing also the quadruple) contains two or four equal times in a bar, with the accent on the first part of each bar, and (in the latter) an inferior accent on the third time. In ordinary common time each bar contains a semibreve, or shorter notes unitedly equivalent to it in value. It is known by a large C at the clef, with or without a stroke drawn through it. In church music this time is often written with two semibreves or four minims in a bar. The figures $\frac{2}{4}$ indicate another mode of writing common time, every bar containing *two-fourths* (or the half) of a semibreve. These kinds of common time are essentially one. The ear can detect no difference between them if in performance a bar of one is made equal to a bar of the other in *velocity*. Thus, the strain variously written at *a*, *b*, *c* in Ex. 1 might be played by three instruments simultaneously without the least difference being perceptible even to the most critical ear:

Ex. 1.—MM = 80.



In regard to accent, it was formerly assumed that in a bar with four equal times the first only of those times was accented, and in a bar of two equal times the first was accented and the last unaccented. In actual practice, however, this nice distinction vanishes. Albrechtsberger remarks that the difference between these two times is not a real one, as "a bar of four crotchets or beats is really only a double bar of two-crotchet time." *Triple* time contains three equal times in each bar. Like common time, it may be written in minims, crotchets, or quavers, and marked as $\frac{3}{2}$, $\frac{3}{4}$, and $\frac{3}{8}$, which figures give the time-value of each bar as compared with the semibreve. In old collections of music, pieces may be found in $\frac{3}{16}$ time, each bar containing only three semiquavers, or their value in other notes or rests. *Compound* time is a modification of the above simple times, produced by a mingling of the triple element with the duple or quadruple; as when the two crotchets of a bar in two-four time are turned into two groups of three quavers each, or when the same process is applied to a bar in three-four or any other triple time. (See Ex. 2, at *a* and *b*.)

Ex. 2.—*a* *b*

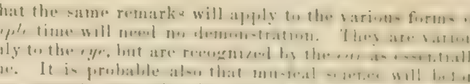


The forms of compound *common* time in most ordinary use are $\frac{6}{4}$ and $\frac{6}{8}$, the former having six crotchets (or their value) in each measure, and the latter having six quavers (or their value). The times marked $\frac{12}{8}$ (twelve quavers) and $\frac{12}{16}$ (twelve semiquavers) are less frequently used by modern composers. The forms of compound *triple* time are chiefly $\frac{9}{4}$, having the value of nine crotchets in each measure, and $\frac{9}{8}$, with the value of nine quavers. In the writings of the old masters, and even as late as the time of Beethoven, we find several other varieties of time and various modes also of indicating the times already described), such as the following:

$\frac{2}{1}$, $\frac{2}{8}$, $\frac{3}{1}$, $\frac{4}{2}$, $\frac{4}{1}$, $\frac{4}{4}$, $\frac{4}{16}$, $\frac{6}{16}$, $\frac{9}{16}$, $\frac{12}{4}$.

Much of the difficulty attending the study of musical time would disappear if it were borne in mind that the *ear*, and not the *eye*, is the proper judge in all questions of this nature. There are indeed certain reasons of *convenience* for writing common or triple time in four or five different modes, but the *ear* infallibly reduces them all to one, provided that they all proceed at the same rate. Everything, in fact, depends on velocity, for in an *adagio* in two crotchet time every *quaver* may equal in duration a *minim* in moderately quick or four minim time. The ear knows only one kind of common time; and the most experienced musician cannot detect a difference between the groups at *a*, *b*, *c*, and *d* in Ex. 3 when performed at the same speed:

Ex. 3.—*a* *b* *c* *d*



That the same remarks will apply to the various forms of *triple* time will need no demonstration. They are various only to the *eye*, but are recognized by the *ear* as essentially one. It is probable also that musical science will before long cease to recognize the minute and almost imperceptible distinctions which composers of a former age thought to exist between the several cognate forms of compound times, such as $\frac{6}{8}$ and $\frac{12}{8}$, etc.; for, though differences of accent may be alleged, yet these are apt to disappear in actual practice, so that a bar of twelve-eight time is hardly distinguishable from two bars of six-eight. Whether all compound times whatever may not prove to be mere developments of the triple germ, and to be nothing more than rapid iterations of triple time measures, is a subject worthy of investigation by those who prefer simplicity to useless distinctions.

WILLIAM STAUNTON.

Time, in philosophy. See SPACE, by W. T. HARRIS.

Time-Signals. See APPENDIX.

Times Presses. See PRINTING, by W. S. PATERSON.

Times, The London. See WALTER, JOHN.

Tim'monsville, p. v., Thomas tp., Darlington co., S. C., on Wilmington and Manchester R. R., has a weekly newspaper. P. 177.

Timo'leon, a native of Corinth and a member of one of the most prominent families of the city; put to death his own brother, Timophanes, who attempted to overthrow the democratic constitution of their native city and make himself tyrant. The date and details of this deed are variously given by Diodorus, Plutarch, and Cornelius Nepos, but the fact itself is unquestionable. In 344 B. C. an embassy arrived from Syracuse in Sicily, a colony of Corinth, and demanded the intervention of the mother city in the struggle between Hicetas and Dionysius the Younger, each of whom wished to become master of the city, and were ruining it by their strife. The aid was willingly granted, and Timoleon was appointed commander of the expedition. Although the armament was very small, he succeeded in expelling both Dionysius and Hicetas, established a democratic constitution, repeopled the city, and brought it in a very short time into a most flourishing state. This excited the jealousy of the Carthaginians, and under the command of Hasdrubal and Hamilcar they sent an army of 80,000 men against Syracuse, but Timoleon, although his force numbered only 12,000 men, attacked them while crossing the Crimissus, routed them completely in 339 B. C., and a treaty was concluded by which the Halycus was fixed as the boundary between the Greek and Carthaginian dominions in Sicily. He also expelled Hicetas from Leontini, and Mamercus from Catana, introducing free constitutions in all the Greek cities of Sicily. The last years of his life he spent in retirement in Syracuse, living as a private citizen, though enjoying the greatest fame and honor throughout the Greek world. D. in 337 B. C., and an annual festival was instituted in Syracuse in honor of his memory.

Timoor. See TIMUR.

Timor', an island of the Malay Archipelago, the largest of the chain which stretches eastward from Java, is between lat. 8° 16' and 10° 25' S., and between lon. 123° 25' and 127° 10' E. Area, 8820 sq. m. P. estimated at [illegible] It is traversed from E. to W. by a range of lofty mountains, which everywhere show marks of volcanic agencies; earthquakes are frequent. Along the shore are [illegible] fertile and densely peopled districts, in which [illegible] indigo, pepper, sago, pineapples, and cocoanuts are [illegible]ed. Buffaloes, oxen, pigs, and fowls are [illegible] pearl oysters, and elegant coral are found [illegible] gold [illegible] and timber are exported. The [illegible] partly Malayans, partly Oceanian negr[illegible] [illegible] belongs to two different r[illegible] the fauna and flora of the island b[illegible] to Asia and to Australia. The [illegible] Koepang, in the south-western [illegible] [illegible] a port, Dilly, in the [illegible]

Timor'-Laut, or **Tenimber Islands,** a group [illegible] belonging to the [illegible] E. of Timor. Their [illegible] population at 1[illegible] Larat, are volcanic [illegible]

are very numerous and very brilliant on these islands, especially the cockatoos.

Tim'othy, or **Herd's Grass** [reputed to have been named from Timothy Herd, who introduced its culture in the U. S.], the *Phleum pratense*, one of the best of forage-grasses, a native of Europe, is much cultivated there and in the U. S. (In Pennsylvania, etc., the red top, *Agrostis vulgaris*, is called herd's grass.) Timothy will not stand close pasturage, but affords fine crops of the best of hay. Others say that it was named from one Timothy Hanson, who took it to England from New Hampshire about 1780; still others, that a Quaker named Timothy sent the seed from Durant's Neck, N. C., about 1662, to England. Both traditions are doubtless incorrect. It is a native European, not an American, grass.

Tim'othy [Gr. Τιμόθεος, "one who honors God"], a disciple and companion of Paul, b. at Lystra or Derbe in Lycaonia, Asia Minor, probably about 20 A. D., the offspring of a mixed marriage between a Greek and a Jewess; was carefully trained in a knowledge of the Jewish Scriptures by his mother Eunice and his grandmother Lois, who were Christians, but was not circumcised until Paul in his second missionary journey selected him as a companion. He became the most constant and devoted of Paul's numerous fellow-workers; was regarded by him with truly paternal affection, and employed as "the messenger of the churches," as the apostle's "other self," in the execution of the most responsible spiritual commissions, and was doubtless his amanuensis in the preparation of most of the Epistles, his name being associated with Paul's, in a manner to suggest some degree of joint authorship, at the head of the Second Epistle to the Corinthians, those to the Philippians and Colossians, and the two to the Thessalonians. Whether he shared in the voyage to Italy is uncertain, but he afterward appears at the side of Paul while a prisoner at Rome, and finally as overseer of the important church at Ephesus, where Paul addressed him two canonical Epistles. His later history is unknown, as the tradition of his martyrdom under Domitian rests upon no evidence. Since the time of Schleiermacher a large number of German commentators have been inclined to regard him as the author of the book of the Acts, or, at all events, of the personal narrative in the second part, characterized by the use of the formula "we" in narrating the journeys of Paul. The absence, however, of all evidence that he was a companion of Paul's voyage and shipwreck, and especially a comparison of Acts xx. 4 with the following verse, seem decisive against this hypothesis, it being more probable that TITUS (which see) was the writer of the itinerary in question. In the later period of his career we learn from the Epistle to the Hebrews (xiii. 23) that Timothy had been in prison, had just been released, and the subscription of that Epistle states that he was its bearer, but from whom, whence, and whither have been much debated, many modern critics inclining to the opinion that it was written by Apollos from Rome to the Hebrew portion of Timothy's churches at and near Ephesus. Timothy was identified by Calmet, Tillemont, and others as the "angel" or messenger of the church of Ephesus to whom the message of Rev. ii. 1–7 was addressed, but this theory is apparently not now held. PORTER C. BLISS.

Timothy, First and Second Epistles to, two short canonical books of the New Testament, addressed by Paul to Timothy as first overseer of Ephesus, the former from Laodicea, the latter from Rome, according to the (unauthentic) subscriptions. They are both chiefly occupied with instruction in the duties of a spiritual teacher, mingled with some admonitions of a personal nature and some references to Timothy's personal history; and the Second Epistle is endowed with a peculiar interest from its references to Paul's anticipated martyrdom, this being probably the last extant production of his pen. With the similar letter to Titus they constitute the so-called "Pastoral Epistles," the genuineness of which was denied by the Gnostics of the second century, and has been one of the problems most vehemently debated by German theologians of the present century. The controversy was practically begun by Schleiermacher, who, admitting the genuineness of Second Timothy and of Titus, attacked the First Epistle on the ground that its contents are all derived from the two companion Epistles, and that it presupposes a developed system of church government quite foreign to apostolic times. Eichhorn and De Wette quickly extended the range of the second argument, denying the genuineness of all the Pastoral Epistles. Other writers, especially Baur and Ewald, reinforced this argument by alleged differences of style and vocabulary from the admitted Pauline Epistles, but especially by the difficulty of fitting the data of Second Timothy into any consistent scheme of the life of Paul, it being impossible, according to them, that the journey in Asia there alluded to could have been made either before or after Paul's imprisonment at Rome. The defenders of the Epistle reply to the latter argument by maintaining a second imprisonment of Paul at Rome. (See especially the commentaries of Ellicott, Huther, and Oosterzee, the latter in Lange's series, New York, 1868.)

PORTER C. BLISS.

Tim'perley (C. H.), b. at Manchester, England, about 1794; entered the army, and was wounded at the battle of Waterloo; resumed his early occupation of engraver and copperplate printer, and in 1821 became a letter-press printer; wrote *Annals of Manchester*, *Printer's Manual* (1838), *Dictionary of Printers and Printing, with the Progress of Literature, etc.* (1839; the second edition of 1842 includes the two last works), *Songs of the Press, and other Poems relative to the Art of Printers and Printing* (1845). D. about 1848.

Tim'rod (HENRY), b. in Charleston, S. C., Dec. 8, 1829; studied for a time at the University of Georgia, but did not graduate; became a teacher, studied law, and contributed verse to various periodicals, and during the civil war wrote several stirring war-lyrics. In Jan., 1864, he became editor of the Columbia *South Carolinian*, which was discontinued after the conflagration of the city in Feb., 1865, by which he suffered severely. He subsequently took up his residence in Charleston, where he suffered from ill-health and pecuniary embarrassments. D. at Columbia, S. C., Oct. 6, 1867. A collection of his poems was published in Boston (1860), and an enlarged edition, with a *Memoir* by Paul H. Hayne, in New York (1873).

Timuquans, an extinct tribe of Indians of the Choctaw family, formerly occupying the coast of Florida N. of St. Augustine. Missions were maintained among them by the Spanish Franciscans from 1592 until the middle of the eighteenth century, when the tribe was nearly exterminated by war with the colonists of Georgia and Carolina, the few survivors taking refuge with other tribes. Three catechisms and a manual of confession in the Timuquan language, by Father Francisco Pareja, were printed at Mexico between 1612 and 1627.

Timur', or **Tamerlane'** (the latter name being a corruption of TIMUR LENK—that is, "Timur the Lame"), b. Apr. 9, 1336, at Kesh, about 40 miles S. E. of Samarcand, the son of a chief of a Mongol tribe settled here, and descending on the mother's side directly from Genghis Khan. In 1360 he became chief of his tribe, and now began that wonderful evolution of conquering power which ended by subjugating the whole of Central and Western Asia, from the Chinese Wall to the Mediterranean and from the Siberian steppes to the mouth of the Ganges. In 1393 he stood on the banks of the Dnieper threatening Moscow, but he turned to the S., burnt Azof, and retreated into Asia. In 1398 he conquered Delhi, whence he sent an immense amount of booty to Samarcand, and meditated pushing onward to the S., when he was called to the western frontier of his realm. Here the conquest of Armenia, Georgia, and the countries on the Euphrates had brought him into contact with the Turkish empire, ruled over at that time by Bajazet, also a great conqueror. On July 20, 1402, the two huge armies, led by Bajazet and Timur, met each other on the plain of Angora, and the Turks were completely routed; Bajazet himself was taken prisoner. In 1404, Timur prepared for a grand expedition to China, and in the beginning of the following year crossed the Jaxartes at the head of an army of 200,000 veteran troops, but d. at Otrar Feb. 18, 1405, and his empire soon became scattered. His cruelty and that of his soldiers was beyond description. Before the battle of Delhi he ordered all the male captives who followed his army, said to have numbered about 100,000, to be put to death, and after the suppression of an insurrection in Herat he constructed, for the sake of warning, a pyramid in which layers of brick and mortar alternated with layers of the revolted inhabitants of the city. But in other respects he is said to have been possessed of political statesmanship, administrative ability, and even of literary taste. (See *Histoire de Timur-Bei*, 4 vols., Paris, 1722; translated into French by Pietis de la Croix from the Persian text by Sheref-ed-Din.) The works ascribed to Timur, the *Constitutions* and *Commentaries*, are of doubtful authenticity. They were translated into English in 1783 by Davy and White.

Tin [Ger. *Zinn;* Fr. *étain;* Lat. *stannum*], a lustrous, white metal, not easily affected even by moist air at low temperatures, soft, malleable, of low tenacity, quite ductile at 212° F. (100° C.), a moderately good conductor of heat and electricity, not sensibly volatile at ordinary furnace-heat, fusing at 442° F. (227.8° C.), having after fusion a specific gravity of 7.292. Very pure tin in blocks is sometimes disintegrated by extreme cold. It is one of the oldest

of known metals, being mentioned in the Pentateuch, and obtained long before the Christian era by the Phœnicians from the British Isles, hence called Cassiterides (from κασσίτερος, "tin"). Pliny's *stannum* was an alloy of silver and lead, perhaps also tin, which he called *plumbum album*, white lead; the alchemists called it Jupiter, and gave it the symbol of that planet, ♃. Tin ores are largely worked in Cornwall, England; Banca, Billiton, and Malacca in the East Indies; less abundantly in Saxony, Bohemia, France, Spain, Australia, Ireland, China, Japan, the United States of Colombia, and Mexico; small quantities are found in Greenland, Sweden, Finland, and California; other places in the U. S. have afforded very small quantities—viz. Paris and Hebron, Me.; Chesterfield and Goshen, Mass.; near Jackson, N. H.; near Boonville, Id.; and Missouri is said to have furnished it. Tin ores occur in veins in gneiss, granite, mica and chlorite schists, and porphyry, associated with iron pyrites, copper pyrites, zinc-blende, galena, fluor-spar, apatite, topaz, mica, and wolfram. The most important ore is the oxide, called *cassiterite, tin stone*, and *tin ore;* it occurs in veins, when it is called *mine tin*, and also as rolled pebbles in alluvial deposits, furnishing excellent ore, known as *stream tin* and *wood tin*. It is generally a dark-brown mineral, very hard, of sp. gr. 6.4 to 7.1; crystallizing in tetragonal prisms, with pyramidal ends; generally has a high, vitreous lustre, and contains 78.67 per cent. of tin. A far less abundant and less valuable ore is *stannite* or *tin pyrites*, a sulphuret of tin, copper, iron, and zinc, with 27.2 per cent. of tin and 29.3 per cent. of copper. Native metallic tin has probably never been found. A little tin has been detected in meteoric iron, some zinc-blendes, and several rare minerals.

In England and Germany tin ore is worked by sorting it, stamping, concentrating by washing, roasting to remove sulphur, washing again to dissolve sulphate of copper and to wash out oxide of iron, reducing in reverberatory furnaces or shaft furnaces (the former being best adapted to good ores, and being used in England), and refining. (See REFINING OF METALS.) The concentrating is so thoroughly done in Saxony that ores containing only 0.5 to 1 per cent. of tin can be treated profitably. The best tin thus obtained is known as *grain tin*, the inferior varieties as *bar* or *block tin*. When the tin ores contain much wolfram (tungstate of iron and manganese), they must be calcined with carbonate of soda, thus forming tungstate of soda, which is dissolved out before smelting the ore for tin. Banca tin is the purest in the market. Tin artificially crystallized by a voltaic current is tetragonal; it can also be obtained in crystals by fusing and slowly cooling it. Stannous chloride, $SnCl_2$, is formed by dissolving tin in hydrochloric acid; it is a powerful reducing agent, and is used as a mordant under the name of *salt of tin*. Stannic chloride, $SnCl_4$, can be formed by heating corrosive sublimate with tin filings, or by passing chlorine over melted tin. It forms with chloride of ammonium a double salt, called *pink salt*, used for a red dye. An impure stannic chloride, formed by the action of nitric and hydrochloric acids on tin, is used for brightening and fixing red colors, under the name of *nitro-muriate of tin, composition*, or *tin solution*. Stannous oxide, SnO, stannous hydrate, $Sn_2H_2O_3$, and sesquioxide of tin, Sn_2O_3, are unimportant commercially. Stannic oxide, SnO_2 (*putty powder*), is formed when tin is heated above fusion in the air. It forms two hydrates; one of these, stannic acid, H_2SnO_3, forms various stannates, the stannate of soda being used as a mordant in calico-printing; arsenic-stannate of soda is also employed. The other is metastannic acid, produced by the action of nitric acid of sp. gr. 1.3 upon tin. Dried at 212° F. (100° C.), it is $H_{10}Sn_5O_{15}$. It becomes anhydrous on ignition. Monosulphide of tin, SnS, and sesquisulphide, Sn_2S_3, are of little interest. The bisulphide, SnS_2 (*mosaic gold*), can be obtained by powdering an amalgam of 12 parts of tin and 6 of mercury, and heating it in a flask with 7 parts of sulphur and 6 of sal-ammoniac; other proportions are also used. Tin forms many other chemical compounds, of little general interest. The most important alloys of tin are britannia metal, equal parts of brass, tin, antimony, and bismuth; pewter, 4 of tin and 1 of lead; queen's metal, 9 of tin, and 1 each of antimony, bismuth, and lead; fine solder, 2 of tin and 1 of lead; common solder, equal parts of each; coarse solder, 2 of lead and 1 of tin; speculum metal, 1 of tin and 2 of copper (but variable), with sometimes a little arsenic; bell metal, 78 of copper and 22 of tin, with sometimes a little zinc and lead; bronze, with less tin than bell metal, and with 3 to 4 of zinc; gun metal, best with 9 of copper and 1 of tin; sheathing for ships, 32 of copper and 1 of tin; fusible metal, with 1 of lead, 2 of bismuth, and 1 of tin, fuses at 200.7° F. (93.7° C.); type metal, for fine work, contains a little tin; amalgam of tin and mercury for coating mirrors; and Babbitt's metal. Melted tin is used to coat sheet iron (tin plate) and copper; copper, zinc, brass, and iron can also be tinned in the wet way; and tin has been successfully deposited on textile fabrics.

The following table shows the value in dollars of tin and tin products imported into the U. S. from different [illegible] during the year ending June 30, 1873, according to the Congressional reports on commerce:

	Blocks or pigs.	Plates.	Other manufactures.
China	401,442	46	870
Japan	59,[illegible]	......	1,047
Germany	2,[illegible]	46	15,817
British Isles	751,7[illegible]	14,957,[illegible]	54,[illegible]
" North America	5,173	31,[illegible]	4,881
" West Indies	7,125	......	524
" East Indies	1,781,8[illegible]		
Dutch East Indies	286,[illegible]		
Mexico	1,576	27	
U. S. of Colombia	683		
Other sources	......	1,411	10,[illegible]
Total	3,277,884	14,99[illegible]	8[illegible]

Phillips gives the production of tin in 1871 as follows: England, 11,320 tons; Saxony and Bohemia, about one fifteenth as much; Banca, 4320; Billiton, 3190; South America, 1200; the total from all sources, 25,000 to 28,000 tons.

H. B. CORNWALL.

Tinam'idæ [from *Tinamus*—the Latinized form of *Tinamou*, a popular name—the typical genus of the group], a family of birds presenting several peculiarities, and even anomalies, of structure, which have caused their isolation as an independent "super family," "sub order," and even "order." In external appearance the species resemble, perhaps, the quails and partridges more than any other familiar birds; the head is rather small, the neck rather short, and the back and tail depressed; the bill is rather slender and mostly straight, but more or less decurved at the tip, and with the upper mandible overhanging the lower; the base is covered with a membrane which encroaches on the nostrils; the nostrils are large, elongate, and near the base of the bill; the wings are rounded behind, concave, and short; the tail is short, and sometimes quite rudimentary, and more or less concealed by the incumbent coverts; the legs are inserted rather far behind; the tarsi moderate or stout, and provided with large plates in front, the anterior toes well developed and entirely free, the posterior small and elevated or wanting; the claws are curved. These are all normal characters, and it is only in the osteology that great deviation from ordinary birds is manifested. As indicated by Parker and Huxley, the skull has a palate much like that of an ostrich. "In fact, the vomer is very broad, and in front unites with the broad maxillo palatines, as in *Dromæus* (cassowary), while behind it receives the posterior extremities of the palatines and the anterior ends of the pterygoid bones, which thus are prevented, as in the Ratitæ, from entering into any extensive articulation with the basisphenoidal rostrum. The basipterygoid processes spring from the body of the sphenoid, not from its rostrum, and thus articulate with the pterygoids very near the distal or outer ends of the latter bones. The head of the quadrate bone is single, as in the struthious birds." (*Huxley*.) The sternum and the pelvic bones are, however, essentially the same as in ordinary carinate birds. In view, then, of this combination of characters the family has been regarded by Huxley as the representative of one of the four groups into which the carinate birds are divided. The group has been named Dromæognathi, in allusion to the similarity of the jaws (and palate) to those of *Dromæus*. The family is peculiar to South and Central America, and is represented by a goodly number of forms. Sclater and Salvin have recognized 41 species, which have been distributed among [illegible] genera and under 2 sub families, viz. (1) Tinaminæ, with the genera *T*[illegible] (7 species), [illegible] ([illegible] species), *Crypturus* (17 species), *Rhynchotus* (2 species), *N*[illegible] (6 species), *N*[illegible] (1 species), and *T*[illegible] (1 species); and (2) Tinamotinæ, with the genera *E*[illegible] ([illegible]) and *T*[illegible] (1 species). The species [illegible] some inhabiting the thickest forests, and [illegible] They feed chiefly on grains, and indeed [illegible] represent the partridges, etc., which [illegible] America. The females generally lay [illegible] some not more than half a dozen, [illegible] in rude nests made on the ground [illegible] mother as soon as hatched.

Tinamou. See TINAMIDÆ.

Tincal. See BORAX.

Tinc'tures [Lat. [illegible]] [illegible] to designate solutions [illegible] In their preparation [illegible]

verized, and as a rule it is found advantageous to use diluted or aqueous alcohol as the solvent, as by this means numerous substances which are insoluble in anhydrous alcohol can be brought into solution; but many of the tinctures prepared in this way undergo acetous fermentation, which objection is best obviated by preserving them in well-closed and completely-filled bottles. Usually, maceration and digestion accelerate the preparation of tinctures; percolation has also lately been extensively practised. Occasionally, the expressed juice of the plant is dissolved in alcohol, which method is especially applicable to the preparation of tinctures of narcotic substances, such as conium and belladonna. J. P. BATTERSHALL.

Tin′dal (MATTHEW), LL.D., b. at Beer-Ferris, Devonshire, in 1657; studied at Oxford, where he took his degree in 1676; became fellow of All Souls, and in 1685 was made LL.D., shortly after which he went over to the Roman Catholic Church, but returned to the Church of England when the revolution of 1688 seemed imminent. After the revolution he held several legal positions, and received from the Crown a pension of £200. He took an active part in the polemics of his day, and in 1706 published *The Rights of the Church Asserted*, in which he took ground against the prevalent High-Church doctrines. This gave rise to sharp controversies, during which he put forth two *Defences*, in which he treated of the obedience due to princes, the law of nations, the liberty of the press, and the rights of mankind in matters of faith. In 1710 he issued a pamphlet, the *New High Church turned Old Presbyterian*, in opposition to the famous sermon of Dr. Sacheverell. The House of Commons ordered the productions of both controversialists to be publicly burned. In 1730 he put forth his most noted work, *Christianity as Old as the Creation*, in which he argued that in Christianity there was nothing which human reason might not have discovered without a special revelation, which called forth a host of replies, and a defence by himself of the doctrines which he had advanced. He also wrote a second volume of his work, of which only the preface has been published. D. in London Aug. 16, 1733.

Tindal (NICHOLAS), nephew of Matthew Tindal, b. in Devonshire in 1687; studied at Trinity College, Oxford, where he graduated in 1713, and of which he became a fellow; entered holy orders, and held several valuable preferments, among which was that of chaplain of Greenwich Hospital. He put forth several historical and miscellaneous works, the most important of which is a translation of Rapin's *History of England*, with a very valuable *Continuation from 1688 to the Accession of George II.* (1744–47). D. in 1774.

Tindale (WILLIAM). See TYNDALE (WILLIAM).

Tin′der [Ang.-Sax. *tyndre*], a material, usually composed of half-burned linen, which was formerly used in kindling fires. A flint and steel ignited the tinder, which inflamed in turn a sulphur match. Amadou, touch-wood, and touch-paper were substitutes for tinder.

Tinea. See TINEIDÆ.

Tine′idæ [from *Tinea*—so called on account of the small body—the typical genus], a family of Lepidoptera rich in species, and including the moths so destructive to clothes. The developed insects are of small size, have a slender body, elongated, narrow wings, which when the insect is at rest are rolled round the body, and which are edged with long fringes; the maxillary palpi are very large, and the antennæ are long and filiform. The larvæ are elongate, and generally provided with numerous (14 to 18) feet, although occasionally entirely footless. They differ among themselves chiefly in the form and furniture of the head (whether hairy or naked), the development of the maxillary and labial palpi, and the form of the wings. The imagines mostly affect the lee side of hedges, etc.; the larvæ burrow in leaves, stems, grain, etc., of plants, as well as other substances, such as cloth. The most notable species are the clothes moth (*Tinea flavifrontella*), the carpet moth (*Tinea tapetzella*), and the grain moths (*Tinea granella* and *Gelechia cerealella*). The ravages of these, or at least of the first, are well known. The clothes moth is light buff, glanced with a silvery iridescence on the wings and tawny on the head. It makes its appearance in the Northern U. S. in May or June. The female lays her eggs in cloth, generally woollens, sometimes cotton, and a whitish larva is soon hatched therefrom. The carpet moth has yellowish-white but black-based fore wings, dark-gray hind wings, and white head. Benzine and carbolic acid, and precautions as to cleanliness, are the best antidotes to the ravages of these little pests. THEODORE GILL.

Tin-Foil. See FOIL.

Ting-Hai. See CHUSAN.

Tin′icum, tp., Bucks co., Pa. P. 2401.

Tinicum, tp., Delaware co., Pa. P. 147.

Tin-Mines. See APPENDIX.

Tin′mouth, p.-v. and tp., Rutland co., Vt. P. 589.

Tinne, or **Tinneh,** the name applied by recent explorers to the most northerly branch of American Indians, forming a branch of the Athabaskan family, and extending from Hudson's Bay N. W. to Central Alaska. They embrace more than twenty tribes, with a total of about 15,000 souls, having some six different languages. The best known and most typical tribes are the Chepewyans or Montagnais, the Beavers, the Dog Ribs, the Tacullies or Carriers, the Loncheux, and the Kenai. They are pacific, live chiefly on game and fish, are tall and slender, with full faces and dark complexions, and some beard. A few have been converted by the Roman Catholic and Protestant missionaries.

Tin′ne (ALEXANDRINA PETRONELLA FRANCINA), b. at the Hague Oct. 17, 1835, the only child of a rich merchant; received an excellent education; travelled after the death of her father through most European countries, Syria, Palestine, Egypt, etc., and settled in 1861 in Cairo. From Feb. 2, 1863, to Mar. 29, 1864, she undertook a grand journey of exploration from Khartoom to the Bahr el-Ghazal, the western arm of the White Nile. She invited Baron von Heuglin and Dr. Steudner to accompany her, and the valuable scientific results of the expedition were communicated in John A. Tinne's *Geographical Notes of Expeditions in Central Africa*, in the *Transactions* of the Historic Society of Lancashire and Cheshire (Liverpool, 1864); Von Heuglin's *Die Tinnesche Expedition im westlichen Nilquellgebiet*, supplement to Petermann's *Mittheilungen* (1865); and Th. Kotschy and Peyritsch's *Plantæ Tinneanæ* (1867). From Tripoli she started on another expedition, Jan. 30, 1869, with the purpose of reaching the upper Nile through Bornoo, but at Fezzan she was murdered by her Arabic attendants, Aug. 1, 1869.

Tinni′tus Au′rium [Lat. for "ringing of the ears"], a symptom which often accompanies a cold or an attack of indigestion. It may, however, attend a severe febrile or other acute disease, but is unimportant, except for the fact that when persistent it sometimes indicates disease of the auditory nerve, when it may be the forerunner of total deafness. Cases are, however, not unknown of ringing of the ears which lasts for many months with apparently good general health.

Ti′no, or **Ti′nos,** an island of Greece, belongs to the Cyclades, and is situated immediately S. of Andros. Area, 81 sq. m. P. 21,171. The soil is stony, and not so very productive, but it is well watered and exceedingly well cultivated. Wine, melons, figs, barley, oil, and wheat are produced. Marble, raw or worked into different kinds of vessels and ornaments, and silk, raw or manufactured into gloves and stockings, are the principal articles of export. The principal town is St. Nicholas, which has a splendid cathedral, built of white marble and visited by many pilgrims, and a small but convenient harbor.

Tinoc′eras [Gr. τίνειν, to "avenge," and κέρας, "horn"], an extinct genus of herbivorous mammals from the Eocene of Wyoming and Utah, and the first known representative of a remarkable group, now regarded as forming a distinct order, Dinocerata, so named from the best-known genus, *Dinoceras*. This genus may be taken as typical of the order, and its principal characters are as follows: The skull is long and narrow, the facial portion being much produced. It supports three separate pairs of osseous elevations, some of which, if not all, seem to have been the bony support for horns. They form the most conspicuous feature of the skull, and suggested the name of the genus, "the terrible-horned." The smallest pair are near the end of the nasal bones; a larger pair rise from the maxillary or cheek bones, in front of the orbits; while the largest pair are on the parietal bones, and are supported by an enormous crest, which extends from near the orbits around the lateral and posterior margins of the cranium, nearly surrounding a deep depression upon the crown of the head. The dental formula in *Dinoceras* is as follows: incisors, $\frac{0-0}{3-3}$; canines, $\frac{1-1}{1-1}$; premolars, $\frac{3-3}{3-3}$; molars, $\frac{3-3}{3-3}$. The premaxillaries are toothless, as in ruminants, and may have supported a callous pad also, as in that group. The upper canine teeth are deeply implanted in the maxillary bones. They are long, decurved, and trenchant, separated by an interval from the molar teeth, which are comparatively quite small. The lower incisors and canines were approximate, and projecting forward, and separated from the small molars. The lower jaw sends down a massive process on each side near its extremity, apparently for the support and protection of the large upper canines while the mouth was closed. The cervical vertebræ are longer than in the elephant, while the legs are short and the skull elongated, so that the head could easily reach the

ground. There was, therefore, no necessity for a proboscis, and the structure of the skull affords no evidence of its existence, although some naturalists, misled by superficial resemblances of the feet of these animals to those of the elephant, have contended that they were proboscidians. The feet were short and stout, and there were five toes before and behind, but the carpal bones form interlocking series, and the astragalus articulated with both the navicular and cuboid bones. The metapodial bones are of moderate length, and their articular surfaces for the phalanges nearly flat, or even concave, indicating but little motion in the toes. The phalanges are very short, the distal ones rugose. In the hind limb when at rest the knee-joint was straight, as in the elephant and man, instead of being considerably flexed, as in nearly all quadrupeds. The brain-cavity of *Dinoceras* is, however, the most remarkable feature of this remarkable genus. It proves that the brain was smaller than any more recent mammal, whether living or fossil, and was even less than in some reptiles. The entire brain was so diminutive that it could perhaps have been drawn through the neural canal of all the presacral vertebræ, certainly through the cervicals and lumbars. In the brain itself the most striking feature is the small size of the cerebral hemispheres, which do not overlap either the cerebellum or the olfactory lobes. The latter were large, and produced well forward. The brain, as a whole, resembled that of some marsupials. Besides the genera already mentioned, there was at least one other, *Uintatherium*, closely allied. These animals were all large, some of them nearly equalling the elephant in size, and, with their armature of horns and tusks, must have presented a formidable appearance. O. C. MARSH.

Tintoret'to, whose true name was GIACOMO ROBUSTI, b. at Venice in 1512, the son of a dyer, from which circumstance he received his surname; studied first under Titian, afterward independently, and made it his great aim to connect the drawing of Michael Angelo with the coloring of Titian. He worked with an astonishing ease and rapidity, and the churches, convents, and palaces of Venice are full of brilliant and dazzling representations by him of historical, mythological, and scriptural subjects, and he is well represented in almost every collection of the European continent. Toward the close of his life he fell into a somewhat gross and mechanical manner. D. at Venice in 1594. Among his most remarkable pictures are—the *Paradise*, in the palace of the doge, 84½ feet long, 34 feet high, and containing several hundred figures; the *Marriage in Cana*, in the church of Santa Maria della Salute; the *Wonder of St. Mark*, in the Academy; the *Crucifixion*, etc.

Tio'ga, county of S. New York, bordering on Pennsylvania, intersected by the N. branch of Susquehanna River, and crossed by several railroads; the surface very hilly, soil generally moderately fertile. There are manufactories of agricultural implements, boots and shoes, carriages, saddlery, machinery, pianos, etc., saw-mills, grist-mills, planing-mills, paper-mills, and tanneries. Horses, cattle, and sheep are numerous. Staples, oats, Indian corn, wheat, hay, dairy products, and wool. Cap. Owego. Area, 480 sq. m. P. 30,572.

Tioga, county of N. Pennsylvania, bordering on New York, drained by Tioga River and its affluents, and penetrated by Corning, Antrim, and Tioga R. Rs. Surface hilly, well watered, and better adapted to grazing than tillage. Iron ore is found, and bituminous coal is abundant, which finds its chief market in Buffalo. There are numerous saw-mills, tanneries, and grist-mills, and manufactories of carriages, agricultural implements, furniture, glassware, woollens, and cheese. Cattle, sheep, horses, and swine are numerous. Staples, butter, cheese, hay, lumber, oats, Indian corn, wheat, buckwheat, potatoes, and maple-sugar. Cap. Wellsborough. Area, about 1100 sq. m. P. 35,097.

Tioga, tp., Tioga co., N. Y. P. 3272.

Tioga, p.-b. and tp., Tioga co., Pa., on Tioga and Corning Cowanesque and Antrim R. Rs., contains [illegible] churches, a graded school, a banking house, 4 tanneries, 1 newspaper, a handsome park, lock and firkin factories, a race-track, an excellent system of waterworks, 3 hotels, and a street railway. Principal business, farming and lumbering. P. of b. 440; of tp. 1074.

A. H. BENNETT, ED. "TIOGA CO. EXPRESS."

Tioga Centre, p.-v., Tioga co., N. Y. P. [illegible]

Tioga River rises in the W. part of Bradford co., Pa. Its general course is northward through Tioga co., Pa. At Painted Post, Steuben co., N. Y., its waters enter the river Chemung. The upper part of Tioga Valley affords much semi-bituminous coal of good value.

Tiones'ta, p.-b. and tp., cap. of Forest co., Pa., 20 miles N. E. of Oil City, has 3 churches, good schools, 2 newspapers, banks, 1 stave and 2 saw mills, and 4 hotels. Principal business, lumbering. P. of b. [illegible]

W. R. DUNN, ED. "REP[illegible]"

Tioomen', or **Tjumen,** town of Siberia, [illegible] of Tobolsk, on the Thura, an affluent of the [illegible], oldest, but at the same time one of the handsomest and most prosperous, of the Siberian cities. It is an entrepôt for the traffic between Russia, Siberia, the Kirgheez territory, Bokhara, and China, and has extensive manufactures of leather, tallow, candles, pottery, mats, wooden articles, carpets, and coarse woollen fabrics; 100,000 skins are annually tanned and dressed here. P. 11,[illegible].

Tip'pah, county of N. Mississippi, drained by Hatchie, Tallahatchie, and Tippah rivers. Surface undulating, soil fertile. Cattle and swine are numerous. Staples, cotton, Indian corn, sweet potatoes, and wool. Cap. Ripley. Area, about 500 sq. m. P. 20,727.

Tippecanoe', county of W. Indiana, drained by Wabash and Tippecanoe rivers, and intersected by Wabash and Erie Canal, and by several railroads. Surface generally level, soil a rich black loam. There are manufactories of agricultural implements, carriages, boots and shoes, machinery, and woollens, grist-mills, saw-mills, planing mills, pork packing establishments, and breweries. Horses, cattle, sheep, and swine are numerous. Staples, Indian corn, wheat, oats, wool, and dairy products. Cap. Lafayette. Area, about 500 sq. m. P. 33,515.

Tippecanoe, tp., Carroll co., Ind. P. 1109.

Tippecanoe, tp., Kosciusko co., Ind. P. 12[illegible].

Tippecanoe, tp., Marshall co., Ind. P. 1165.

Tippecanoe, tp., Pulaski co., Ind. P. [illegible].

Tippecanoe, tp., Tippecanoe co., Ind. P. 2274.

Tippecanoe, tp., Henry co., Ia. P. 1750.

Tippecanoe City, p.-v., Monroe tp., Miami co., O., on Great Miami River and Cincinnati Dayton and Michigan R. R., has manufactures and a weekly newspaper. P. 1204.

Tippecanoe River rises in Tippecanoe Lake, Kosciusko co., Ind. It pursues a devious S. W. course for 200 miles, and falls into the Wabash. On the banks of this river, at the present village of Battle Ground, in the county and township of Tippecanoe, Gen. Harrison fought and defeated the Indian tribes commanded by the Prophet, the brother of Tecumseh, Nov. 5, 1811.

Tippera'ry, county of Ireland, province of Munster, borders N. and N. W. on the Shannon and Lough Derg, and comprises an area of 1659 sq. m. The soil is in most places very fertile. Wheat is grown in large quantities and of superior quality, and dairies are numerous; wheat, flour, meal, and butter are largely exported. Yet agriculture is in a backward state, and the population lives in a depressed condition. Coal, copper, lead, and zinc are found, but not worked, and the formerly flourishing woollen trade is now nearly extinct. The population numbered 331,487 in 1851, but over 40 per cent. of that population has since emigrated, and of the present population, numbering 216,715, there are 59,049 who are unable to read or write. Principal towns, Clonmel, Nenagh, and Thurles.

Tipperary, town of Ireland, county of Tipperary, province of Munster, is an old but well built city, and has 6084 inhabitants.

Tippoo' Sa'hib, sultan of Mysore 1782–99, b. Nov. 19, 1749, a son of Hyder Ali, received a good education, was instructed in European tactics, and distinguished himself in the war against the English, defeating them at Perimbakum, Sept. 10, 1780, and on the banks of the Koleroon, Feb. 18, 1782. On Dec. 7, 1782, Hyder Ali died, and Tippoo Sahib now prepared for a still more energetic prosecution of the war. Apr. 28, 1783, he took Bednore, and soon after also Mangalore, but in the mean time peace had been concluded between England and France, the French [illegible] with their active participation in the war, and Tippoo Sahib felt thereby compelled [illegible] peace at Mangalore Mar. 11, 1784 [illegible] It was [illegible] to drive the E[illegible] but [illegible] the English East [illegible] religious [illegible] was greater than [illegible] and [illegible] making allies of [illegible] He [illegible], he waged [illegible] the company, which feared [illegible] France, Persia, and [illegible] and fell upon h[illegible] native princes, and [illegible] by ceding half of h[illegible] This [illegible] and when N[illegible] the company [illegible] might become [illegible] 1799 [illegible]

declared war against Mysore, invaded the realm with two armies, and shut up the sultan in his capital, Seringatam. Here he fell (May 4, 1799) while fighting on the walls; his dominions were confiscated by the company, and the spoils from his palace were carried to London. (See Michaud, *Histoire de l'Empire Mysore sous le Règne de Hyder Aly et Tippoo Saib* (2 vols., 1801); Wilks, *The South of India* (3 vols., 1810); and *The History of Tippoo Sultan, written by Mir Hussain Ali Khan*, translated into English by Col. Miles 1844).)

Tipps, tp., Wise co., Va. P. 985.

Tip'toft (John), Earl of, b. at Everton, Cambridgeshire, England, about 1425, son of Lord Tiptoft and Powys; educated at Baliol College, Oxford; became the most eminent classical scholar among the English noblemen of the time; was created earl of Worcester on the occasion of his appointment by Henry VI. to the post of lord deputy of Ireland, where his government was extremely rigorous; was afterward made lord high constable of the Tower, lord high treasurer, and knight of the Garter by Edward IV., whose cause he espoused in the "war of the Roses;" became obnoxious to the Lancastrians by the execution of several of their chieftains who had landed on the S. coast of England, on which occasion they fastened on him the epithet "the butcher;" visited Rome; delivered a Latin oration before the pope; made a careful inspection of the Vatican Library; went on a pilgrimage to Jerusalem, and on his return presented many valuable MSS. to the University of Oxford. He was the earliest English patron of William Caxton, who printed his translations of a part of Cæsar's *Commentaries*, Cicero's *De Amicitiâ*, and other works, but did not live to see the establishment of the press in England, having been executed on Tower Hill by the Lancastrians Oct. 18, 1470, under pretext of maladministration in Ireland many years before. Caxton pathetically deplores his death in the preface to one of the first books printed in England.

Tip'ton, county of Central Indiana, drained by Cicero Creek and other streams, and traversed by Indianapolis Peru and Chicago and Pittsburg Cincinnati and St. Louis R. Rs. Surface level, soil productive. There are saw-mills and some manufactures of woollen goods. Staples, Indian corn, wheat, wool, lumber, and live-stock. Cap. Tipton. Area, 290 sq. m. P. 11,953.

Tipton, county of W. Tennessee, bordering on Mississippi River, bounded N. by Hatchie River, and intersected by Louisville and Nashville and Great Southern R. R. Surface level, soil productive. Staples, cotton, Indian corn, and wool. Cap. Covington. Area, 370 sq. m. P. 14,884.

Tipton, tp., Cass co., Ind. P. 1808.

Tipton, p.-v., cap. of Tipton co., Ind., on Indianapolis Peru and Chicago R. R., 40 miles N. of the former place, has 3 churches, good schools, 1 bank, 2 newspapers, 1 flouring and 2 planing mills, 3 hotels, 2 stove-factories, 1 tannery, and 2 furniture establishments. Rich farming lands abound. P. 892. J. T. Cox, Ed. "Times."

Tipton, p.-v., cap. of Cedar co., Ia., on Stanwood branch of Chicago and North-western R. R., in the exact geographical centre of Cedar county, has 7 churches, public schools, 1 bank, 2 newspapers, a steam flouring-mill, county-seat buildings, and several manufactories. P. about 1143. Charles L. Longley, Ed. "Advertiser."

Tipton, tp., Hardin co., Ia. P. 397.

Tipton, p.-v., Moniteau co., Mo., on Atlantic and Pacific R. R., has a weekly newspaper.

Tipton, tp., Cass co., Neb. P. 315.

Tirabos'chi (Girolamo), b. at Bergamo Dec. 28, 1731; educated at Monza by the Jesuits, whose order he subsequently entered; was appointed professor in rhetoric at Milan in 1766, and librarian to the duke of Modena in 1770. D. at Modena June 3, 1794. His *Storia della Letteratura Italiana* (13 vols., 1772–83) is considered a model of historical research, and is still the principal work on its subject. He also wrote *Biblioteca Modenese* (6 vols., 1781–86) and *Memorie Storiche Modenei* (3 vols., 1793).

Tira'no, town of Italy, province of Sondrio, lying in the Valtellina, S. W. of Bormio, and about 17 miles E. of the town of Sondrio. Though a place of considerable industry, the inhabitants, like those of this valley generally, are for the most part very poor. P. 5667.

Tiras'pol, town of Russia, government of Kherson, on the Dniester, has some manufactures. P. 5384.

Tiree', an island of Scotland, one of the Inner Hebrides, is 13 miles long and 6 miles broad, low, destitute of wood, but affording good pastures. Oats, barley, and potatoes are raised, but the inhabitants, numbering 3201, are mostly engaged in fishing and rearing cattle and poultry.

Tire'sias, a celebrated soothsayer in ancient Greece, was blind, but understood the language of the birds, and lived through nine generations; even after his death he did not lose his power of prophecy. He had a famous oracle at Orchomenus, but after a plague it became silent. The Greek mythology tells many stories of the origin of his blindness and soothsaying power.

Tirlemont', town of Belgium, province of Brabant, on the Grande-Geete, has several good educational institutions, and manufactures of woollen stuffs, blankets, carpets, hosiery, leather, soap, oil, malt, and gin. It carries on an active general trade. P. 12,354.

Tir'nova, town of European Turkey, in Bulgaria, on the Jantra, an affluent of the Danube, has large dyeworks and some manufactures of silk and cloth. P. 12,000.

Ti'ro (Marcus Tullius), the freedman and pupil of Cicero, to whom he became an amanuensis, and was also an author of some reputation, writing several works, including a life of his patron: to him is due the collection of Cicero's *Letters*. Becoming familiar with the stenography of the period, he extended and systematized it, and by its aid preserved several of Cicero's orations. (See Stenography.) It is believed he lived to the age of one hundred.

Ti'ryns, an ancient city of Argolis, Peloponnesus, was one of the oldest cities of Greece, but in 468 B. C. was entirely destroyed by the Argives, and never rebuilt. The remains of its fortress, with its cyclopean walls, are the grandest and most curious ruins in Greece.

Tisch'bein (Johann Heinrich Wilhelm), b. at Haina in Hesse Feb. 15, 1751; received his first instruction in painting from his father, uncle, and elder brother, who all were painters of reputation; went in 1770 to the Netherlands, in 1779 to Rome, in 1787 to Naples, where he was director of the academy of painting from 1790 to 1799; returned in the latter year to Germany and settled in Hamburg. D. at Entin July 26, 1829. He painted mythological and historical subjects, scenes of animal life, and produced a great number of excellent illustrations, among which the most celebrated was *Homer nach Antiken gezeichnet* (Göttingen, 1801–04).

Tisch'endorf (Lobegott Friedrich Constantin), b. at Lengenfeld, Saxony, Jan. 18, 1815; studied theology and philology at Leipsic 1834–38; was appointed professor of theology there in 1843. From an early period of his life he concentrated his study on a critical revision of the text of the New Testament; made extensive journeys in Europe, examining the materials for such a revision contained in the various European libraries, and visited Egypt, the Sinaitic peninsula, Syria, and Palestine in 1844, 1853, and 1859, the last time at the expense of the Russian government. From the monastery of Sinai he brought back the famous *Codex Sinaiticus*, the oldest Greek manuscript of the Bible, which is now preserved in St. Petersburg, and was published in 1862 in 4 vols. fol. at the expense of the emperor Alexander II. D. in Leipsic Dec. 7, 1874. The principal results of Tischendorf's researches were several critical editions of the New Testament, but he also published *Codex Ephraemi Syri* (1843), *Monumenta Sacra Inedita* (1846), *Evangelium Palatinum Ineditum* (1847), *Codex Amiatinus* (1850), *Codex Claromontanus* (1852), *Novum Testamentum Vaticanum* (1867), *Monumenta Sacra Inedita, nova Collectio* (9 vols., 1854–65), *Acta Apostolorum Apocrypha* (1851), *Evangelia Apocrypha* (1853), *Apocalypses Apocryphæ* (1866), *Reise in den Orient* (2 vols., 1845–46), *Aus dem heiligem Lande* (1862), etc.

Tishabee, tp., Greene co., Ala. P. 1440.

Tishomin'go, county of N. E. Mississippi, bordering on Tennessee and Alabama, bounded N. E. by Tennessee River, drained by affluents of Tennessee and Tombigbee rivers, and traversed by Memphis and Charleston R. R. Surface hilly, soil productive. There are saw-mills, planing-mills, and some woollen manufactories. Staples, cotton, Indian corn, wool, a little tobacco, and lumber. Cap. Iuka. Area, 550 sq. m. P. 7350.

Tiskilwa, p.-v., Bureau co., Ill.

Tis'ri [Heb.], the first Hebrew month of the civil year and the seventh of the ecclesiastical year. It corresponds to part of September and October.

Tissapher'nes, appointed satrap of Lower Asia by Darius II. Nothus in 414 B. C. After the death of Darius in 407, his younger son, Cyrus, who was viceroy of Asia Minor, tried to oust his brother, Artaxerxes II. Mnemon, from the throne, but was defeated at Cunaxa in 401 by Tissaphernes, who in reward received the command also in Asia Minor. His attempt, however, to punish the Greek cities which had supported Cyrus was unsuccessful. They were supported by the Spartans, and he was defeated by

Agesilaus in Lydia. Meanwhile, his treacherous and insidious character had made him odious even in the eyes of Artaxerxes, and on the instigation of Parysatis, the king's mother, he was assassinated at Colossæ, Phrygia, in 395.

Tissot′ (Pierre François), b. at Versailles Mar. 10, 1768; received a good education, and was, after various vicissitudes during the Revolution, employed by Napoleon as censor, and in 1814 appointed professor of general literature at the Collége de France. After the restoration of the Bourbons, he founded the *Constitutionnel*, and gave so much offence by his Bonapartist opposition that he lost his chair, but received it again after the revolution of July, 1830. D. at Paris Apr. 7, 1854. He produced some original poems, translated Virgil's *Bucolica* and the elegies of Johannes Secundus, and wrote *Histoire complète de la Révolution française* (6 vols., 1833–36) and *Mémoires historiques sur Carnot* (1824).

Tissot (Simon André), b. at Grancy, canton of Vaud, Switzerland, Mar. 20, 1728; studied medicine at Geneva and Montpellier; settled as a practitioner in Lausanne about 1750; was appointed professor of clinical medicine in 1780 at the University of Pavia by Joseph II., but returned in 1783 to Lausanne, where he d. June 15, 1797. His complete works, containing many valuable contributions to medical science, were published at Lausanne in 15 vols. (1783–95), and at Paris in 11 vols. (1809–13), but it was especially his *L'Onanisme* (1760) and *Avis au Peuple sur la Santé* (1761) which attracted general attention, and were translated into most European languages.

Tis′sues [Fr. *tissu*], the ultimate anatomical elements which constitute the fibrillated structures of the body—the muscles, tendons, and connective tissue. (For the structure of these see Histology.) The individual tissue is developed from an antecedent nucleated cell by a transition of the round or ovoid shape to spindle shape, to live processes, and finally becoming the extended fibre. White fibrous or connective tissue tends to develop in all processes of repair of wounds, the exuded nutritive matter organizing around nuclei, probably exuded white blood cells, and developing wavy lines. Such newly-developed tissues may gradually atrophy, the scar or inflammatory deposit disappearing: in other cases they become highly vascular, are permanent, or tend to excessive growth.

E. Darwin Hudson, Jr. Revised by Willard Parker.

Titan′ic Diox′ide, generally called **Titanic Acid** (TiO_2). This compound alone constitutes three distinct mineral species—*octahedrite*, *brookite*, and *rutile*. A synonym of octahedrite is *anatase*, and a synonym of brookite is *arkansite*. These species are referred to under Isomerism (which see), but by an error which escaped correction the synonym *arkansite* was there appended to octahedrite instead of brookite. The statements of mean densities there given, moreover, may be modified to an important degree with advantage. They were averaged from figures cited in mineralogical textbooks, but further examination of the records, made since by the writer, has developed a long list of additional figures, and these, taken into connection with the writer's now-published discovery (see *Am. Chemist* for Mar., 1876) of the geometric law of molecular volumes (see also Volumes, Molecular), enable him to compute the following precise figures for these three species, with one or two of their modifications:

	True densities at zero.	Experimental densities.	
A *minimum* octahedrite of Boullay	3.766	3.75	Boullay.
The normal or *dominant* octahedrite	3.902	3.89	H. Rose.
The normal or *dominant* brookite	4.177	4.166	" "
The normal or *dominant* rutile	4.316	4.3	Hautefeuille.
A *maximum* rutile of Kopp	4.461	4.42	Kopp.

Kopp's heavy rutile is cited here because a special interest attaches to it as containing a volume or molecule of titanium identical with that of *carbon* in carbonates and hydrocarbons. At the same time, it may be remarked that the *minimum* anatase (octahedrite) cited from Boullay is of equal interest, as containing one titanium molecule equal in dimensions to that of *silicon* in quartz and in crystallized silicates generally. The precise molecular volume of the silicon in quartz is still more closely approached, moreover, by *artificial* octahedrites obtained by Hautefeuille, for which he gives a range of densities running as low as 3.7. Precise parallelism in structure with quartz would require a density of 3.639. The dioxide of titanium form, therefore, doubtless, a progressive series (see Series in Chemistry) of allotropes or homologues (the geometric law of construction of homologous series being the same as that of series of allotropes, according to the writer's researches), which connects the dioxide of carbon (in combination) with the dioxide of silicon. By heat, octahedrite acquires density 4.16, that of brookite.

Of the three mineral forms of titanic dioxide, rutile is far the most abundant, being indeed in some districts a quite common mineral. The commoner varieties have a peculiar reddish tinge, and a lustre of a peculiar [illegible] brilliancy on the cleavages, which, with its high density, enables it to be distinguished at a glance by those expert in minerals. Its hardness is between those of [illegible] and feldspar. The crystals are dimetric or tetragonal, [illegible] usually prismatic, sometimes acicular, and are found in the latter form penetrating transparent quartz crystals from side to side in a great many directions, like needles, forming interesting cabinet specimens known as "rutilated quartz." In these cases the rutile needles have evidently been first formed, crossing a cavity filled with the menstruum from which they were deposited, in which the quartz has subsequently crystallized out from the same or some other menstruum. There are a great many American localities of rutile, too numerous to mention here.

Brookite is trimetric or orthorhombic in crystallization, translucent, with cleavage less distinct than rutile, but having the same metallic-adamantine lustre. It has been found in small crystals in North Carolina [illegible] at Paris in Maine, and at Ellenville in Ulster co., N. Y., and in a number of foreign localities. At the [illegible] locality at Magnet Cove, Ark., it is found as the variety *arkansite*, so called by Prof. Shepard, which is described as iron black and opaque, though nearly pure titanic oxide, according to Whitney and Damour.

Octahedrite, or anatase, is tetragonal like rutile, but with very different angles and cleavages. It is [illegible] octahedral in form, highly lustrous like diamond, and sometimes mistaken for it in placer washings. [illegible] North American locality is cited, in dolomite at Smithfield, R. I.

Pure TiO_2 may be obtained from minerals containing it, as follows: They are fluxed with [illegible] parts of potassic carbonate, the mass washed with cold water to remove the excess of the flux, and the remaining acid titanate of potash dissolved in muriatic acid. The solution is diluted, treated with H_2S to precipitate tin, and then ammonia added to precipitate the TiO_2, which will carry down with it sulphides of iron and manganese when present. These are dissolved out from the precipitate with a solution of SO_2, which leaves pure "titanic hydrate." Also, if the muriatic solution be boiled with *sulphite of ammonium*, pure titanic acid hydrate goes down. H. Rose found its composition to be [illegible]. On ignition it leaves TiO_2, which is yellow when hot. Dissolved in dilute mineral acids and boiled, a [illegible] precipitates, called *metatitanic acid*, of the same composition, which is no longer soluble in acids, except in [illegible] of vitriol. Titanic dioxide, as rutile, is used to a small extent to give a pale yellow color to porcelain and to artificial teeth.

Henry Wurtz.

Titanites. See Titanium.

Tita′nium. Dr. William McGregor, in examining the mineral now called [illegible], from Menachan in Cornwall, in 1791, discovered the existence of [illegible] new element, afterward found by Klaproth in 1794 in [illegible], and called by him in 1797 *titanium*, in [illegible] to the Titans, who were the children of [illegible]. (See the article Titans.) Titanium is [illegible] element, but very little is as yet known of it in the [illegible] form. For a long time certain [illegible] of [illegible] color found in blast-furnaces were [illegible] titanium, but Wöhler has proved that [illegible] ogen and nitrogen. The element [illegible] the double fluoride of titanium and potassium with [illegible]. It is described as a dark green heavy powder, which cannot be burnished and is [illegible]. Its [illegible] Its metallic nature [illegible] assumption, and its [illegible] with [illegible] and [illegible]. Titanium occurs in many minerals. [illegible]

[illegible]

and phosphates—but, unfortunately, it happens that the titanium is excessively difficult to flux out from the mass, tending apparently to form slags of very difficult fusibility, thus limiting their use very greatly. It has been recently reported that some have overcome this obstacle successfully, but the subject must yet be regarded as in the experimental stage. HENRY WURTZ.

Titanothe′rium [Gr. τιτάν, "titan," and θηρίον, a "beast"], an extinct genus of mammals from the "Mauvaises Terres," or "Bad Lands," of White River, Dakota. The formation is regarded as Miocene, and the bones of this animal were the first fossils obtained from the region. They were made known by Dr. H. A. Prout, and the species was afterward named by Dr. Leidy *Titanotherium Proutii*. Later researches and extensive collections in the same region, and in the Miocene of Nebraska and Colorado, have shown that this species is but one of an extinct family of herbivorous mammals, now known as the Brontotheridæ, and including at least four genera—viz. *Titanotherium*, with short nasal bones, and *Megacerops*, with more elongated nasals; both genera with a diastema or toothless interval between the upper canine and molar teeth, and a short or rudimentary third trochanter on the femur; *Brontotherium*, with four incisors above and below, and *Diconodon*, with no upper and but two lower incisors, both genera without a diastema, and the first, at least, having a distinct third trochanter. The best-known genus is *Brontotherium*, and its principal characters are as follows: The skull is long and depressed, and resembles that of the rhinoceros. There is a pair of large horn-cores on the anterior part of the skull, in front of the orbits. They stand on the maxillary bones, and are placed transversely, as in ruminants. They vary much with age, and probably differed in the sexes. There are large air-cavities in the base of these horn-cores. The nasal bones are greatly developed and firmly co-ossified. They are produced in front, and overhang the narial orifice. The zygomatic arches are massive and much expanded. The occipital condyles are large and well separated. The dental formula is as follows: incisors, $\frac{2}{2}-\frac{2}{2}$; canines, $\frac{1}{1}-\frac{1}{1}$; premolars, $\frac{4}{3}-\frac{4}{3}$; molars, $\frac{3}{3}-\frac{3}{3}$. The upper incisors are small. The canine is short and stout, and placed close to the first premolar. The upper true molars are very large and powerful grinding teeth, measuring in some specimens nearly 5 inches in diameter. Each has a pair of external connate cusps, and two inner tubercles or cones. The lower molars are of the *Palæotherium* type. The brain-cavity is small in proportion to the skull. The cerebral hemispheres did not extend at all over the cerebellum, and but little over the olfactory lobes. The latter were of moderate size, and separated by a wide osseous septum. The hemispheres were comparatively large, and much convoluted. The cerebellum was small, and there is a rudimentary tentorial ridge. The neck was stout and of moderate length. The atlas is large, and much expanded transversely; the axis massive, and its odontoid process stout and conical. The lumbars are slender and smaller than the dorsals. There are four sacral vertebræ. The caudals indicate a long and slender tail. The epiphyses of the vertebræ are loosely united, as in proboscidians and many other large animals. The limbs were intermediate in proportion between those of the elephant and the rhinoceros. The radius and ulna are separate. The carpal bones are shorter than in the rhinoceros, and form interlocking series. They support four stout toes. The fibula is separate from the tibia, and entire but slender. The calcaneum is long; the astragalus short, and articulates with both the navicular and cuboid. There were three toes on the hind foot, of nearly equal size. None of the bones of the skeleton are hollow. The Brontotheridæ nearly equalled the elephant in size, but the limbs were shorter. The nose was probably flexible, as in the tapir, but there was evidently no true proboscis. All the remains yet known are from the Miocene beds of the Rocky Mountains, in Dakota, Nebraska, Wyoming, and Colorado. The name *Titanotherium* at the head of this article has been used because so well known in this country; it must, however, give way, in scientific nomenclature, to the previously-applied name, *Menodus*. O. C. MARSH.

Ti′tans, in Greek mythology, were the children of Uranus and Gea, numbering, according to the most common record, twelve—six male, Oceanus, Cœus, Crius, Hyperion, Iapetus, and Cronos; and six female, Theia, Rheia, Tethys, Phœbe, Mnemosyne, and Themis. Uranus feared his own children, and shut them up in Tartarus, but by the aid of Gea they broke out of the prison, overthrew their father, and placed Cronos on the throne. The curse, however, which Uranus let fall on his children was fulfilled. Cronos was dethroned by his own son, Zeus, and the Titans were once more imprisoned in Tartarus, where the Cyclopes and Hecatoncheires were set to watch them. Among their descendants were Atlas, Prometheus, Helios, Hecate, and Selene.

Tite (Sir WILLIAM), F. R. S., b. at London, England, in 1802; educated at a private school; was articled as a pupil to Mr. Laing, the architect of the custom-house; was entrusted with the rebuilding of the church of St. Dunstan's-in-the-East, which he executed so successfully in the Gothic style, then recently become popular, as to gain a high reputation; was employed to erect a Gothic church for the celebrated Edward Irving; subsequently built many public and private edifices, including some of the largest railway-stations of England and France; became architect to the New Royal Exchange 1840; was for some time president of the Architectural Society and of the Royal Institute of British Architects; was elected Liberal member of Parliament from Bath 1855; was governor of the Bank of Egypt and member of parliamentary committees on banking, and was knighted 1869. D. Apr. 20, 1873. He published some essays and lectures, and was author of a *Descriptive Catalogue of the Antiquities found in the Excavations at the New Royal Exchange* (1848), and other miscellaneous writings.

Tithe [Ang.-Sax., *teódha*, the "tenth"], the name of a tax, consisting of one-tenth of the annual profit of land, stock, or labor, which, instituted by Moses, was paid by the Jews for the maintenance of the Levites and in compensation for their service in the temple. From the Jewish theocracy the institution was gradually transferred to the Christian Church, and by the second Council of Tours (567) the tax was officially introduced by a statute, which again was confirmed by the second Council of Mâcon (585). It was not firmly established, however, in Germany, France, and England until the ninth century, and in the Scandinavian countries not until the eleventh century. Even before the period of the Reformation, but especially after that time, the tithes became subjects of bargains, of buying and selling, like other property. Originally, they were paid *in natura*, but in the eighteenth century a certain sum of money was generally substituted. In France they were finally abolished by the Revolution.

Ti′tian (TIZIANO VECELLIO), b. in 1477 at Tai, a village near Pieve di Cadore, in Friuli, then a Venetian possession; received his first instruction in painting from Sebastiano Zuccati, a Venetian painter and worker in mosaic, but was very early sent to Venice, where he studied under Gentile and Giovanni Bellini. Bellini was the founder of the Venetian school, whose head Titian afterward became, and on the earlier works of the latter the former exercised a decided influence. It is also probable that Titian had studied under Albert Dürer, who visited Venice in 1494 and in 1507, and very striking is the influence which at one time he received from his friend and fellow-student Giorgone. Indeed, their style was so much alike that, on the death of Giorgone in 1511, Titian could undertake to finish some of his pictures. To this period of his career belong the *Visit of Mary to Elizabeth*, in the Academy of Venice; the *Vierge au Lapin*, in the gallery of the Louvre; the *Christ with the Tribute-money*, in the museum of Dresden; and a *Resurrection*, in five compartments, in the church of San Nazaro at Brescia. In 1514 he went to Ferrara, where he painted for Duke Alfonso I. the *Arrival of Bacchus in the Island of Naxos* and *A Sacrifice to the Goddess of Fertility*, both of which are now at Madrid; the *Bacchus and Ariadne*, now in the British National Gallery; portraits of Lucrezia Borgia, Ariosto, etc.; and in 1516 he returned to Venice, where he continued to reside till 1530. During these years his style ripened into perfect originality. All foreign influences were toned down into mere elements of his own individuality, and his pictures became masterpieces. The most prominent feature of this style—which is the style of the Venetian school, but which, although it found many able disciples, has had only one master—is the coloring. With respect to composition Titian succeeded several times in representing passionate and highly pathetic subjects, such as the *St. Peter Martyr*, in the church of Santi Giovanni e Paolo in Venice, painted during this period, but destroyed by fire in 1867, and the *Martyrdom of St. Lawrence*, in the church of the Jesuits at Venice, painted at a later period, but both belonging among his greatest productions. Nevertheless, the general character of his compositions is a noble repose. The scene may involve the deepest feeling, but it is without passion—such as the *Assumption* and the *Presentation of the Virgin*, in the Academy of Venice; the *Entombment of Christ* and *Christ crowned with Thorns*, in the gallery of the Louvre; the *Last Supper*, in the Escurial; several representations of the *Holy Family*, among which the *Virgin and Child with Saints*, in the Uffizi gallery in Florence, and the *Madonna with Saints*, in the museum of Dresden, etc. Often the composition comprises only one or two figures, and the situation is almost without movement, like that of a statue, such as the

numerous *Madonnas*, *Magdalens*, *Venuses*, *Danaës*, etc., scattered over all European collections. But just this kind of composition was the best suited for that kind of coloring which was Titian's mastership, not to say his genius. Without employing any violent contrasts of light and shade, or of one color to another, he worked out a peculiar light, golden, mellow ground-tone, which by itself exercises a magical charm, into innumerable small but significant shades, and produced thereby, especially in his portraits and in the representation of the nude female form, an almost complete illusion of life. In 1530 he was invited by Charles V. to Bologna to paint his portrait, and he painted him several times afterward—in 1532, in 1536 at Asti, on his return from Africa, and in 1550 at Augsburg. In 1543 he again visited Bologna, Ferrara, and this time also Rome, where he met Michael Angelo and painted the celebrated portrait of Pope Paul III. In 1548 he went to Augsburg, again on the invitation of the emperor, who was his great patron, made him a count, and gave him a pension, which was continued after the abdication of Charles by Philip II. of Spain. After 1550 he resided almost without interruption at Venice, busy with his art to the very last of his life. He was eighty-one when he painted the *Martyrdom of St. Lawrence*, and several others even of his most remarkable pieces are of a still later date. D. at Venice Aug. 27, 1576, not of old age, but of the plague, and was buried in the church of Santa Maria de' Frari, which contains one of his most beautiful pictures, the *Madonna on the Throne*. He educated numerous disciples—Bonifazio, Domenico Campagnola, Girolamo Rumanino, Pordenone, Bordone, etc.—but he exercised the greatest influence on the development of modern art by the method he adopted of filling out the background with the representation of a real landscape. In this point he was imitated by the Carraccis, Poussin, and Rubens, and thereby he became the founder of modern landscape-painting. His *Life* has been written by Northcote (2 vols., London, 1830) and by Crowe and Cavalcasello (1875).

Titica'ca, the largest lake of South America, is between lat. 15° 15′ and 16° 35′ S., and between lon. 68° 40′ and 70° W., at an elevation of 12,800 feet above the level of the sea, and surrounded by the high and towering peaks of the Andes. It covers an area of about 4000 sq. m., receives several smaller streams, and discharges its surplus water through the Desaguadero. It contains a great number of islands, which are very interesting on account of the remains of old Peruvian architecture which are found on them. Its depth is 120 fathoms near the shore, and probably considerably more in the middle.

Tit'lark, or Pipit, name given to species of birds of the genus *Anthus* and group or sub-family Anthinæ. These are generally associated with at least the wagtails (Motacillinæ) in a family, Motacillidæ, and contrasted with them by the comparative shortness of the tail (shorter than the wings), which is emarginated, and has the two central feathers shorter than the lateral, and all broadest near their ends, and boldly round at the extremities. They are mostly grayish-brown, and in the under parts variously streaked. Over 50 species are known, and almost every land has representatives of the group. By some authors (*e. g.* Gray) they are all combined in one genus, but by most distributed among several. They are birds of passage, insectivorous and graminivorous as to food, rather fine songsters, and graceful in appearance and movements. Two species are found in the U. S.—namely, *Anthus ludovicianus* (American titlark or pipit) and *Neocorys Spraguei* (Missouri skylark); a third species (*Anthus pratensis*, or European titlark) sometimes straggles into Greenland and Alaska. THEODORE GILL.

Ti'tle [Lat. *titulus*], in law. Although this word is often used as synonymous with property or right of ownership, in its proper and technical signification it denotes the sources of such right, or the facts and events which are the means whereby property in land is acquired. In this sense the common law divides all titles into two classes—by descent and by purchase. Title by descent includes the single mode of acquisition through inheritance; title by purchase embraces all other methods. The descriptions given by the standard English text writers tend to mislead the American reader by reason of the radical differences between the law of Great Britain and that of the U. S. Following the arrangement of an able American author, the means of acquiring property in lands otherwise than by descent may be separated into two divisions—title not by grant, and title by grant. The first class includes escheat to the state; prescription, as a means of gaining incorporeal rights; accretion, or the acquisition of additional soil by the gradual operation of natural causes; estoppel, and adverse possession, aided by the statute of limitations. In the second class are found (1) governmental grants, which may be in the form of statutory concessions and donations, the patents issued by the national government to purchasers of and settlers on the public lands, and similar conveyances made by the States. (2) Official grants, or conveyances made by persons acting in an official capacity in pursuance of some statute or of some judicial order or decree. The instances of this subdivision are very numerous. Among the most important are assignments in bankruptcy or insolvency, the conveyances directed in foreclosure and partition suits, suits for assignment of dower, and in proceedings to settle the estates of decedents, sheriffs' deeds, deeds given on tax sales, and the proceedings to acquire property under the right of eminent domain. (3) Private grants, or the ordinary deeds of conveyance whereby property in land is transferred. (4) Devise, or the conveyance of land by last will and testament. The foregoing enumeration embraces the various species of title, or means of acquiring and transferring property in land, known to our law. It will be seen that the public patents from the U. S., or from the States, and most of the methods of transfer through official acts, as well as the devise by will, are merely varieties or modifications of the deed or simple grant, for nearly all official conveyances are actually consummated by the execution and delivery of a deed. All these modes are often described together as "title by alienation." (For more detailed information concerning the several titles above mentioned the reader may consult the articles on DESCENT, HEIR, ESCHEAT, PRESCRIPTION, and others.) JOHN NORTON POMEROY.

Tit'mouse, Tit, Tomtit, and Chickadee, names given by the English-speaking peoples to species of birds of the group or sub-family Parinæ. These have been defined by Baird as distinguished by a compressed body, soft and lax plumage, the bill shorter than the head, the wings rounded and short, and with the second quill as short as the tenth, the tarsi larger than the middle toe and claw, and the expansion of the sides of the toes into a palm. Their affinities are in dispute, some (*e. g.* Baird, Brewer, and Ridgway) associating them with the nuthatches in a family, Paridæ, others (*e. g.* Gray, Coues) isolating them as a peculiar family, etc. The species are numerous, but ornithologists are again in disaccord as to their grouping. For example, G. R. Gray, admitting only five genera in the sub-family, while others (*e. g.* Baird) greatly multiply the genera. There are about 87 species scattered over all parts of the world. Of these, 12 are found within the limits of the U. S., and belong to the extended genus *Parus* of Gray, but are differentiated by American authors into the genera *Lophophanes* (4 species), *Parus* (6 species), *Psaltriparus* (1 species), and *Auriparus* (1 species). They are rather small birds, mostly between four and six inches long. They feed upon insects and seeds. Some of them (*e. g. Parus atricapillus*) are very familiar, and rather prone to resort near the habitations of man. They are remarkable for devotion to their young. Their nest is usually built near the ground, and in it are laid generally not more than eight eggs, which are mostly white sprinkled with reddish or brownish. THEODORE GILL.

Titmouse, Cape. See CAPE TITMOUSE.

Tittabawassee, tp., Saginaw co., Mich. P. 864.

Ti'tus, county of N. E. Texas, lying between Sulphur fork of Red River and Big Cypress Bayou, and intersected by White Oak Bayou. Surface level, soil well timbered and productive, with some iron ore. Cattle and swine are numerous. Staples, cotton and Indian corn. Cap. Mount Pleasant. Area, about 940 sq. m. P. 11,339.

Ti'tus, a disciple and companion of St. Paul, to whom one of the canonical Epistles of the New Testament is addressed. He was a Gentile, but his native place is uncertain, the probability being in favor of Antioch, as he first appears as a delegate from the church of that city, accompanying Paul to Jerusalem. He was a companion of the apostle in his next missionary journey to Asia Minor and Macedonia, and was twice charged with important [illegible] to the church at Corinth. By some he has been [illegible] have been a companion of Paul in his voyage [illegible] wreck, and has even been identified with the [illegible] memoranda or itinerary upon which the [illegible] Acts is based, while others would [illegible] of the whole book of Acts, in which [illegible] he is not mentioned by name, and [illegible] Gospel usually ascribed to Luke [illegible] but soon after Paul's first [illegible] [illegible]—Titus took part with [illegible] in Crete, where he was labo[illegible] [illegible] pastoral Epistle was wr[illegible] Paul at Nicopolis in [illegible] matia, from which [illegible]

Titus, Epistle to. [illegible] Epistles of the New [illegible]

convey instruction as to the work in Crete, with the execution of which Titus had been commissioned. If the hypothesis of Paul's second imprisonment be true, this Epistle and the first to Timothy were written during Paul's journey to Asia Minor and Greece, before his last imprisonment. The Epistle, it is thought, was written from Nicopolis, probably the Epirote town of that name, and not the Macedonian city. (On the question of authenticity see TIMOTHY, EPISTLES TO.)

Ti'tus Fla'vius Sabi'nus Vespasia'nus, commonly called by his prenomen TITUS, Roman emperor (79-81), b. Dec. 30, 40 A. D., a son of Vespasianus and Flavia Domitilla. Vespasianus was of mean extraction, but he had acquired a great fame as a general, and, although Nero disliked him, his son Titus was nevertheless educated with Britannicus, the son of Claudius, with whom he formed an intimate friendship. When, in 66, Vespasianus was sent to the East as commander in the Jewish war, Titus accompanied him, and when, in 69, Vespasianus was declared emperor and returned to Rome, Titus was left as commander-in-chief, and finished the war by taking and destroying Jerusalem, Sept. 8, 70. As cæsar and co-regent with his father he did not give great promise; on the contrary, the people feared that he would be another Nero. After his accession, however (June 24, 79), he proved a kind and conscientious ruler. The *delatores* (informers) were branded and banished, and no one was prosecuted for *crimen læsæ majestatis.* Many splendid public buildings, the Colosseum, the baths, etc., were finished and dedicated with magnificent festivals for the people; but the emperor deserved most praise for the energy he developed in aiding the people under the great calamities which befell them during his reign—the destruction of Herculaneum, Pompeii, and Stabiæ by the terrible eruption of Vesuvius; the conflagration in Rome in the following year, by which the Capitol, the library of Augustus, and many of the most magnificent edifices of the city were destroyed; and, finally, the plague. But his reign was very short. He d. Sept. 13, 81, at Reate in the Sabine country, probably poisoned by his younger brother, Domitian, who succeeded him.

Titus Livius. See LIVY.

Titus'ville, city, Crawford co., Pa., in the extreme S. E. corner of the county, originally a part of Oil Creek township. It was incorporated as a city in 1867. Oil Creek—originally so called on account of the petroleum which was occasionally found floating upon its surface—flows through the S. part of the city from W. to E., affording good water-power. It is regularly laid out upon a plateau which gently slopes to the S., affording natural facilities for sewerage, which have been taken advantage of in the construction of an excellent system of drainage. The principal streets are well built, laid with block pavements, and lighted with gas. The Holly system of waterworks supplies every part of the city with the purest water, and furnishes the fire department with the means of subduing fires so quickly that a serious conflagration has not occurred since the system was inaugurated. The Presbyterian, Baptist, Methodist, Episcopal, Universalist, Irish and German Roman Catholic, M. E. Zion, and German Reformed Church organizations all have well-built houses of worship. The city owns a fine building used for official purposes. The public schools are of a high order. Two of the school edifices are brick, and two are frame, buildings. Four banks, with an aggregate capital of over $500,000, carry on the financial operations. It has 2 newspapers. The Pittsburg Titusville and Buffalo R. R. passes through the city, and its Union City branch has its southern terminus here. The Dunkirk Allegheny Valley and Pittsburg R. R. also terminates in this city. A railroad from Cambridge on the Atlantic and Great Western Railway is projected and partly built. Petroleum was discovered in the eastern confines of the city in 1859, since which time thousands of wells have been bored, from Bradford on the N. to Butler county on the S. Titusville has always been a large refining-point, and can turn out 4000 barrels of refined oil per day. The industries connected with the production and refining of petroleum, such as the manufacture of engines, boilers, oil-well boring and pumping tools, iron tanks, stills, barrels, etc., have largely centred in this city, giving employment to large machine-shops, with thousands of skilled mechanics. An oil exchange regulates the buying and selling of crude and refined petroleum. It has good hotel accommodations, and one of the best opera-houses in the State. P. 8639. BLOSS & COGSWELL, EDS. "MORNING HERALD."

Tiv'erton, town of England, in Devonshire, at the confluence of the Exe and Laman, has some educational institutions, a fine church, and manufactures of lace which employ more than 1000 hands, and of woollen cloth. P. 10,025.

Tiverton, tp., Coshocton co., O. P. 804.

Tiverton, p.-v. and tp., Newport co., R. I. P. 1898.

Ti'voli [anc. *Tibur*], town of Italy, province of Rome, 19 miles E. N. E. of the city of Rome, on a plateau formed by a spur of Monte Ripoli, about 900 feet above the sea, and down which the Anio tumbles in its course toward the Tiber. This town, founded at least 500 years before the first stones were laid in old Rome itself, is most interesting, not only for its historical associations, but for the extraordinary beauty of the natural scenery in the midst of which it stands. The celebrated falls of the Anio or Teverone, so praised by the Roman poets, are perhaps even more beautiful now that changes in the bed of the river, brought about by the violence of floods, have compelled the hand of art to lend its aid to nature. The last great work, made necessary by the destructive flood of 1826, was the turning of the Anio into an entirely new channel by cutting two tunnels (885 feet and 980 feet in length, respectively) through the limestone rocks of Monte Catello on the opposite side of the valley. This was effected by the very able Roman engineer Folchi in 1832, and the river now takes a single leap of 320 feet, forming a cascade as grand as it is graceful. The Cascatelle are a series of smaller but most picturesque falls, produced by diverting, for manufacturing purposes, a portion of the water of the main stream of the Anio. On a rock overlooking the cascades stands the beautiful little temple generally called that of the Tiburtine Sibyl, though probably dedicated to Vesta—a circular structure (21½ feet in diameter) surrounded by an open portico composed originally of eighteen columns, only ten of which now remain. These columns, of the Corinthian order, the shafts being 18 feet in length and the capitals ornamented with lilies, are formed of travertine covered with stucco—a thing not common in ancient architecture. The entablature is very rich, and on the architrave is inscribed "L. Gellio. L." The neighboring oblong Ionic temple, also of travertine, is now converted into a church. The so-called Tempio della Tosse, circular and covered with a dome, is probably a sepulchral monument of the time of the first Christian emperors. Traces of old Roman villas are found everywhere, though few can be identified as belonging to a particular family. The very extensive Villa of Cassius is one of the latter, and the Vatican and other museums have derived some of their choicest treasures from excavations made here. The Villa of Mæcenas has no authority for its name, but its vast size, its ruined Doric temple, and the magnificent view from the terrace make it well worthy a visit. The old castle near the Porta Santa Croce, with its five circular towers, is a very striking object and the most interesting relic of mediæval Tivoli. From the Villa d'Este (1549), from the Villa Braschi, and indeed from very many other points, the views, reaching over the Campagna to the sea, and embracing the Eternal City itself, are altogether beyond description. It is greatly to be regretted that this place, so favored in other respects by nature, should suffer from malaria—a circumstance which alone prevents it from becoming a most favorite summer resort. As it is, though many noble Roman families have superb villas here, yet they seldom occupy them more than a few days at a time. The manufacturing industry of the modern town is, however, very considerable. Important ironworks were established by Lucien Bonaparte among the ruins of the Villa of Mæcenas; large paper-factories are also in operation, and an incombustible fabric is here made from asbestos.

The settlement of Tibur by the *Siculi* is variously fixed between 500 and 700 years before the foundation of Rome. Syphax, king of Numidia, died here 202 B. C. Under the Roman emperors it was very flourishing; Horace, Virgil, Catullus, and Propertius have praised it in their immortal verses. It was here that Queen Zenobia, after her glorious but vain resistance to the arms of Aurelian, lived in luxury and died in peace. The destruction and rebuilding of the city by Totila (sixth century) is a memorable event; the subsequent mediæval history of Tivoli is intimately connected with that of the city of Rome itself, and is filled with violence and disaster. It was for a time the headquarters of Cola di Rienzi. P. 8105.

CAROLINE C. MARSH.

Tivoli, p.-v., Red Hook tp., Dutchess co., N. Y. P. 452.

Tiwappity, tp., Scott co., Mo. P. 580.

Tizza'na, town of Italy, province of Florence, on a beautiful hill about 10 miles S. W. of Pistoia. Its mediæval wall and castle are now in ruins. The wines produced here are among the best in Tuscany. P. 9352.

Tlaxca'la, or **Tlascala** [Mexican, "land of maize"], a state of the Mexican republic, occupying a portion of the central table-land, N. of the Valley of Puebla and E. of the Valley of Mexico. It is the smallest of the Mexican states, having an area of only about 1500 sq. m.; is bounded W. by Mexico, N. W. by Hidalgo, and on all other sides

by Puebla. The territory is mountainous on the N. and W., and the centre of the state is occupied by the celebrated mountain Malinche; the N. valley between Malinche and the Sierra de Puebla is traversed by the Mexico and Vera Cruz R. R., completed in 1872, and from Apizaco in the N. W. a branch diverges S. to the city of Puebla. The soil is somewhat hard, and usually bare of trees, but extremely productive of maize (whence the name), and in some parts produces the maguey or pulque-plant. Hemp has lately been successfully introduced near Apizaco, a town which owes its growth to the railway. There are no towns of great importance, Huamantla, the largest, having less than 10,000 inhabitants, and the city of Tlaxcala, the capital, having less than 5000. Tlaxcala is celebrated in the annals of the Conquest as the seat of a warlike Indian republic, which made a gallant resistance to Cortez under its chief Xicotencatl, and subsequently became his most faithful and efficient ally in the siege of Mexico. The city of Tlaxcala was reported by Cortez to have numbered 20,000 families; doubtless a gross exaggeration, as there are no existing remains to prove such former greatness, though there are preserved in the archives of the *Cabildo* numerous documents and relics of that period, as well as the banner of Cortez and authentic portraits of the Tlaxcalan senators. The oldest Franciscan convent in Mexico is at Tlaxcala, which was the seat of the first Mexican bishopric, now transferred to Puebla. The people are nearly all of Indian blood, are intelligent and industrious, though poor, and have taken a large part in the civil and foreign wars of Mexico. A *History of Tlaxcala*, written in the sixteenth century by Camargo, a native of the city, was published there in 1870 by the care of the governor, Don Miguel Lira y Ortega, a descendant of the celebrated Magiscatzin, who was at the head of the Tlaxcalan senate at the Conquest. PORTER C. BLISS.

Tlemcen′, town of Algeria, province of Oran, is well built and is in a fine plain, sheltered against the scorching S. winds by a chain of lofty mountains, cultivated with great care, and producing olives, figs, grapes, and other kinds of fruit in abundance. Tlemcen has some manufactures of leather, ironware, carpets, and woollen fabrics, and a considerable trade in wool, ivory, and ostrich-feathers. P. 21,728.

Toad [Ang.-Sax. *tade*], the English name for various species of Salientia or anurous amphibians, agreeing in having a stumpy body, short legs, as compared with the frogs, and a warty skin. Animals thus distinguished, nevertheless, may differ much in other respects, and severally be related to forms differing in external characters; and indeed the name cannot be definitely applied to a natural group. Under this heading, however, may be considered the typical toads and those immediately related to them. The toad, then, is the representative of a group (Bufoniformia) of families called Bufonidæ, Rhinophrynidæ, and Batrachophrynidæ. This group or superfamily (or, according to Cope, sub-order) Bufoniformia is distinguished by the absence of teeth in the jaws, the development of a sternum which is deficient in a manubrium, the dilation of the diapophysis of the sacrum, and the absence of articulate ribs.

I. In the Bufonidæ the skin is warty; both a tympanum and cavum tympani are developed; there are well-developed (two) eustachian tubes and parotid glands, and the tongue is free behind. Other less superficial characters have been indicated by Cope; the superior plate of the ethmoid is completely ossified, and usually covered by the fronto-parietals, which are mostly completely ossified, or by them and the prefrontals together; there is no pterygoid; the epicoracoids are divergent from the coracoids; the "latter dilated, nearly or quite in contact, each connected with the former on the same side by a cartilaginous arch, of which that on the right (the animal being on its back) overlaps with its convexity the left coracoid, and that of the left coracoid underlaps that on the right." The family is quite rich in species, and very generally distributed. It is represented by many species of *Bufo* in the northern hemisphere, as well as by some in Asia, Africa, and S. America, and by other genera of more restricted range. At least 10 species of *Bufo* occur within the limits of the U. S., and these are the only North American representatives of the family. The common toad of the Northern States is *Bufo lentiginosus*; the common toad of Europe, *Bufo vulgaris*. They all live upon insects, and their appetite is almost insatiable. The [illegible] emits an acrid secretion, which has been held to be poisonous by many people, but erroneously so, although a person of bad constitution with an open wound may suffer from touching it with the wounded part.

II. In the Rhinophrynidæ the skin is also smooth; neither tympanum nor cavum tympani are developed; the eustachian tubes are rudimentary or absent; there are no parotid glands, and the tongue is free [illegible] behind; the ethmoid septal walls are [illegible] of the muzzle, separating the prefrontals, and the superior plate is covered by the fronto-parietals, which [illegible] ossified; there is no pterygoid bone; the epi[illegible] coracoids are divergent, and connected by a single [illegible] cartilage, which is in contact with or slightly [illegible] from that of the opposite side. The family is represented by a single genus, confined to tropical America.

III. In the Batrachophrynidæ the skin is smooth; there is neither tympanum nor cavum tympani; [illegible] tubes; no parotid glands; the tongue [illegible], the middle part only of the [illegible]; the cranial characters have not been indicated; the [illegible] epicoracoid cartilages not united, the right being the lower." The family has been proposed for a single genus of two species from Peru. (See also [illegible] and FROG.) THEODORE GILL.

Toad-Fish, the name applied to the species of fishes representing the families Batrachidæ and [illegible]. These two forms belong to entirely distinct groups [illegible] of the class, and have really nothing in common except a certain hideousness of aspect other than [illegible], have with each, although they were formerly associated together, even by scientific ichthyologists [illegible].

I. The Batrachidæ belong to the order [illegible] and are characterized by their [illegible] body, [illegible] pressed backward, and gradually diminishing from the head to the tail; the skin is naked or covered with [illegible] scales; the head is more or less [illegible], broad, and depressed, and distinctly differentiated from the body; the opercular bones are mostly invested in the skin, but the operculum emits one or more spines; the [illegible] nearly horizontal, and mostly transverse; the teeth are mostly conical on the jaws and palate; the [illegible] tures are narrow, vertical slits in front of the [illegible]; the branchiostegal rays [illegible] pairs; the fins normally developed, the [illegible] by (1) a small anterior fin, with two or three [illegible] rigid spines, and (2) a long posterior [illegible] also moderately long; the caudal well developed [illegible] free; the pectorals are not pediculated, [illegible] form and flexure, and their rays are [illegible] are jugular, and have two soft rays. [illegible] and no pseudobranchiæ; the intestinal [illegible] cæca, and an air bladder is developed. [illegible] 12 abdominal vertebræ, and from 17 to 27 [illegible]. The family is represented by [illegible] tropical and temperate seas, [illegible] cies. They are bottom fishes, [illegible] and in some instances [illegible] valves of shells. The Batrachidæ [illegible] of their bite, as their teeth and [illegible] the *Thalassophryne*, on account of the [illegible] can inflict with their opercular spines. [illegible] spines of most of the species are [illegible] *sophryne* are hollowed, and at the base [illegible]. The species are generally of moderate size [illegible] so called *Batrachus* [illegible] 1869 (*Ann. and Mag. Nat. Hist.* [illegible]) Seychelles Islands, [illegible]. Less than 20 species of the family [illegible] been generally distributed [illegible] *Thalassophryne*, and [illegible] group.

II. The [illegible]

[illegible]

vertebræ (*e. g.* A. 9 + C. 9, and A. 12 + C. 10). The family is quite rich in species, remarkable for their grotesque physiognomy and often rich colors. They are mostly inhabitants of the open or deep tropical seas. Not far from 50 species are known. They are divisible among 3 subfamilies and 6 genera—viz. (1) Antennariinæ, with the genera *Pterophryne*, *Antennarius*, *Histiophryne*, and *Saccarius*; (2) Brachionichthyinæ, with the genus *Brachionichthys*; and (3) Chaunacinæ, with the genus *Chaunax*. The *Pterophryne lævigata* builds a nest in the floating seaweed of the open sea, and is the one specially signalized in this connection by the late Prof. Agassiz. THEODORE GILL.

Toast [so called from the old custom of putting toasted bread into punch and sack] is the liquor drunk to one's health; also a sentiment uttered on festal occasions, to be responded to in a short speech. Sometimes it designates the person, especially a lady, whose health is proposed.

Tobac'co [Sp. *tabaco*; Fr. *tabac*; Ger. *Tabak*], an important plant or genus of plants introduced to the knowledge of civilized nations on the discovery of America, where it was found in use by the natives of both the islands and the continent as far N. as Virginia. During the first century of communication with the New World little notice appears to have been taken of it, but after 1650 tobacco began to enter largely into the trade of the colonies with Europe, and its consumption became general. Though often violently opposed and denounced, it made steady progress, until now there are but few single products exceeding it in importance or in the extent of its use. The purpose to which it is applied is solely as a tonic, stimulant, or sedative through smoking, chewing, or snuffing. Though no form of direct nutrition is possible, its application to the palate and sensory organs of the mouth undoubtedly supports the strength of those accustomed to its use, calms nervous excitability, and relieves hunger, pain, constraint, and *ennui* in a remarkable manner. The common testimony of almost all nations and all races ascribes value to this singular plant, though it cannot be taken into the stomach without injurious results, and is essentially poisonous in its general properties. There are several species of the genus *Nicotiana* (so named from Nicot, French ambassador to Portugal, by whom it was first brought to the attention of scientific men, and who did much to render its use fashionable in France). *N. tabacum* is the common tobacco of the U. S.; *N. fruticosa* and *N. repanda* are grown in Cuba and other tropical countries of America; *N. quadrivalvis* and *N. nana* are species found growing wild in the interior near the upper Missouri, and there put to use by the Indians for smoking, it is said, long before the advent of the whites. *N. rustica* is cultivated on the coasts of the Mediterranean and at Latakia, Turkey. The tobacco-plant is everywhere an annual, forming broad, ovate-lanceolate leaves near the ground, which enlarge to eighteen inches in length by six inches in width or more as the strong fleshy stem rises, on which other leaves, diminishing in size, alternate to the top. The flowers are in a loose terminal panicle, with purple or light-red petals, with funnel-form corollas, and a small seed-capsule, ripening many small black seeds. It belongs to the natural order Solanaceæ, all the genera of which are acrid, inedible, and poisonous as plants or fruits. In the tobacco-plant the distinctive and valuable properties are found only in the leaf, which is thick, heavy, and pubescent, becoming oily and semi-resinous as it ripens. This leaf, when the plant approaches maturity, is dried and cured by partial sweating, which effects a chemical change, removing the characteristics of the fresh leaves, and developing a powerful aroma, with strong narcotic and acrid properties. After the curing, tobacco, either in leaf or manufactured, will remain a long time without decay or other change than by drying, and of the vast quantities that enter into commerce very little is lost from such causes. The essential properties that give tobacco its value are readily soluble in water and alcohol, but they have little value as an extract. By the analysis of Posselt and Riemann 10,000 parts of fresh leaves contain 6 of *nicotine*, 1 of *nicotianine*, 287 of bitter extractive, 174 of gum, 26.7 of green resin, 26 of albumen, 104.8 of a substance analogous to gluten, 51 of malic acid, 12 of malate of ammonia, 20.6 of potash-salts, 40.6 of lime-salts, 8.8 of silica, 496.9 of lignine, and 88.28 parts of water. The *nicotine* is a crystallizable alkaline substance, to which, and to an acrid dark brown oil which is more easily separated, the distinctive qualities of the plant are due. The alkaloid nicotine contains nitrogen in larger proportions than any other product of its class, its composition being $C_{10}H_{14}N_2$, and it is one of the most virulent poisons known. Orfila states that Havana tobacco yields 2 per cent. of this alkaloid, Maryland 2.6 per cent., and Virginia 6.9 per cent. *Nicotianine* is supposed to be the odorous or volatile principle of tobacco.

The history of tobacco in its use as a stimulant is remarkable for the violent opposition it has constantly encountered, and for the severity with which it has been denounced as both useless and dangerous. The early colonists of America were attracted to imitate the uses to which it was put by the Indians, but in Europe systematic and strenuous efforts were made at frequent intervals during the first century to prevent its introduction altogether. Various incidents of vigorous social resistance to its use have occurred, and James I. of England himself wrote a *Counterblast to Tobacco*, which was expected to overthrow the social habit altogether. Pope Urban VIII. issued a bull excommunicating those who should use tobacco in churches; Amurath IV. of Turkey, the grand duke of Muscovy, and the emperor of Persia also prohibited the use of tobacco in their several dominions during the seventeenth century. Modern society is not without demonstrations against the use of tobacco, and literary skill has often directed satire or denunciation against chewing and snuff-taking particularly. In some localities snuff is applied to the palate with a small wooden spoon, the practice being called *dipping*. This is a gross form of using it, and should be exposed and broken up.

Production of Tobacco.—The production of tobacco is greater in the U. S. than in any other country, and it may fairly be estimated to furnish one-half the quantity entering into the general commerce of the world. The average crop in the U. S. for five years ending with 1875 was nearly 450 million pounds each year, of which an average of 250 million pounds was exported to foreign countries, and 180 million pounds were manufactured in the U. S., almost wholly for consumption here. Internal revenue tax was paid in the year ending June 30, 1875, on 168,435,874 pounds, and undoubtedly a small percentage escaped taxation, and another small portion was consumed in the leaf or lost. The census returns of tobacco produced in the U. S. for 1840 were 219,163,319 pounds; for 1850, 199,752,655 pounds; for 1860, 434,209,461 pounds; and for 1870, 262,735,341 pounds. These last are greatly in error, since the export for the same year was 195,780,712 pounds, and the home consumption not less than that amount in addition. The average production per acre in the U. S. is nearly 1000 pounds, and about 450,000 acres of the richest cultivated land are devoted to its growth. No crop is more exhausting than tobacco, in consequence of the large proportion of mineral elements and nitrogenous matter found in its leaves, the ash of the dried leaves yielding 21 per cent. of mineral constituents. Inferior soils will not produce it successfully, and under the higher prices prevailing for it for the last twenty years its growth was extended to the richer soils of Connecticut, Massachusetts, New York, Ohio, and all the Western States in this latitude. The greatest quantity is now grown in Kentucky; Virginia, Ohio, Tennessee, Maryland, and North Carolina follow in order, with Indiana, Connecticut, and Massachusetts, the three last furnishing 8 to 10 million pounds. Its cultivation is possible in a range almost as great as Indian corn, but it is destroyed by frost, and the risk in this respect in the Northern States is very great. In Connecticut, Hartford co. produces a great quantity, and in Massachusetts, Franklin, Hampden, and Hampshire cos. produce 2 to 3 million pounds each. The largest-producing countries other than the U. S. are tropical or semi-tropical. Cuba may be estimated to produce 60 million pounds, chiefly in the Yara district or Vuelta del Abajo, a rich plain S. W. of Havana, 80 miles in length by 20 in breadth. In 1852 there were in Cuba 7979 tobacco-plantations, producing for that year 59,750,000 pounds. A government monopoly long existed in Cuba, but the production and trade were thrown open in 1820. The finest leaf is grown in Cuba for the manufacture of cigars both there and in the U. S. and Europe. Porto Rico produces tobacco in considerable quantity, but not so good as that of Cuba. In 1840 the exports were 4,247,484 pounds, valued at $169,100. Hayti produces much more than Porto Rico, chiefly in the N. E. part of the island. The exports were 3,219,690 pounds in 1841, and are now twice as great, going chiefly to Bremen and France. Mexico produces largely, and exports a small share only to England and France. The Central American states produce and export not more than Mexico; New Granada and Venezuela produce and export largely, furnishing 20 million pounds to general commerce, and consuming freely in addition; the town of Varinas is a chief place of export. Peru furnishes a small quantity; Brazil has recently greatly enlarged its production, and with Uruguay and the Argentine Confederations contributes very largely to the European supply—perhaps 20 million pounds. The imports at Bremen alone from Brazil in 1874 were 156,067 bales.

British India produces inferior tobacco, which is largely consumed there, and exported to a small extent to Europe. The Philippine Islands produce 2 million pounds for export, chiefly to England and Bremen, from Manila. Java furnishes 20,000 piculs (2,670,000 pounds) for annual export, and China and Japan together as much more, which is brought to Europe. Turkey produces a considerable quantity of fine tobacco, the best being sent from Latakia in Syria. Other localities on the eastern shores of the Mediterranean produce tobacco for the general European supply, and in Italy, Spain, France, and Germany a considerable quantity is grown which does not enter into general commerce, the several state or government monopolies taking practical charge of it, as well as of all that is imported. Where a monopoly of sale exists, as in France, importation is free of duty, but only for the manufactures conducted by the government. The present system was established in 1811, under which a certain extent of land is allowed to be cultivated in tobacco, averaging about 20,000 acres, and producing nearly 20 million pounds yearly: with this a much larger quantity of imported tobacco, mostly from the U. S., is manufactured, and the whole sold only under authority of the government, producing 275 to 300 million francs annual revenue. In Germany the cultivation of tobacco is allowed in many districts, a tax of 180 to 360 silver groschen per acre being laid, according to quality of the soil, in Saxony; in other states the tobacco raised was taxed, the revenues so raised being greater than the customs duties on imported tobacco in some states, and in others less. The amount grown in Germany is less than in France. In Austria the best soils of Hungary and Transylvania have long been devoted to the growth of tobacco, the average annual produce being 45 million pounds, of which about one-tenth is exported.* A considerable quantity is imported, and revenues are raised largely by monopoly of sale and to a small amount by import duties. In Belgium less tobacco is grown than formerly, and the imports are large. In Holland a small amount of tobacco is grown, in Guelderland chiefly, and a very large amount imported. In Italy the sale of tobacco is a royal monopoly, and its cultivation has for a long time been prohibited, except in the Papal States, where 2 million pounds yearly were grown previously to the union. A little is still grown, paying an excise, but nearly all consumed is imported by the government and sold as a monopoly. In England its growth was prohibited, first in part in 1652, and effectively by act of 12 Chas. II. c. 34, which ordered that no tobacco should be planted in England under penalty of forty shillings for each rod of ground, and directed justices of the peace to search for and destroy all that should be planted. But this did not apply to Ireland: it was grown there until 1830, when by acts of 1 & 2 Will. IV. c. 13, its cultivation was forbidden, and all existing plantations were destroyed. These severe measures were deemed necessary to secure the customs and excise duties on which so much reliance is placed in the British revenue system.

Cultivation.—The tobacco-plant is a strong-growing herbaceous annual, capable of being greatly changed by high cultivation, and requiring a rich soil and favorable climate to attain perfection. The value being wholly in the leaves, every care is taken to increase their size and to concentrate the strength of the plant upon them. The best rise from the ground or from the stem near the ground, although the flower-stem rises from three to six feet, and if left for seed the upper leaves are retained, though less valuable. Usually, the flower-stem is pinched or cut off at half its natural height, the operation being called "topping." The leaves, as well as all parts of the plant, are covered with a viscid down, and a resinous exudation appears as they mature, adding to their weight and thickness. The seeds are sown thickly in covered or protected beds in March, and the young plants are developed as much as possible before planting out in the open field in April or May, care being taken to avoid frosts. They are planted in rows two to three feet apart in the U. S., and usually with the purpose of cultivating with a horse and plough at least one way. The soil must not only be fertile, but the cultivation thorough, to produce the best tobacco. All broken or injured leaves are removed, the flower stem topped, and the strength of the plant concentrated on eight to twelve large succulent leaves, cutting off lateral shoots also if any appear. Insects must be watched, particularly the destructive tobacco worm (*Macrosila carolina*), which cuts the leaf with great rapidity. Four months are thought necessary as the period of growth, and in August or September, according to the latitude, the proper color and characteristics appear, and the plant is ready to be cut. The process usually is to cut the whole stem close to the ground, sometimes splitting very large plants, and removing them to an open shed or partial shelter for preliminary drying. They are sometimes hung on poles, and sometimes thrown in heaps for partial sweating or curing, the leaves being then stripped, and further dried or cured before packing for market. Usually, the full curing is done on the plantation, and the bundles were packed for shipment, but sometimes the final curing is done months afterward, and the packing for market is done by machinery, not available on the small plantation. If the leaves are fermented before being stripped, they are then stripped and dried more readily and tied in bundles for packing. Much depends on the state of the weather during cutting and curing; usually some weeks are required to perfect the drying in the curing house, and the tobacco barns or curing houses are prepared to use artificial heat if the weather is damp and cool. Sometimes a second curing or sweating is resorted to before the final manufacture; and it is conceded that fermentation is essential to the development of the best qualities of the leaf, and some fanciful views have been put forth as to the changes effected in the constituent principles by successive fermentations. The crop is packed in hogsheads on the plantation or at the nearest market-town, and immediately inspected as a preliminary to sale. Inspection is provided by State authority in nearly all the tobacco-growing States, and the brand given it by the inspector establishes its grade, and consequently its value. It is packed in hogsheads 48 inches in length and 32 inches at the head, containing 900 to 1200 pounds, according to the size and richness of the leaf, for most of that grown in Virginia and the adjacent States. Maryland tobacco is packed for export of lighter material, stems, lugs, etc., and weighing but 650 to 800 pounds the hogshead. Western tobacco is packed in heavier hogsheads, those of Ohio weighing 1,500 pounds or more; in Kentucky the weight is also heavy, but less than in Ohio. Leaf tobacco is also packed in bales of about 200 pounds each for export, and manufactured tobacco in cases of the same average weight. Much inferior and scrap tobacco is sent from Maryland and Virginia factories to the German market, where it is cut and mixed for smoking chiefly. The lowest qualities of shipping tobacco are called *lugs*, and these are distinguished into "factory lugs" and "plantation lugs," both being the stems, strippings, and broken leaves attached to them. The best full leaves are usually packed separately as "wrappers," and the value of these last is six to ten times as great as the lowest "lugs."

The export trade of the U. S. in tobacco exhibits the largest movement in this article known, about 2[illegible]0 million pounds annually being sent to English and continental markets. The following tabular statement shows the quantity and declared value exported for each year from 1850 to 1875, inclusive: for the first five years of the period the statement was in hogsheads only; next, from 1855 to 1865, inclusive, the returns were made in hogsheads, cases, and bales; while from 1866 to 1875, inclusive, the actual weights were given. For the several years previous to this return of actual weights a calculation of weight has been made at an average of 1000 pounds the hogshead and 2[illegible]0 pounds each for cases and bales. The values are given as originally returned:

Exports of Tobacco and Manufactures of Tobacco from the U. S., 1850 to 1875 (fiscal years ending June 30).

Year.	Pounds.	Value.	[illegible]
1850	108,730,375	$6,417,251	6
1851	10[illegible],767,710	10,[illegible]	10
1852	11[illegible]	11,[illegible]	8
1853	17[illegible]	12,[illegible]	7½
1854	1[illegible]	11,[illegible]	9
1855	1[illegible],811	1[illegible]	9[illegible]
1856	1[illegible]	1[illegible]	1[illegible]
1857	1[illegible]	21,[illegible]	1[illegible]
1858	1[illegible]	1[illegible]	1[illegible]
1859	2[illegible],811	21,[illegible]	1[illegible]
1860	1[illegible]	15,[illegible]	[illegible]
1861	18[illegible]	1[illegible]	[illegible]
1862	12[illegible]	1[illegible]	[illegible]
1863	12[illegible],172	2[illegible]	[illegible]
1864	12[illegible]	2[illegible]	[illegible]
1865	211,[illegible]	1[illegible]	[illegible]
1866	19[illegible]	31,[illegible]	[illegible]
1867	194,[illegible]	2[illegible]	[illegible]
1868	21[illegible],621	[illegible]	[illegible]
1869	1[illegible],127	[illegible]	[illegible]
1870	195,7[illegible],112	[illegible]	[illegible]
1871	21[illegible]	[illegible]	[illegible]
1872	21[illegible]	[illegible]	[illegible]
1873	2[illegible]	[illegible]	[illegible]
1874	[illegible]	[illegible]	[illegible]
1875	2[illegible]	[illegible]	1[illegible]

The destination [illegible] has been most [illegible] many and the [illegible]

* "Hungary produces annually 250,000 to [illegible] centners of 123½ pounds, of which [illegible] are used in the kingdom, 1[illegible] to 150,000 in Austria, and 20,000 to 30,000 exported."—M[illegible]

yearly; next to England, about 42,000 hogsheads yearly; to France, 38,000; to Italy, 24,000; to Holland, 20,000; to Austria, 5500; to Portugal, 3250, etc. The aggregate to Germany, Belgium, and the Low Countries reaches 95,000 hogsheads. To each of these countries American tobacco is a necessary source of revenue, and the exportation is therefore regular and sustained. The greatest general market in Europe is Bremen, and Liverpool is next. One-third or more of the American export to the Continent goes to Bremen, or more than 35,000 hogsheads yearly. The following statement of the receipts at Bremen for 1874 and 1875 show the extent of that market:

	1874.	1875.
Ohio, Maryland, and Virginia leaf, hhds......	42,168	13,206
" " " stems, "	16,014	5,567
Florida, chests..........	121	36
Cuba (Havana and Yara), serons	49,276	16,110
San Domingo, serons..........	90,438	77,004
Seed-leaf (Connecticut), chests..........	59,705	15,151
Porto Rico, bales..........	6,074	2,763
Peru, Esmeralda, bales..........	2,204	1,800
Venezuela, Varinas, rolls..........	10,562	2,103
Colombia, serons and bales..........	107,011	99,155
Brazil, serons and bales..........	156,067	95,094
Java, bales..........	3,178	4,116
Manila, bales..........	430	1,623
Mexico, bales..........	562	96
Turkish, bales..........	5,057	5,234
Other sorts, bales..........	7,064	2,991
Total, packages..........	555,931	342,049

At the lowest estimated weight, the total would be 120 million pounds for 1874. At Liverpool the annual receipts are less than 40 million pounds; the actual quantities received, consumed, and remaining in warehouse in England for each half-year ending June 30, 1874, 1875, and 1876 were—

	Pounds.		Pounds.		Pounds.
Received, first six months of 1874,	19,003,844;	1875,	20,635,510;	1876,	14,596,797
Consumed, " " "	22,469,512;	"	23,059,459;	"	23,723,796
In warehouse end of 1874,	68,232,705;	"	81,865,563;	"	65,236,134

At London there is a general market for the tobacco of remote and tropical countries, but the amount received is much less than at Liverpool. At Havre there are large receipts for the French government, but no general market. The production of European countries does not enter into general commerce unmanufactured. The export of Brazil for five years, 1869 to 1874, averaged 14,975,504 kilogrammes yearly, or 33,015,000 pounds, and the average value was 6540 milreis, or $3,568,224. (*Official Account of Brazil*, 1876.)

Manufactured Tobacco is technically distinguished from both the cured leaf and from cigars or snuff. It is made from ordinary or inferior leaf by twisting, pressing, or cutting, and assumes various forms and names. Syrups and licorice are largely used in its preparation, particularly in the U. S., though adulteration with other leaves or deleterious substances rarely occurs here. In England adulteration is carried to great extremes, and stringent laws have been enacted to suppress it. Great improvements have recently taken place in cutting, preparing, and flavoring tobacco manufactured for chewing and smoking. About 10 million pounds of manufactured tobacco are yearly exported, at an average value of 25 cents per pound. Cavendish, navy, twist, negrohead, etc., are standard names or brands in the trade for that which is compressed in solid forms; "fine-cut" is shredded and loose in fibrous masses, cut by delicate machinery from leaf of good quality and flavored acceptably. Smoking tobacco is prepared of every grade and quality, but usually from broken leaves, stems, and inferior parts. Less of such grades, or of smoking tobacco generally, is made or consumed in the U. S. than in Europe, and the tax being relatively higher compared with the small original cost of the materials, little is manufactured in this form here for general trade.

Cigars (Sp. *cigarro*; Fr. *cigare*)* constitute the most important form in which tobacco is consumed for smoking, and in fact the largest aggregate in general consumption in any form; and their greater value induces every effort to produce leaves suited to covering cigars by the growers. The cigar is of Spanish or Spanish colonial origin, and it was long in use there before its general adoption by other nations. The greatest skill in the manufacture of cigars has always been shown by Spanish or Cuban artificers, and Havana has been the seat of the best manufacture for a century or more. The materials used for filling must be good, and must be skilfully arranged and combined so as to secure a proper firmness with a good draught. The wrappers must be of elastic and moistened leaf, so applied as to form a perfect ovoid cylinder, one end of which is closed and the other open. Uniformity in size, length, weight, and color is essential. They are tied in bundles of twenty-five to fifty cigars each, and these are packed in boxes of Spanish cedar containing two, three, or four bundles, usually 100 in a box. The Spanish cedar is largely imported into the U. S. for making boxes, and is also imitated in American cedar, but the general form of tying and packing is tenaciously adhered to. Nearly one-half in value of all tobacco grown is made up into cigars; and in the U. S. revenue system 25 pounds of rough leaves are allowed to manufacture 1000 cigars. Of this one-third or more is wasted in stems or lost in drying, the average weight of cigars manufactured being 15 to 17 pounds per 1000. The growth of the cigar manufacture in the U. S. has been rapid, even under the highest tax on materials imported and on the finished product. Since 1868, when the tax was reduced to $5 per M., the quantity made has advanced from 992,191 M. to 1,866,718 M. in 1874, and 1,926,661 M. in 1875, having more than doubled. The average wholesale selling price is over $50 per M., making the total value of cigars consumed in the U. S. nearly $100,000,000, few being exported.

The relation of tobacco and its manufactures to the revenue systems of civilized states is a striking and important feature of its history and present position. In all civilized countries it is the subject of heavy taxation, and in many countries its sale in any form is a government monopoly. In Great Britain its cultivation is forbidden in order to secure greater revenues on its importation. In the U. S. every form of preparation of the leaf for consumption is taxed, and thus its cultivation comes to a great extent under the observation of the government. Producers of leaf tobacco are required to account for all they prepare and sell, and all dealers and manufacturers must take out a license and keep books showing their transactions. In France, Italy, Spain, and several South American states similar internal revenue systems exist. Internal taxes were levied on tobacco in the U. S. to some extent under the early systems of 1792 to 1820, but nothing was subsequently levied until a tax was imposed on manufactured tobacco Sept. 1, 1862; after this date many changes were made, increasing or diminishing the tax, as follows, the rate being given in cents per pound:

	Sept. 1, 1862.	Mar. 3, 1863.	July 1, 1864.	May 3, 1865.	July 13, 1866.	July 20, 1868.	June 6, 1872.	Sept. 1, 1875.
Smoking (of stems only).	2	5	15	15	15	16	20	24
Smoking, fine,	5	5	25	35	40	32	20	24
Twisted, by hand,	15	15	35	30	30	32	20	24

On snuff the same rates were charged as on chewing tobacco. On cigars the rates were $1.50 to $3 per M. under the act of 1862; advanced in 1864 to rates varying from $3 to $40 per M.; in 1865 all were put at $10 per M.; in 1872 all were reduced to $5 per M.; and Sept. 1, 1875, all were advanced to $6 per M. The revenues received from these taxes advanced rapidly, from $3,055,562 in the first fiscal year 1862–63 to $37,303,462 in the fiscal year 1874–75, including all paid as excise and internal revenue taxes on all forms of tobacco and cigars, exclusive of duties on imports. These duties for the same year being $5,271,094, the total revenue to the U. S. government from tobacco and its manufactures was $42,574,556. The internal revenue alone for seven calendar years was as follows:

Years.	From manuf. tobacco.	From cigars.	Total.
1869	$17,371,063	$4,960,053	$22,331,116
1870	24,300,483	5,718,780	30,019,263
1871	25,560,539	6,598,173	32,158,702
1872	24,570,776	7,566,157	32,136,963
1873	23,397,858	8,940,391	32,338,249
1874	21,938,955	9,333,592	31,272,547
1875	25,200,754	10,140,384	35,341,238

For the year ending June 30, 1876, the receipts of internal revenue from tobacco in various forms were as follows:

		Receipts.
Cigars and cheroots, number	1,828,782,297	$10,969,572.49
Cigarettes, number..........	77,407,166	135,462.54
Snuff, pounds..........	3,317,086	1,061,467.64
Tobacco, other, pounds..........	107,064,051	25,694,398.05
Stamps for tobacco and snuff exported..........		6,694.30
Manufacturers of cigars..........		153,075.26
Dealers in leaf tobacco..........		112,954.63
Dealers in manufactured tobacco..........		6,615,208.38
Manufacturers of tobacco..........		11,375.64
Peddlers of tobacco..........		35,066.50
Total receipts..........		$39,795,275.43

These sums show a steady increase, and strikingly establish the importance and permanence of this source of revenue. The maximum rate on tobacco has, however,

* There appears no good reason for the change of spelling of this word to *segar*. The original is Spanish, and it follows naturally and easily in French, Portuguese, German, and all European languages. Its actual derivation is not known, but it is not important.

evidently been exceeded in the advance from 20 to 24 cents per pound made in 1875; the former rate produced a larger revenue, and the higher one being found to react injuriously on the producer, to whom the ordinary grades and qualities have become almost valueless. The customs revenue from tobacco and cigars is also large, and important as an increasing sum. The law of July 14, 1862, first made the duties specific, at 35 cents to $1 per pound on cigars, and 25 cents to 35 cents per pound on tobacco. On July 30, 1864, these rates were increased about threefold on cigars, and nearly doubled on tobacco. On July 28, 1866, all cigars were put at $3 per pound and 50 per cent. *ad valorem*; and on July 20, 1868, the rates were reduced to $2.50 per pound and 25 per cent. *ad valorem*; which rate continues, leaf tobacco paying, under the law of 1861, 35 cents per pound, and manufactured tobacco 50 cents per pound. Under these rates the sums received were, in 1870–71, $4,801,577; 1871–72, $5,169,237; 1872–73, $6,219,317; 1873–74, $6,150,000; and 1874–75, $5,269,042. These sums are made up almost equally from cigars and from leaf, a very small amount only being yielded by other forms.

The revenues received by other nations are in almost all cases large from tobacco. The most recent receipts were as follows: Great Britain (1874–75), from customs £7,305,047, licenses £85,057 (duties 3s. to 4s. 6d. the pound); France (1875), from monopoly of sale 295,988,000 francs; Germany (1874), from customs 1,019,460 marks; Alsace-Lorraine, from tax on manufacture (1874), 800,000 marks; Zollverein (1873), from customs, 16,255,000 marks; Austria-Hungary (1874), budget, monopoly, 59,705,000 florins; Hungary, alone (1874), monopoly, 29,237,346 florins; Italy (1873), from monopoly of sale 73,232,144 francs, tax on cultivation 50,760 francs; Portugal (1874–75), from customs 2,205,200 milreis, licenses 24,500 milreis; Russia (1873), from taxes on consumption 10,266,000 roubles. In Russia duties on importation are also levied, but the amount received is not stated. In Spain the sale of tobacco is a monopoly of the Crown, but there is no recent distinct return of the revenue yielded; stamps, lotteries, and tobacco together yielded, in 1871, 156,467,671 pesetas (or francs). Sweden and Norway levy duties on importation. In every country revenue in some form is raised on the importation or the sale of tobacco, and it generally constitutes a more productive source than any other. In the U. S. it now yields 42 million dollars; in England, 37 million; in France, 60 million; in Austria, 42 million; in Italy, 15 million. It would be quite impossible to supply the place of so desirable a subject of taxation.

Tobacco as a crop is deprecated by the better agriculturists in consequence of its exhausting character. In the early history of Virginia the light lands of the eastern counties were cultivated in tobacco, extensive shipments to England being made from towns on the Chesapeake long since abandoned. Less than a century of tobacco growing completely exhausted the coast-counties, and left the towns, mansions, and churches that once flourished there buried in forests of new pine.

Snuff has been made from a very early period, first and most largely by the Spanish, who prepared it with care and scented it with various materials. Next the Low Countries, Scotland, and England extended and popularized the use of snuff. For the last half-century or more, Scotch snuff has been the favorite in commerce, and large manufactures have existed in England, with a moderate production in the U. S. The export and import of snuff have not been usually distinguished from manufactured tobacco; the amount, however, has been large, and the consumption in England larger than all elsewhere. The amount of snuff manufactured in the U. S. in the year ending June 30, 1876, was 3,317,086 pounds, yielding $1,061,467 revenue. The manufacture was originally conducted by grinding the leaf in conical mortars, and more or less was produced in all tobacco-consuming countries. It is now ground in iron mills by steam-power. The old and standard brands of snuff were *maccaboy*, originally from Martinique and Spain; *rappee*, or the French; and that known as Scotch or *Lundyfoot*. There has been a great decline in the use of snuff in England and Germany within the last twenty years, and in the U. S., with local exceptions, an even greater decline. *Cigarettes* are small rolls of fine smoking tobacco enclosed in white paper wrappers; they are largely made in Cuba and in the U. S. They are ranked and counted as cigars for revenue purposes. *Cigarillos* is the Spanish term for cigarettes or small cigars. LOUIS BUGGERT.

Tobac'co [Span. *tabaco*], **Chemistry and Physiological Relations of.** The most important ingredient of the tobacco leaf is the alkaloid *nicotine*, which is present in quantities varying from 2 to 6 per cent. Pure nicotine ($C_{10}H_{14}N_2$) is a colorless, oily liquid of a strong alkaline reaction, disagreeable smell, and hot, acrid taste. It is volatile, inflammable, soluble in water, alcohol, ether, and oils. On exposure to light it turns to a reddish-brown color. With acids it forms crystallizable salts. Nicotine was first isolated by two German chemists, Posselt and Reimann, in 1828. It is a virulent poison, a [illegible] drop sufficing to kill a rabbit in less than four minutes. *Nicotianine*, or *tobacco camphor*, is a principle obtained by distilling the leaves, whether fresh or dry, with water. This is a fatty substance, occurring in the form of minute [illegible]ular crystals, having little taste, but a tobacco-like smell. Besides these principles, tobacco contains albumen, resin, and gum, and an unusual quantity—from 16 to 27 per cent.—of inorganic ingredients. Lime composes from 2[illegible] per cent. of the ash, and potash about [illegible]0. Nitric, phosphoric, and malic are among the acids that occur. By dry distillation tobacco affords a dark empyreumatic oily substance ("oil of tobacco"), of the peculiar strong smell of old, foul tobacco pipes, and an exceedingly [illegible], disagreeable taste. This oil is apparently a complex substance, and, like nicotine, is an exceedingly powerful poison.

The *effects of tobacco upon the animal system* have been critically studied by experimenting with nicotine upon animals. This alkaloid is one of the most powerful of nerve-poisons, producing tetanic convulsions, followed by paralysis, and death through failure of respiration. The cerebrum is little affected, and the pulse rate, while first lessened, is afterward quickened. The pupil is contracted. In man, tobacco taken in sufficient quantity to show poisonous effects produces giddiness, faintness, and an indescribable feeling of sinking and misery, followed shortly by intense nausea, severe and long-continued vomiting, and great relaxation and feebleness of the muscular system. The skin becomes pale and moist, and the pulse exceedingly feeble. More or less of these effects may persist for a day and more after the poisoning. They are familiarly seen in young lads when first beginning to smoke. As to poisonous dose, there is none, for not only do different persons vary in their susceptibility to tobacco, but habit also makes an enormous difference in the effect following a given dose; so that, as is well known, very large quantities of tobacco can be smoked or chewed without the development of any of the above-mentioned poisoning. In sufficient dose, tobacco proves a dangerous and even fatal poison. The symptoms are, in general, an intensification of those just described—namely, intense nausea and vomiting, faintness, muscular debility, cardiac failure, and general prostration. Often, too, there are violent pains in the abdomen, cramps, convulsions, and profuse purging. An injection *per rectum* of an infusion representing the strength of [illegible] grains of tobacco has several times killed, and death may take place within an hour from the time of [illegible]ing the poison. Extensive *external* applications of tobacco may also cause poisoning, and even death. There is no antidote, and in cases of acute poisoning the stomach or bowels should be evacuated by appropriate means, and restorative agents employed, such as [illegible], ammonia, the application of heat, friction, and artificial respiration. *Chronic poisoning* by tobacco, such as results from undue indulgence in the weed, [illegible] itself in *dyspepsia*, the smoker experiencing loss of appetite, especially in the morning, [illegible] and thirst; and in *nervousness*, as evinced by a general physical and mental restlessness, with [illegible] external impressions, and by tremulousness of the muscles, and palpitation or irregular action of the heart. With smokers, also, a form of chronic [illegible], and even inflammation, of the throat and [illegible] is exceedingly common. Graver evils, such as paralysis, mental [illegible] and loss of sight from wasting away of the optic nerve, have been charged to excessive use of tobacco, but when we consider the enormous number of persons who indulge heavily in the weed, and the comparatively rare occurrence of the affections in question, when there is [illegible] other obvious and valid cause for the same, the [illegible] tobacco is to blame for the disease must be [illegible] caution. *Moderate* use of tobacco by persons [illegible] it "agrees" (i. e. does not produce [illegible] effects) often calms and soothes the [illegible] nervous system, helps digestion, [illegible] the bowels, removes the sense of [illegible] compensate for an insufficient food [illegible] ular question, whether good or [illegible] use of tobacco, is too broad [illegible] answer. According to [illegible] the facts bearing on th[illegible]. In the first place, tobacco is not [illegible] man race; for individuals [illegible] races of men, have attained [illegible] and mental development without the use of the [illegible]. In the second place, [illegible]

years or so, tobacco, even in small quantity, is so apt to disorder health in some way or other that for such it should be considered generally harmful. Thirdly, many persons, even adults, can never indulge at all in tobacco without being to some degree poisoned. For such individuals common sense teaches that the weed is to be regarded as wholly noxious. Fourthly, an enormous number of persons can and do use tobacco (the actual quantity consumed varying with the individual) not only without apparent present disturbance of health, but with maintenance of as full physical and intellectual vigor, freedom from sickness, and longevity, as are found with non-consumers. To say that such individuals, did they abstain, would be still more hearty or long-lived, is to assert that which obviously can be neither proved nor disproved. Finally, the exigencies of our artificial civilization often demand a continued overtaxing of either the physical, intellectual, or emotional faculties, and in some such cases, especially where the sufferer be past the most vigorous period of life, tobacco in moderation often seems to counteract in some measure the evil effects of the strain, disposing to emotional and physical calm, removing fatigue, assisting digestion, and supplementing a scanty food-supply. If, then, the abatement of morbid symptoms and restoration of the bodily functions to their normal status be beneficial, we must accord to tobacco in the present instances the right to be regarded as a useful agent. But in connection with this topic it is proper to bear in mind the fact, that while tobacco in due moderation may be often apparently harmless, and even, under some circumstances, useful, yet that to indulge in an excess which, for the individual, *is* injurious, is both easy and tempting, and, as a matter of fact, is an exceedingly common habit. Any tobacco-consumer, by reverting to the symptoms of chronic tobacco-poisoning detailed above, can easily determine for himself whether he is or not crossing the "poison-line" in his use of the luxury. As to the relative power of the various modes of consuming tobacco, it is probable that a given quantity of a given leaf will most promptly and powerfully affect the system if *chewed*, next if *smoked*, and least if taken as *snuff*. In the matter of smoking, again, less of the active principles will reach the mouth if the dose of tobacco be smoked in a clean pipe than if a foul one be taken, and less with a pipe, if clean, of porous material, like meerschaum, and with a reasonably long stem, than where the same tobacco is smoked as a cigar. With both pipe and cigar, again, the last portion smoked is proportionately stronger than the first, for it becomes saturated with a certain percentage of the smoke-ingredients of the earlier portions, mechanically arrested in their passage. The time of day and state of the stomach also modify the effect of tobacco, the influence being comparatively stronger earlier in the day or upon an empty stomach than in the evening or after a meal.

Medicinal Uses.—In medicine tobacco is used solely for its relaxing influence upon the muscular system. Before the introduction of anæsthetics it was thus sometimes employed in cases of visceral spasm, or where hernias or dislocations were to be reduced, but its use in these circumstances is now almost obsolete. In tetanus the drug has been tried, and shows, as might be expected, a certain power in blunting the irritability of the motor tract of the spinal cord, and thus reducing the severity of the spasms. It has been given in this disease in the form of nicotine, administered by subcutaneous injection in doses of a small fraction of a drop. In asthma some sufferers find relief from smoking tobacco, but as a rule the remedy is not of much use. The most common way of administering tobacco for medicinal purposes is by giving an infusion of the leaf by enema, but great prudence is necessary, as the drug thus introduced is a powerful and even dangerous remedy. Externally, lotions and ointments of tobacco have been used for various purposes, but anything like an extensive application is in the highest degree dangerous, fatal poisoning having more than once occurred in consequence.

EDWARD CURTIS.

Tobacco-Pipe. See PIPE.

Toba'go, an island in the West Indies, in lat. 11° 25 N., lon. 60° 32′ W., 18 miles N. E. of Trinidad, belongs to Great Britain. Area, 97 sq. m., with 15,410 inhabitants. The surface is mountainous and rugged, covered for a large part with primitive forest, but presenting several fine and well-watered valleys. The principal product is sugar, of which 90,265 cwts. were exported in 1866, together with 5533 cwts. of molasses and 119,292 gallons of rum. Coffee is also extensively cultivated. The climate is utterly injurious to Europeans.

Tobin, tp., Perry co., Ind. P. 2345.

To'bit, Book of, an apocryphal book of the Old Testament, whose text is found in the Septuagint, the Syriac, and the Hebrew; none of which texts are considered to be the original one. According to Ewald, it was probably written in Hebrew or Chaldee by a Jew of Palestine in the fourth century B. C. It is canonical with the Roman Catholics and some of the Orientals.

Tobolsk', government of Siberia, bounded W. by the Ural Mountains, and extending from the Kirgheez territory to the Arctic Ocean, comprises an area of 564,825 sq. m., with 1,105,855 inhabitants. The western and southern part of the country is occupied by spurs of the Ural and Altai mountains, from which the land slopes toward the Arctic Ocean in one extensive plain. The northern portion of this plain, between lat. 66° N. and the ocean, is a frozen swamp during nine months of the year; the middle portion, between lat. 58° and 66° N., is a forest region, inhabited by hunters and producing excellent fur; the southern portion is good agricultural land, where rye, barley, oats, and the fruits of Middle Europe are raised. Iron, copper, silver, gold, and platinum abound in the Ural Mountains, and mines are extensively worked. Manufactures of leather, soap, and woollen fabrics, and a very important transit-trade between Europe and Asia, are carried on.

Tobolsk, town of Siberia, capital of the government of Tobolsk, at the confluence of the Tobol and the Irtish, in lat. 58° 12′ N., is a neat and handsome town, though most of its houses are built of wood, and it carries on extensive manufactures of leather, soap, and tallow, besides important fishing and shipbuilding. P. 20,330.

Toboyne, tp., Perry co., Pa. P. 914.

To'by, tp., Clarion co., Pa. P. 1140.

Tobyhan'na, tp., Monroe co., Pa. P. 477.

Tobyhanna Mills, p.-v., Monroe co., Pa.

Tocantins', river of Brazil, South America, rises in lat. 14° S., flows northward with a great western bend, receives the Araguay in lat. 6° S., and joins, 130 miles from the Atlantic, the Para, the southern branch of the mouth of the Amazon. The entire course of the Tocantins is 1100 miles, for the greatest part of which it is navigable, though its navigation is difficult on account of sandbanks and rapids.

Toc'coa, p.-v. and tp., Habersham co., Ga., has a weekly newspaper. P. 713.

Tock, The Crowned, the *Buceros coronatus*, an African passerine bird of the family Bucerid æ, having an enormous red bill. It feeds on carrion, and probably on vegetable food also.

Tocology. See OBSTETRICS, by PAUL F. MUNDÉ, M. D.

Tocqueville, de. See DE TOCQUEVILLE.

Tod (DAVID), b. at Youngstown, O., Feb. 21, 1805, son of Judge George (1773–1841), a distinguished jurist, under whom he was trained to the law; was admitted to the bar 1827; practised at Warren until 1842; was elected to the State senate as a Democrat 1838; was defeated as a candidate for governor 1844; was minister to Brazil 1847–52; was in 1860 first vice-president of the Charleston convention, in which he warmly supported Stephen A. Douglas, and became presiding officer after the withdrawal of the Breckenridge element; was a champion of the "peace policy" 1861, but being elected governor of Ohio 1862, he gave Pres. Lincoln an unhesitating support during the two years of his official term. D. at Youngstown, O., Nov. 13, 1868.

Tod (JAMES), b. in Scotland in 1782; went to India as a cadet 1800; took part in several wars in Central India, attaining the rank of lieutenant-colonel; made a topographical survey of the Rajpoot country, completed in 1815; was political agent in Mewar and other Rajpoot states 1817–23, returned to England 1823. D. at London Nov. 17, 1835. Author of a splendidly-illustrated work, *Annals and Antiquities of Rajasthan, or the Central and Western Rajpoot States of India* (London, 2 vols., imp. 4to, 1829–32), and of *Travels in Western India* (1839), published posthumously.

Toda, Tuda, or **Tudawa,** a singular race of people inhabiting parts of the Neilgherry Hills in Southern India. In 1858 they numbered only 337 persons, yet they are the dominant people of their region, and receive from the inferior tribes a heavy tribute. They have a peculiar language, which is unwritten. Their religion is the worship of departed spirits and of the sun. Their only industry is the herding of buffaloes for their milk and butter. They practice polyandry, all the brothers of one family having but one wife in common. The men, however, claim and receive, at certain seasons, the rights of temporary husbands to the women of the subject villages. The Toda men are tall, well-proportioned, and in many respects are a superior race of men.